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TAHERA
DIAMOND CORPORATION

Closure and Reclamation Plan Update
Jericho Diamond Mine, Nunavut

Submitted to:

Nunavut Water Board
Gjoa Haven, Nunavut

Submitted by:
Tahera Diamond Corporation
Toronto, Ontario

April 2007

Water Licence 2AM-JER0410

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EXECUTIVE SUMMARY

This reclamation and closure plan update was written to address Jericho Diamond Mine (Jericho) requirement for an update of the 2005 Closure and Reclamation Plan (AMEC 2006) pursuant to Nunavut Water Board (NWB) approval (letter to Greg Missal dated 25 August 2006). Jericho commenced construction in Q1 2005; this update reflects as-built to 31 December 2006. This plan updates reclamation requirements and activities required to address reclamation and closure at Jericho based on the mine operations to the end of 2006.

Reclamation Objectives

The reclamation plan for the mine has the objective of minimizing the environmental impact of mining operations to the extent practical, and of maintaining the overall present productivity of the site. The end-land use will be to leave disturbed areas so that they may return as quickly as possible to productive wildlife habitat.

Reclamation Activities

The general reclamation program components will be as follows:

- salvage and stockpile till from the areas of disturbance where practical;
- revegetate areas disturbed by the pre-production phase to the extent practical pending results from trials;
- reslope rock dumps to a maximum overall 2:1 slope angle (26°); average slope angle will be approximately 19°; this will be accomplished by grading off the benches which will be 10 m high and set back from the one below 15 m;
- prepare surfaces for the replacement of top dressing materials;
- recover suitable stockpiled till and spread it over reclaimed areas that would benefit from addition of top dressing material;
- depending on reclamation trials results, coarse PK may be substituted for top dressing material if the PK proves to be a suitable growth medium;
- revegetate the prepared areas where appropriate and indicated from reclamation trials;
- establish test plots to optimize growth mediums, particularly on the PKCA where Ekati Diamond Mine™ (Ekati) experience has shown positive results; and
- monitor growth and develop performance objectives which will be developed as part of revegetation research.

Till Requirement Estimate

The table below contains a summary of top dressing material requirements for reclamation. Top dressing material will be till (preferred) or esker (alternate). Till is a mine unit that is already disturbed, whereas use of esker will require additional disturbance.

Reclamation Top Dressing Material Requirements

Facility	Requirements for 0.3 m Cover 31 December 2006 (Year 2) (m^3)	Requirements for 0.3 m Cover Final Mine Configuration (m^3)
Waste Rock Dump 1 Top	0	35,900
Waste Rock Dump 2 Top	29,790	29,790
PKCA Slurry containment cells	28,137	35,259
Coarse Kimberlite Tops[1]	8,979	20,200
Pads: Camp Storage, Explosives Storage, Crusher Site, Laydown, Waste Transfer	69,800	69,800
Airstrip	0	0
Total	**136,706**	**190,949**

Notes
[1] Should revegetation trials indicate successful plant growth on coarse PK, no top dressing will be applied.

Top Dressing Placement Strategy

For reclamation, top dressing material will be windrowed along the top dressing area in preparation for a dozer to replace the material. Stockpiles located remote to the replacement area will be hauled by truck, and again windrowed along the top dressing area for replacement.

Closure Erosion and Sediment Control Plan

In summary, all clean water (runoff from undisturbed areas) will be routed around the site as required. All runoff from disturbed areas will be directed to the open pit, east sump or sediment ponds (when constructed) as required for settling of suspended sediment and then released to the environment (in most cases, upland tundra). Alternatively, this water will be discharged to the PKCA if water licence criteria are not met. On closure mine area drainage will be directed to the open pit which will act as a sink until it eventually fills and overflows, either into Stream C1 or an open channel to direct water away from Stream C1.

Revegetation

Revegetation studies are scheduled to commence in 2007. Pre-existing native plant communities cannot be completely re-established, however some reclamation is possible. Many species of wildlife (e.g. caribou, canids) should resume use of disturbed esker habitats when the infrastructure is removed. A cooperative approach will be sought with Ekati and Diavik mines information exchange on reclamation research at diamond mines in Arctic environments. Wherever possible islands of undisturbed vegetation will be left in disturbed areas. These islands will provide a seed source for adjacent areas once reclamation of those areas commences.

Reclamation trials will be conducted throughout the mine life with greater intensity of activity during the initial years. The purpose of the trials will be to develop a database on establishment and growth success of vegetation on reclaimed land.

Reclamation Program

On Going Reclamation

The current plan calls for mining to cease after Year 6 and processing to continue for the following two years. At the end of Year 6 the waste rock dump tops can be reclaimed. Minor amounts of reclamation may be possible prior to that time, but most of the mine area will remain active. Waste rock dump slopes will be graded off to result in a final angle of about 19 degrees.

Final Reclamation

On closure all salvageable equipment will be taken off site. Buildings and other facilities with no salvage value will be demolished. Scrap will be decontaminated if necessary, buried in the waste rock dump or open pit, and covered with waste rock.

Dumps that remain active throughout mine life will be reclaimed at closure; the dump tops may be revegetated. The final slope after grading down is expected to be stable; post closure monitoring will be employed to verify this expectation.

A safety berm will be constructed around the open pit on closure a minimum of 10 m back from the crest which will be graded back at a gentle slope. Once the pit fills with water it will be allowed to flow back into the pre-mining stream channel if water quality meets objectives; if not water will be treated prior to discharge. A passive treatment system is envisaged which will not require maintenance.

The part of the PKCA holding fines will be covered with coarse PK and possibly till and vegetated if reclamation trials during operations indicate probable success. If success is not indicated, non-acid-generating waste rock will be placed on the prepared surface to retard dusting. Dams will remain in place after closure. The West Dam will be breached and natural drainage through the basin is expected to be restored. Water quality in the pond at the west end of the PKCA will have to meet discharge criteria before release is allowed.

Coarse PK

Coarse PK will be graded down in a manner similar to waste rock dumps. Overburden cover will be placed on the coarse PK stockpile tops if vegetation trials indicate probably successful vegetation establishment; otherwise rock armouring will be used to retard dusting.

Pads, Roads and Airstrip

Once equipment is removed, pads will be scarified and vegetated if practical.

Sediment Ponds, Berms and Ditches

Sediment ponds, berms and ditches will be reclaimed on closure. Berms for petroleum tanks will be tested for hydrocarbons and burned or shipped off site if concentrations of hydrocarbons are above guidelines. Liners will be removed and shipped off site.

To the extent possible, natural drainage will be restored at Jericho on closure. Other than streams C1 and C3, only ephemeral streams will have been affected by mine development.

Borrow Areas

Borrow areas will be graded to shallow angles to retard erosion. If practical, these areas will be revegetated.

Post Closure Monitoring

During the period immediately after mine closure, sedimentation ponds, berms, and outfall (if required) will be maintained. Water quality will be monitored monthly for parameters controlled by the Jericho Project Water Licence in place at the time of closure. An annual seepage survey will be conducted for two years post closure. If results indicate water quality is improving, annual surveys will cease and be replaced by surveys at Year 5 post closure and every 5 years after that until abandonment.

Land Use At Abandonment

Wildlife Habitat

Disturbed areas, other than mesic and moist soil microhabitats will only very slowly revegetate. Wildlife habitat lost to create dumps, pads, and roads will regain pre-disturbance productivity at the same rate as vegetation returns. Every practical effort will be made to accelerate this process. Upon successful establishment of vegetation, wildlife habitat in these areas should return to pre-mining conditions.

Fish Habitat

Enhancements constructed during mine operations (spawning shoals constructed in lakes) will function long after the mine closes. Stream C1 will be maintained until the open pit fills and, depending on water quality in the filled pit, will either be allowed to flow through the former pit in its pre-mining course or be permanently diverted away from the pit. Fish habitat in the lower portion of Stream C1 will thus be maintained.

1.0 INTRODUCTION

This reclamation and closure plan update was written to address Jericho Diamond Mine (Jericho) requirement for an update of the 2005 Closure and Reclamation Plan (AMEC 2006) pursuant to Nunavut Water Board (NWB) approval (letter to Greg Missal dated 25 August 2006). Jericho commenced construction in Q1 2005; this update reflects as-built to 31 December 2006.

1.1 Concordance

Two concordance tables are provided in this section:

1. an updated concordance table for Water Licence Part M and Schedule M;
2. a concordance table for the information requests contained in the NWB 25 August 2006 approval letter.

Table 1-1: Concordance Table – Reclamation and Closure Plan Requirements Under Water Licence Part M, Items 2 and 7 and Schedule M, Item 1

Schedule M, Item 1 Requirement	Closure Plan Section
a: The combined use of a Inuksuit built by Elders, berms, and signs to warn people and animals about the unfilled open pit. The edge of the Pit Lake shall be contoured and controlled-blasted on a shallow 5:1 angle into the lake for a 10 meter distance so as not pose a hazard to people or wildlife	Not applicable at the current mine stage
b: Maintenance of the diversion channel, as a permanent structure beyond closure should water quality dictate. This issue shall be further addressed during operation and resolve the issue prior to closure, when water quality concerns and the options available to re-instate the flows in the channel are better understood	Not applicable at the current mine stage
c: the implementation of revegetation through the abandonment and restoration planning	Section 5.5
d: to conduct re-vegetation research on the kimberlite to determine if the post-closure conditions can be improved	Section 5.5
e: details of the proposed methodology for recovering the stockpiled overburden materials for reclamation purposes	Section 3.3
f: address how meltwater from the stockpile is managed to prevent release of suspended sediment	Section 4 refers to the planned closure drainage control
g: revisions based on all monitoring data collected to that time	No revisions of handling methods based on monitoring to the end of 2006
h: an updated prediction of pit fill rate and effluent discharge quality after closure	Only one construction and one operating year of data collected and more data are required.
i: a plan to remove and dispose all chemicals and regulated materials in a manner that meets all current regulations	Section 6.4
j: An evaluation of alternative closure and reclamation measures for each project component, including the rationale for selection of the preferred measures, to include, but not be limited to all site facilities/infrastructure as defined in this licence	Section 6.4
k: detailed description, including maps and other visual representations, of the pre-disturbance conditions for each site, accompanied by a detailed description of the proposed final landscape, with emphasis on the restoration of surface drainage over the restored units	Sections 4.4, 5.0. Maps in Appendix A, photos in Appendix E.
l: a comprehensive assessment of materials suitability, including geochemical and physical characterization, and schedule of availability for restoration needs, with attention to top-dressing materials, including maps where appropriate, showing sources and stockpile locations of all reclamation construction materials	Section 5.5. Schedules for use cannot be developed until materials are identified as suitable.
m: an assessment of the long-term physical stability of project components	Section 6.4
n: an assessment and description of any required post-closure treatment for drainage water that is not acceptable for discharge from any of the reclaimed mine components including a description for handling and disposing of post-closure treatment facility sludges	Section 7
o: monitoring programs to assess reclamation performance and environmental conditions including, but not limited to, monitoring locations for surface water and groundwater, parameters, schedules and overall timeframes	Section 7
p: contingency measures for all reclamation components including action thresholds that are linked to the monitoring programs	Sections 6.4

Schedule M, Item 1 Requirement	Closure Plan Section
q: a description of the proposed means for providing long-term maintenance of each reclaimed project component, including the water collection and distribution systems, retaining structures and spillways	Section 6.4
r: an evaluation of the potential to re-vegetate disturbed sites that includes the identification of criteria to be used to determine technical feasibility and alternative restoration options	Revegetation studies are scheduled to commence in 2007
s: a description of how Waste Rock Dumps and the PKCA could use a geomorphic approach to simulate surrounding landscape conditions, rather than the highly engineered closure designs	The current designs are optimized for safety, long-term stability and minimization of footprint. Options within these constraints will be reviewed as mining moves forward. Dumps are graded to direct runoff water toward the open pit.
t: an identification of the research needs for reclamation	Section 5.5
u: a description of how progressive reclamation will be employed and monitored throughout the life of the mine, plus reclamation scheduling and coordination of activities with the overall sequence of the project; details of restoration scheduling and procedures for coordinating restoration activities within the overall mining sequence and materials balance	The exploration camp area has been cleaned up and tents removed. All other disturbed areas are actively used.

Table 1-2: Concordance Table – Reclamation and Closure Plan Requirements Under NWB 25 August 2006 Letter to Tahera

25 August 2006 Information Request	Closure Plan Section
1. The approved 2006 Interim Closure and Reclamation Plan was developed during construction of the mine and therefore has only taken into account the facilities as they existed on December 31, 2006 (as noted in the introduction of the Plan); the next submission shall be updated to reflect the fully operational status of the mine.	This plan
2. A more detailed description of the site components is required to provide a stand-alone document for future use.	Section 2
3. Include a schedule of the studies required for final Closure and Reclamation Planning. Due to the relatively short duration of the mining operations, the studies referenced (especially the vegetation studies) require initiation in the early stages of the mine life.	Section 6.5
4. The concordance table indicates that information is pending U of A reclamation research. This research should be documented and a timeline given as to when this information will be made available for incorporation into the Plan.	Section 5.0
5. Rather than referencing supporting documents for further information, the C&R Plan should be a stand alone plan and where items such as design details for the divider dyke are referred to, the Plan should include as-built designs and drawings.	Section 2.0
6. The Plan should identify a period of time for monitoring that would precede any decision for looking at the alternatives presented in the Plan and a revision of the estimates that were developed in the design phase of the project (i.e. pit infilling and in-pit water treatment).	Section 6.5
7. Clarification is required with respect to the monitoring for each closure scenario, temporary, indefinite and final closure. If monitoring should change for any of these scenarios, or no additional monitoring is being recommended, this should be identified in the Plan.	Sections 6.1.6 and 6.2.6
8. The issue of global warming has not been addressed. An indication of whether or not any of the plans for closure would be influenced by the anticipated effects of global warming in the long term.	Section 7.6
9. Section 5.5.2.3 suggests that Tahera has 8 years of operations and up to twenty years post closure to establish the end-pit water quality before discharge to Carat Lake. The Closure Cost Estimate provided in Appendix D should be extended to account for monitoring over this period. The current estimate only allows for 10 years of overall monitoring.	Appendix D
10. In-Pit water treatment may be required and a treatment contingency provided. These costs should be incorporated into the estimate in Appendix D.	Appendix D
11. Executive summary, pages iv and v; Reclamation/revegetation trials are considered a significant part of the Plan, these are required early in the mine life in order to proceed with progressive reclamation. This needs to be included in the Plan Schedule to indicate timing and progress.	Section 5 discusses revegetation

25 August 2006 Information Request	Closure Plan Section
12. Page v; Major reclamation is to occur following completion of open pit mining with the reclamation of the waste dumps. These waste dumps are ongoing from the start of mining and areas may be available for reclamation prior to completion of open pit mining. These should be included in a Reclamation Schedule as part of the Plan.	All surfaces of dumps are currently active. As areas become inactive they will be stabilized and reclaimed.
13. Page 8, Section 2.2; Provide an explanation as to why the dump slopes are not anticipated to be receiving top dressing materials. There could be potential for enhanced growth due to the slope and increased sun exposure (depending on direction of facing slope). Are the vegetation trials going to address the potential for growth (or no growth) on the slopes?	Section 2.2
14. In addition to the above, any top-dressing materials to be used (amendments) that are used in addition to the natural materials need to conform with the New Substances Notification Regulations under the CEPA.	No unnatural top dressing materials will be used
15. Page 8, Section 2.2., M1-h; Estimates of the pit infill rates are to be provided and refined once adequate water balance data are collected by the mine. The Plan is to be revised by providing an updated prediction, or a timeline when suitable data will be available for providing a more accurate fill rate and effluent discharge quality estimate.	Section 6.5
16. M1-l; All materials to be utilized for restoration are to be characterized for stability and their resulting geochemisty as suitable materials. The concordance table and current plan with reference to M1-l, only refer to the materials (specifically overburden) being assessed based on vegetation trials. These trials should not be the only deciding factor in determining the suitability of materials.	Section 5.6
17. Page 12, Section 4.0, M1-c; Provide a progress update on the cooperative approach with Ekati, Diavik and Snap Lake mines on reclamation research in Arctic environments. It is also indicated that the research on reclamation will begin in the early operating life of the mine, with the assistance of Dr. Anne Naeth of the UofA. This program should be included in the Reclamation Schedule to be prepared for the Plan revision.	Section 5.5
18. Page 16, Section 4.6; In addition to the above, expand on the planned revegetation trials. It was indicated in the C&R Plan that experience at Diavik has been limited due to its recent development. Therefore, Jericho with the relative short mine life in comparison to the Ekati and Diavik mines, should be initiating these trials early in the life of mine and relying on the other mines for experience as a basis for trials at Jericho.	Revegetation trials were not undertaken in 2006 but are scheduled to commence in 2007.
19. The Interim C&R Plan needs to address how these trials at Jericho will be reported and the recommendations brought forward for inclusion in the C&R Plan.	Section 5.5. Reports will be forwarded to NWB when received and reviewed.
20. Page 18, Section 5.1; remediation objectives are to be included for the soils placed within the Landfarm; how they will be ultimately used and what will be the alternative if the objectives are not met.	Not applicable. There will be no landfarm at Jericho
21. Page 19, Section 5.2.3; under temporary closure scenarios, what is the contingency for operation of the Wastewater Treatment Plant and meeting its treatment criteria. Is there alternative treatment planned.	Section 6.1.3 states the sewage treatment plant would be operated as normal. No alternatives for short-term closure are anticipated.
22. Page 20, Section 5.4.1 and 5.5.8; monitoring of the reclaimed borrow pits is to be included after closure to ensure erosion and potential deposits to water are not taking place.	Section 7.5.1
23. Page 24, Section 5.5, M1-j; Not all of the mine components have been addressed to fulfill the requirement of providing alternatives to closure and reclamation measures. An evaluation is required, providing an explanation on alternatives for each component.	For some mine facilities, such as pads and roads, there are no alternatives other than to revegetate or stabilize to prevent erosion into water bodies. Those for which there are alternatives are discussed in Section 6.
24. M1-k; provide detailed maps and description of the proposed final landscape and the restoration of surface drainage over the restored units, including any alterations that may not be restored.	Drawing 2, Appendix A provides a map of the planned final configuration.
25. Page 24, Section 5.5.2, M1-a; The final configuration of the Pit is not planned until the closure, at which time a safety berm will be constructed beyond the ultimate crest of the till slope. This berm should be in place, where possible as early on in the life of mine, unless there are other measures in place that accomplish the same goal.	It is not possible to place the berm until the final pit limits are reached in most locations because the berm would restrict access to the pit ramps which are moved as required.
26. Page 26, Section 5.5.2.2; The exploration portal will not be removed by the open pit development, therefore this component may be reclaimed prior to the closure of the mine. This reclamation component needs to be included on the Reclamation Schedule to indicate the timing of progressive work.	The exploration portal is now within the pit development area.

25 August 2006 Information Request	Closure Plan Section
27. Page 29, Section 5.5.3.2, M1-n; The C&R Plan indicates that water from the PKCA would be treated if necessary to meet discharge criteria. The planning of research objectives for treatment of PKCA water should be included within the Interim Plan and the schedule of activities for closure.	Section 6.5, Table 6-2; Section 6.5.3.2
28. The section on long-term stability should include as-built drawings of all structures and their planned "final" design configuration for closure, including methods to be used for "breaching" of the West Dam and preliminary design of the overflow or spillway.	Drawing 2, Appendix A: site arrangement Figure 6-2: ultimate pit Figure 6-3: conceptual West Dam spillway
29. Page 31, Section 5.5.5, M1-j; An alternative to the revegetation option is required in the event that trials indicate low probable plant growth.	As indicated in the Plan, Section 4.0, rock armouring will be used where erosion may be problematic in the event vegetation trials indicate low probability of revegetation success.
30. Page 31, Section 5.5.6; Long term maintenance issues with the road between the camp and airstrip need to be addressed. Describe potential issues for sedimentation of nearby water bodies through erosion or any drainage issues that need to be addressed.	Section 6.5.6.3
31. Page 31, Section 5.5.10; Additional detail is required on the potential volumes of infrastructure that will require disposal at closure, the decontamination of this infrastructure, hazardous materials, disposal of liners (if any) from sedimentation ponds and the location as to where non-salvageable items would be buried. Infrastructure should be reduced in size (cut up, crushed etc.) to minimize void space prior to disposal.	Structures: Section 6.5.10 Berms: Section 6.5.7
32. The removal of infrastructure will require considerable time, will this be possible the first winter of final closure? This major component of the reclamation needs to be included in the schedule of activities for closure.	Given the existing infrastructure was transported to site in one winter, given normal winter road opening, infrastructure should be backhauled off site in one winter
33. Page 32, Section 5.5.11; landfarming of contaminated soils is presented as the only treatment with the exception of shipment off-site. Alternative options should be considered or included.	A landfarm will not be constructed at Jericho. Contaminated soils left at closure will be placed in the PKCA or backhauled off site, depending on volume.
34. Information is requested on how long the Dams/dykes will operate post closure and how or when the various dams and dykes on site will be breached at closure.	Dams and dykes, except the West Dam, will remain in perpetuity. The West Dam will be breached on closure. Section 6.5.3
35. Page 32, M1-i; The removal of hazardous materials will require the registration with the Government of Nunavut, Department of Environment as a waste generator as well as carrier (if applicable) prior to transport. This requirement should be identified as a requirement within the C&R Plan.	Jericho Hazardous Waste Generator Number: NUG100017
36. Page 33 and 35, Section 6 and 6.5.1, M1-o; the identification of surface water monitoring sites is presented. Figure 6.1 provided identifies Stream C3 outlet. This station is to be added to the list under section 6.5.1.	Section 7.5.1
37. The evaluation of the requirement for groundwater monitoring is to be included for any site components with the potential to affect groundwater quality.	Section 7.5.1
38. The figure provided (Figure 6.1) does not illustrate the mine site as it would be presented at closure for the post closure monitoring under Section 6.5.1. A revised map is to be included that includes all the remaining site components at closure (pit, PKCA etc).	See Drawing 2, Appendix A

1.2 Reclamation Objectives

The reclamation plan for the mine has the objective of minimizing the environmental impact of mining operations to the extent practical, and of maintaining the overall present productivity of the site. The end-land use will be to leave disturbed areas so that they may return as quickly as possible to productive wildlife habitat.

The short-term reclamation objectives are to:

- progressively reclaim disturbed areas as soon as they are no longer active;
- minimize the risk and impact of water erosion and sediment transportation;
- stabilize slopes;
- restore drainage;
- cover ground to prevent fine material drifting/dust;
- start to rejuvenate the top dressed material; and
- (where practical) create a green cover for aesthetic reasons.

Long-term objectives are to:

- maintain or improve the level of wildlife habitat; and
- (to the extent practical) create an aesthetically pleasing environment.

Specific commitments made by Tahera on the Jericho Diamond Project with respect to achieving the objectives include:

- to the extent practical, minimize disturbed areas through progressive reclamation;
- where stripping occurs, recover all overburden practical;
- conduct revegetation trials through the mine life to determine what prescriptions work most effectively at Jericho;
- maintain an active liaison with other mines in the Canadian Arctic with respect to reclamation initiatives at their mine sites.

This abandonment and restoration plan has been developed consistent with the objectives of the *Mine Site Reclamation Policy for Nunavut* (INAC 2002).

1.3 Reclamation Activities

The general reclamation program components will be as follows:

- salvage and stockpile till from the areas of disturbance where practical;

- revegetate areas disturbed by the pre-production phase to the extent practical pending results from trials;

- reslope rock dumps to a maximum overall 2:1 slope angle (26°); average slope angle will be approximately 19°; this will be accomplished by grading off the benches which will be 10 m high and set back from the one below 15 m;

- prepare surfaces for the replacement of top dressing materials;

- recover suitable stockpiled till and spread it over reclaimed areas that would benefit from addition of top dressing material;

- depending on reclamation trials results, coarse PK may be substituted for top dressing material if the PK proves to be a suitable growth medium;

- revegetate the prepared areas where appropriate and indicated from reclamation trials;

- establish test plots to optimize growth mediums, particularly on the PKCA where Ekati Diamond Mine™ (Ekati) experience has shown positive results; and
- monitor growth and develop performance objectives which will be developed as part of revegetation research.

1.4 Mine Plan

The Jericho Mine Plan was submitted to the NWT/NU Mines Inspector 17 October 2005 and accepted January 2006. The plan provides details on construction and operation of the open pit mine. The construction phase was substantially complete at the end of 2005 and operation commence Q1 2006.

2.0 SITE COMPONENTS

The Jericho site components that will be present at full mine development are discussed in this section. This section includes discussion of facilities listed in Table 2-1 in the order listed in the table which also contains references to documents submitted to NWB.

Table 2-1: Jericho Facilities

Facility	Reference Document
Waste Rock Dumps	SRK (2005) Waste Rock Management Plan (Part 1)
Open Pit	Tahera Diamond Mine, Notice to Commence Work, Version 2, October 2005. Piteau Associates (2005). Jericho Diamond Mine Geotechnical Investigations and Preliminary Slope Design Criteria for the Proposed Open Pit. Tahera (2003) Jericho Final EIS, Appendix A.1, Project Description
PKCA	EBA (2006) PKCA Management Plan
Kimberlite Ore, Coarse Processed Kimberlite and Recovery Circuit Rejects	SRK (2006) Waste Rock Management Plan (Part 2)
Mine Access Roads and Pads	Tahera (2005a). Jericho Diamond Mine Notice of Intention to Commence Work, Version 2 (Mine Plan)
Sediment Ponds and Ditches	Tahera (2005b). Water Management Plan
Fuel and Hazardous Materials Berms	Tahera (2005c). Fuel Farm Design Plan
Borrow Areas	Tahera (2005d). Borrow Management Plan
Airstrip	Existing; extension in 2006 to 1374 m
Freshwater Intake Causeway	SRK. 2005. Specification for the Fresh Water Intake Causeway.
C1 Diversion	EBA (2005). Letter Report to Tahera, 30 August 2005
Infrastructure	Tahera (2005a). Mine Plan

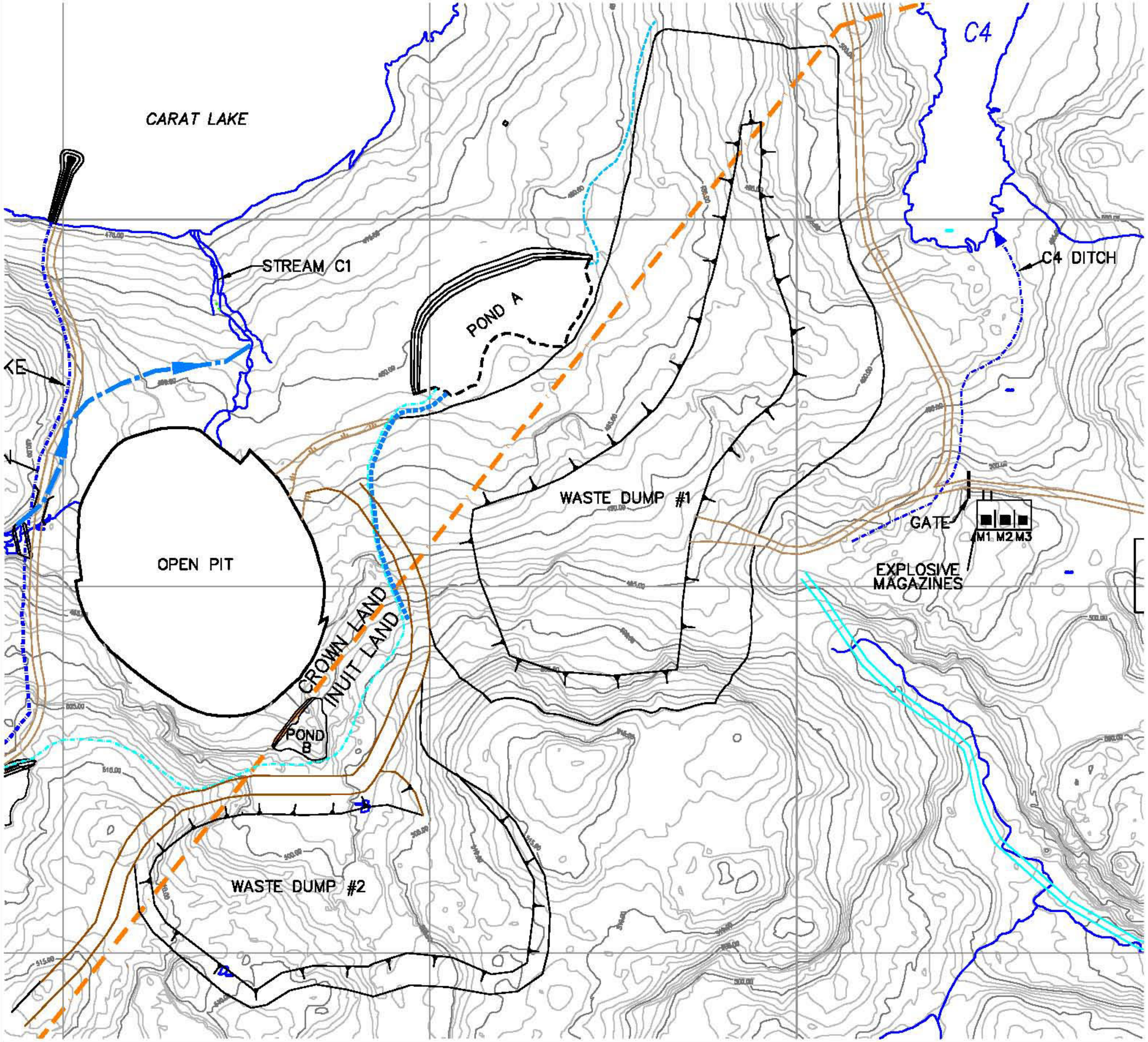
2.1 Waste Rock Dumps

The Jericho Waste Rock Management Plan (SRK 2005) provides details of the construction and operation at the waste rock dumps.

2.1.1 Design of the Waste Rock Dumps

2.1.1.1 General Layout

The layout of the waste dumps is illustrated in [Figure 2-1] Drawing WRMP-P1-1 and was selected to:
• Minimize the number of catchments potentially affected by drainage from the waste dumps;
• Facilitate the design and operation of seepage control structures related to the waste dumps;
• Maintain an adequate buffer zone between the toe of waste dump #1 and Carat Lake;
• Optimize the offsetting impacts associated with the minimized project footprint and conformity with the natural relief in the immediate area; and
• Minimize haul distances.



NOTES:

1. THE LAYOUTS OF THE WASTE DUMPS AND STOCKPILES ARE APPROXIMATE AND HAVE BEEN BASED ON EXISTING TOPOGRAPHIC DATA.
2. IN RELATIVELY FLAT AREAS WHERE THE DUMPS ARE CLOSE TO THE ASSUMED CATCHMENT LIMIT, GROUND SURVEY METHODS WILL BE USED TO ACCURATELY DEFINE THE CATCHMENT LIMIT.
3. A BUFFER ZONE WILL BE ESTABLISHED BETWEEN THE DUMP/STOCKPILE TOE AND THE ASH/KEY LAKE CATCHMENT ON A FIELD FIT BASIS IN AREAS WHERE GROUND SURVEY METHODS ARE REQUIRED (SEE NOTE 2).
4. THE NEED FOR POND B WILL BE EVALUATED DURING THE FIRST YEAR OF OPERATION.

TAHERA CORPORATION
JERICHO LAKE SOUTHWEST EXTENSION

Scale of Photography: 1:10 000

0 50 100 150 200 250 METRES
1:3000

						A	FINAL DESIGN	MAY 2006
DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION		DATE	REV.	ISSUE PURPOSE	DATE
REFERENCE DRAWINGS		REVISIONS				ISSUE AUTHORIZATION		

DETAILED DESIGN

SRK Consulting

DESIGNED BY: CCS	DRAWN BY: JM
DATE: MAY 2006	DATE: MAY 2006
CHECKED BY: CCS	DISCP. ENGR.
DATE: MAY 2006	DATE:
PROJ. MGR: CCS	PROJ. ENGR.
DATE	DATE
SRK PROJECT NUMBER: 1CT004.09	

Tahera Diamond Corporation

JERICHO DIAMOND PROJECT

Figure 2-1

LAYOUT OF WASTE DUMPS

DRAWING NUMBER: WRMP – P1 – 1

REV. A

Waste dump #1 will store primarily waste rock. The construction of the waste dump will start at contour elevations that allow any runoff to flow to the open pit and be handled by pit sumps. In the event that seepage water quality is low and quantity from waste dump site 1 is high enough, Pond A will be constructed.

Waste dump #2 will store overburden and waste rock. Any drainage from the waste dump site 2 will initially flow to a sump in the open pit and subsequently to Pond B if significant quantities are encountered.

Since the initial waste rock production will be needed for project development, access and overburden containment, waste rock disposal at waste dump #1 is scheduled to occur after overburden deposition at waste dump #2 commences. There is flexibility to increase the height and/or merge the dumps to provide additional capacity should mine plans be altered during the first year of operation.

2.1.2 Foundation Conditions

2.1.2.1 Waste Dump Site 1

The drilling results and the surficial geological mapping indicate that the foundation conditions at waste dump site 1 consist of bedrock with isolated soil deposits. The soil deposits typically range in thickness from 0 to 3.2m and consist of granular colluvial soils or till with, in some locations, a thin veneer of organic soil. The site is underlain by permafrost. A series of ephemeral streams flow across the dump site to Carat Lake. In general, these occupy broad zones over which the water flows very slowly in the spring and early summer. Grassy vegetation is commonly associated with these streams.

2.1.2.2 Waste Dump Site 2

Based on site reconnaissance and surficial geological mapping, the foundation conditions at waste dump site 2 consist primarily of bedrock, with some till in the south edge of the site. This site is also underlain by permafrost.

2.1.3 Dump Designs

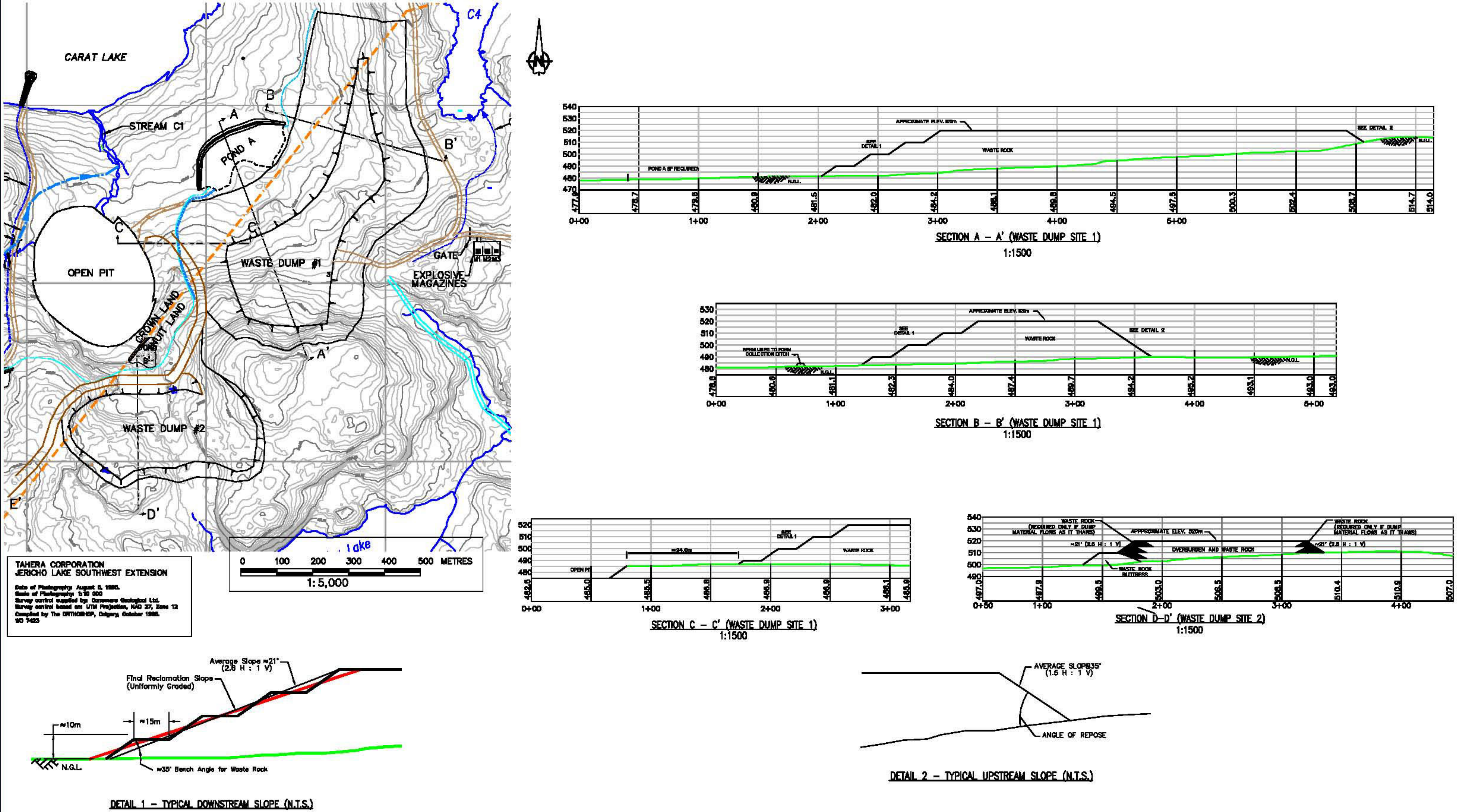
2.1.3.1 General

Dump designs have been developed on the basis of the properties of dump materials, the foundations conditions at the dump sites and the approximate volume of mine waste that will be produced as a result of the current mine plan. The details of these designs are provided below. Typical sections through the two waste dumps are provided in [Figure 2-2] Drawing WRMP-P1-3. The corresponding dimensions and storage capacities of the proposed waste dumps based on the planned OP/UG quantities are provided in Table 2-2 [SRK Table 4.1]. The dump capacity can be increased through design modifications if required.

Table 2-2: General Dimensions and Storage Capacities of the Waste Rock Dumps

Site	Area (ha)	Approx. Crest Elev. (m)	Height (m)	Capacity (Mt)	Capacity (Mcm)
Waste Dump Site 1	37.7	520	44	13.930	7.739
Waste Dump Site 2	12.5	520	21	2.382	1.377

Notes:
1. The storage capacities quoted in Table 4.1 are based on the current dump layouts.
2. Depending on the findings from the first year of mining, the mine plan may change.
3. In the event that a change in the mine plan leads to an increased waste rock storage requirement, the storage capacity of these dumps can be increased significantly by measures such as raising the dumps and/or increasing their footprint areas in a way that preserves the objectives outlined in Section 4.1.



DRAWING NO.	DRAWING TITLE	NO.	DESCRIPTION	DATE	REV.	ISSUE PURPOSE	AUTH. BY	DATE
					A	FINAL DESIGN	CCS	MAY 2005
REFERENCE DRAWINGS		REVISIONS			ISSUE AUTHORIZATION			

DETAILED DESIGN

SRK Consulting

DESIGNED BY: CCS — DRAWN BY: JM
DATE: MAY 2005 — DATE: MAY 2005
CHECKED BY: CCS — DISCP. ENGR.
DATE: MAY 2005 — DATE:
PROJ. MGR. CCS — PROJ. ENGR.
DATE: — DATE:
SRK PROJECT NUMBER: 1CT004.09

Tahera Diamond Corporation

JERICHO DIAMOND PROJECT

Figure 2-2
WASTE DUMPS 1 AND 2
SECTIONS AND DETAILS

DRAWING NUMBER: WRMP – P1 – 3
REV. A

The thickness of each dump lift is expected to be approximately 10 m, but depending on the projected height of the structure and the number of benches, the lift thickness may be modified in order to develop relatively uniform bench heights. Overall slopes of between 2.6:1 to 1.4:1 depending on location and dump performance, as described below. During the LOM, the slopes between benches will correspond to the angle of repose of the dump material, which is expected to be about 1.4H:1V (35 degrees).

2.1.3.2 Waste Dump Site 1

The overall downstream slopes at this waste dump will be about 2.6H:1V (21 degrees), except for internal slopes during the course of dump development. Those slopes along the east side of the dump will be equal to the angle of repose or approximately 1.4H:1V (35 degrees). This variance is based on how the dumps will be constructed and the fact that the ground along the east side of the dump toe is rising, which is favourable to dump stability.

2.1.3.3 Waste Dump Site 2

Waste dump site 2 will be used primarily to store a mixture of overburden and waste rock, much of which will be frozen when it reports to the waste dump #2. Some portion of the overburden stockpile may thaw during the summer months and may require confinement at the dump perimeter. As a consequence, the design of the waste dump #2 includes a waste rock buttress for the downstream slope that will be used to provide confinement to the soils in the event they thaw and show a propensity to slump or “run.” The slopes at this waste dump will be about 2.6H:1V (21 degrees), except for internal slopes during the course of dump development. The performance of the overburden will be evaluated following the first summer of operations, and if conditions warrant, the slopes on the upstream side may be optimized.

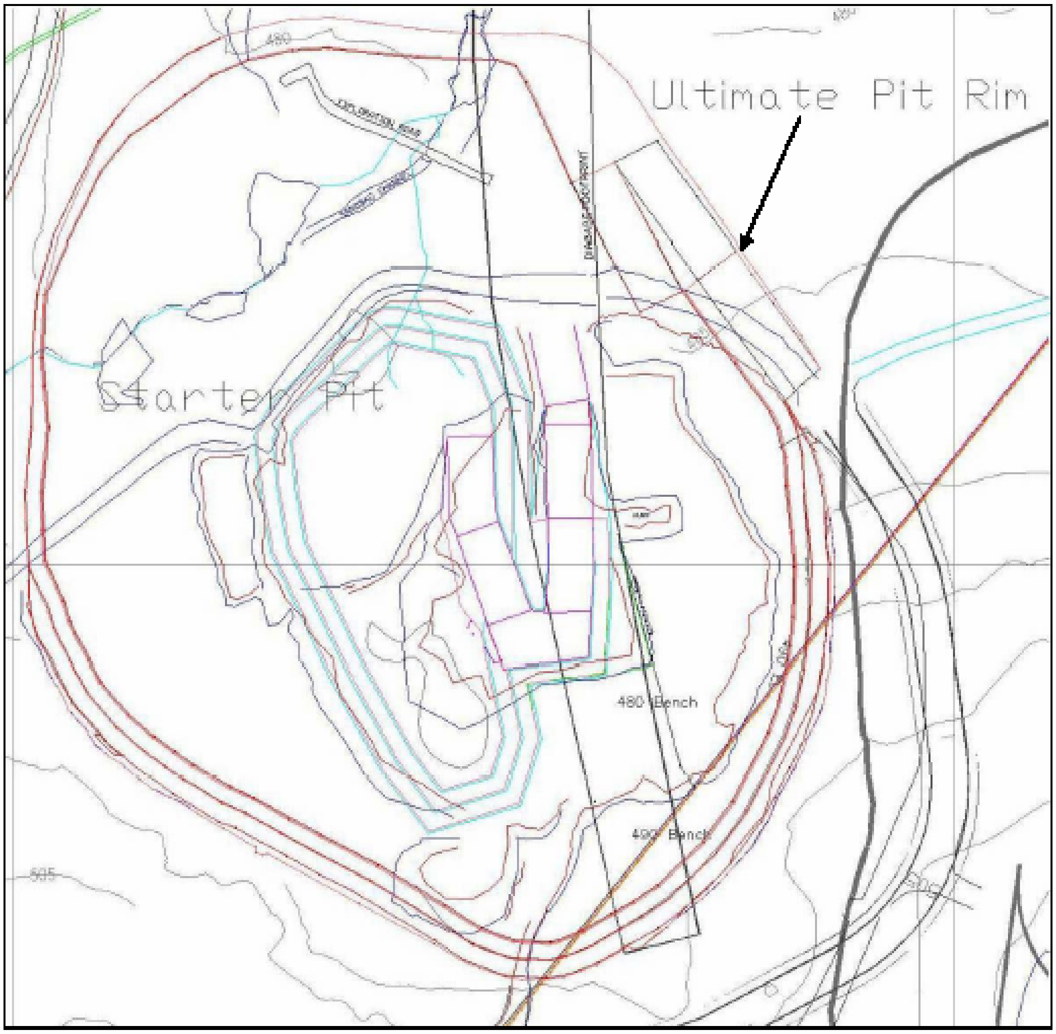
Some of the overburden at waste dump site 2 may be used in conjunction with the mine closure activities.

2.2 Open Pit

The ultimate pit planned is shown in Figure 2-1. The open pit was designed by SRK (Tahera 2003, FEIS, Section 5). The Mine Plan submitted for commencement of work (Tahera 2005a) discusses operation of the pit and some modifications from the SRK 2003 design recommended by Piteau Associates (2005). This section provides pit design.

The ultimate pit (Figure 2-3) will be approximately 350 m wide by 400 m long and will cover an area of approximately 10 hectares (the pit is roughly oval). Permafrost extends to a depth of approximately 540 m, thus it is assumed there will be essentially no groundwater seepage into the pit. The small stream crossing the northern pit area was diverted into Carat Lake via a surface diversion.

Figure 2-3: Ultimate Pit



2.2.1 Pit Slope Angles

Piteau revised the conceptual pit slope angles designed by SRK based on rock characteristics confirmed from starter pit development. Following a desktop review of SRK design information, Piteau conducted geotechnical field investigations to collect data from the starter pit benches to obtain information on rock mass competency and variability, and to assess geologic structural conditions and current bench performance.

Kinematic Analysis

At the Jericho Mine, the rocks are generally of sufficient intact strength and competency that bench and interramp stability will primarily be controlled by geologic structure rather than by the strength of the rock mass. Kinematic analyses were conducted to identify possible structurally controlled failure mechanisms that could occur on individual benches and interramp slopes.

Recommended Preliminary Interramp Slope Design

The basic parameters used to define the geometry of a benched slope are illustrated in [Figure 2-4], and recommended preliminary slope design criteria are summarized in Table 2-3 below. Applicable slope design criteria depend on the structural domain and slope dip direction.

For rockfall catchment protection, a minimum (effective) berm width of 9m afer breakback, is recommended for the 22.5 m high triple benches. The berm widths reported in Table 2-3 include the 9 m effective width plus the expected breakback. Note that no additional berm width to account for potential crest breakback has been included in the calculation of berm width for design, as good bench crest performance was observed in the starter pit.

Where a pit wall transitions through two or more adjacent design sectors with different slope design criteria, blending of the designs will be required to establish a practical overall pit design. Transition zones should be located in the design sector with the steeper slope design to avoid oversteepening.

2.2.2 Pit Design

This section is taken from Tahera (2003) Project Description, Section 5.

While pit shells generated from optimization routines provide a relatively good preliminary indication of resources amenable to economic exploitation by open pit methods, a workable design is normally required before reliable material inventories can be produced. Equipment logistics, pit wall configurations, and access are a few of the considerations that impact on the overall design. The vertical pipe shape of the Jericho orebody and resulting deep conical shape of the optimized pit shell requires a spiral ramp access that can result in a significant discrepancy between the optimized pit reserves and the detailed pit design reserves. This is usually due to the difficulties with accessing the lower ore in the optimized pit shell and errors in estimating the overall angle during the optimization. It must be stressed that pit shells generated by pit optimization routines often contain less waste and are marginally deeper than workable designs. Therefore the detailed (workable) pit design is primarily for the purpose of improving the accuracy of the ore reserve and the waste volume.

Table 2-3: Pit Slope Angles

	Kimberlite	Granodiorite	Overburden
Slopes			
Inter-ramp < 100m (degree)	41-70	65-70	26.5 (2:1)
Inter-ramp > 100m (degree)	41	60	-
Bench Configuration			
Bench height (m)	10	10	10
Bench face angle (degree)	70	85	-
Bench width (m)	8	8	-
Berm Interval (m)		30 (triple bench)	
Ramp Configuration			
Gradient (%)	10	10	10
Width (m)	22	22	22
Operating Limits			
Minimum mining width -pushback	40	40	40
Pit Bottom	50	50	50

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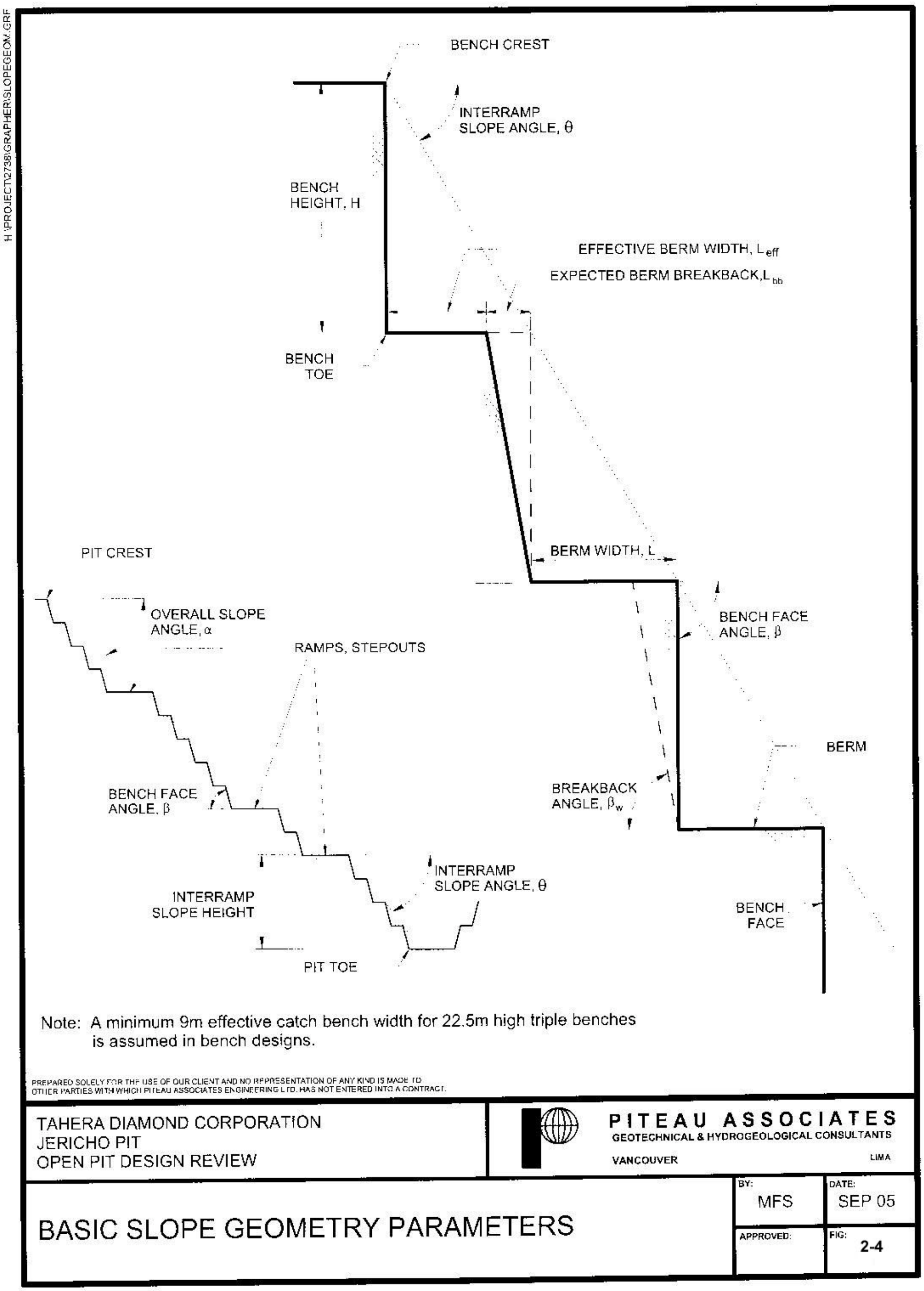
Figure 2-4: Pit Slope Angles



To 31 December 2006, 568,500 tonnes of kimberlite and 3,132,400 tonnes of waste had been mined from the Jericho open pit.

2.3 Processed Kimberlite Containment Area

The processed kimberlite containment area (PKCA) was designed by SRK and was described in the Jericho Final EIS, Appendix A (Tahera 2003). SRK dam design was updated by EBA Engineering in a number of design and operation reports submitted to NWB in 2005 and 2006 for the West, East and Southeast dams and the Divider Dyke. Appendix A (this report), Drawing 1 shows the layout of the PKCA.

2.3.1 PKCA Impoundment

The PKCA impoundment was constructed in a small lake basin by means of damming low areas. The lake was dewatered in late 2005 to provide storage capacity. The West and East dams were constructed in the winter of 2005/2006; the Southeast Dam was constructed in the winter of 2006/2007.

2.3.2 West Dam

This section was taken from EBA Jericho West Dam Design Report. (2005a).

2.3.2.1 Design Cross-Sections

The planned layouts and typical cross-section of the West Dam are presented in Figures 2-5 and 2-6 [EBA Drawings WD-3 and WD-4].

The nature of the foundation soils is such that it is desirable to maintain them in a frozen condition rather than necessitating a massive excavation below the embankment. Consequently, a frozen core earth dam on a permafrost foundation will be utilized. An effective frozen core dam requires that the central core and foundation remain frozen year around to act as an impervious barrier against seepage. The core and foundation must be nearly saturated with ice to produce a well-bonded and impermeable mass, and the permafrost must be sustained. A secondary seepage barrier is provided by a geosynthetic liner on the upstream face of the frozen core. Similar designs have been developed by EBA for the EKATI Diamond Mine.

The upstream shell primarily consists of rockfill. A small till zone has been placed at lower elevations to reduce convective water movement through the open graded rockfill. The downstream shell of the dam will be constructed of rockfill. This will provide a strong material and will have minimal settlement. The rockfill shells are designed to be constructed with 3.0H:1V outside slopes.

COORDINATE LAYOUT TABLE
WEST DAM

POINT	NORTHING	EASTING	ELEVATION
1	7 318 827.45	476 219.32	--
2	7 318 821.69	476 218.43	528
3	7 318 819.64	476 224.69	528
4	7 318 822.93	476 212.04	528
5	7 318 639.85	476 183.73	528
6	7 318 637.60	476 189.96	528
7	7 318 637.86	476 196.58	528
8	7 318 664.19	476 212.80	524
9	7 318 662.86	476 219.67	524
10	7 318 805.14	476 241.67	524
11	7 318 805.75	476 234.71	524
12	7 318 618.10	476 186.95	--

				0	ISSUED FOR CONSTRUCTION	SEPT/05	WTH
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Figure 2-5
WEST DAM
LOCATION PLAN

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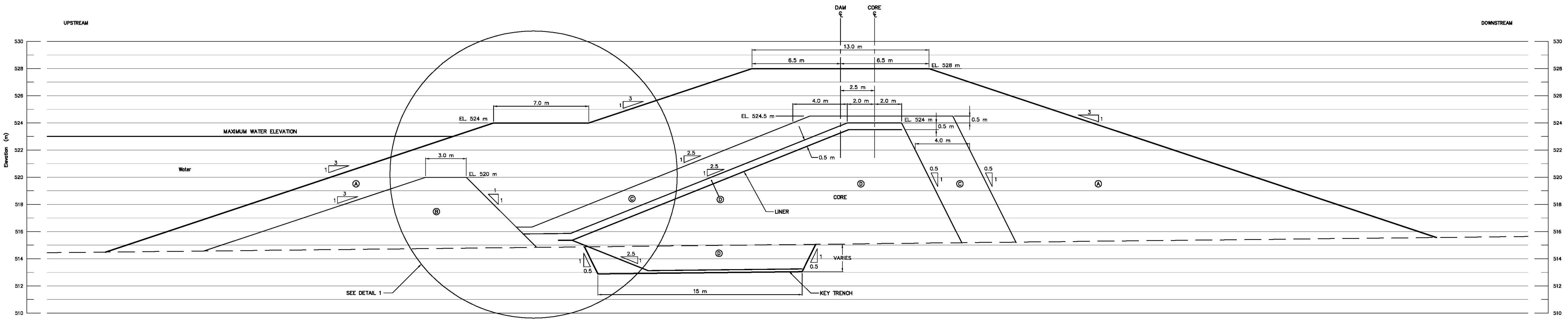
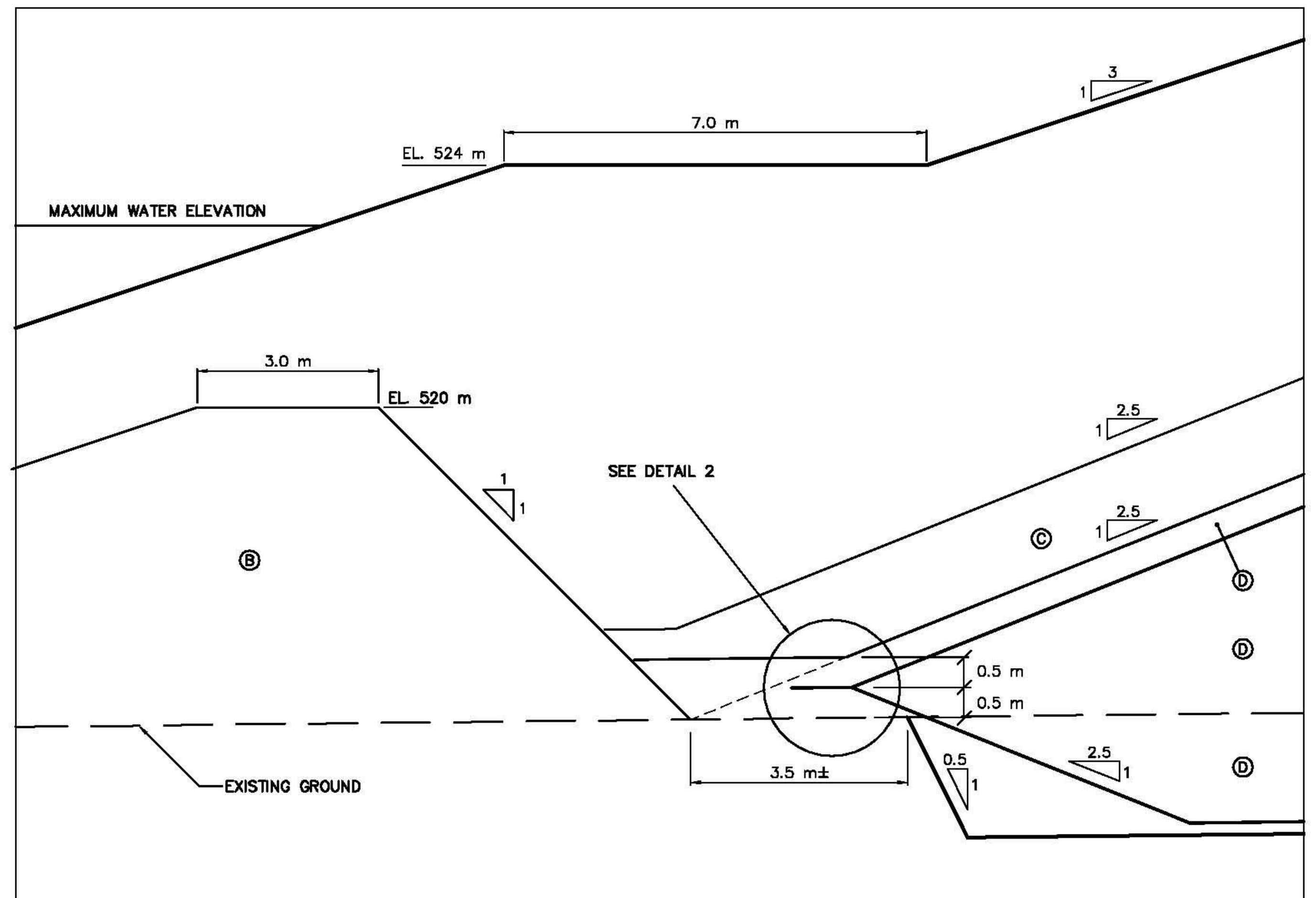
DRAWING No. WD-3

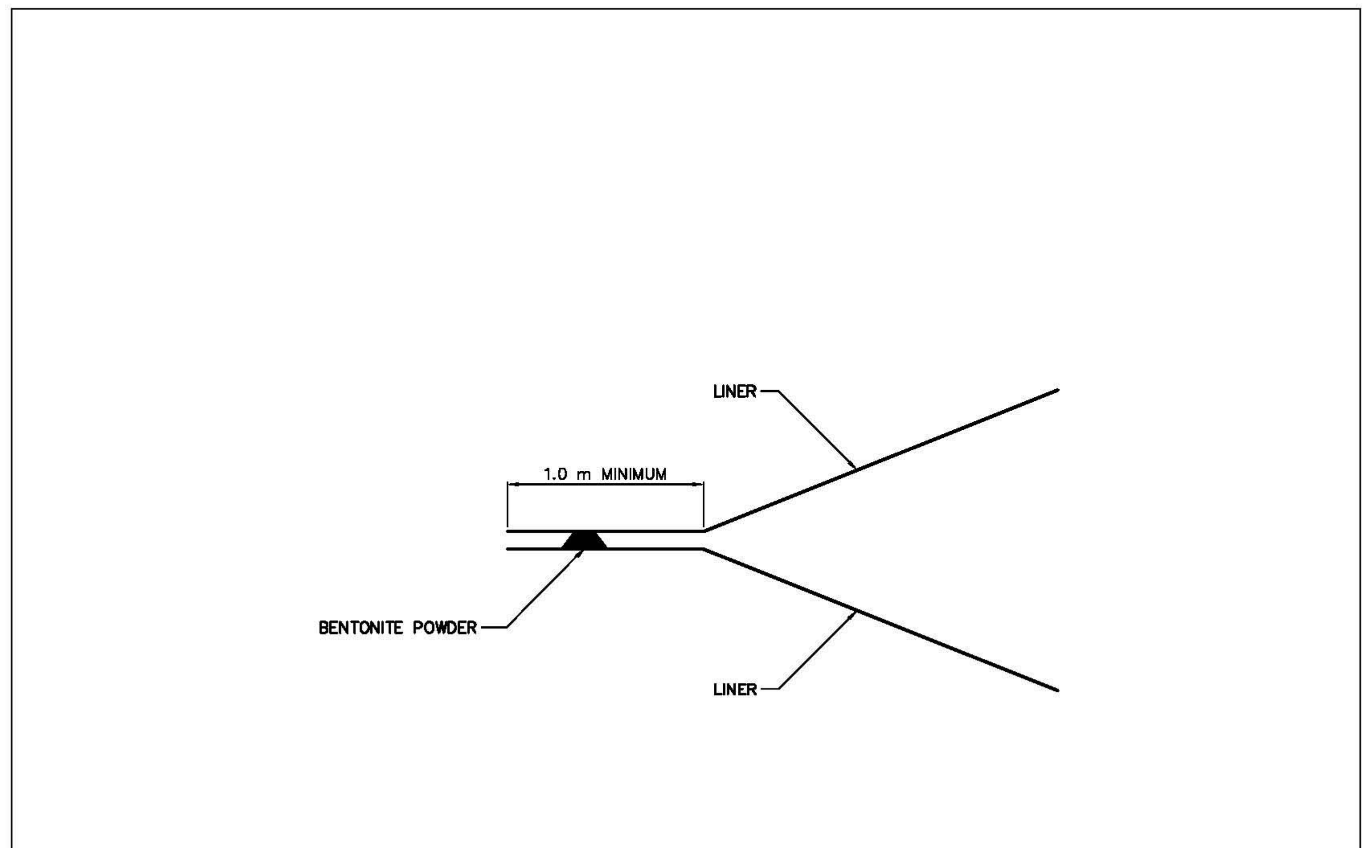


TYPICAL SECTION

MATERIAL TYPES
- (A) RUN-OF-MINE
- (B) TILL
- (C) 200 mm MINUS
- (D) 20 mm Minus



DETAIL 1
GEOSYNTHETIC CLAY LINER HINGE POINT



DETAIL 2
GEOSYNTHETIC CLAY LINER OVERLAP DETAIL

0 5
metres

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Figure 2-6
WEST DAM
TYPICAL CROSS-SECTIONS

REVISION ISSUE
0
DRAWING No.
WD-4

2.3.2.2 Material Properties

The following provides a summary of the materials that will be used to construct the dam. Specifications for the material gradations and placement requirements are presented in the West Dam Construction Specifications.

Slope Protection

The upstream slope of the West Dam may be subject to wave action. The fetch length between the West Dam and Divider Dyke is 750 m. The calculated wave height is 0.5 m for the maximum sustained wind of 74 kph. Rip-rap with a minimum average particle size (D50) of 300 mm is required to protect the dam against wave action.

It is proposed that the upstream dam shell will be run-of-mine rock with a maximum particle size of 700 mm. It is anticipated that the run of mine will have an average particle size larger than the minimum requirements for rip-rap and therefore will be suitable slope protection.

2.3.2.3 Run-Of-Mine Rockfill

The upstream and downstream shell materials will be run-of-mine granitic rock with a maximum particle size of 700 mm. The material shall be placed in lifts of a maximum of 700 mm. Any boulder larger than 700 mm can be wasted to the outside downstream edge of the dam.

2.3.2.4 Till

A small till berm will be constructed within the upstream shell. The natural till deposits on site vary from sand and gravel with some cobbles and boulders to silty sand and gravel with cobbles and boulders. The till for the West Dam should be a silty sandy till with some cobbles. Particles larger than 250 mm should be removed from each lift of material to allow for compaction of the till. The large particles can be wasted on the outsides of the till berm.

2.3.2.5 20 mm Minus Core

A 20 mm minus crushed granite will be used to construct the frozen core. The material must have a minimum of 4% particle sizes smaller than 80 microns.

2.3.2.6 Geocomposite Clay Liner

A geocomposite clay liner (GCL) will be placed on the upstream side of the frozen core and within the key trench. The recommended GCL consists of two non-woven geotextiles encapsulating a layer of bentonite. The GCL will be needle punched to provide adequate shear strength.

2.3.2.7 Liner Bedding

Bedding material must be placed on either side of the GCL. The bedding material can consist of 20 mm minus crush material, or 40 mm minus esker material with sub rounded particles.

2.3.2.8 Transition Material

A 200 mm minus transition material is required between the liner bedding material and the rockfill material and also between the core and the rockfill. The transition material must meet filter criteria for the liner bedding and the rockfill as follows:

- D15 of the transition < 5 * D85 of the filter

• D15 of the rockfill < 5 * D85 of the transition

2.3.2.9 Quantities

Table 2-4 [EBA Table 4] presents the in-place quantities of material required for each zone of the West Dam if constructed as per design geometry. The quantities of material do not include any contingency for waste.

Table 2-4: Dam Material Quantities

TABLE 4: DAM MATERIAL QUANTITIES

Structure	Geocomposite Clay Liner (GCL) (m^2)	Fill Material Type			
		20 mm minus (m^3)	Transition (m^3)	Rockfill Shell (m^3)	Till (m^3)
West Dam	6100	17,000	7,600	52,000	3,100

Note: Quantities are "in-place". Seaming allowance and contingencies must be added to GCL quantities. It is recommended that 20% extra quantities be available on site. Bulking factors and contingencies must be added to fill quantities; 20% should be added to reported quantities for stockpile volumes.

2.3.3 East and Southeast Dams

The section is taken from EBA East and Southeast Dam Design Report (2005b)

2.3.3.1 Dam Siting and Alignment Selection

The Dams are located at the east end of Long Lake, immediately south of the mine process plant as shown on Drawing ED-1. The dams are located in small saddles between bedrock ridges.

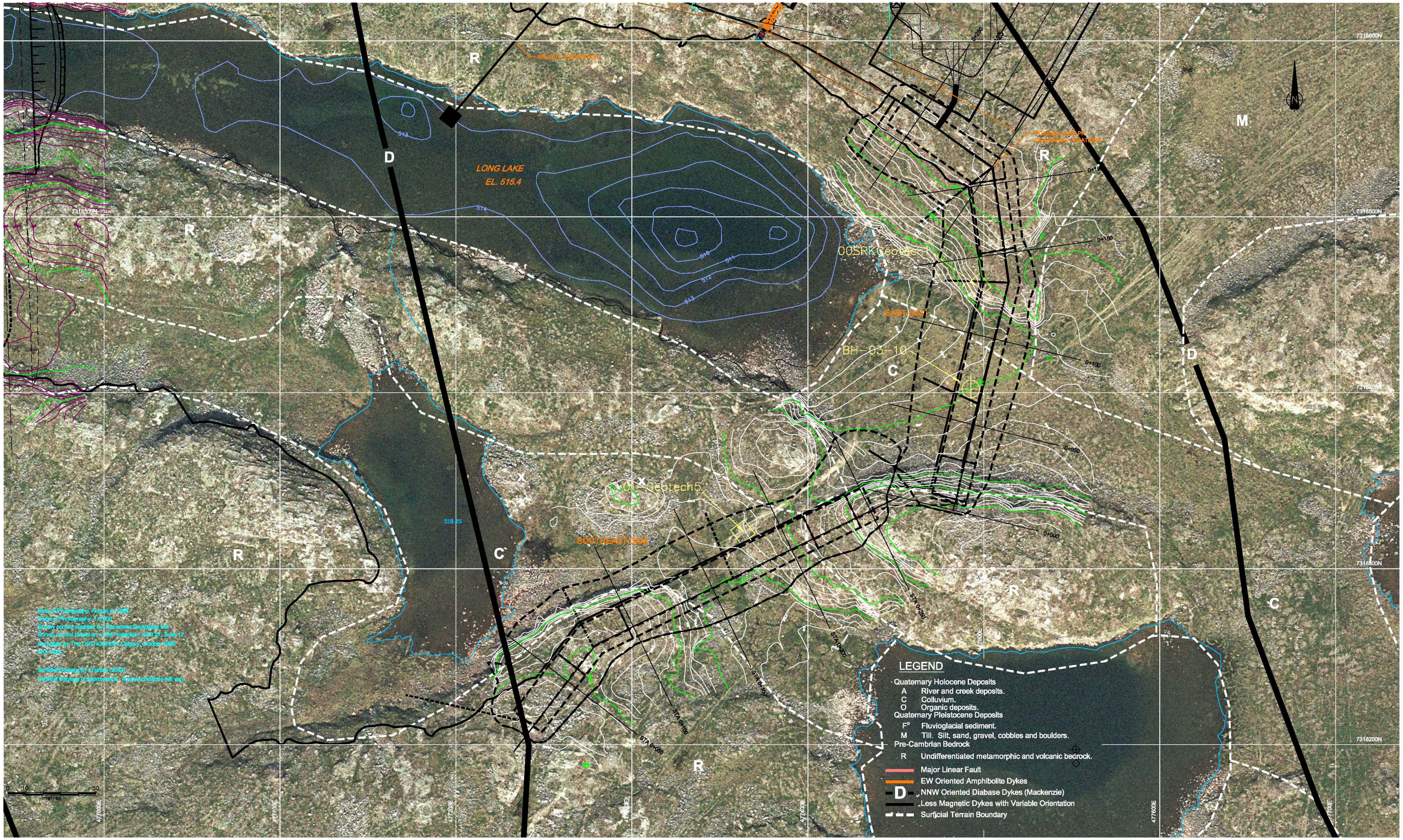
2.3.3.2 Foundation Conditions

The estimated surficial geology of the East and Southeast Dam is shown in Figure 2-7 [EBA Drawing ED-2].
Bedrock outcrops are visible at the abutments of the East Dam and Southeast Dam.

For design purposes, it has been assumed that the tills are ice rich in the low-lying areas between the bedrock abutments. This assumption provides a conservative design for stability analyses and dam design.D

2.3.3.3 Design Cross-Sections

The planned layouts and cross sections of the East and Southeast Dams are in Figures 2-8 and 2-9 [EBA Drawings ED-3 and ED-4].



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Permit: Derek C. Cathro, P.Eng. Date: August 30, 2005

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Figure 2-7
EAST AND SOUTHEAST DAM
SURFICIAL GEOLOGY

REVISION ISSUE: 0
DRAWING No.: ED-2

COORDINATE LAYOUT TABLE
EAST DAM

POINT	NORTHING	EASTING	ELEVATION
1	7318337.96	477490.10	527
2	7318342.74	477470.61	527
3	7318463.65	477500.22	524
4	7318462.62	477520.56	524
5	7318531.64	477510.94	527
6	7318520.17	477492.34	527
7	7318559.01	477436.05	527
8	7318568.70	477457.22	527
9	7318521.67	477512.26	527
10	7318518.67	477492.59	527
11	7318482.33	477517.81	524
12	7318478.97	477498.09	524
13	7318359.6	477495.33	524
14	7318364.41	477475.92	524
15	7318337.96	477490.11	527
16	7318342.74	477470.61	527

COORDINATE LAYOUT TABLE
SOUTHEAST DAM

POINT	NORTHING	EASTING	ELEVATION
1	7 318 212.95 N	477 253.46 E	527
2	7 318 221.23 N	477 226.97 E	527
3	7 318 267.97 N	477 270.38 E	525.62
4	7 318 252.06 N	477 283.39 E	525.65
5	7 318 328.16 N	477 439.63 E	527
6	7 318 346.14 N	477 430.88 E	527
7	7318323.59	477430.03	527
8	7318341.54	477421.29	527
9	7318311.67	477405.87	524
10	7318329.79	477397.29	524
11	7318260.41	477300.69	524
12	7318278.4	477291.94	524
13	7318239.44	477273.66	527
14	7318251.71	477257.92	527

0 10 50
metres

477100E

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Figure 2-8
EAST DAM AND SOUTHEAST DAM
LOCATION PLAN

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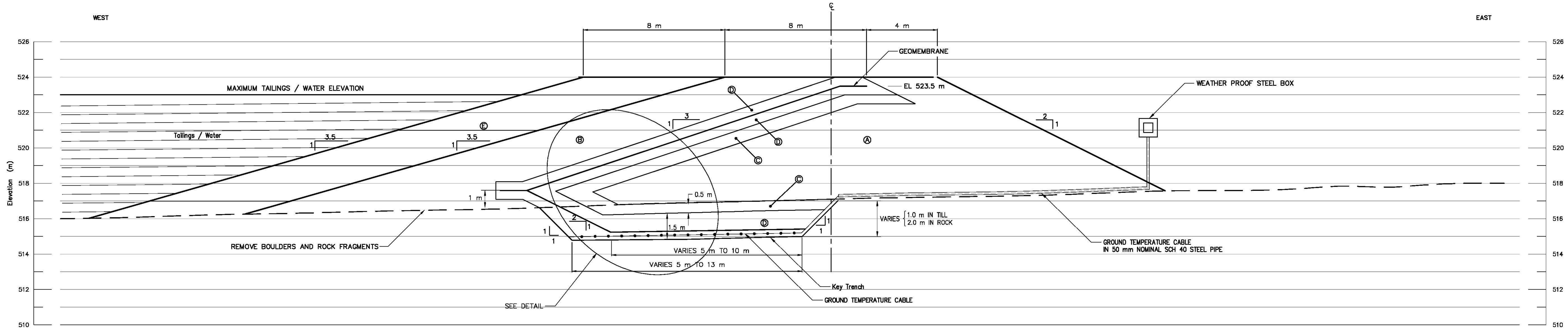
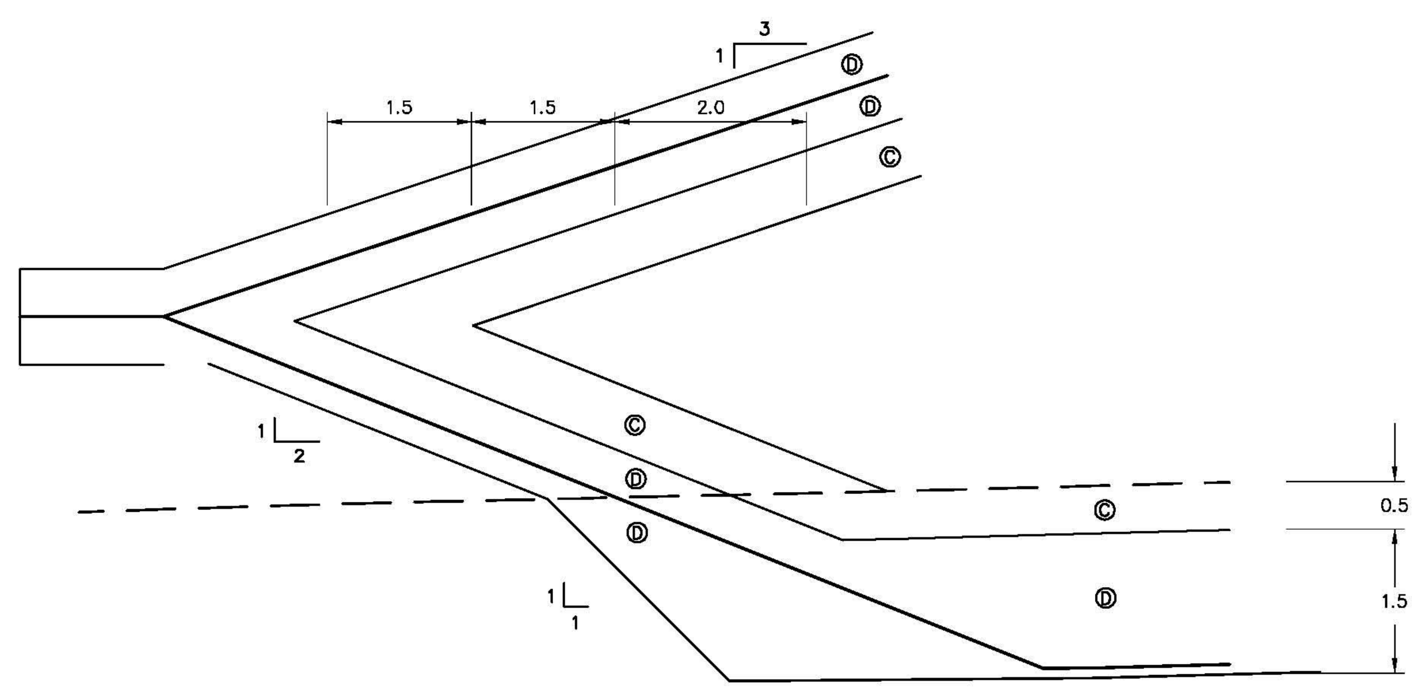
DRAWING No.: ED-3

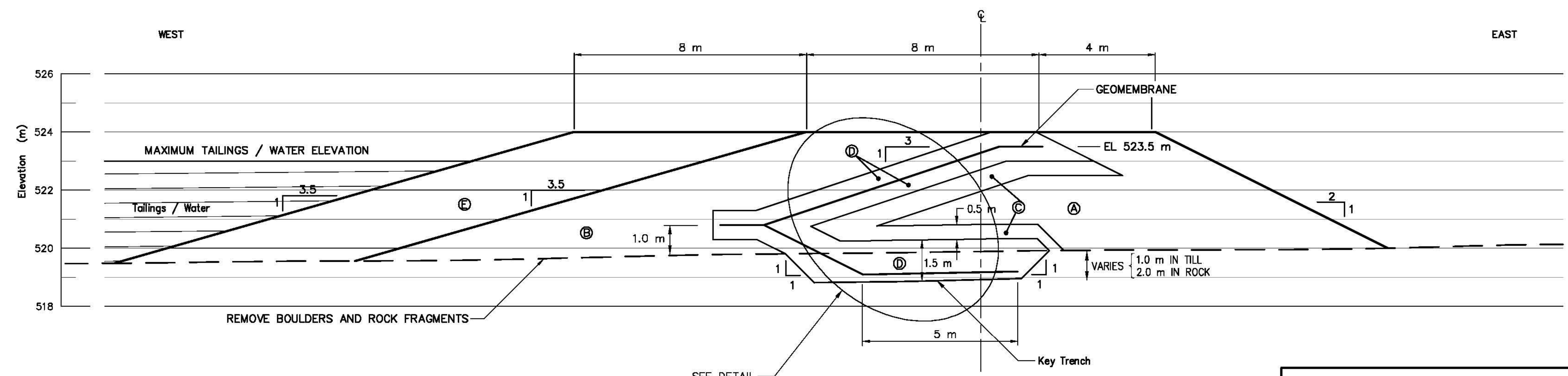


TYPICAL SECTION

MATERIAL TYPES
Ⓐ RUN–OF–MINE
Ⓑ TILL
Ⓒ 200 mm MINUS
Ⓓ BEDDING (Screened Esker or 20 mm Minus)
Ⓔ COARSE TAILINGS



DETAIL
N.T.S.



TYPICAL SECTION

MATERIAL TYPES
Ⓐ RUN–OF–MINE
Ⓑ TILL
Ⓒ 200 mm MINUS
Ⓓ BEDDING (Screened Esker or 20 mm Minus)
Ⓔ COARSE TAILINGS

NOTE: COARSE TAILINGS PLACED DURING MILL PRODUCTION. COARSE TAILING LEVEL TO REMAIN 2 m HIGHER THAN WATER LEVEL

0 — 5 metres

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Figure 2-9
EAST DAM AND SOUTHEAST DAM
TYPICAL CROSS–SECTIONS

REVISION ISSUE: 0
DRAWING No.: ED–4

Both dams contain a central geomembrane liner surrounded by bedding and filter layers. The liner will be keyed into the foundation materials, and sufficient cover over the key trench will maintain the base of the liner in a frozen condition.
The downstream shell of the dam will be constructed of rockfill. This will provide a strong material and will have minimal settlement. The rockfill shells are designed to be constructed with a 2.0H:1V outside slope.

The upstream shell will be constructed of till mined from the open pit overburden. The till is variable, from a sand and gravel with cobbles and boulders to a silty sand and gravel with cobbles. The till will provide an additional layer of medium permeability to reduce water flow through the dam. A thick layer of coarse processed kimberlite will regularly be placed over the till to maintain ponded water well away from the liner; reducing the possibility of thawing the foundation soils under the liner. The upstream till and coarse tailings will be constructed at slope of 3.5H:1V. The slopes will be flattened over time as fine PK is beached off the dam's upstream slope.

2.3.3.4 Material Properties

The following provides a summary of the dam materials. Specifications for the material gradation and placement are presented in the East Dam and Southeast Dam construction specifications.

2.3.3.5 Slope Protection

The upstream dam slopes of the East and Southeast Dams may be exposed to water during spring freshet and the short summer season. Fine PK will eventually be beached up against the dam; therefore there will be not be direct contact with the reservoir and the dams over the long term.

There is no plan to place erosion protection on the dams. The coarse tailings and fine PK will be placed on the dam face on a regular basis. The course tailings will be replaced if wave action erodes them. The initial performance will be monitored, and slope protection added if required.

2.3.3.6 Coarse Processed Kimberlite Tailings

The upstream slope of the dam will be covered with a layer of coarse processed kimberlite tailings. This material is composed of sand sized particles ranging from approximately 0.1 mm to 5 mm. This material will be placed after plant startup and throughout the mine operation, as opposed to being placed during the dam construction.

2.3.3.7 Till

The upstream shell of the dam will be constructed with till. The natural till deposits on site vary from sand and gravel with some cobbles and boulders to silty sand and gravel with cobbles and boulders. Silty till, as opposed to sandy till should be used where practical. Boulders larger than 250 mm must be removed by blading them out of each lift of material to allow for compaction the till. The large particles can be wasted on the upstream dam slope.

2.3.3.8 Geomembrane Liner
The geomembrane liner is recommended to be a 40 mil polypropylene liner. The liner is flexible at cold temperatures. A 16 oz non-woven geotextile is recommended to be placed above and below the geomembrane.

2.3.3.9 Liner Bedding
Bedding material must be placed on either side of the geomembrane. The bedding material can consist of 20 mm minus crush material, or 40 mm minus esker material with round particles.

2.3.3.10 Transition Material
A transition material is required between the liner bedding material and the downstream rockfill material. The transition material must meet filter criteria between the liner bedding and the rockfill as follows:
- D15 of the transition < 5 * D85 of the filter
- D15 of the rockfill < 5 * D85 of the transition

2.3.3.11 Rockfill
The downstream shell materials will be run-of-mine granitic rock and have a maximum size of 700 mm. The material shall be placed in lifts of a maximum of 700 mm. Any boulder larger than 700 mm can be wasted to the outside downstream edge of the dam.

2.3.3.12 Quantities
Table 2-5 [EBA Table 4] presents the in-place quantities of material required for each zone of the intermediate dykes if constructed as per design geometry. The quantities of material do not include any contingency for waste.

Table 2-5: East and Southeast Dam Material Quantities

TABLE 4: DAM MATERIAL QUANTITIES

Structure	Geomembrane (m^2)	Geotextile (m^2)	Fill Material Type				Coarse Tailings (m^3)
			Bedding (m^3)	Transition (m^3)	Rockfill Shell (m^3)	Till (m^3)	
East Dam	4,900	9,800	6,804	2,100	17,000	8,400	12,000
Southeast Dam	4,200	8,400	5,800	2,600	14,000	8,600	12,000

Note: Quantities are "in-place". Seaming allowance and contingencies must be added to geomembrane and geotextile quantities. It is recommended that 20% extra quantities be available on site. Bulking factors and contingencies must be added to fill quantities; 20% should be added to reported quantities for stockpile volumes.

2.3.4 Divider Dyke
The configuration as of 31 December 2006 included one divider dyke. The divider dyke acts as a filter and removes suspended solids. Once the East Cell approaches capacity, a second divider dyke will be constructed to maintain the filtering efficiency of the dyke system.

The section is taken from EBA Long Lake Divider Dyke Design Report (2005c).

2.3.4.1 Dyke Siting and Alignment Selection

Two dykes are proposed. Dyke A is located in the eastern portion of Long Lake, and Dyke B is located in the western portion of Long Lake. The divider dykes will be situated in narrow parts of the Long Lake basin as shown on Figure 2-10 [Drawing DD-1]. The lake bathymetry indicates that the maximum depth is approximately 2 m and 4 m at the Dyke A and Dyke B locations respectively. The lake it is approximately 55 m and 60 m wide at the Dyke A and Dyke B locations respectively.

2.3.4.2 Foundation Conditions

The estimated surficial geology of the PKCA is shown in Figure 2-11 [Drawing DD-2]. Limited geotechnical information is available at the dyke locations. Bedrock outcrops are expected at both the north abutments of Dyke A and Dyke B. A combination of bedrock outcrops and till and colluvium is expected at the south abutments.

Boreholes drilled at the PKCA West Dam and Settling Pond Dam locations encountered 4 to 5 m of till overlying rock. The till was generally logged as cobbles and boulders in a sand and gravel matrix with some silt. Low ice contents were logged in some boreholes with moisture contents ranging from 5% to 15%.

Local data suggests that the soils present in the exposed portions of Long Lake valley typically consist of granular till and colluvium. Lacustrine sediment is present on the lakebed however the deposit thickness is thin because of the small catchment area of the lake and coarse nature of the local soils. Three test probes were pushed into the lakebed at locations as shown in Drawing DD-2. The probes consisted of pushing a steel rod into the lakebed. The measured thickness of soft sediments is listed in Table 2-6 [EBA Table 1].

Table 2-6: Long Lake Divider Dyke Probe Results

TABLE 1
LONG LAKE DIVIDER DYKE PROBE RESULTS

Probe Location	Lakebed Elevation	Solid Strata Elevation	Estimated Thickness of Soft Sediments (m)
P 1101	510.86	510.48	.36
P 1102	511.53	511.53	minimal
P 1103	512.16	512.16	minimal

Note: Probes pushed on March 7, 2005. Ice elevation was 514.96 m

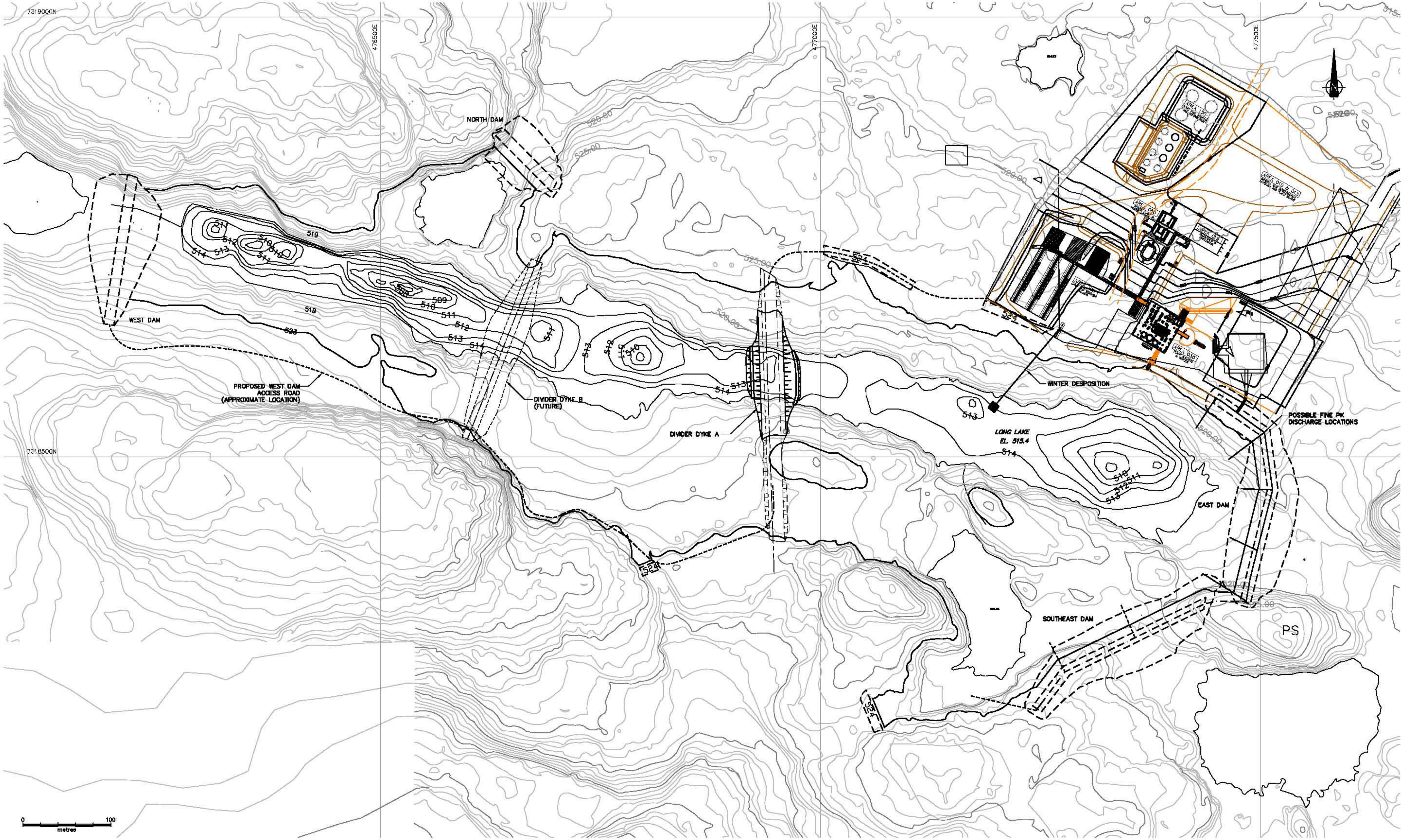

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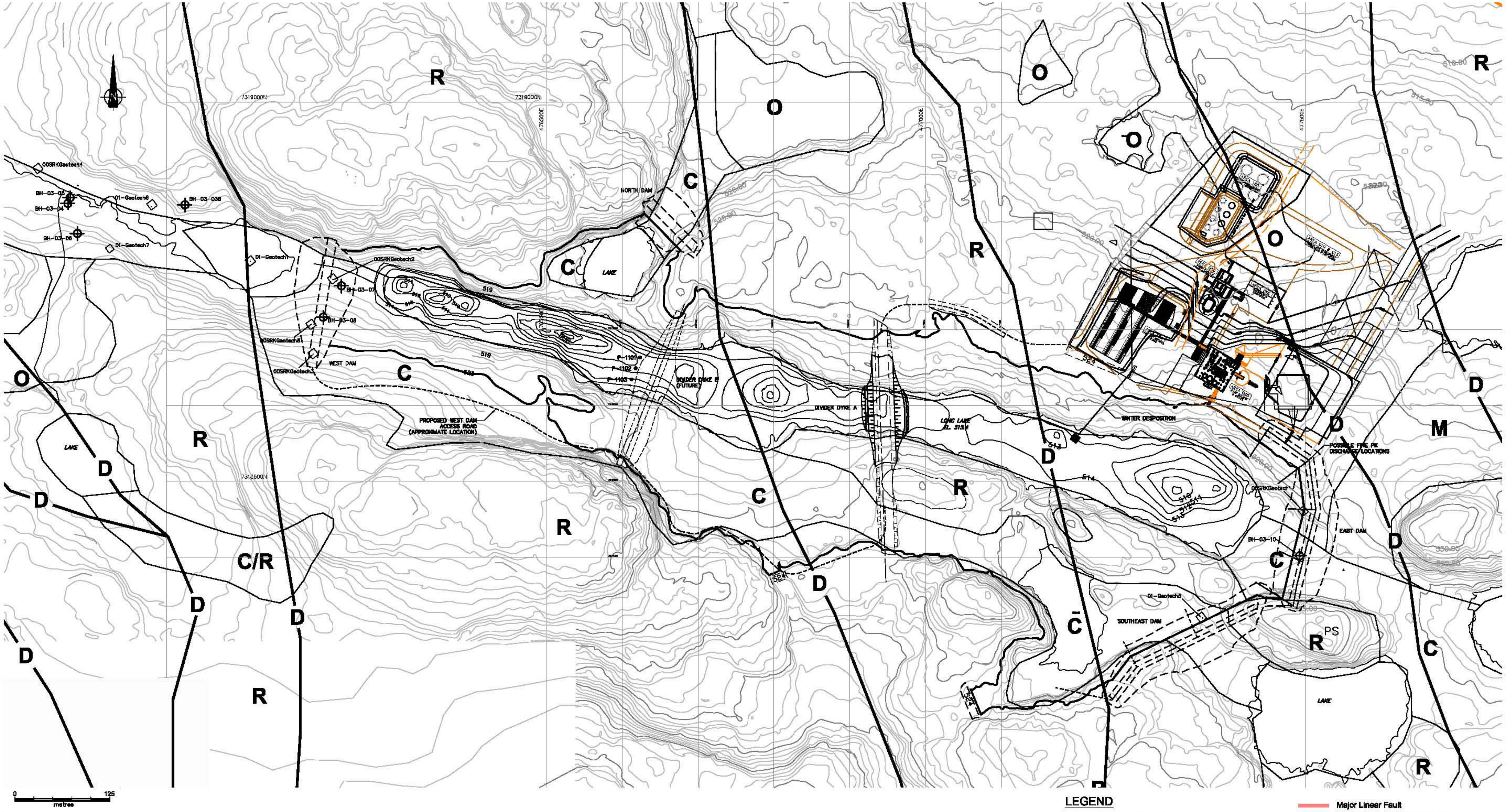
Figure 2-10
DIVIDER DYKE A
LOCATION PLAN

REVISION ISSUE: B

DRAWING No.: DD–1



[redacted]

LEGEND

Quaternary Holocene Deposits
- A — River and creek deposits.
- C — Colluvium.
- O — Organic deposits.

Quaternary Pleistocene Deposits
- F° — Fluvioglacial sediment.
- M — Till. Silt, sand, gravel, cobbles and boulders.

Pre-Cambrian Bedrock
- R — Undifferentiated metamorphic and volcanic bedrock.

- Major Linear Fault
- EW Oriented Amphibolite Dykes
- -D- NNW Oriented Diabase Dykes (Mackenzie)
- Less Magnetic Dykes with Variable Orientation
- Borehole Location
- Borehole Location
- Probehole Location

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Figure 2-11
SURFICIAL GEOLOGY AND TERRAIN MAP

REVISION ISSUE: B

DRAWING No.: DD–2

2.3.4.3 Design Cross-Sections

The planned layouts and profiles of the intermediate dykes are in Figures 2-12 and 2-13 [EBA Drawings DD-3 and DD-4].

The upstream slopes of the rockfill shells are overlain with filters sand and gravel bedded on transition materials of crushed granite.

The rockfill shells are designed to be constructed with 1.5H:1V slopes on both the upstream and downstream sides. The rockfill shell crest width is 8 m. A portion of the dykes are within Long Lake and filling will take place by advancing rockfill into open water.

Transition materials will be placed on the upstream slopes of the rockfill to act as transitional bedding for the filters. The transition material will be constructed with 1.75H:1V slopes on the upstream side with a 3 m wide crest. Where the transition slope is deposited into open water, a variation to slopes of 1.5H:1V can be accommodated.

Filter material will be placed over the transition on the upstream slope. The outside slope of the filter should be no steeper than 2H:1V and have a minimum crest width of 3 m. A layer of rip-rap shall be placed over the filter material.

Along the shore abutment portion where existing terrain is covered by boulder fields, a key trench will be excavated beneath the upstream filter, transition and rip-rap zones.

2.3.4.4 Material Properties

Filter

The PKCA will retain the fine processed kimberlite (fine PK). The fine PK is approximately 15% of the total PK product by weight. The fine PK will have particle sizes less than 0.1 mm. Initial particle size testing indicate an average D85 particle size of 0.0315 mm and D50 of 0.0125 mm (85% smaller than 0.0315 mm, 50% smaller than 0.0125 mm). The samples had an average of 24% of the particles smaller than 0.002 mm.

The divider dyke filter has been designed to prevent a significant flow of fine PK through the filter. The filter is not designed to retain all fines in the supernatant. A filter to retain all fine particles would quickly blind off, rendering it ineffective since the supernatant would then have to be pumped over the divider dyke.

Slope Protection

The divider dyke will be exposed to open water for the short summer season. The original fetch length for Dyke A is 450 m; however the fetch length will decrease over time as the fine PK is deposited from the east end of the facility.

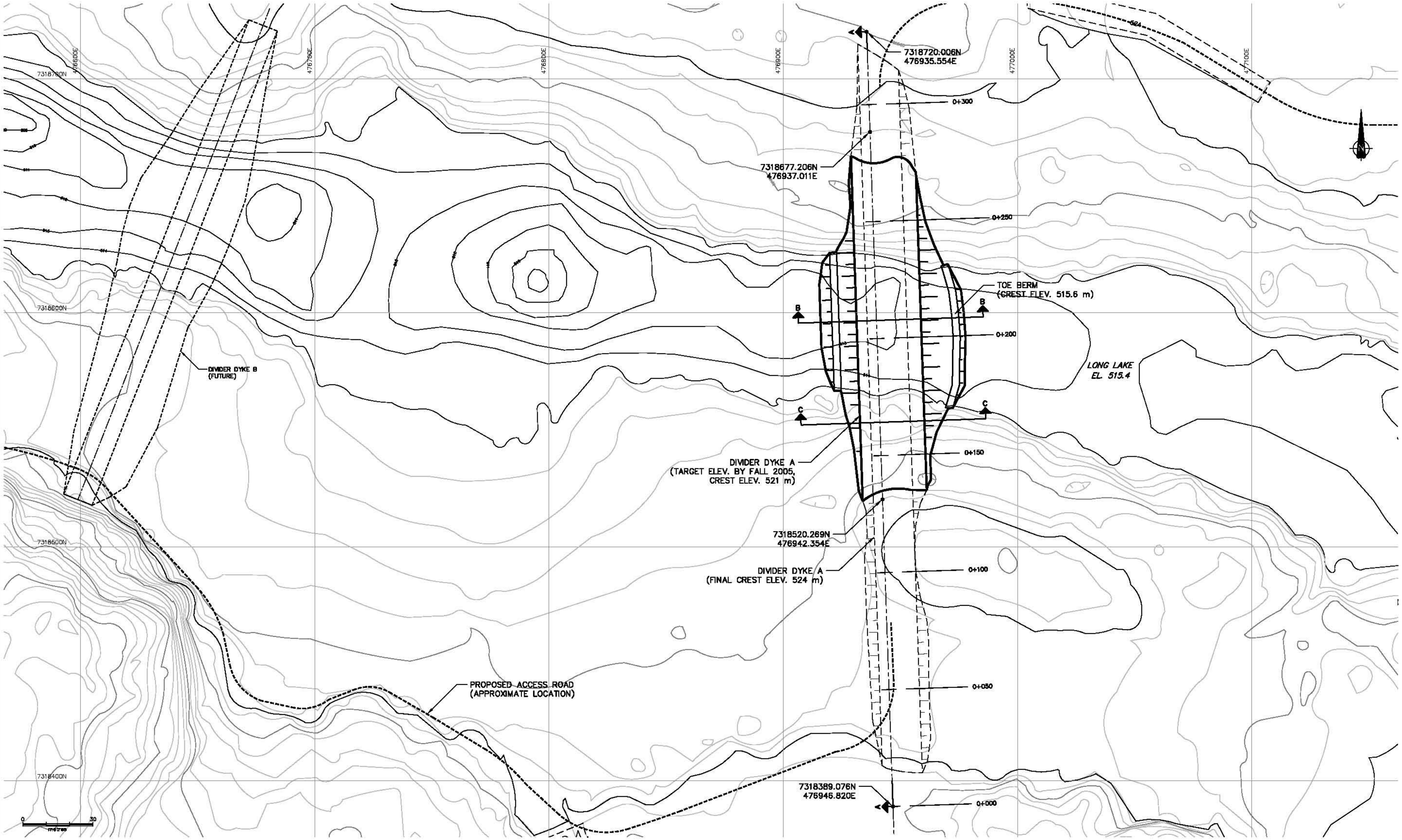

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Figure 2-12
DIVIDER DYKE A
SITE PLAN

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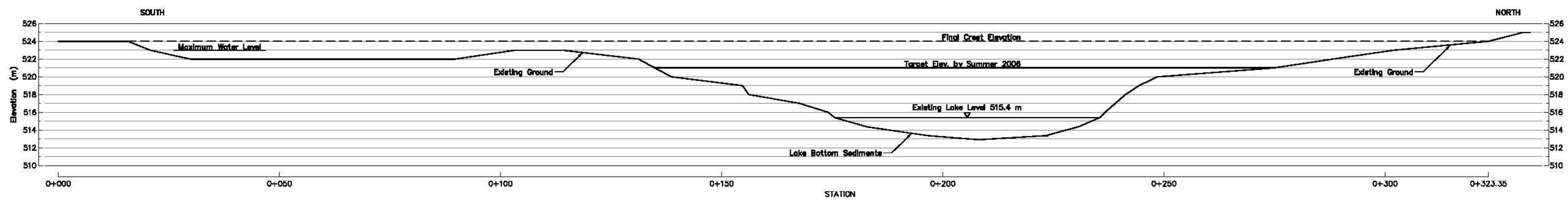
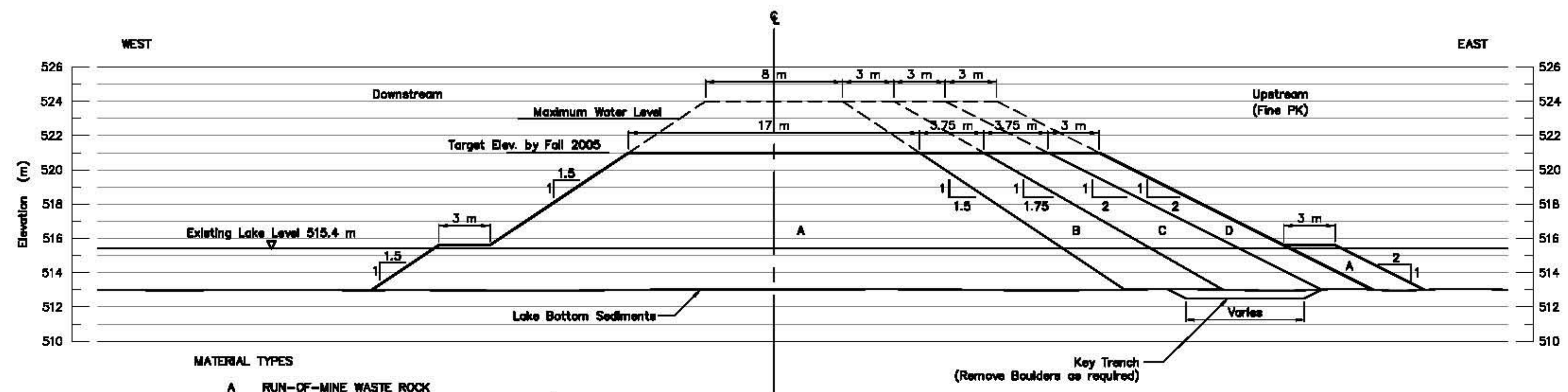
DRAWING No.: DD–3



2 X VERTICAL EXAGGERATION

PROFILE A–A

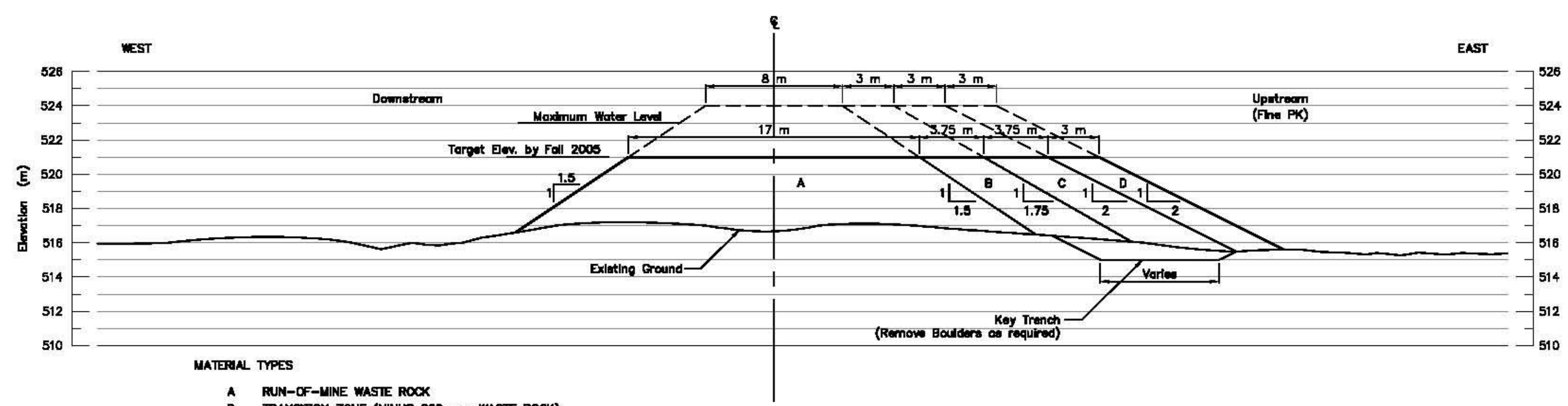
0 25
metres



MATERIAL TYPES

- A RUN–OF–MINE WASTE ROCK
- B TRANSITION ZONE (MINUS 200 mm WASTE ROCK)
- C FILTER ZONE (ESKER ZONE)
- D RIP RAP

CROSS–SECTION B–B



MATERIAL TYPES

- A RUN–OF–MINE WASTE ROCK
- B TRANSITION ZONE (MINUS 200 mm WASTE ROCK)
- C FILTER ZONE (ESKER ZONE)
- D RIP RAP

CROSS–SECTION C–C

0 10
metres

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Figure 2-13
DIVIDER DYKE A
PROFILE and CROSS–SECTIONS

REVISION ISSUE: B
DRAWING No.: DD–4

Transition

A transition layer is required between the filter and the run of mine rock fill to prevent the filter from piping into the dyke rockfill.

2.4 Kimberlite Ore, Coarse Processed Kimberlite and Recovery Circuit Rejects

The Jericho Waste Rock Management Plan, Part 2 (SRK 2006) provides design information on the Kimberlite ore storage, coarse processed kimberlite storage and recovery circuit rejects storage. This section is taken from SRK 2006.

Four coarse PK stockpiles are planned, with Area 2 being incorporated in the East Dam (Figure 2-14 [SRK Drawing WRMP-2-2]). At the end of December 2006 all coarse PK was stored adjacent to the diamond plant (designated coarse PK Site 4). Recovery circuit rejects are stored in the same location, separated from the rest of the coarse PK pending construction of Area 1.

2.4.1 Kimberlite Ore Stockpile

The kimberlite ore will only be stockpiled to separate mining and processing operations and provide a surge against weather and mine delays. It is expected that no more than one month's supply will be stockpiled at any given time (<30,000 m^3 of kimberlite). The kimberlite ore stockpile will be situated immediately east of the plant facility and will be limited to blending piles. The kimberlite ore stockpile [was] graded so that any runoff is directed to the east sump for recycling or pumping to the PKCA.

2.4.2 Foundation Conditions at the Stockpiles

2.4.2.1 Kimberlite Ore Stockpile

Based on site reconnaissance and surficial geological mapping, the foundation conditions at the kimberlite ore stockpile area consist primarily of bedrock, with till under portions of the stockpile. Local permafrost data indicates that all areas are underlain by permafrost conditions.

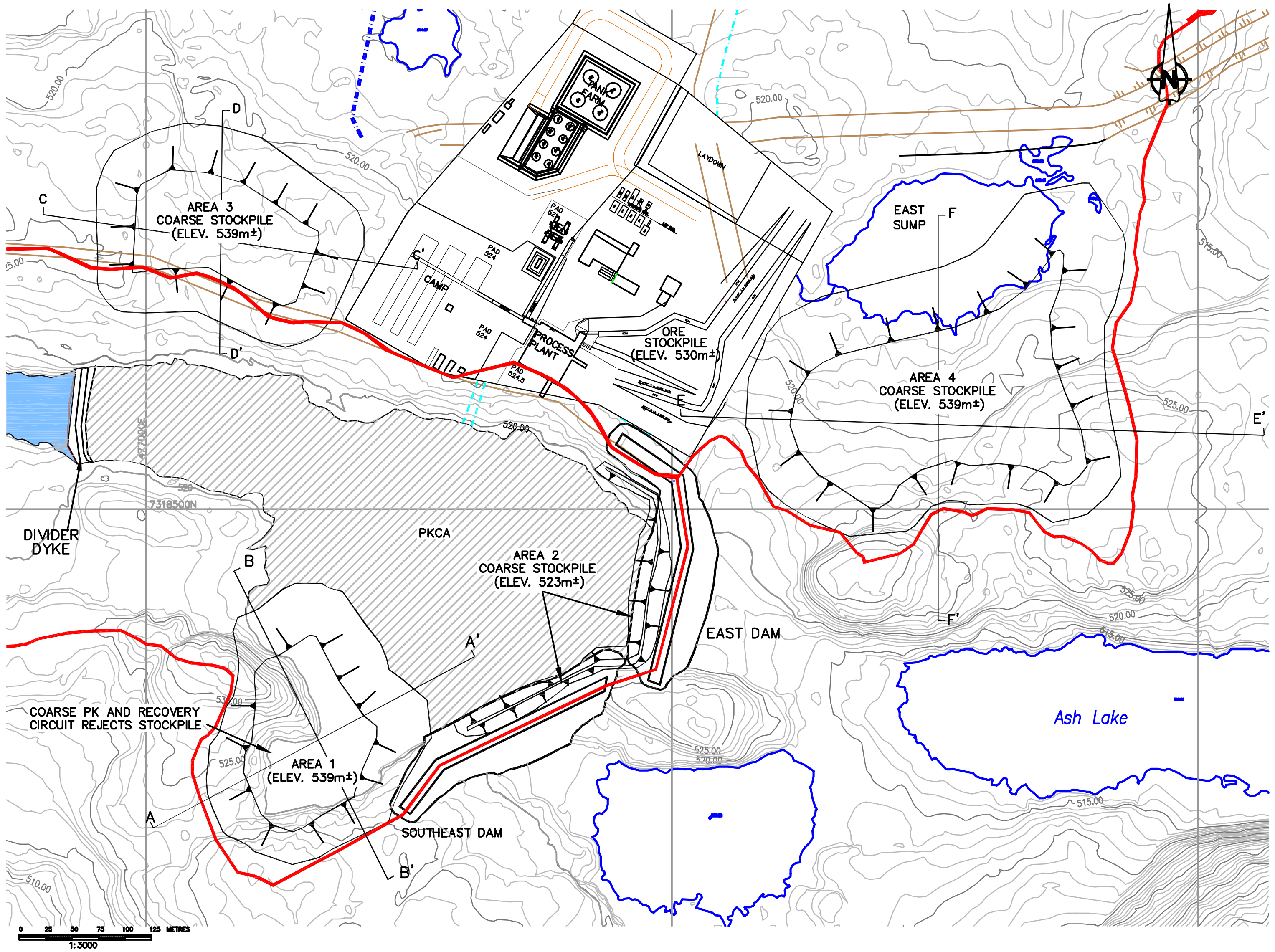
2.4.2.2 Coarse PK Stockpile

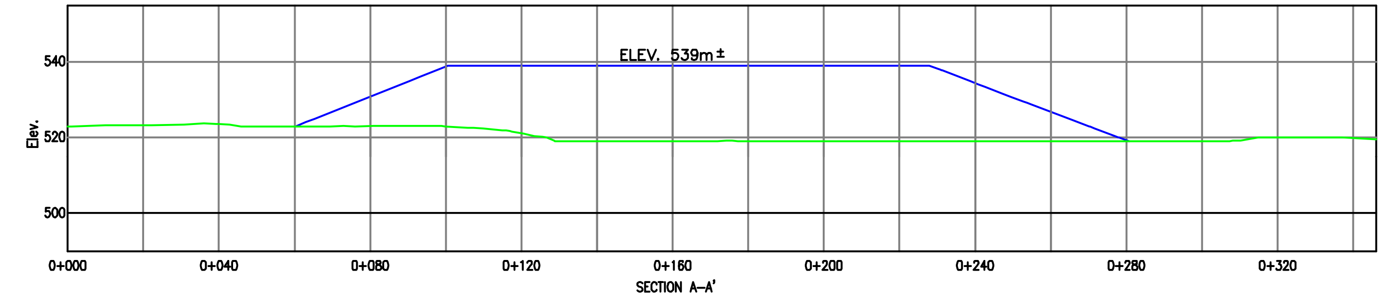
Coarse PK stockpile Areas 1 and 2 will be integrated with the fine PK in the PKCA, and will therefore be discussed in the PKCA Management Plan. Site reconnaissance and surficial geological mapping indicates that the foundation conditions at coarse PK stockpile Area 3 consist primarily of bedrock. At coarse PK stockpile Area 4, the foundation conditions consist primarily of bedrock with isolated small pockets of granular colluvial soils or till with, in some locations, a thin veneer of organic soil. The small natural pond (East Sump) will be left in place as a water management control structure for the coarse PK drainage and plant area drainage. Local permafrost data indicates that all areas are underlain by permafrost conditions.

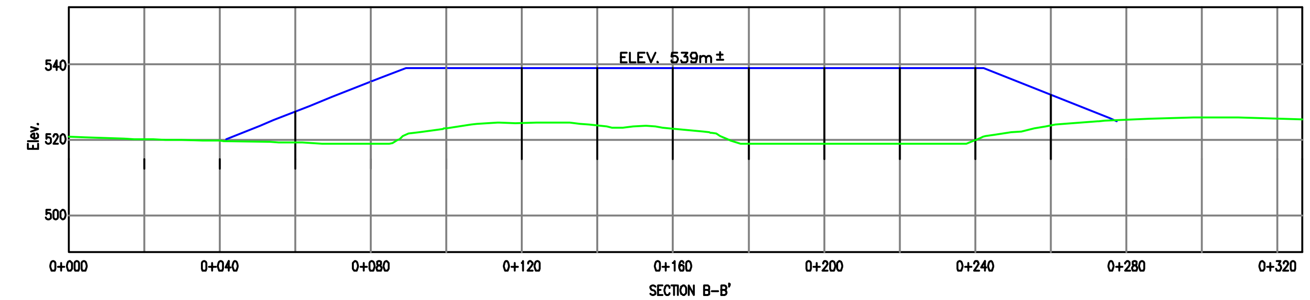
2.4.3 Stockpile Designs

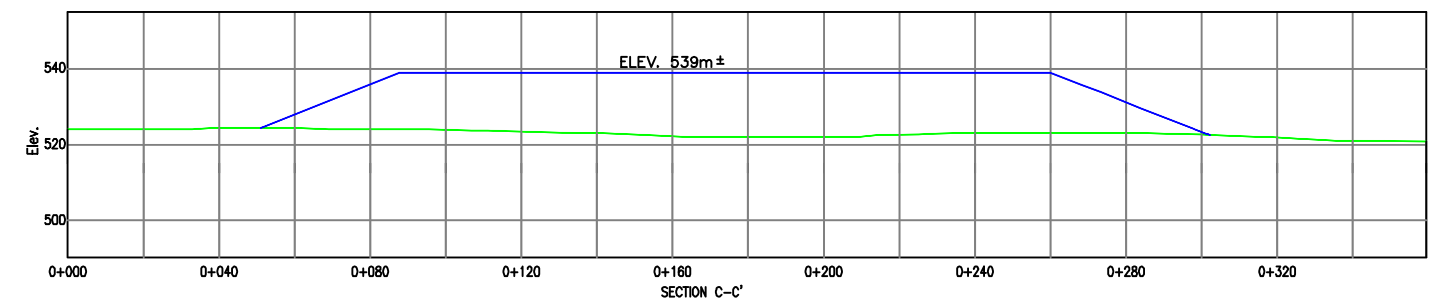
2.4.3.1 General

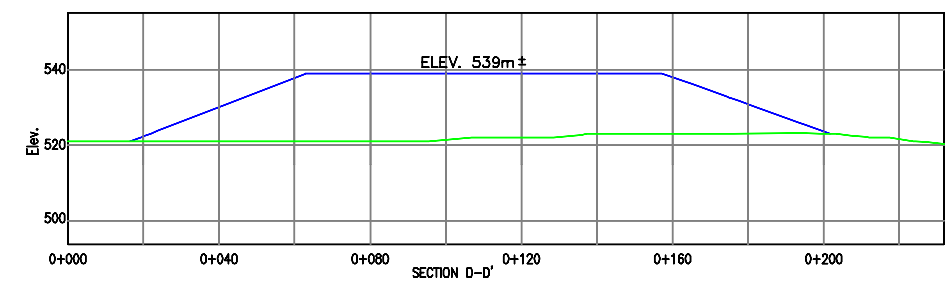
The dimensions and storage capacities of the proposed stockpiles are provided in Table 2-7. Excluding the kimberlite ore stockpile, the total available capacity of the four stockpile areas is 1.94 Mcm. [T]he required stockpile capacity is 1.86 Mcm, which is based on 1.77 Mcm of coarse PK and 0.09 Mcm of recovery circuit rejects.

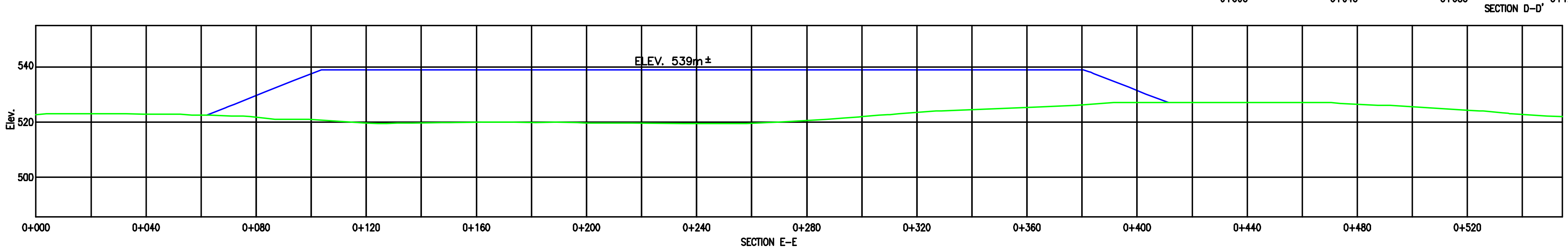


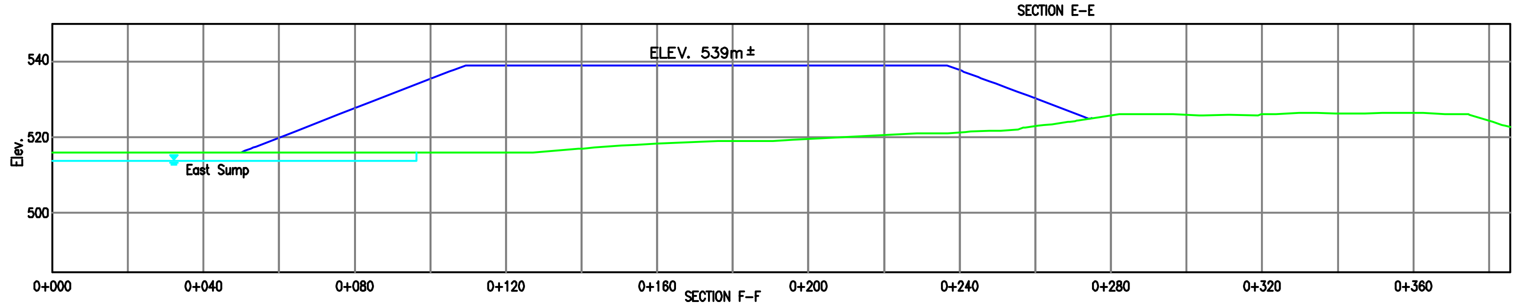












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DETAILED DESIGN

SRK Consulting
Engineers and Scientists

DESIGNED BY: DJ/CS — DATE: DEC. 2005
DRAWN BY: JM — DATE: DEC. 2005
CHECKED BY: CCS — DATE: DEC. 2005
DISCIP. ENGR. — DATE:
PROJ. MGR: — DATE
PROJ. ENGR. — DATE
SRK PROJECT NUMBER: 1CT004.09

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FIGURE 2-14

SECTIONS THROUGH SELECT STOCKPILES

DRAWING NUMBER: WRMP – P2 – 2

REV. 0

Table 2-7: General Dimensions and Storage Capacities of the Stockpiles

Site	Area (ha)	Approx. Crest Elev. (m)	max Height (m)	Capacity (Mt)	Capacity (Mcm)
Kimberlite Ore Stockpile	2	530	5	0.05	0.03
Coarse PK Stockpile & Recovery Circuit Rejects – Area 1 (south side of PKCA)	4.0	539	23	0.77	0.48
Coarse PK Stockpile – Area 2 (upstream of E and SE dams)	0.9	523	8	0.03	0.02
Coarse PK Stockpile – Area 3 (west of camp facilities)	4.0	539	19	0.50	0.31
Coarse PK Stockpile – Area 4 (south of East Sump)	8.4	539	24	1.81	1.13
Total Available Capacity (excluding live storage at the ore stockpile)				3.10	1.94

Notes:
1. The capacity stated for the kimberlite ore stockpile is based on several blending piles and incorporates less than one month of plant feed at full capacity
2. The recovery circuit rejects stockpile will be developed in stages within Area 1, according to the actual rate of production.

2.4.3.2 Kimberlite Ore Stockpile

The kimberlite ore stockpile will be a relatively small, "live" stockpile. The stockpile area will be sloped so that any drainage from the area will either flow to the East Sump for transfer to the PKCA or recycle to the process plant.

2.4.3.3 Coarse PK Stockpiles

Typical sections through the coarse PK stockpiles are provided in Figure 2-12 [SRK Drawing WRMP-P2-2]. The overall slopes at these stockpiles will be about 2.6H:1V (21 degrees), though they will be made up of benches. The slope angles between benches are expected to about 1.4H:1V (35 degrees).
The thickness of each lift in the stockpile is expected to be approximately 5 m, but depending on the projected height of the structure and the number of benches, the lift thickness may be modified in order to develop relatively uniform bench heights. The overall coarse PK stockpile areas will have nominal excess capacity at the final elevations indicated in Table 2-6.

2.4.3.4 Recovery Circuit Rejects Stockpile

Recovery circuit rejects are piled at the north abutment of the East Dam where drainage is to the PKCA. The stockpile is relatively small and may be reprocessed prior to mine closure.

2.5 Pads and Mine All Weather Access Roads

2.5.1 Main Haul Road

The information in this section is taken from the Jericho Diamond Mine Notice of Intention to Commence Work, Version 2 (Mine Plan, Tahera 2005).

The haul roads and ramps are for two lane traffic to accommodate Cat 777D trucks. From the maintenance shop to the open pit the roads are 24 m wide. Pit ramps are wider to accommodate crest blast over-break, ditches and shoulder barriers ¾ the height of the Cat 777 tire (Ø is 2.63m). The surface roads are constructed of run-of-mine granite waste and capped with a mixture of esker and -2" or -3/4" crush to minimize tire wear and improve operator comfort. The height of the roads is about 2m and incorporate a 5H:1V side slope for those that have a height greater than 3m. The side slopes provide ease of maintenance and emergency run-out capability.

2.5.2 Other Access Roads

All other roads are constructed in a manner similar to the main haul road but with a running surface of 10 to 18 m.

2.5.3 Facilities Pads and Laydowns

Facilities pads are composed of crushed rock of variable thickness to provide a level surface for placement or construction of buildings. The average pad thickness is approximately 2 m principally to insulate the tundra and prevent permafrost melt. The diamond processing plant DMS and other heavy plant equipment are exceptions, being founded directly on bedrock. Drawing 1, Appendix A shows the general mine layout and location of pads.

The following pads were constructed:

- accommodations complex, truck shop, crusher
- emulsion plant
- ammonium nitrate storage
- explosives magazines
- laydown area opposite the waste transfer area
- laydown area at the south end of the airstrip

The list excludes lined and bermed pads for fuel and hazardous materials containment which are discussed in Section 2.7.

2.6 Sediment Ponds and Ditches

Sediment ponds and ditches are discussed in the Jericho Water Management Plan (Tahera 2005).

2.6.1 Pit Pond

Sumps will be constructed within the open pit to keep the working area of the pit dewatered and to allow pumping of runoff inflows from the pit to the East Sump for possible reclaim use or onward to the PKCA. The location and size of the pit sump(s) will vary as the pit is developed. During the construction period all the pit water was pumped to the East Sump for containment and construction use. The construction period is expected to be the highest water inflow period of the mine life as water and ice saturated tills covering the kimberlite are exposed. By the end of the first year of operations, these tills were to be substantially removed and placed in the till dump (centre of Waste Dump Site 2).

2.6.2 East Sump

The East Sump is a natural surface depression located in the area of the plant site, fuel farm and ore stockpiles. During the construction phase it was determined that this natural topographic feature was well suited for the purposes of area drainage for the plant and ore stock pile areas, and as an interim storage and transfer point for the pit discharge water. During operations excess water from this sump is to be either pumped to the PKCA, or used for plant reclaim, or for construction, and road maintenance.

Facilities listed below are staged contingency structures that would be constructed during operations if and as required to maintain adequate control of site water quantity and quality.

- Pond A - to collect runoff and potential seepage from Waste Dump Site 1.
- Pond B - to collect runoff and potential seepage from Waste Dump Site 2 that is not
- directed to the pit.
- Pond C – to collect runoff and potential seepage from the Ore and Coarse Rejects piles if required.

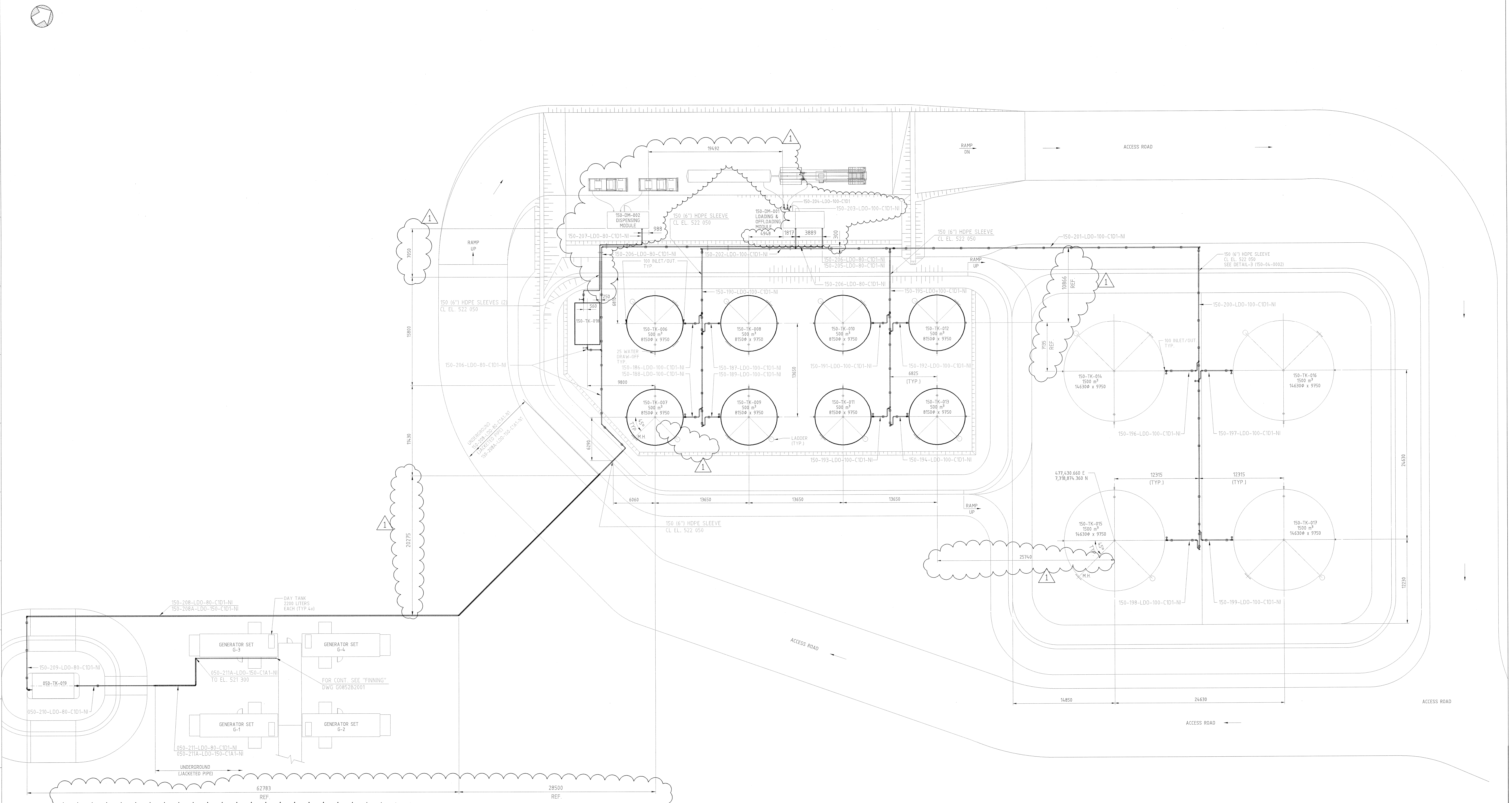
To date, ditches have not been required at the Jericho site; water is trained by roads and culverts where necessary. Other than the culverted C1 diversion where it passes beneath the freshwater intake access road, the only culverts are located on the airport access road to pass small, mostly intermittent streams. Culvert locations are shown on Drawing 1, Appendix A.

2.7 Fuel and Hazardous Materials Berms

Fuel and hazardous materials berms include:

- main fuel farm
- main generator day tank
- hazardous materials transfer area
- airstrip Jet A tanks

The layout of the Fuel Farm is shown in Figure 2-15. Berms are all constructed in a manner similar to the main fuel farm. The information in this section is taken from the Fuel Farm Design Plan (Tahera 2005). Figure 2-16 and 2-17 [EBA Figures 2 and 4] show a plan of the accommodation complex area including the fuel farm and a cross section of the fuel farm berm. The pad at the main fuel farm is a minimum of 3.5 m thick to preserve permafrost.



NOTES:

1. TANK SPACING IN ACCORDANCE WITH NFPA 30 AND THE NATIONAL FIRE CODE.
2. READ THIS DRAWING WITH PIPING ISOMETRICS. (1)

LEGEND

- SINGLE PIPE SUPPORT
- DOUBLE PIPE SUPPORT

PERMIT TO PRACTICE
HATCH LTD.
Signature
Date February 1, 2005
PERMIT NUMBER: P 512
The Association of Professional Engineers, Geologists and Geophysicists of the NWT / NU

DRAWING NO.	DRAWING TITLE
150-09-0001	DIESEL FUEL FARM - CONTAINMENT BASSIN - LAYOUT

REFERENCE DRAWINGS

PERMIT TO PRACTICE
HATCH LTD.
ORIGINAL SIGNED BY
BERNARD BRUMAN
01/19/05
PERMIT NUMBER: P512
The Association of Professional Engineers, Geologists and Geophysicists of the NWT/NU

NO.	DESCRIPTION	CHK.	APPR.	DATE
1	REVISED AS NOTED	JCP	JCP	27/01/05

REVISIONS

STAMP

NWT/NU
ORIGINAL SIGNED BY
J.-C. PARADIS
P. Eng.
L1541
01/19/05

REV.	ISSUE FOR	AUTH. BY		DATE
1	CONSTRUCTION CG-501	JCP	DL	27/01/05
0	CONSTRUCTION CG-501	JCP	DL	01.19.05

ISSUE AUTHORIZATION

HATCH

DESIGNED BY K. LEMCELLI DATE: 12.10.04	DRAWN BY B. KRICKOVIC DATE: 16.10.04
CHECKED BY H. RUPNIK DATE: 01.19.05	DISCIPLINE ENG. J.-C. PARADIS DATE: 01.19.05
PROJ. DES. COORD. J.-C. PARADIS DATE: 01.19.05	PROJECT ENG. M. CAMPANELLI DATE: 01.19.05
PROJECT MGR. D. LAM DATE: 01.19.05	

TAHERA DIAMOND CORPORATION

PROJECT TITLE
JERICHO DIAMOND PROJECT

DIESEL FUEL FARM
PIPING LAYOUT
PLAN

HA PROJECT NO. 316996 **FIGURE 2-15**

SCALE	DWG NO.	SHEET NO.	REV.
1:200	150-04-0001		1

01/27/2005 11:02:49 AM P:\tahera\316996\CAD\P\DWG\150-04-0001.dgn PARA2354

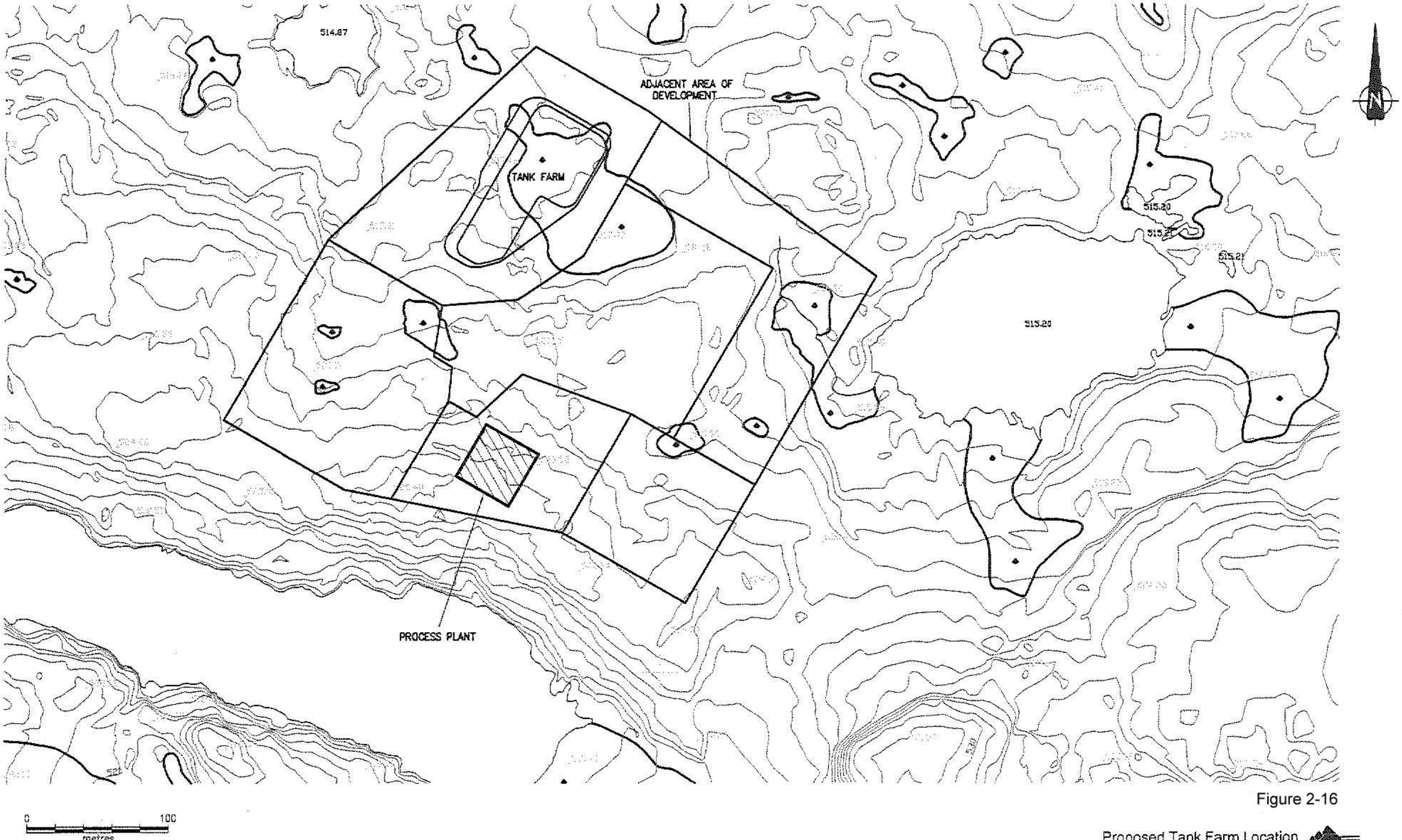


Figure 2-16

Proposed Tank Farm Location

1100060Q03a dwg

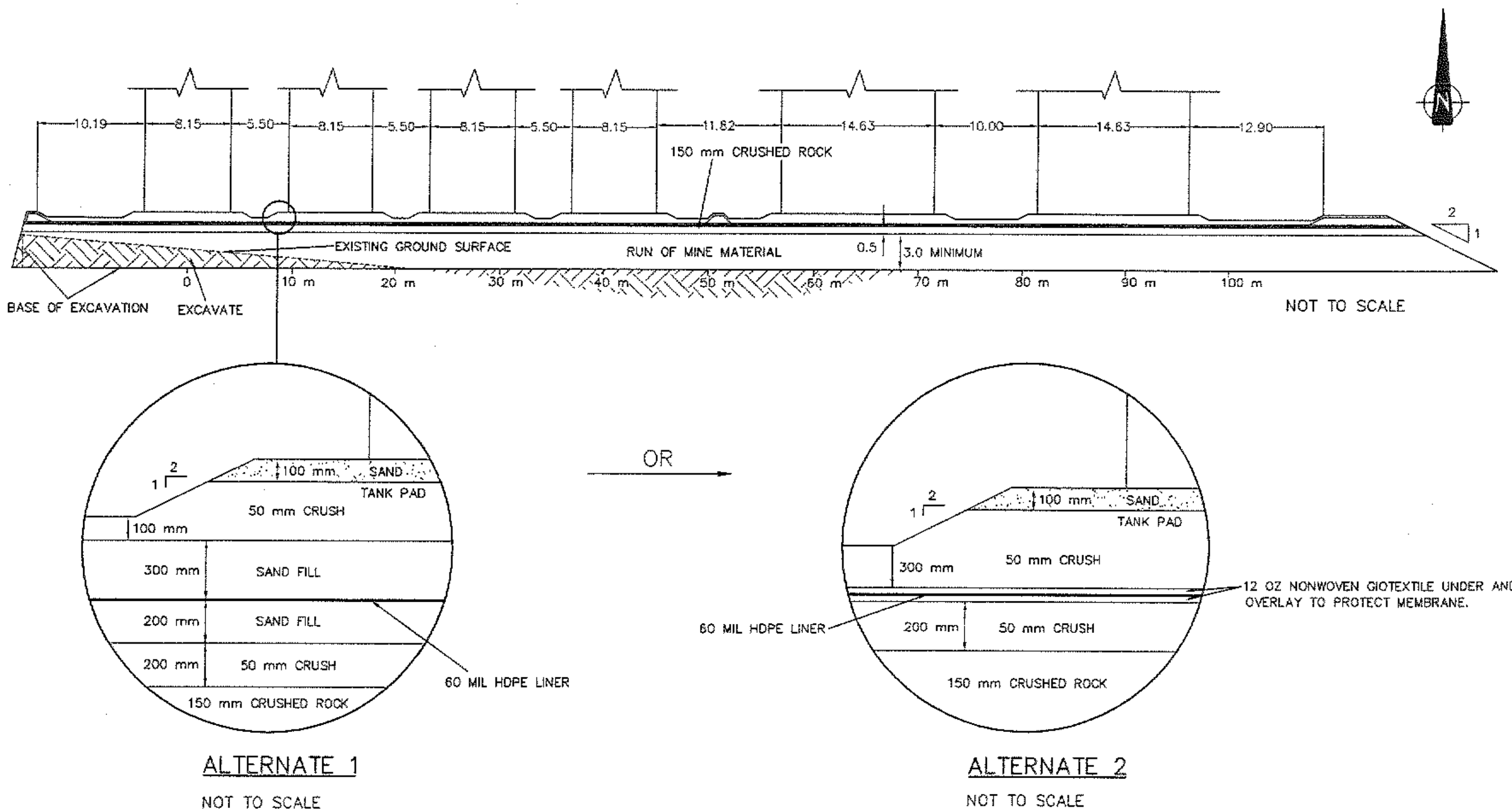


FIGURE 2-17
Proposed Fill Configuration
Tank Farm Liner Design

1100060002K01A.dwg

2.8 Borrow Pits

The Jericho Mine Plan includes three esker borrow areas. Partial development had occurred at Borrow A as of 31 December 2006 (See Appendix A, Drawing 1). Design and operation information in this section is taken from Tahera Borrow Management Plan (Tahera 2005d)

2.8.1 Exploitable Esker Area

Areas of the proposed borrow sites are as follows:

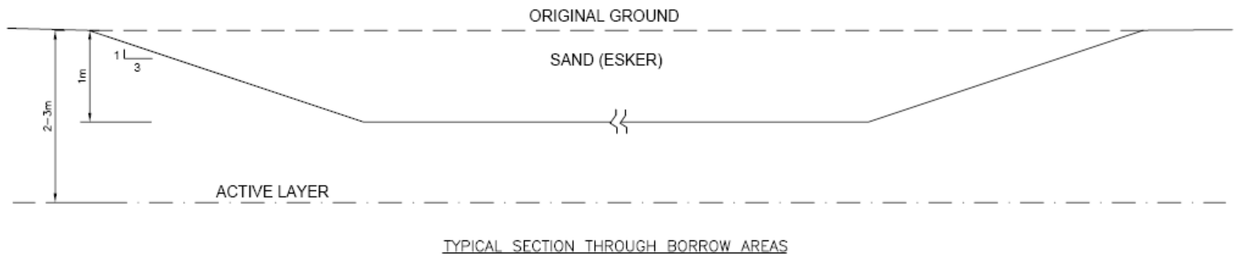
- Area A 95,320 m^2
- Area C 89,960 m^2
- Area D 155,400 m^2
- Total 340,680 m^2

Area C constitutes the airstrip and immediately adjacent areas on the west and east sides and will not be used unless other borrow sources are exhausted.

The mine manager discusses needs for esker borrow with the mining contractor prior to extraction and sets out the sequence of removal of aggregate material. The mine manager or designate supervises esker removal. Payment of a royalty is required for esker use and thus the volume of esker removed is recorded. Records are kept by the mine manager available for government inspection and reported annually.

To ensure aggregate is removed from designated areas only, the sites are staked out prior to removal of aggregate. No esker material was or will be removed closer than 30 m from a permanent water body. Vegetative layers and organic soil on the borrow surface will be removed, if of sufficient volume to practically handle, and stockpiled near the borrow site for revegetation on closure of the site. To date (end of 2006) insufficient organic soil was removed from the esker area exploited to be practical to stockpile. A front-end loader is used to scrap up the aggregate in bucket-width rows across the area being exploited and esker is transported via a D300 mine truck to the required. The eventual profile of borrow areas will resemble that shown in Figure 2-18.

Figure 2-18: Borrow Pit Cross Section



Source: Tahera. 2005. Borrow Management Plan

2.9 Airstrip

The airstrip was initially constructed in 1997 on an esker north of the exploration camp (Drawing 1, Appendix A) to be 1000 m long by approximately 30 m wide taxi and takeoff surface (total width 223 m). The strip was extended in 2006 to 1374 m length and widened on the extension to 360 m. Strip extension was accomplished by leveling the existing esker surface and adding fill of crushed mine rock where required. The airstrip is equipped with runway lights powered by a small generator at the airstrip. Two 62,000 L bermed tanks are located at the south apron for refueling of aircraft if required.

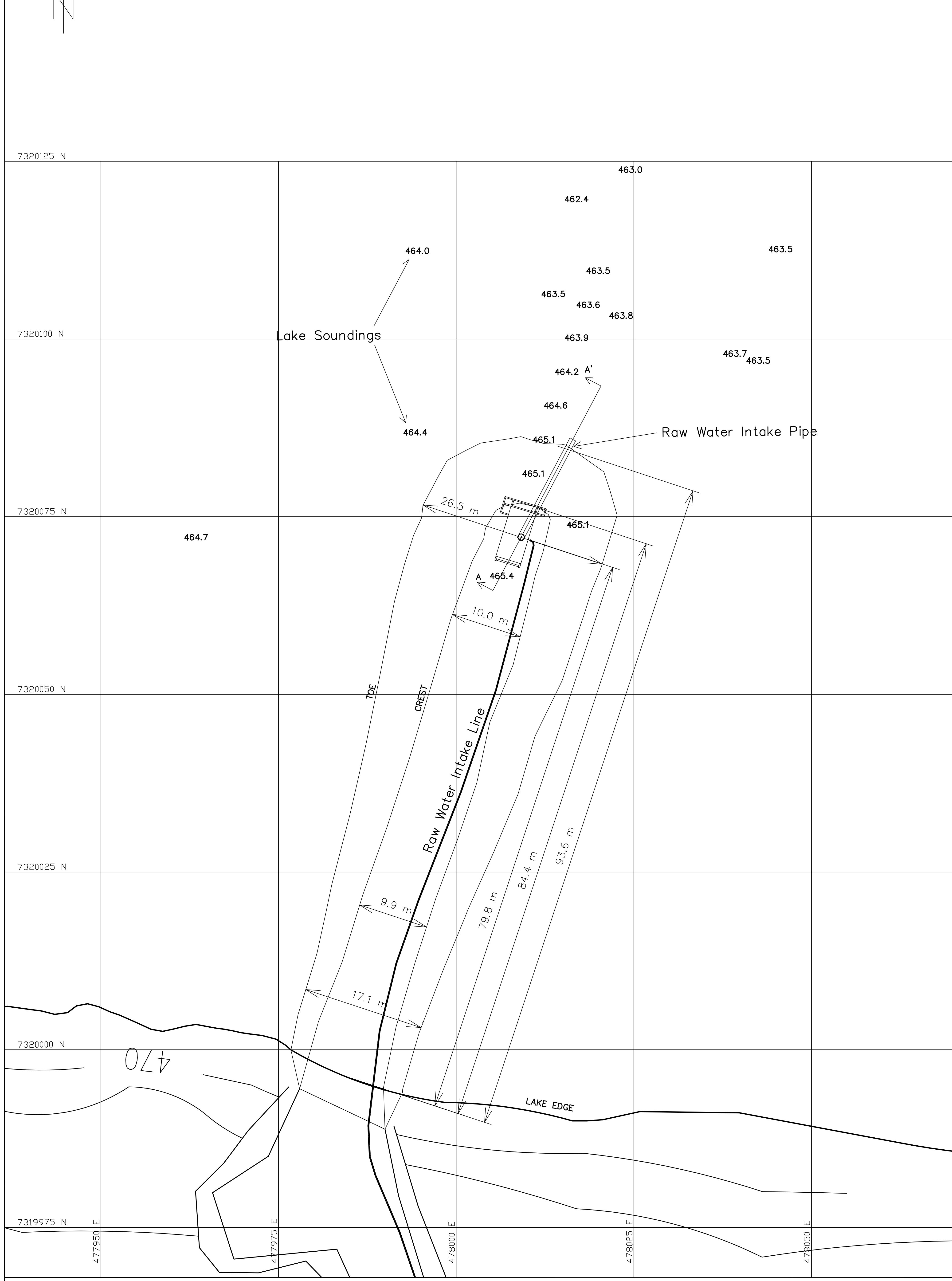
2.10 Water Intake Causeway

This section is based on the information contained in the causeway design plan (SRK 2005). Figure 2-19 shows the as-built construction details and Figure 2-20 shows design cross sections and water intake detail, both figures from Tahera (2006). Photo 1, below, shows the completed intake causeway.

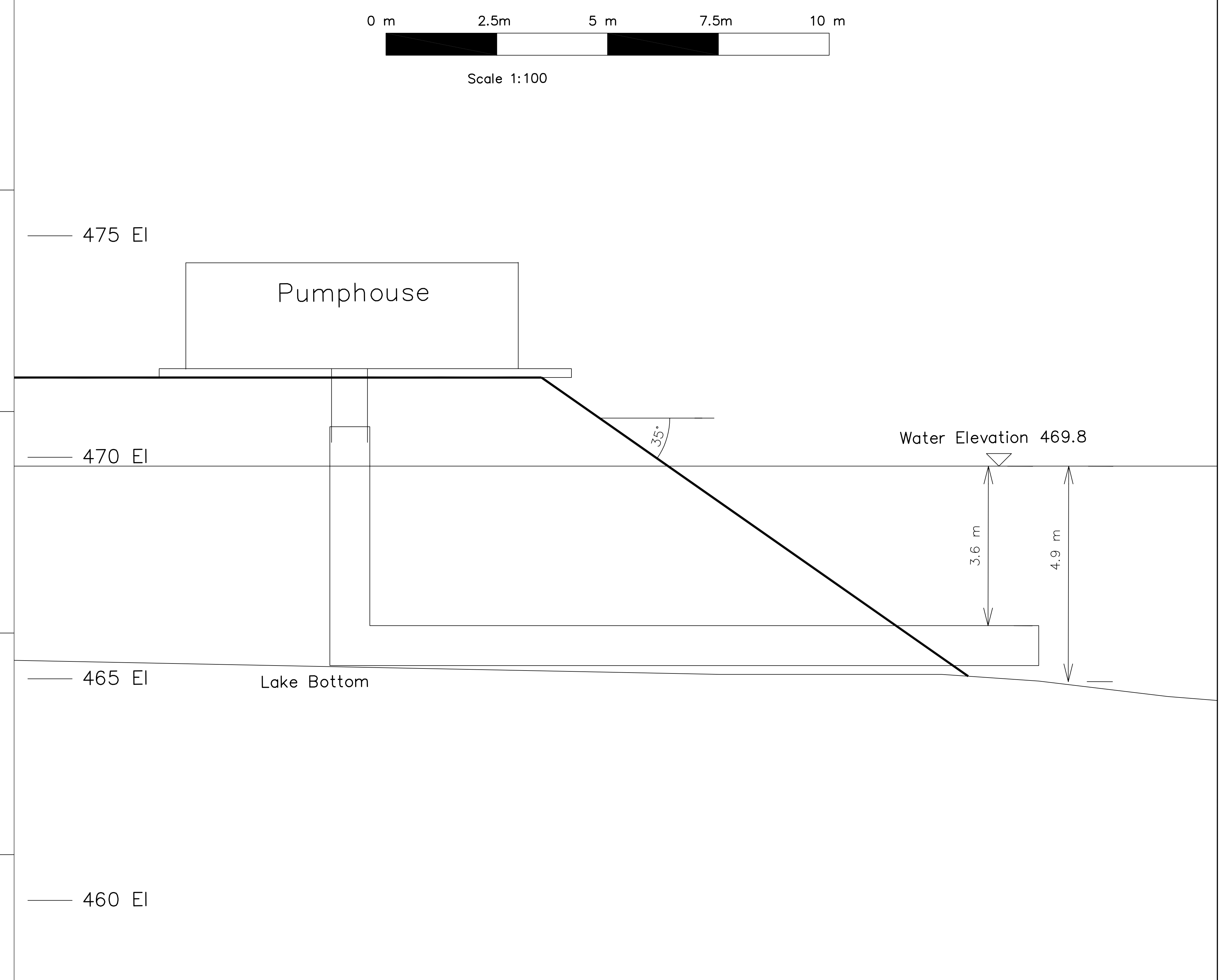
Photo 1: Completed Water Intake Causeway

Plan View

Scale 1:500



Section A–A'



Notes:

Causeway footprint in Carat Lake 2,000 sq m.
Causeway toe calculated from crest survey and angle of repose of granular material (35 deg). Visually inspected at pipe inlet.
Measured points:
- crest of causeway fill.
- lake soundings.
- ends of intake pipe.
- depth of water and of pipe at inlet of intake pipe.

Lake edge and 1 m contours from 1997 photogrammetry.
As a reference, the vertical distance from the base plate of the pump to the bottom of the intake pipe was measured - 7.02 m on Oct 24, 2006.

No	Description	Date
B	Final for seal.	06-Oct-24
A	Draft for client review.	06-Oct-22

Revisions

Seal

Original Signed and Sealed

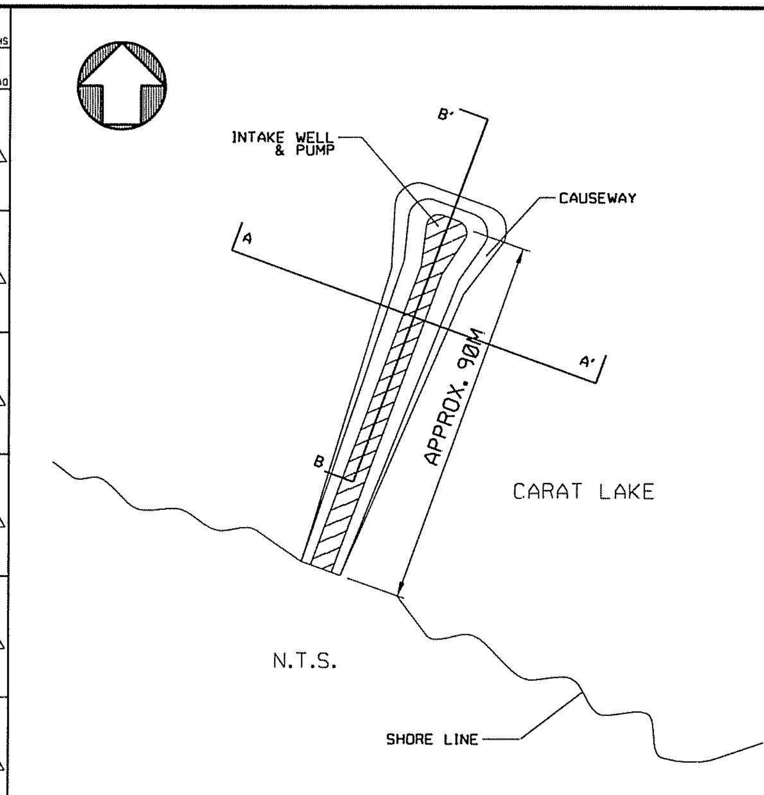
Anthony Bayduza, P. Eng.
9807 - 69 Ave
Edmonton, AB
T6E 0S9
(780)634-3877

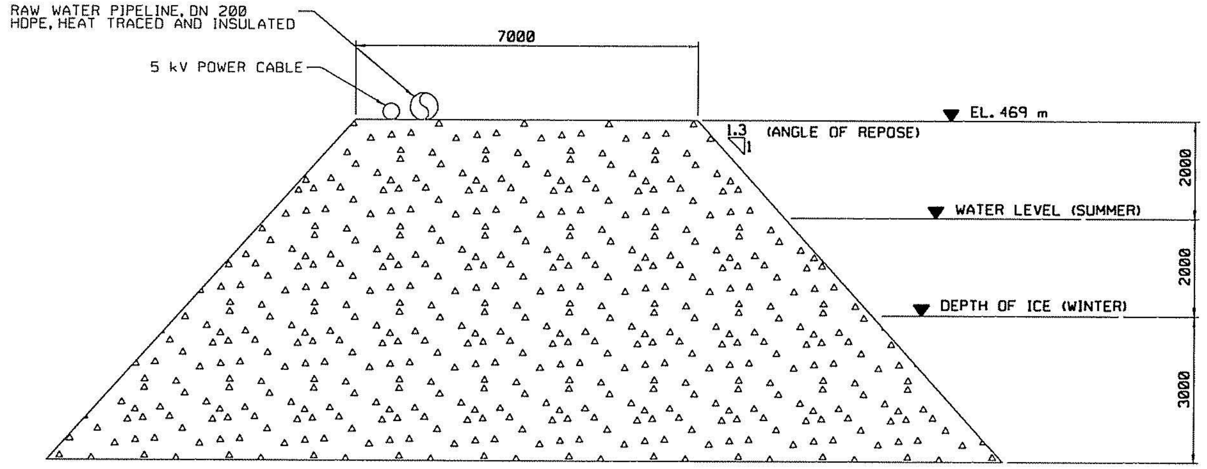
Tahera Diamond Corp.

Jericho Mine

Dwn	Date	Drawing Name
AEB	Oct 24, 2006	Raw Water Intake As Built

Scale	Sheet Size	Drawing #		Rev
as shown	ANSI C	TDC-06001-RWIAB	FIGURE 2-19	B





CAUSEWAY SECTION A-A'

NTS

NOTES:

1- FISH SCREEN DESIGN BASED ON DEPARTMENT OF FISHERIES AND OCEANS "FRESHWATER INTAKE END-OF-PIPE FISH SCREEN GUIDELINE" -1995 AND THE FOLLOWING CRITERIA:

A) FISH SWIMMING MODE: SUBCARANGIFORM

B) WATER INTAKE DESIGN FLOWRATES:
1. 50 M3/HR (CONTINUOUS AVERAGE)
2. 100 M3/HR (INSTANTANEOUS MAXIMUM)

C) REQUIRED AREA, BASED ON 50 M3/HR
1. OPEN SCREEN AREA: 0.13 SQ.M
2. EFFECTIVE SCREEN AREA: 0.22 SQ.M.

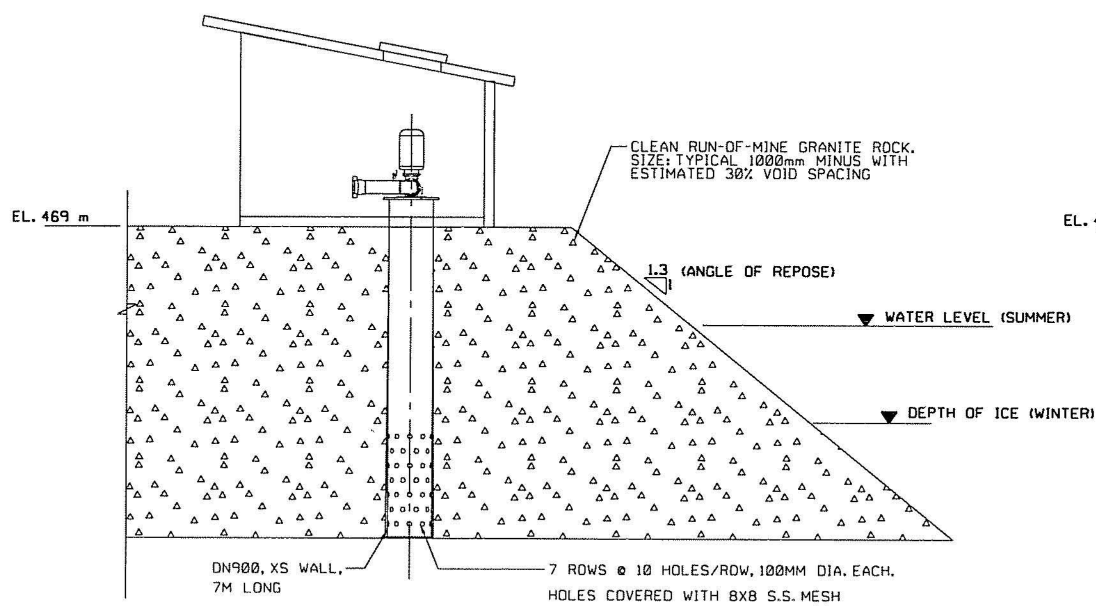
D) REQUIRED AREA, BASED ON 100 M3/RH
1. OPEN SCREEN AREA: 0.26 SQ.M.
2. EFFECTIVE SCREEN AREA: 0.43 SQ.M.

E) FOR ACTUAL PHYSICAL EFFECTIVE AND OPEN SCREEN AREAS, REFER TO NOTES ON EACH ALTERNATIVE SECTION.

F) SCREEN MATERIAL: 8x8 STAINLESS STEEL ALLOY MESH. ALL PIPE OPENINGS TO BE WRAPPED WITH MESH AND SECURED WITH S.S. SELF-TAPPING SCREWS AS REQUIRED.

G) SCREEN MAINTENANCE TO BE DONE MANUALLY, EITHER BY BACK-FLUSHING THE INTAKE OR BY PHYSICALLY REMOVING TRAPPED DEBRIS.

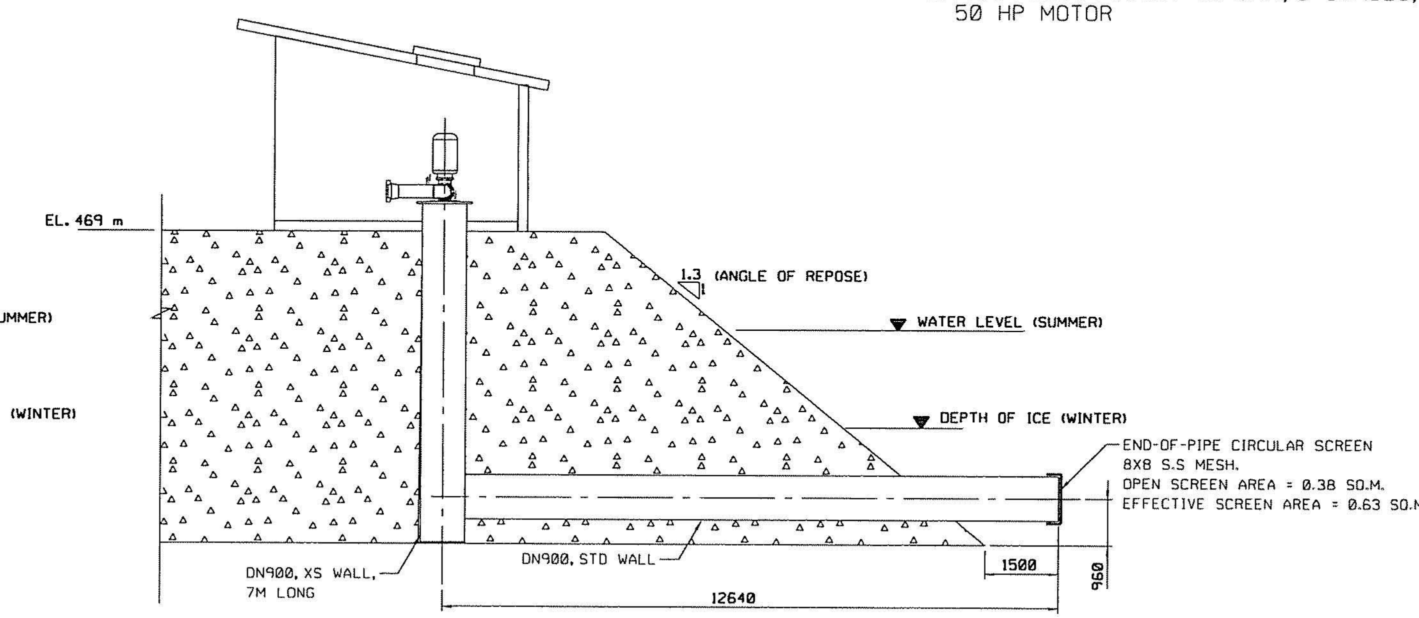
H) PUMP: WEIR/FLOWAY 10 JKM, 6 STAGES, 50 HP MOTOR



VELOCITIES BASED ON AVERAGE FLOW (50M3/HR):
A) AT SCREEN: 0.046 M/S
B) AT EDGE OF ROCKS:
1. WINTER CONDITIONS: 0.000125 M/S
2. SUMMER CONDITIONS: 0.000075 M/S

CAUSEWAY AND INTAKE WELL - SECTION B-B'

ALTERNATIVE 1



VELOCITY BASED ON AVERAGE FLOW (50M3/HR):
A) AT SCREEN: 0.037 M/S

CAUSEWAY AND INTAKE WELL - SECTION B-B'

ALTERNATIVE 2

FOR WATER LICENSE APPLICATION

Figure 2-20

P2	REVISED WITH CLIENT'S COMMENTS — JCH — 23/11/04
P2	INFORMATION — JCH JCP — 23/11/04

REFERENCE DRAWINGS — REVISIONS — ISSUE AUTHORIZATION

HATCH

TAHERA DIAMOND CORPORATION

PROJECT TITLE: JERICHO DIAMOND PROJECT

CARAT LAKE WATER INTAKE
PLAN AND SECTIONS
FOR LICENSE APPLICATION

DESIGNED BY: J.-C. PARADIS — DATE: 23/11/04
DRAWN BY: J.-C. PARADIS — DATE: 23/11/04

HA PROJECT NO. 316996

SCALE: N.T.S. — DWG NO. 316996-SK-P-1000 — REV. P3

DWG NO. 316996-SK-P-100

The following description is from the SRK (*op. cit.*) report:

The fresh water intake causeway [was] constructed in order to provide water for the Jericho kimberlite processing plant and potable camp water. The causeway [was] constructed of clean coarse rock fill and [extends] approximately 90 m into Carat Lake. A steel intake well [was] installed within the rock fill. The intake well [is] comprised of a vertical section, the base of which [is] located in [4.5 m] depth of water to allow operation under the ice during winter, and an approximately horizontal section that [extends] beyond the limits of the rock fill. A stainless steel fish screen [is] set at the end of the intake pipe.

1.6 Causeway Materials
Clean, non acid generating (NAG), run-of-mine granitic waste rock obtained from the development of the open pit will be used in the construction of the causeway. Select granitic waste rock, which is somewhat finer than the average run-of-mine granitic waste rock, will be used immediately adjacent to the intake well. The contractor will be responsible for developing, hauling and placing all waste rock.

Design drawings submitted in the detail design plan indicated a causeway with a minimum roadway surface of 5m extending 100m into Carat Lake with a widened area surrounding the pump house. Upon detail bathymetric data taken as part of the field construction the following field modification were made to the design:

- The length of the causeway was shortened to 93.6m which corresponded to the minimum length possible to insure that the intake pipe would be 0.5m off the lake bottom as well as being 2m below the design bottom of the maximum ice thickness.
- The widened area surrounding the pump house was eliminated
- The causeway width was constructed to provide a minimum 5 m maintenance roadway surface plus room for a pipeline and power cable as well as suitable safety barriers.

During a site inspection conducted by DFO on August 18, 2005 the top dressing on the Carat Causeway was identified as a potential source of sedimentation into Carat Lake. A layer of clean rock has been added as cover material to contain and prevent erosion of the fines into Carat Lake.

2.11 Stream C1 Diversion

The following information is taken from EBA Engineering letter report to Tahera (30 August 2005).

Figure 2-21 [EBA Figure 1] shows the layout of the C1 Diversion.

The diversion consists of three reaches and a diversion section at the upsteam end to divert the natural drainage from Lake C1 to the diversion facility.

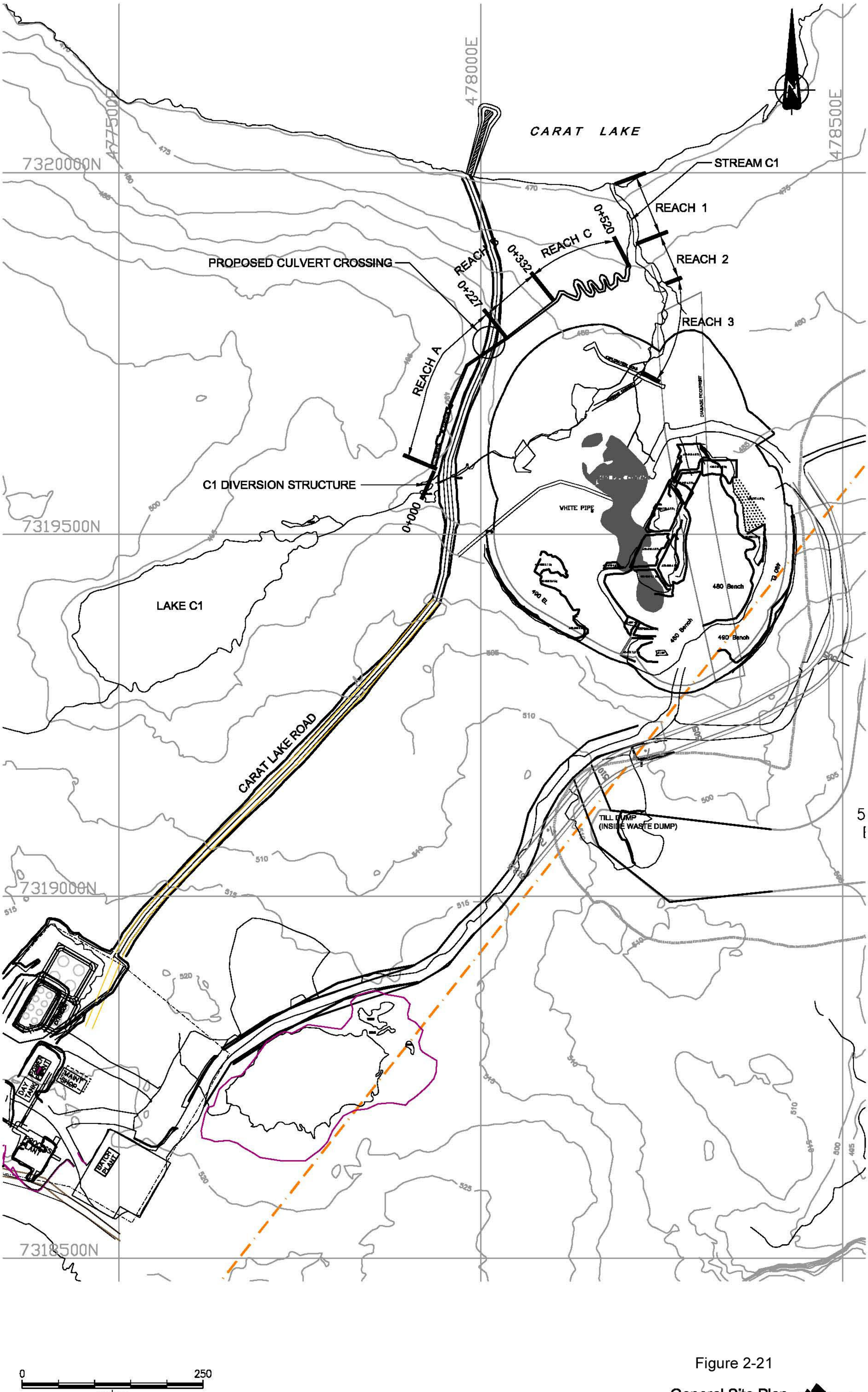


Figure 2-21

General Site Plan

1100060006R04B.dwg

3.0 TILL MATERIALS AND HANDLING PLAN

3.1 Surveys

Till information at the Jericho Diamond site was derived from two sources: geotechnical surveys conducted by Bruce Geotechnical and a surficial geology survey conducted by Thurber Engineering in 2003 and was discussed in the 2006 Closure and Reclamation Plan update.

The approximate total tonnage of till salvaged to date is 2,030,000 tonnes which is located on the Till Stockpile. No estimate is available for any additional till salvage, although expansion of the pit to its ultimate dimension will result in additional till salvage. The Till Stockpile is composed primarily of glacial till with some sand and gravel.

The density of these tills after dumping could range from about 1.6 to 1.9 t/m^3. Due to the presence of ice, the settled density has been conservatively estimated to be 1.7 t/m^3, leading to an estimated dump volume of about 1.5 million m^3 when all tills have been salvaged.

3.2 Salvage Requirements at Full Mine Development

3.2.1 Waste Rock Dumps

The combined waste rock dump tops will encompass an estimated area of 21.9 ha. At a top dressing material depth of 0.3 m, coverage would require 65,690 m^3. The dump slopes are not anticipated to be top dressed. Priority areas for reclamation will be sites that have the highest chance of benefiting from top dressing, such as the PKCA and infrastructure pads. Dump slopes will be graded down to provide a relatively flat slope at an estimated angle of 19 degrees. Till will not be placed on these slopes because it will slump and run off the first snow melt freshet. Further, side slopes will not hold moisture and it is unlikely plant growth could be sustained without artificial addition of water.

3.2.2 Ore Stockpile Pad

The ore stockpile pad is located in the diamond plant area and will be reclaimed with the camp, discussed below.

3.2.3 PKCA

The PKCA will cover an area of 18.8 ha including dams. As the PKCA is developed from east to west it will be progressively covered with coarse PK and rock over the eastern part of the impoundment. On dry and settled areas, vegetation trials will be carried out and if proven successful, the PKCA will be progressively revegetated. A cover of up to 0.5 metre of coarse kimberlite may be used. If growth trials indicate poor plant growth success on coarse kimberlite, suitable overburden top dressing material may be placed to top dress the coarse PK. Use of overburden will pre-suppose successful vegetation trials on this growth medium. As shown on Appendix A, Drawing 2, a pond will remain at the close of the PKCA. A total of 58,765 m^3 of PK and 35,259 m^3 of overburden will be required to reclaim the PKCA. Most of the coarse kimberlite stockpiles will not be required for reclamation. They will be regraded similar to waste rock dumps. Planting and/or cover with overburden will be decided on the same basis as for the PKCA. The area of the coarse kimberlite stockpile tops will be 6.7 ha upon completion of ore processing (discounting removal of coarse PK for reclamation of the processed kimberlite containment area).

3.2.4 Roads and Pads

Roads, laydown areas, the plant, generators, accommodation, truck shop, crusher site, explosives storage, emulsion plant and explosives truck shop, and miscellaneous small areas will cover an additional approximately 23 ha.

The total area of disturbance of borrow areas and airstrip will be 36 ha, if borrow areas are completely exploited. As shown on Appendix A, Drawing 2, only relatively small parts of the borrow areas are planned for extraction; a total estimated area of 8.6 ha will be disturbed. These facilities are/will be located on eskers and no top dressing of additional material will be required, only regrading where required to eliminate steep slopes and add micro-contours where indicated.

3.2.5 Open Pit

The open pit is not slated for revegetation due to the steep side slopes. Rather it will be allowed to fill with water. Current plans call for discharge through a dedicated channel once the pit fills (estimated to be a minimum of 20 years post mine closure). Estimates of pit refill time will be refined once adequate water balance data are collected by the mine. Water balances are calculated annually for the mine and the 2006 water balance is expected to be completed in 2007 prior to spring runoff.

3.2.6 Summary

Table 3-1 contains a summary of top dressing material requirements for reclamation. Top dressing material will be till (preferred) or esker (alternate). Till is a mine unit that is already disturbed, whereas use of esker will require additional disturbance.

Table 3-1: Reclamation Top Dressing Material Requirements

Facility	**Requirements for 0.3 m Cover 31 December 2006 (Year 2) (m^3)**	**Requirements for 0.3 m Cover Final Mine Configuration (m^3)**
Waste Rock Dump 1 Top	0	35,900
Waste Rock Dump 2 Top	29,790	29,790
PKCA Slurry containment cells	28,137	35,259
Coarse Kimberlite Tops[1]	8,979	20,200
Pads: Camp Storage, Explosives Storage, Crusher Site, Laydown, Waste Transfer	69,800	69,800
Airstrip	0	0
Total	**136,706**	**190,949**

Notes
[1] Should revegetation trials indicate successful plant growth on coarse PK, no top dressing will be applied.

The largest proportion of overburden tills was removed in Year 1 and 2 (2005/2006) and is stockpiled on the till stockpile portion of Waste Rock Dump 2 (Appendix A, Drawing 1). Till may temporarily (less than one season) be stockpiled at other locations where sedimentation in runoff can be controlled and where the area is already in a disturbed site, such as one of the pads with vacant space. Temporary storage may occur, if it allows placement of till near its final location and if it is anticipated the till will be placed at its final location within that year.

3.3 Till Stockpile Design and Construction

The Till Stockpile is used primarily to store potential top dressing material, most of which was frozen when it reported to the stockpile. The surface of the Till Stockpile thaws during the summer months and requires confinement. The design of the Till Stockpile was based on the use of waste rock to provide confinement to the till in the event it thaws and, due to excess water, shows a propensity to slump or "run." The Till Stockpile is located on the north central side of the present Waste Rock Dump 2 confined by a toe berm. Performance of the rock berm in 2005 and 2006 confirmed its effectiveness at prevent runout of thawed till.

Till was hauled to its stockpile using off-road mine trucks on all-weather mine access roads. The foundation preparation procedures for the till were the same as those used for the waste dumps. Waste rock was placed by end dumping and spread with a dozer.

In order to preserve the frozen conditions within the base of the waste rock, a frozen foundation layer was developed at the base of the overburden. In addition, waste till placement will be managed to try to lock in the frozen conditions within the foundation layer and prevent thawing of either the foundation layer or the underlying foundation.

In the summer prior to the anticipated need for material from the stockpile, the anticipated quantity will be windrowed if necessary to facilitate handling when frozen and to increase the active layer depth if required. Because excessive rehandling negatively affects top dressing material properties, rehandling will be minimized to the extent practical.

3.4 Top Dressing Placement Strategy

For reclamation, top dressing material will be windrowed along the top dressing area in preparation for a dozer to replace the material. Stockpiles located remote to the replacement area will be hauled by truck, and again windrowed along the top dressing area for replacement.

The replacement of the top dressing material will be under the direct supervision of in-house environmental personnel to ensure the required replacement thickness is achieved and to monitor the condition of the replaced material. Weather or material conditions, which are not conducive to effective replacement, will require temporary suspension of the program or remediation measures. Any amendments to the top dressing material, which are identified as being required based on reclamation trials, will be added during replacement.

4.0 CLOSURE EROSION AND SEDIMENT CONTROL PLAN

Sedimentation control structures and erosion control are discussed in the water management plan for the project (Tahera 2005). In summary, all clean water (runoff from undisturbed areas) will be routed around the site as required. All runoff from disturbed areas will be directed to the open pit, east sump or sediment ponds (when constructed) as required for settling of suspended sediment and then released to the environment (in most cases, upland tundra). Alternatively, this water will be discharged to the PKCA if water licence criteria are not met. On closure mine area drainage will be directed to the open pit which will act as a sink until it eventually fills and overflows, either into Stream C1 or an open channel to direct water away from Stream C1 (see Section 6.4.3).

Erosion will be controlled principally by slope angles of constructed facilities being kept less than the angle of repose or by rock armouring, as appropriate. Long-term sediment control will consist of revegetation, where such is feasible, or rock armouring where it is not, and where erosion control is required.

There will be areas where revegetation is not possible and rock armouring will be used in such areas. Because overburden material will be placed and revegetation will proceed on most flat surface areas, the un-revegetatated areas are likely to be the slopes of the waste rock, coarse kimberlite and the remaining overburden stockpiles. The regraded surfaces will consist of coarse rock in most of these cases, so the requirement for additional erosion protection is likely to be very limited. Where it is necessary to import armouring for erosion protection, it will be obtained by screening suitably sized inert material from the waste rock or overburden stockpiles.

5.0 REVEGETATION PLAN

5.1 Introduction

Revegetation studies are scheduled to commence in 2007.

Pre-existing native plant communities cannot be completely re-established, however some reclamation is possible. Many species of wildlife (e.g. caribou, canids) should resume use of disturbed esker habitats when the infrastructure is removed. A cooperative approach will be sought with Ekati and Diavik mines information exchange on reclamation research at diamond mines in Arctic environments.

Wherever possible islands of undisturbed vegetation will be left in disturbed areas. These islands will provide a seed source for adjacent areas once reclamation of those areas commences. This approach has been shown to be effective in temperate alpine areas (Bittman 1995), and also at preliminary trials at Ekati (Reid 2002).

5.2 Consultation with Arctic Diamond Mines

To date, only published results from Ekati and Diavik are reviewed as they become available. Once revegetation trails commence at Jericho dialog with the mentioned mines is expected to increase.

5.3 Revegetation Objectives

The target end land use is wildlife habitat and the aim of Jericho reclamation is to promote, to the extent practical, rehabilitation of the land to this use. Vegetation prescriptions will be developed and tested based on the pre-disturbance ecological zones, where the disturbed areas are located. The aim will be to provide conditions similar to pre-disturbance and to the extent possible, revegetate or encourage native species at the site similar to those that occurred prior to disturbance.

The active layer (permafrost) plays an important role in erosion, particularly thermokarst and slumping. An objective of reclamation activities will be to design rehabilitation so as to minimize any potential negative effects to the active layer (particularly increases) and prevent melting of ice lenses, which can lead to slumping and erosion from runoff. The principal control will be building in winter to lock in permafrost where possible; alternately addition of till or till and rock cover.

A primary objective in some cases will be to retard wind and water erosion. In areas particularly susceptible to erosion this objective may require the use of agronomic species in favour of slower growing native species, with the realization that this will lead to retarding of natural successional processes and delay return of these sites to productive natural wildlife habitat. Failing relatively rapid establishment of vegetation, rock armouring may be required.

5.4 Mine Land Units

5.4.1 Ecological Zones

The pre-mining mine land units at the Jericho Diamond Project are best visualized by superimposing the ecological zones existing at the site with the mine facilities. This superposition is attached here in Appendix A, Drawing 3. The mine land units for planned construction together with the maximum disturbance areas of each are listed in Table 5-1. All mine land units, with the exceptions of the airstrip and borrow pits are in multiple ecological zones. The 1999 vegetation study (Burt 1999) described vegetation associations and relevant extracts are presented in this section.

Aerial photographs of the mine area prior to mine construction are provided in Appendix E.

Table 5-1: Approximate Areas of Surface Disturbance at Full Mine Development by Ecological Zone

Mine Unit	Ecological Zones and Areas Affected (ha)[1,2]							
	WGBM	MBM	DBT	DRT	LK	CRH	EKD	Total
Mine								
Open Pit	3.8		10.2	2.8				16.9
Waste Rock Dumps	5.9	6.7	10.5	32.1				55.2
Roads								
Haul (18 m width)	0.2	0.6	0.8	4.2	0.01			5.8
Access (9 m width)	1.3	0.4	2.5	4.0				8.2
Airport (6 m width)	0.5		0.2	1.1			1.7	3.5
Airstrip							2.4	2.4
PKCA	1.0		1.4	2.4	9.0			13.8
Dams/Dykes	0.3	0.9	1.2	2.2	0.4			5.0
Coarse PK Stockpiles	0.6		6.3	7.3	2.0			16.2
Camp/Plant Area			1.1	9.5				10.6
Crusher				1.5				1.5
Explosives Storage	0.6		0.1	1.0				1.7
Borrow Areas	0.1						8.5	8.6
Waste Transfer Area							0.5	0.5
Total	**14.5**	**8.7**	**39.8**	**73.9**	**11.4**	**0.3**	**13.8**	**162.3**
% of Total	**9%**	**5%**	**25%**	**46%**	**7%**	**0.2%**	**8%**	**100%**

Notes
1 Based on maximum areal extent of surface disturbance
2 WGBM = Wet grass/birch meadow, MBM = Moist birch meadow, DBT = Dry barrenground tundra
DRT = Dry rocky tundra, LK = Lake, CRH = Cliffs/rocky hills, EKD = Esker, Kame Delta

Maximum area disturbance will occur at approximately Year 3 with the expected ultimate footprint of the waste dump being established (excluding pit wall development) given that Borrow Area A3 will require development. A small reduction in some disturbed area may be possible with preparation for revegetating parts of the camp and borrow areas not longer required. Realistically, however, greening up will not have occurred in this short timeframe in that decades are normally required for revegetation of mesic sites and typically even longer for dry sites.

Ecological zones are described in detail in the vegetation report for the Jericho Final EIS (Burt 1999) and a summary attached in Appendix B.

5.4.2 Surficial Geology of Mine Units

Surficial geology provides some insight into surficial characteristics and the mapping produced by Thurber (2003) is attached in Appendix A, Drawing 4.

Surficial cover of most of the mine units listed in Table 5-1 will be altered by mine development. These units include the open pit, waste rock dumps, ore stockpiles, building pads and the part of the PKCA holding fine PK. The surficial conditions of other areas will not be completely altered. These units include the airstrip, most mine roads except for extensive fill areas, laydown areas and the exploration camp area. Section 6 discusses the reclamation plans for each of the mine units. Based on Ekati experience, till and organic surficial units are the most likely areas to be successfully reclaimed without soil amendments or other manipulation of the surface other than stabilization and scarification. Reference to the surficial geology map indicates this would include much of those areas that will not be extensively modified from the pre-mining condition.

5.5 Reclamation Research

Revegetation trials will be used to determining what reclamation prescriptions are most likely to be successful in the Jericho Project area; reclamation research is scheduled to commence early in the production phase. The reclamation research planned will build on the experiences of Ekati.

Annual reports on revegetation trials will be issued to NWB once internal review is completed.

5.6 Reclamation Trials

Reclamation trials will be conducted throughout the mine life with greater intensity of activity during the initial years. The purpose of the trials will be to develop a database on establishment and growth success of vegetation on reclaimed land. As discussed previously, other diamond mine operators in the area will be canvassed as to their successes and failures. The reclamation literature will also be reviewed on an on-going basis. Conceptually, trials could include:

- the effects of top dressing on plant growth for a particular land unit;
- the effects of mixing organic and mineral soil;
- the success of establishment of various vegetation prescriptions;
- the effects of fertilizer mixtures and rates of application;
- the existence and rate of encroachment of native species;
- effects of water content of soil;
- effects of drainage characteristics of soil including erosion resistance;
- soil characteristics measurements:
    - pH
    - organic carbon content
    - texture/particle size distribution
    - salinity (sodium adsorption ratio)
    - electro-conductivity (EC)
    - total N
    - trace metals in soils, roots and shoots

Because some limited success with use of PK as a growth medium has been demonstrated by Ekati, test plots both on and off the PKCA will be established at Jericho to test the use of PK at the mine. As part of this program, the on going results at Ekati and other diamond mines will be monitored by the Jericho Mine.

6.0 RECLAMATION PROGRAM

6.1 Temporary Shutdown

A temporary shutdown for this plan is defined as a cessation of mining and processing operations for a finite period with the intention of resuming operations as soon as possible after the reason for the shutdown has been resolved. Possible causes for such a shutdown could be a major mechanical equipment failure, late delivery of critical equipment or supplies, or labour conflict.

6.1.1 Open Pit

The follow procedures will be undertaken:

- All mobile equipment will be removed from the pit and stored in the plant area.
- During the summer, electricity to the pit will be maintained and the sump pumps operated as required to keep the pit drained; if maintenance of power to the pit is not practical, diesel pumps will be substituted for the normal sump pumps. During the winter this precaution is not necessary.
- All hazardous materials will be taken from the pit and stored in appropriate central locations.
- The pit will be inspected regularly to ensure overall integrity.

6.1.2 Processing Plant

The plant will be shut down in a planned and orderly sequence to prevent damage to equipment, piping and instrumentation. The following preparatory measures will be taken:

- The plant will be run until all kimberlite in the process stream is through the plant.
- The plant will be purged of all diamondiferous materials.
- All diamonds will be removed from the site.
- All slurry lines will be flushed of solids.

Procedures during the shutdown will be as follows:

- Minimal heating to the process building will be maintained to prevent equipment freezing.
- Electricity to the building will be maintained.
- All major equipment will be run periodically to ensure lubrication and integrity of the rotating parts.
- Ferrosilicon will be recirculated once per day to prevent setting up in the circulating medium tanks.

6.1.3 Surface Infrastructure

During temporary shutdown, the site infrastructure will be placed into a care and maintenance mode to ensure environmental stability and orderly restartup as follows:

- Minimal heating to critical facilities will be maintained to prevent equipment freezing.
- All non-critical equipment will be shut down.
- All necessary support facilities and services for care and maintenance personnel will continue to operate:
    - o freshwater intake and potable water treatment;

  - sewage treatment;
  - power plant;
  - glycol heating systems;
  - diesel fuel storage and distribution;
  - part of the accommodation and kitchen facilities.
- All major equipment will be run periodically to maintain operability.
- All hazardous materials stored within site facilities will be collected and stored in a central secure area, e.g., hazardous materials storage building.

6.1.4 Mine Waste and PKCA

The following actions will be taken:

- PK slurry lines will be purged, flushed and drained.
- Dust control operations will be maintained.
- Routine dam inspections will be continued.
- Pump back equipment below dams (except the reclaim water system) will continue to operate.
- The reclaim pump and line will be purged, flushed and drained.

6.1.5 Water Management Facilities

Collection sumps and ditches around the site will be maintained to manage runoff from the site.

6.1.6 Monitoring

All monitoring required by the Jericho water licence would be maintained, except that required by PKCA discharge if no discharge is to occur.

6.2 Indefinite Shutdown

For this plan, indefinite shutdown is a cessation of mining and processing operations for an indefinite period with the intention of resuming operations in the future. During indefinite shutdown the site will be placed into a mode of minimal operating expense while maintaining safety and environmental stability. Possible causes included prolonged unfavourable market conditions or protracted labour dispute.

6.2.1 Open Pit Mine

Procedures similar to those for temporary closure will be followed.

6.2.2 Processing Facilities

Procedures similar to those for temporary closure will be followed. In addition:

- Equipment and gearboxes will be drained of lubricants, which will be stored in sealed drums in the maintenance shop.
- Tanks will be drained.
- Remaining ferrosilicon will be pumped to the PKCA.
- All water, glycol and slurry lines will be flushed and drained. Glycol will be stored in sealed drums.
- Reagents will be stored in locked sea containers.

- The entire process plant will be locked and all heating and electricity turned off.

6.2.3 Surface Infrastructure

Procedures similar to those for temporary closure will be followed.

6.2.4 Mine Waste and PKCA

Procedures similar to those for temporary closure will be followed.

6.2.5 Water Management Facilities

Procedures similar to those for temporary closure will be followed.

6.2.6 Monitoring

All monitoring in the first year of indefinite shutdown would be as established by the mine's Water Licence. If no significant changes in water quality or aquatic receptors as determined from the mine's AEMP after one year, monitoring would be reduced to once in the spring before breakup, once in the summer and once in the fall before freeze up. During any discharge of PKCA supernatant required to maintain storage capacity in the facility, monitoring as required by the mine's water licence would be conducted.

6.3 On-Going Reclamation

Table 6-1 lists areas of disturbance and the year reclamation will be carried out.

Table 6-1: Reclamation Areas by Year

Facility	Area (m^2)	Year Reclaimed
Waste Rock Dump tops	218,962	Years 7&8
Roads	175,000	Year 9
Airstrip	92,700	Year 9
PKCA	94,350	on going
Coarse PK	67,220	on going
Camp and Storage, Explosives, Crusher, Waste Transfer	233,667	Year 9
Exploration Camp[1]	50,000	Year 1-3
Borrow Area A1	31,000	on going
Borrow Area A2	8,000	on going
Borrow Area A3	29,000	on going

[1] Reclamation underway; not included in reclamation cost estimate, Appendix D.

6.3.1 Borrow Areas

To date only Borrow Area A has been disturbed. There is currently no timeframe to develop any other borrow area.

Once borrow areas are no longer required, they will be reclaimed. Borrow pits are exclusively on eskers or kame deltas and overburden is granular, thus not presenting surfaces easily eroded by wind. However, any steep micro-slopes will be subject to water erosion during the summer. Removal of esker surface material will increase the depth affected by freeze-thaw. As well, there is a potential to expose ice-rich overburden, which could result in further melting and slumping; geotechnical investigations by Bruce Geotechnical (1996) suggest limited existence of ice lenses in areas proposed for extraction. This in turn may lead to additional potential for erosion. During active use, esker borrow areas will be managed so as to minimize any potential for water erosion. Once areas are no longer active, steep slopes will be regraded to the angle of repose or 3:1, as appropriate, and revegetated as indicated by reclamation trials.

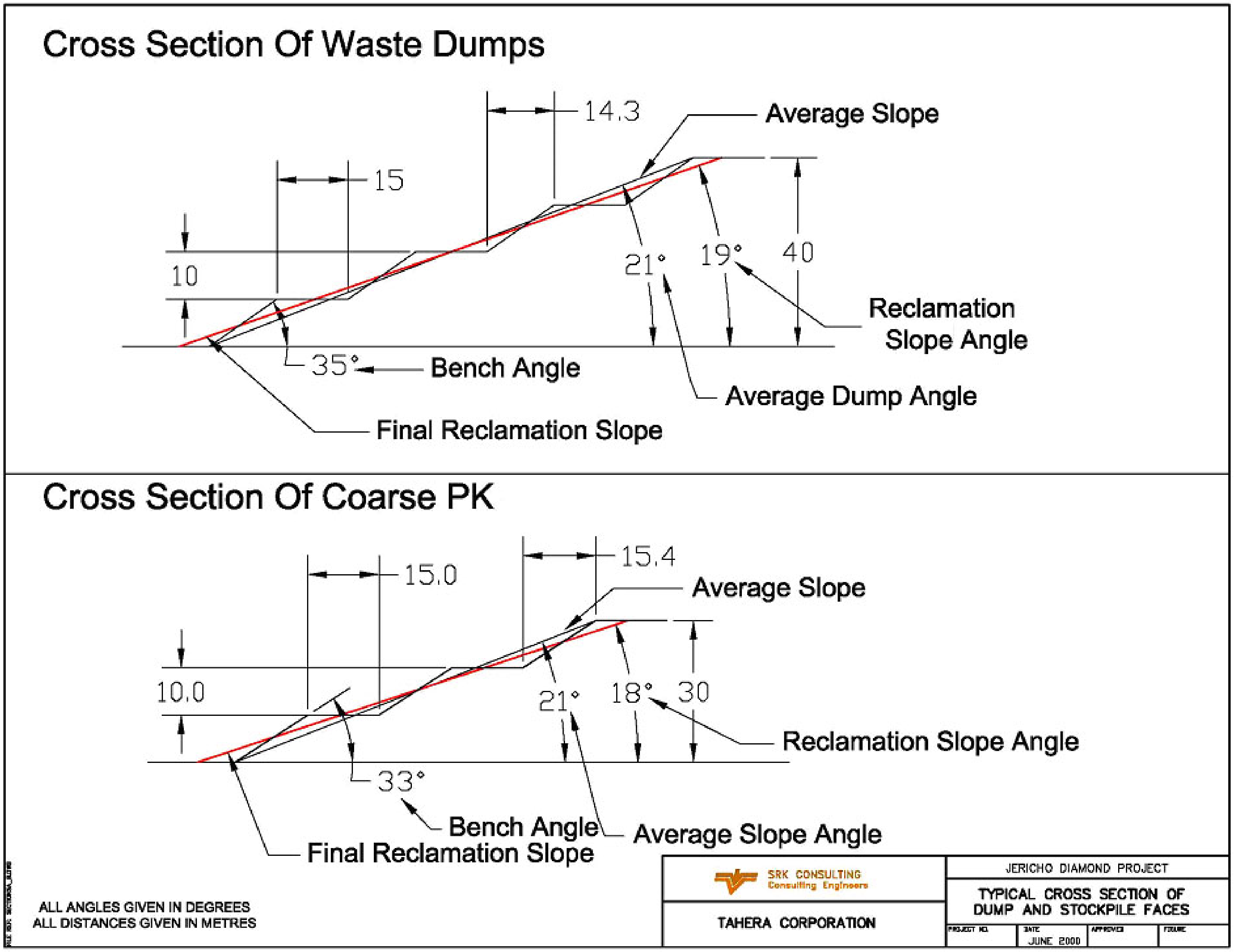
6.3.2 Waste Rock Dumps

Waste rock dumps will remain active until the end of open pit mining. Open pit mine equipment on site for mining will be used for reclaiming the dumps. Dumps will be constructed in step-back lifts; final regrading of slopes will be to attain an average slope of approximately 19° by pushing material down onto benches. Top surfaces will be compacted from traffic use and will be ripped or scarified to loosen the surface and provide microhabitat for plants. Dumps are expected to be dry microhabitats and inimical to plant growth. If revegetation trials indicate the potential for successful revegetation of the dump tops, salvaged top dressing material will be placed on the top or flat surface of the dump to a depth of up to 0.3 m. This top dressed material will be fertilized and seeded as indicated by reclamation trials. Consideration will be given to placement of boulders on the dump top surfaces to provide perches for raptors. Ramps will be built into lifts to allow safe caribou transit across the dump slopes.

Portions of the dumps that remain active throughout the mine life will be reclaimed at closure in the manner indicated above. The side slopes will be left in a stable condition not subject to water or wind erosion, but will not be revegetated. Slopes will be coarse rock to retard water and wind erosion. Both moisture content and the probability of successful revegetation on these slopes will be very low. Organic overburden will be scarce, making their use in areas with a low probability of successful revegetation unwise. Any planting will take place in the spring or fall so as not to moisture stress seedlings during summer months.

Figure 6.1 illustrates reclamation regrading concepts for dumps.

Figure 6-1: Cross Section of Dumps and Coarse PK Stockpile



6.3.3 Open Pit

The open pit will remain for a number of years as a large opening in the ground. To prevent accidental entry or fall into the pit by animals such as caribou, or by people that may visit the site after closure, a rock berm will be placed around the lip of the pit. The rock berm will be built of rock mined from the open pit after it is pushed back to its final position. Waste rock from the mine will be directly dumped in place and dozed into a berm. The berm will remain unfinished at the access road point until pit closure. A swale will be placed at the location in the berm where the natural channel of Stream C1 would exit once the pit fills. There are a number of options for managing pit water on closure that have been considered and these are discussed in Section 6.4.3.4. The present plan, subject to change pending on results of monitoring after closure, is for a channel to direct pit water, once it fills, back into the Stream C1 channel if water quality is acceptable or away from the lower Stream C1 channel to the east where the water will enter Carat Lake either with or without in pit treatment. In pit treatment is discussed by John Chapman in a memorandum to SRK (Appendix C).

6.3.4 Ore Stockpiles

The ore stockpile area will be completely processed at the end of Year 8. Following processing the pad will be reclaimed by scarifying and grading down the perimeter as required. Top dressing the margins with overburden will be undertaken, if reclamation trials indicate probable success.

6.3.5 Access Roads

Access roads are anticipated to be required throughout the mine life. Should access roads no longer be required, these roads will be reclaimed during the mine life before closure. The road surface will be scarified, or ripped, and the surface revegetated as indicated from reclamation trials.

6.3.6 Monitoring of Progressive Reclamation

Monitoring of revegetation will be dependent on the reclamation research carried out during mine operations. Monitoring frequency will be annual. An outline of possible revegetation initiatives was presented in Section 4.

Monitoring of chemical and physical stability will be identical to monitoring programs for active mine components until final mine closure. Final reclamation is discussed in the following section.

6.4 Final Reclamation

6.4.1 Schedule of Studies Required for Closure

A number of studies have been identified that are required to finalize decisions regarding final closure of some of the facilities at Jericho. Table 6-2 provides a list of those known at the time of writing of this update report.

Table 6-2: Studies Required Before Final Closure

Item	Study/Data Required	Mining Years
Pit in-fill time after closure estimate	Water balance	Until the waste rock dump is developed to its final extent and freeze back is complete, all estimates are approximations. Improvements in the initial estimation can be made but will remain approximations until after completion of the waste rock dump. A minimum of 3 years water balance calculations commencing the 1st operating year (2006) will be collected before a re-estimate of pit filling time is attempted
Revegetation of mining units	Vegetation trials on target units	As soon after commencement of mining as possible and on going until closure
Treatment of PKCA supernatant water for discharge on closure	Water quality data throughout mine life to determine trends	Should trends in water quality indicate discharge on closure may be problematic, at least one year prior to closure testing of PKCA supernatant water will be undertaken with the goal of selecting a treatment system that will treat the water to Water Licence objectives.
Need for water collection Pond A	Runoff patterns from the waste rock dump	Commencement of mining until the fall before the waste rock dump reaches the area where runoff could drain to Carat Lake
Need for alternate pit overflow discharge than Stream C1	Water quality in the refilling pit	Post closure through the number of years required to establish trends
Causeway reclamation	Recycling of construction rock as fish habitat	One year prior to closure, discussions with DFO
Finalize estimation of volume of demolition waste	Not applicable	Prior to closure once open pit-related facilities are demobilized

6.4.2 Waste Rock Dumps

6.4.2.1 Reclamation

Dumps that remain active throughout the mine life will be reclaimed at closure in the manner indicated in Section 6.3.2. The tops of the dumps may be revegetated. The side slopes will be left in a stable condition not subject to water or wind erosion, but will not be revegetated. The principal reasons for this are:

- the impracticality of making granular mineral overburden remain in place on angle of repose rock slopes;
- the low probability of successful revegetation on these slopes considering the high probability of very low moisture content; and
- the probable scarcity of overburden available for top dressing, making its use in areas with a low probability of successful revegetation unwise.

6.4.2.2 Long-term Stability

The final angle on the waste rock dumps will be an average 19°, slightly more than half the angle of repose of 33°. Stability of the dumps during operations will be monitored by an independent geotechnical engineer annually as required by the water licence; monitoring will continue as required after closure until the water licence is cancelled. Any modifications of dump configurations suggested from monitoring results will be implemented during the life of the mine.

6.4.2.3 Alternatives and Contingencies

Alternatives for cover and soil amendments for the tops of the waste dumps will be assessed in light of vegetation trials. Should revegetation not prove practical, due to low survival of plants in test plots, the tops of the dumps will not be dressed with wind or water erosion prone soils, rather the use of coarse run-of-mine rock in erosion prone areas will be evaluated.

6.4.3 Open Pit

6.4.3.1 Final Configuration

A plan of the expected ultimate pit configuration is presented in Figure 6.2.

A safety berm will be constructed beyond the ultimate crest of the till slope. The berm will be constructed with a steep outer face to discourage caribou entry, and a flatter inner face to allow any caribou to exit. The setback distance will be adjusted as necessary to allow snowmobiles and caribou that happen to cross over the berm sufficient time and space to stop before reaching the pit edge. As required by the mine water licence, the lip of the ultimate pit will be graded and/or blasted down to a 5:1 angle for 10 m between the berm and the lip of the pit.

The final pit will have steep walls and a ramp road connecting the bottom and top of the pit. Walls will be entirely in bedrock. The pit will be allowed to flood on closure which will require a minimum of 20 years if all mine area drainage is directed to the pit. If pit water quality on filling is of adequate quality (assumed to be CCME), Stream C1 will be re-directed back into its natural channel.

Runoff, precipitation, and melt water will not exit the pit until it is filled. The pit will form a deep, relatively small lake. Some shallows will be present near the lip of the pit, especially where the access ramp enters and the mining 8 m mining catch bench that lies below the final pit water level. Once the pit is filled, water will flow out and into Carat Lake. Pit water quality estimates on closure were provided by SRK (2003) in Technical Memorandum F and re-examined taking into account probable partial freeze back in a subsequent memorandum (SRK 2004a, Appendix B).

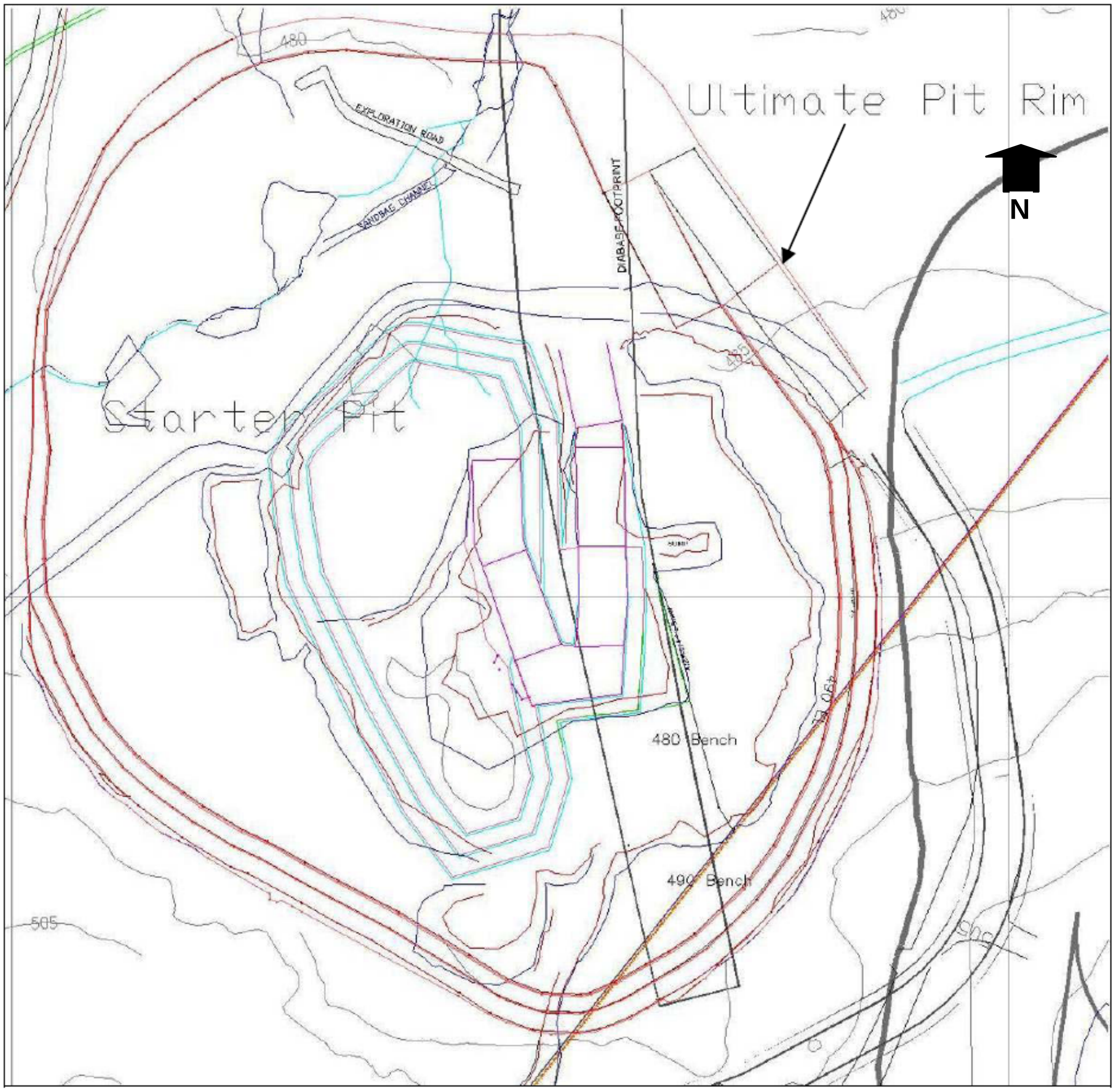
6.4.3.2 Alternatives and Contingencies

An alternative to allowing the pit to flood would be to backfill with waste rock. This alternative was examined and rejected on economic and practical grounds. Cost to backfill the pit would be approximately $2 per tonne; total cost $16 million plus mobilization / demobilization. Backfill could not occur until the end of mining. At that time much of the mass of waste rock dumps is expected to be infiltrated by permafrost. Any use of this rock would require re-blasting, which would further raise costs. Finally, because there would be void spaces in the backfilled rock, only about two thirds of the 13 million tonnes of waste rock could be backfilled into the pit without overtopping the pit rim. Any runoff water from the pit would require treatment for some years after pit backfill to reduce ammonia levels to acceptable discharge concentrations. This alternative approach to reclaiming the pit would make mining the deposit uneconomic and also increase, rather than decrease, environmental impacts.

6.4.3.3 Exploration Portal

The existing exploration portal is now within the planned ultimate pit and will cease to exist.

Figure 6-2: Jericho Ultimate Pit: Plan View



Source: Jericho Mine Plan October 2005. Grid interval is 500 m. Carat Lake is beyond the top of the figure.

6.4.3.4 Post-Closure Water Management

It is estimated that the pit will take over 20 years to fill, which should allow ample time for flushing and removal of any residual blasting residues from the dumps. Freeze back of the dumps is also expected to occur in the first few years following deposition, which will reduce the exposed surface area and therefore available loading from the rock. During this period, flows to Stream C1 will be maintained to ensure this area remains acceptable for fish habitat.

Current estimates of long-term water quality using the conservative assumptions discussed in SRK Technical Memorandum Q (SRK 2004a, Appendix B) indicate that the pit lake may not meet CCME guidelines for freshwater aquatic life. Monitoring of seepage and runoff during operations and the post closure filling period will result in improved estimates of long term water quality.

If the updated estimates indicate the pit water will meet CCME guidelines for freshwater aquatic life or can be demonstrated to have negligible impacts on aquatic life, the pit will be allowed to spill into the original Stream C1 channel, and Stream C1 will be redirected into the pit. If the revised estimates indicate the pit will not meet CCME guidelines, but could be discharged without significant impacts to the shore of Carat Lake, it will be discharged via a constructed channel to the northeast of Stream C1. The location will be determined when the need is identified and in consultation with regulators. In the unlikely event that the pit water quality would be unacceptable for discharge, contingency measures such as in-pit biological treatment could be used to reduce concentrations to acceptable levels for discharge (SRK 2004b, Appendix C). Current estimates of post-closure concentrations in the pit discharges are presented in Table 6-3.

Tahera has 8 years during operation to establish expected end-pit water quality, and a minimum of 20 years following closure to work out appropriate mitigation before discharge to Carat Lake is required.

6.4.3.5 Long-term Stability

Post-closure, the slopes may ravel or degrade to a slope as flat as approximately 15°. The bedrock below the till will also ravel back over the very long term. This is common in all rock slopes, and is the reason why there is no requirement for long-term stabilization of pit slopes in most mine reclamation guidelines. During 2005, as a starter pit was excavated for construction material, Tahera was able to assess the performance of slopes that intersected the overburden. Observations from that period suggest that the slope performance will be similar to, or slightly better than, expected. Stability monitoring through the mine life will allow assessment this initial finding.

Prior to filling warning signs and the perimeter berm will serve to keep people and animals away from the pit lip. The pit wall will not be dissimilar to the nearby cliff tops of the Willingham Hills. Extensive surveys in the area during baseline wildlife studies failed to reveal any evidence of animals falling accidentally.

Table 6-3: Post-Closure Estimates of Pit Water Quality

	Discharge Scenario	TDS mg/L	TSS	Alk	Ca	Cl	K	Mg	Na	SO4	TAl* mg/L
1	Discharge from Pit Lake without Stream C1	372	2	16	38	161	13	62	8	70	0.15
2	Long-term Discharge from Pit Lake with Stream C1 redirected to pit.	231	2	14	24	96	8	37	5	42	0.13
	CCME Aquatic Life Guidelines	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*na*	*0.1*
	Health Canada Guidelines	*500*	*na*	*na*	*na*	*250*	*na*	*na*	*na*	*500*	*0.1*
	Carat Lake Baseline Data	*11*	*1.4*	*4.7*	*2.3*	*3.4*	*2.0*	*0.8*	*2.0*	*1.2*	*0.052*

	Discharge Scenario	TAs mg/L	TCd mg/L	TCr mg/L	TCu mg/L	TFe* mg/L	TMo mg/L	TNi mg/L	TPb mg/L	TU mg/L	TZn mg/L
1	Discharge from Pit Lake without Stream C1	0.0005	0.0003	0.0017	0.009	0.20	0.032	0.015	0.0020	0.063	0.006
2	Long-term Discharge from Pit Lake with Stream C1 redirected to pit.	0.0004	0.0002	0.0012	0.007	0.24	0.019	0.009	0.0013	0.038	0.004
	CCME Aquatic Life Guidelines	*0.005*	*1.7E-05*	*0.0089*	*0.002*	*0.3*	*0.073*	*0.025*	*0.001*	*na*	*0.03*
	Health Canada Guidelines	*0.025*	*0.005*	*0.05*	*1.0*	*0.3*	*na*	*na*	*0.01*	*0.02*	*5*
	Carat Lake Baseline Data	*0.00016*	*0.00005*	*0.0025*	*0.0020*	*0.025*	*0.00005*	*0.0005*	*0.00005*	*0.00020*	*0.0020*

Notes:

Assumptions and Calculations are provided in SRK (2004a)

1 Assumes all sources of water entering the pit have reached post-closure water quality by the start of filling
2 Reflects mixed water quality in the pit in the long term, once steady-state mixing has been reached (approximately 30 years after pit is filled)

6.4.4 PKCA

6.4.4.1 Reclamation

During operation, the PKCA will be progressively filled from east to west (Site Water Management Plan, Tahera 2005). As areas are filled to design height, they will be covered by a 0.3 to 0.5 m layer of coarse kimberlite to act as a filter for runoff and to improve drainage characteristics of the cap. Coarse kimberlite will be taken from the stockpile for reclamation. The plant front end loader and dump trucks will be used for this operation. Once the coarse kimberlite buffer is placed, one of three scenarios will follow:

1. If vegetation trials indicate vegetation can be successfully established on the coarse kimberlite, finished areas will be revegetated. Ekati has had some success at planting directly onto dried fine kimberlite in the mine's PKCA and, pursuant to further favourable results, PKCA beaches at Jericho will be treated the same way, i.e., by direct planting on the dry beaches. There is some question about the long-term suitability of PK as a growth medium.
2. If vegetation trials indicate overburden promotes successful revegetation, areas will be top dressed with up to 0.3 m of overburden from the overburden stockpile. This will occur in either winter or summer, depending on the driving conditions on the cell. Reclamation costing (Appendix D) conservatively assumes both coarse PK and overburden will be placed on the PKCA at closure.
3. If vegetation cannot be demonstrated to establish successfully, PKCA finished areas will be covered with coarse kimberlite and run-of-mine rock to retard erosion and to provide perching areas for rodents and birds.
4. Revegetation, as indicated from reclamation trials, will take place either in the spring or fall, depending on timing of completion of the overburden placement. Organic overburden will be retained for reclamation of the PKCA as this facility has the best chance of successful revegetation. The proposed facility will occupy a shallow valley, where water naturally collects (a lake and meadows presently occupy the site) and therefore, with the proposed impermeable east and west embankments, can be expected to provide a moist microhabitat for plant growth after closure.

6.4.4.2 Long Term Stability

Long-term stability for the dams and impoundment requires different considerations. Stability after closure will be monitored throughout the closure and post closure period by mine staff and independent geotechnical engineers as a requirement of the mine water licence.

Impoundment

Physical stability of the section of the impoundment containing fine PK will be achieved by placement of coarse PK and top dressing materials if revegetation trials indicate probable success or coarse PK and rock. Chemical stability post closure was discussed in detail in SRK Technical Memorandum P (SRK 2004) submitted to the NWB in support of water licence application. Water in the western end of the PKCA (see Appendix A, Drawing 2 for PKCA anticipated final configuration) is forecast to meet mine discharge criteria; monitoring during operations will provide additional evaluation information. Should the water not meet criteria, the water will be treated until criteria are consistently met.

Should trends in water quality indicate discharge on closure may be problematic, at least one year prior to closure testing of PKCA supernatant water will be undertaken with the goal of selecting a treatment system that will treat the water to Water Licence objectives.

Dams

Stability analyses were completed for all dams which indicated Canadian Dam Association (CDA) guidelines for factors of safety would be met. The performance of the dams will be monitored during operations to verify stability and any adjustments that are required will be made prior to closure. The dams will be inspected annually during operations and post closure by an independent geotechnical engineer until such time as the water licence is cancelled.

<u>East, Southeast and North Dams</u>

All these dams are relatively low structures (maximum 8 m for east and southeast dams and 3 m for the north dam) that will not have water against their upstream faces at closure.

Design details for the east and southeast dams can be found in EBA Engineering (EBA) design reports (EBA 2005 a, b). Preliminary design details for the north dam can be found in SRK (2004d).

<u>Divider Dykes</u>

Design details for the divider dykes can be found in EBA design reports (EBA 2005c, d). The divider dykes on closure will have PK fines and no free water against the upstream face (Divider Dyke B) and both faces (Divider Dyke A). The divider dykes will be inspected post closure by an independent geotechnical engineer until such time as the water licence is cancelled.

A small amount of pore water may be expelled by the freezing process but will have negligible effect on the much larger volume of water in the downstream pond (SRK 2004).

<u>West Dam</u>

Design details for the west dam can be found in EBA 2005 e, f). The west dam is designed to hold water against the upstream face. Long-term thermal and dam stability monitoring will be instituted as part of PKCA operation as recommended by EBA (2005e).

Closure preparation of the west dam is discussed in SRK 2004d and closure procedures will be included in the PKCA Management Plan required by the water licence. At closure, ponded supernatant water will be pumped to Stream C3 if water meets discharge criteria or treated as indicated from operational experience prior to closure to meet these criteria. In order to minimize long-term stability risks, the dam will be breached; the final discharge elevation will be determined as part of final closure planning. The west dam will, therefore, no longer perform or be classified as a dam. The discharge elevation will set so that fine PK in the upstream pond does not wash out through the discharge. Natural discharge from the basin is expected to be restored with these measures.

Figure 6-3, from EBA, provides a conceptual closure spillway located at the north abutment of the West Dam.

6.4.4.3 Alternatives and Contingencies

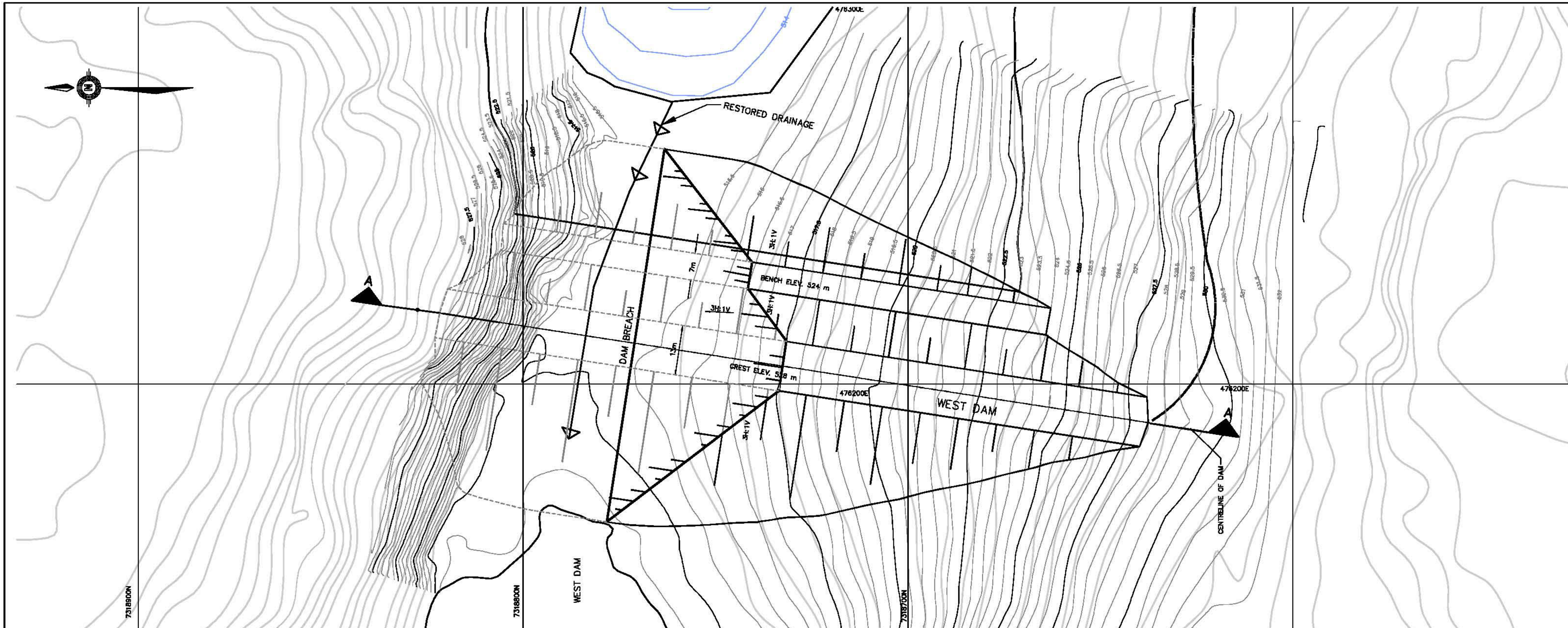
Alternatives and contingences considered for closure include final disposal of PKCA pond water and methods of breaching the West Dam. No alternatives to recontouring dams were considered.

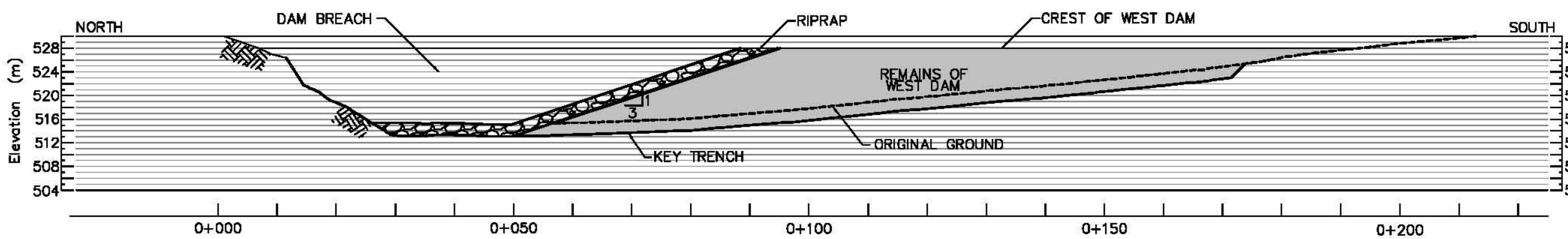
- Should PKCA pond water not meet Water Licence discharge criteria on closure and no reasonable expectation that water will meet these criteria, water will be pumped to the open pit.
- If nutrient addition, as envisaged as possible treatment for the open pit on filling, promises to bring PKCA pond water to discharge criteria, this treatment will be applied. Should the treatment not be effective, water will then be pumped to the pit. If treatment is effective, water will be pumped from the PKCA pond to the West Pond and from there flow to Lake C3.
- Alternatives to breaching the West Dam that will be considered include the proposed conceptual spillway or breaching the dam approximately in the centre after water is pumped from the PKCA pond, and rock armouring the breach with clean, non-acid-generating run-of-mine rock.

6.4.5 Coarse Kimberlite and Recover Circuit Rejects Stockpiles

6.4.5.1 Final Configuration

As shown in Appendix A, Drawing 2, the current mine plan calls for separation of coarse PK into three stockpiles. This configuration was chosen to allow for better environmental control of the coarse PK, particularly of recovery plant rejects which will be stockpiled immediately south of the PKCA east end. Management of coarse PK is discussed in detail in the Jericho Waste Rock Management Plan, Part 2 (SRK 2006). The remainder of the coarse kimberlite and recovery plant reject stockpiles not used for reclamation will be sloped to approximately 18°, as shown in Figure 6-1, and covered with up to 0.3 m of overburden to prevent dust generation from fines should dusting become problematic (not expected since coarse rejects are thoroughly washed in the processing plant). A small amount of runoff may occur in the spring when the stockpile surface is frozen. A shallow ditch will be constructed on the down slope side of the stockpile to retard export of sediment overland in the initial years after reclamation and prior to surface consolidation. Monitoring will continue at the site through this time allowing sediment removal from ditches if required.





SECTION A – A

0 50

Scale: 1: 1000 (metres)

CLIENT

Tahera Diamond Corporation

EBA Engineering Consultants Ltd.

Jericho Project - Closure

Jericho PKCA at Closure
West Dam Breach

PROJECT NO./FILE NO.	DWN	CKD	REV
110060.004 1100600004T02b.dwg	TK	WTH	1
OFFICE: EBA-EDM	DATE: March, 2007		

Figure 6-3

6.4.5.2 Alternatives Considered

Alternatives to overburden cover include rock armouring should overburden cover not prove practical. Based on Ekati experience, direct placement of vegetation on coarse PK is unlikely to be successful. However, creation of microhabitats to prevent sand drifting will be investigated as part of revegetation trials.

6.4.5.3 Long-term Stability

The results of the stability analyses for kimberlite are summarized in Table 6-4. Table 6-5 provides typical factors of safety for waste rock dumps based on the guidelines published by the BC Mine Waste Rock Pile Research Committee in 1991.

The minimum allowable factors of safety have been based on Case B in Table 6-5 for the following reasons:

- Conservative assumptions have been used in the analyses
- The consequences of failure are minimal as they do not involve loss of life or large scale environmental impacts
- The potential failure modes are relatively simple and are well suited to the analytical methods that have been used.

The factor of safety at the face of the stockpile is based on a simple infinite slope analysis. Since the material is end-dumped, the stockpile slope will conform to the angle of repose which in the absence of a water table, means that the dump face has a factor of safety of about 1.

Table 6-4: Summary of Critical Factors of Safety for Kimberlite Stockpile

Stability Condition	Suggested Minimum FOS	Calculated Factor of Safety (FOS)	Comments
Stockpile Surface Short Term	1.0	1.0	Bench face, at angle of repose
Deep Seated Short Term Pseudo-static Pseudo-static	 1.3 1.0 1.0	 1.5/1.4 1.5/1.3 1.5/1.3	During operations, c = 0 kPa Till foundation (low/high water table) Till foundation, acceleration = 0.013g (low/high water table) Till foundation, acceleration = 0.06g (low/high water table)
Deep Seated Short Term Pseudo-static Pseudo-static	 1.3 1.0 1.0	 1.8/1.5 1.8/1.5 1.5/1.5	During operations, c = 10 kPa Till foundation (low/high water table) Till foundation, acceleration = 0.013g (low/high water table) Till foundation, acceleration = 0.06g (low/high water table)

Table 6-5: Guidelines for Minimum Design Factor of Safety – Waste Rock Dumps

Stability Condition	Case A – more severe	Case B – less severe
Stability of Dump Surface Short term (active) Long term (closure)	1.0 1.2	1.0 1.1
Overall stability (deep-seated) Short term (active) Long term (closure) Pseudo-static	1.3 - 1.5 1.5 1.1 - 1.3	1.1 - 1.3 1.3 1.0
Case A: Low level of confidence in critical analysis parameters Possibly unconservative interpretation of conditions, assumptions Severe consequences of failure Simplified stability analysis method (charts, method of slices) Stability analysis method poorly simulates physical conditions Poor understanding of potential failure mechanism(s)		
Case B: High level of confidence in critical analysis parameters Conservative interpretation of conditions, assumptions Minimal consequences of failure Rigorous stability analysis method Stability analysis method simulates physical conditions well High level of confidence in critical failure mechanism(s)		

6.4.6 Ore Stockpile Pad

6.4.6.1 Final Configuration

The ore stockpile pad will be scarified and revegetated if success is indicated from reclamation trials. Overburden will be added to the perimeter of the pad, if reclamation trials indicate probable plant growth success.

6.4.6.2 Alternatives Considered

No alternatives to the proposed reclamation were considered.

6.4.6.3 Long-term Stability

The ore stockpile pad is not proximate to any water bodies, is a low structure (approximately 2 m depth) and any sediment from erosion will simply move out onto the adjacent tundra.

6.4.7 Mine and Access Roads

6.4.7.1 Final Configuration

When no longer required, mine and access roads will be scarified or ripped and possibly revegetated (as discussed above). Road edges will be graded off to form a gentle slope, yet minimize additional disturbance of tundra. The road between the camp and the airstrip will be left in a stable condition until final closure and may be left un-reclaimed at final closure, if requested by a government agency or by a third party who agreed to assume responsibility for its maintenance.

6.4.7.2 Alternatives Considered

No alternatives to closing mine all weather access roads other than indicated in the previous section are contemplated.

6.4.7.3 Long-term Stability

Mine all weather roads are crossed by a number of small, mostly ephemeral, streams. At stream crossings, culverts will be removed, the road approaches pulled back with a backhoe and banks rock armoured to prevent erosion into the streams.

6.4.8 Sediment Ponds, Berms and Ditches

6.4.8.1 Final Configuration

On closure, all mine drainage will be directed to the open pit and sediment ponds, berms and ditches no longer required will be reclaimed. Ditches will be stabilized where they pass through overburden; ditch portions in bedrock will remain as constructed. To the greatest extent possible, ditches will be altered to return drainage to pre-disturbance conditions. For pre-mining areas draining to Lake C1, this would pre-suppose runoff meets CCME guidelines; otherwise, water would be directed to the open pit. Prior to levelling, any sediment in ponds would be removed and placed on one of the dumps, then covered with waste rock or overburden to retard wind or water erosion. Conceptually, all dikes and berms would be flattened and revegetated.

Petroleum tank berms will be treated as hazardous soils and treated as discussed in Section 6.4.12. Liners will be removed, decontaminated and buried along with inert waste in the waste rock dumps or open pit and covered with waste rock. If decontamination of liners is not feasible, they will be transported off site as hazardous waste.

6.4.8.2 Alternatives Considered

No alternatives to reclamation and closure of ponds, berms and ditches were considered.

6.4.8.3 Long-term Stability

Sediment ponds and berms will be removed and the construction materials placed in the waste rock dump. Any remnant of berms or pond dikes left after resloping would be stabilized and revegetated, assuming reclamation trials suggest probable success.

6.4.9 Borrow Areas

6.4.9.1 Final Configuration

Any borrow areas active to the end of mine life will be reclaimed and revegetated as discussed above. Some borrow material may be required for final reclamation and thus this borrow area would be one of the last sites to be reclaimed and revegetated.

6.4.9.2 Alternatives Considered

No alternatives to the proposed reclamation were considered.

6.4.9.3 Long-term Stability

Borrow areas will have shallow sloping banks that should not be subject to erosion. The performance of banks will be monitored when no longer subject to disturbance and banks made more shallow than indicated (between 4:1 and 5:1) if monitoring indicates.

6.4.10 Airstrip

6.4.10.1 Final Configuration

The airstrip will be scarified or ripped and vegetated when no longer required, pursuant to probable success as shown in reclamation trials. However, the strip will be left for others to use, if requested by government agencies or by a third party willing to assume the airstrip land lease. The airstrip will be kept open until final closure for use by Tahera Diamond Corporation reclamation personnel.

6.4.10.2 Alternatives Considered

Other than transfer of the lease for the airstrip to an interested third party, no alternatives to the proposed reclamation were considered.

6.4.10.3 Long-term Stability

Long-term stability concerns for the airstrip include erosion from runoff and wind. The airstrip is located on an esker and no erosion issues were evident on the existing strip which was constructed in 1998. In 2006 the airstrip was lengthened to the north (Drawing 1, Appendix A). The airstrip is not proximate to any water body and no drainages cross the strip. Revegetation, if feasible, will address any stability issues for the airstrip. Because the airstrip is located on an esker vegetation will re-establish in time naturally if short-term vegetation trials prove unsuccessful. Armouring will not be used except in areas that indicate propensity to erode over the life of the airstrip. Armouring will only serve to prevent or greatly slow the revegetation process.

6.4.11 Freshwater Intake Causeway

6.4.11.1 Final Configuration

The causeway will be cut to 2m below the normal summer water level from the northern extent back to a water depth of 3.5m. From 3.5m water depth to 1m the causeway will taper up. The reclaimed causeway will intersect surface near the shoreline.

6.4.11.2 Alternatives Considered

The causeway construction rock has the potential to provide fish habitat if left in the lake as indicated above. Recycling of the rock in this manner will require approval from DFO and will be discussed with the Department one year prior to closure. Alternately, the rock will be pulled back on shore and placed in the waste rock dump.

6.4.11.3 Long-term Stability

Not applicable; the causeway will be largely removed or recycled as fish habitat.

6.4.12 C1 Diversion

6.4.12.1 Final Configuration

The current plan calls for removal of the diversion once the open pit fills and water is found to be of sufficient quality for direct release back into Stream C1. Should this be the case, the head of the diversion will be blocked once the freshwater intake access road is removed and Stream C1 will be re-established in its natural drainage location.

6.4.12.2 Alternatives Considered

The C1 Diversion may need to be kept in place if open pit water must be diverted away from Stream C1 when the pit fills.

The alternative to leaving the C1 Diversion in place is to reblock the head of the diversion channel once the freshwater causeway access road is removed and allow the water to flow in the C1 natural channel which will result in Stream C1 entering the open pit. This option will be chosen if water quality in the open pit substantially meets CCME guidelines.

6.4.12.3 Long-term Stability

Preservation of the permafrost between the open pit and the channel is of utmost importance. Failure to do so could result in seepage losses toward the future pit wall resulting in thermal degradation and possible pit wall instability. In order to avoid seepage losses, the upgradient and pit side embankment of the C1 Diversion is dimensioned with minimum 5 m wide running surface to permit heavy equipment traffic and to positively preserve and aggrade permafrost. Furthermore, an approximate 2 m insulating sand and gravel/rock cover will be used in the zone between Reach C and the pit crest in areas suspected to contain high levels of ground ice. Fills used for the embankment adjacent to the channel will be chosen selectively to provide low permeability when frozen to act as a natural liner/cutoff. Geothermal and hydrogeological considerations determine the berm dimensions and therefore the berm dimension will exceed those that would be required to control runoff if the channel was simply lined with a geosythetic liner.

Stability is not an issue of Stream C1's natural channel can be re-established.

The C1 Diversion is designed as a very stable structure. Reach A is cut in bedrock (see discussion in Section 2) and Reach B is designed to handle flood conditions, is rock armoured and stable. Reach C is composed of meanders which will have stabilized to a natural channel prior to the pit overflowing. Reach C was constructed so as to preserve natural vegetation and is inherently stable. Stability of the facility will be visually monitored throughout mine life and the closure and post closure period until the pit overflows.

6.4.13 Infrastructure

6.4.13.1 Final Configuration

Structures at mine closure will include:

- the accommodation and mine office;
- diamond plant;
- the fuel farm;
- airport and generator day tanks;
- generator;
- the emulsion plant;
- the explosives magazines;
- truck shop;
- freshwater intake pump house, and
- airstrip generator and storage sheds.

Any salvageable structures that are not required for the underground mining phase will be backhauled off site during the winter resupply. If not salvageable, structures will be demolished, decontaminated if required, and buried in the waste rock dump. All hazardous materials will be backhauled off site to a contaminated waste contractor for disposal or return to suppliers (e.g., oil cubes; barrels). This procedure will serve to reduce somewhat the amount of material to deal with at final closure.

Upon closure remaining structures will be removed and the sites graded. All buildings will be torn down. Smaller demolition scrap will be placed on the edge of the waste dumps and covered during final resloping efforts. Large volume demolition scrap will be placed in the open pit and covered with waste rock. Foundations will be covered with top dressing materials. The fuel farm tanks will be emptied into tanker trucks, decontaminated, disassembled and buried in the open pit, as will all warehousing and trailers. The explosives magazine trailers (steel bulk shipping containers) will be removed. Pipes will be removed from the water intake causeway and buried.

Non-salvageable scrap metal left at closure will also be placed in the waste dumps and covered. Any supplies, such as ammonium nitrate, will be removed at the time the emulsion plant building is removed. All necessary removal of infrastructure will take place the first winter of final closure, thus obviating the necessity of constructing the winter road beyond the end of mine life plus one year.

All mine-related mobile equipment will be trucked out on the winter road the first opportunity after completion. Since the equipment will belong to the mine contractors, this will be the contractor's responsibility. Tahera Diamond Corporation, as holder of the land leases for the site, will however retain ultimate responsibility for removal of equipment from Jericho.

All pads used for buildings will be scarified, topdressed, and possibly revegetated as previously discussed.

Most of the mine camp, including trailer modules will be removed on final closure or demolished and buried as scrap in the open pit. Portable housing, such as tents which can be flown off site by aircraft, will be used by reclamation crews once buildings are removed. Alternately, if a third party agrees to assume the land lease for the camp, the applicable part of the mine camp will be retained and signed over to the third party assuming the land lease.

6.4.13.2 Alternatives Considered

Alternatives for closure will be either:

- Demolition and burial in the waste rock dumps where industrial waste will freeze permanently and in an area that drains naturally to the open pit until freezing occurs; or
- removal off site. All hazardous materials will be removed off site to a hazardous waste contractor.

6.4.13.3 Estimated Volume of Demolition Waste

The estimate provided in this section assumes all structures will be left at closure, none will be salvaged and all structures will be torn down to minimize dead spaces. The estimate also assumes that building contents will be salvageable and taken off site. The estimate is provided in Table 6-6.

Table 6-6: Volume Estimate for Demolition Industrial Waste

Structure	**Volume Estimate (m^3)**
Accommodation complex	3300
Diamond plant + truck shop	1570
Vertical fuel tanks	50
Day tanks	Not applicable; backhauled off site
Generator	Not applicable; backhauled off site
Emulsion plant	490
Miscellaneous small buildings	720
Allowance for air voids (25%)	1532
Total	**7662**

6.4.14 Soils Testing

Any soils suspected of being contaminated (stained) with petroleum hydrocarbons, and not previously remediated, will be tested and those not meeting criteria for CCME industrial land use in place at the time of mine closure will be remediated. Soils would be transported off site by truck during the first year after mine closure, or later by aircraft if required. Any spills in areas where additional routine spills are unlikely to occur will be decontaminated prior to end of active mining.

7.0 MINE ABANDONMENT

Mine abandonment refers to the stage at which all reclamation activities aimed at rehabilitation and stabilization have been completed, all infrastructure removed (or transferred to third parties to manage and the only activity is post closure monitoring.

The conceptual site layout at closure is provided in Drawing 2, Appendix A. The objectives of the abandonment plan are as follows:

- show the abandonment condition of the mine site;
- show the final drainage plan; and
- provide the monitoring plan after abandonment.

7.1 Infrastructure

Infrastructure remaining at abandonment will depend on the intended use of the site. Assuming complete closure, all buildings will have been removed, all roads and the airstrip rehabilitated and permanently stabilized against erosion. At the election of Transport Canada, or other government agency, the airstrip may be left intact, likely with removal of the landing lights and associated cabling. The generator and airstrip outbuilding will be removed. The airstrip will only remain if the federal land lease for the airstrip can be terminated by Tahera while leaving an un-reclaimed airstrip.

7.2 Drainage Controls

Natural drainage patterns will be re-established at closure to the extent possible. At abandonment all drainage systems will be confirmed to be stable. The Stream C1 diversion channel will remain intact to ensure the lower end of the stream does not dewater. The diversion dike will be stabilized for long-term maintenance-free operation either by having sufficient vegetation established during its lifetime, or more likely given climatic conditions, by additional armouring with rip rap. Mine area runoff water will be directed to the open pit. Figure 7-1, from EBA (2006), shows conceptual closure drainage. The mine layout shown is approximate and may change; subsequent updates to this plan will reflect any changes to the time of the update.

7.3 Sedimentation Ponds

Sedimentation ponds will be removed on closure and all water directed to the pit until CCME guidelines attainment is demonstrated to the satisfaction of regulators. Reclamation of sedimentation ponds will consist of berm removal (by spreading till used in their construction and removing any liners, if present) and pond surface revegetation as indicated from reclamation trials.

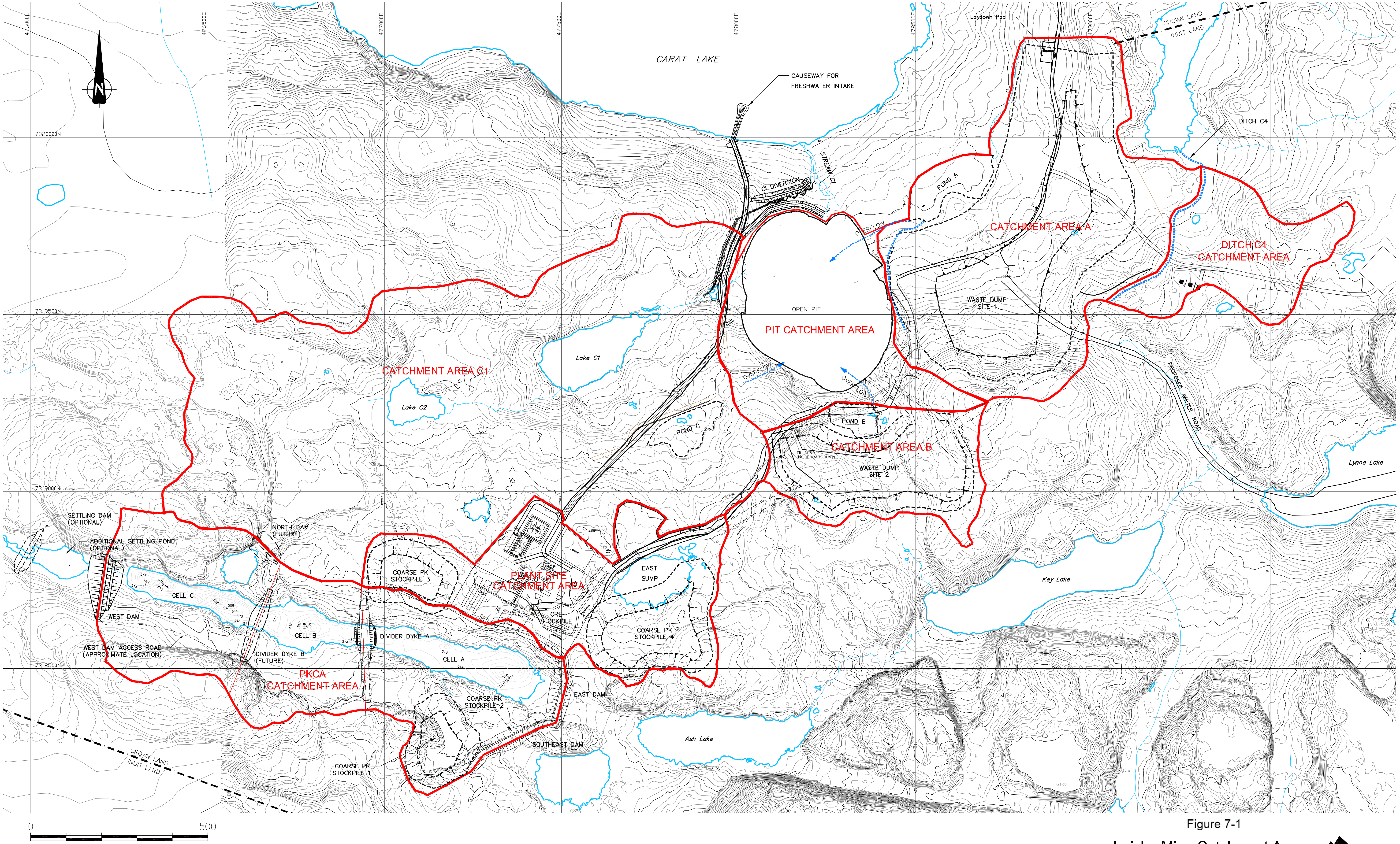


Figure 7-1

Jericho Mine Catchment Areas

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7.4 Land Use at Abandonment

7.4.1 Wildlife Habitat

Disturbed areas, other than mesic and moist soil microhabitats will only very slowly revegetate. Wildlife habitat lost to create dumps, pads, and roads will regain pre-disturbance productivity at the same rate as vegetation returns. Every practical effort will be made to accelerate this process as previously discussed. Upon successful establishment of vegetation, wildlife habitat in these areas should return to pre-mining conditions. The area is currently used by a number of wildlife species discussed in the Jericho Final EIS. Caribou, muskox, carnivores, small mammals (ground squirrels, lemmings, and voles) and birds (passerines, raptors, waterfowl, and upland game birds) use the site to some extent. The dumps may be used by raptors as lookout perches for prey. Ground squirrels are known to den in natural piles of rock and may use crevices in dumps as burrows where adjacent vegetated areas can provide forage. Tops of dumps will be used by birds, small mammals, and carnivores for foraging. The open pit will be flooded and the area of the pit would be permanently lost as terrestrial wildlife habitat.

7.4.2 Fish Habitat

Based on pre-operations modelling, the filled open pit is predicted to have water quality that does not meet 2004 CCME criteria for the protection of aquatic life. Therefore current plans call for use of the pit as a treatment facility and not as fish habitat. Should water quality be found to be suitable upon pit filling, it could potentially serve as fish habitat. Under this latter scenario, once the pit fills and water once again flows in the pre-mining Stream C1 channel, fish will have access to the filled open pit, which will form a small lake. The lake will be deep (approximately 180 m), but will have narrow shallow margins around the edge and a somewhat larger shallow area where the pit access road slopes into the pit (shallow area estimated to be 4800 m^2). The pit lake will follow a primary succession sequence and thus will remain devoid of rooted aquatic vegetation for a considerable length of time. Food chains will consist of freshwater bacteria, phytoplankton, zooplankton, and possibly fish, if they access the pit lake. Diatoms and periphyton (attached algae) will colonize shallow rock surfaces readily and will provide food for grazing macrobenthos once these organisms invade the pit lake. Fish-eating birds will forage for fish, should they invade the pit lake, or result from fertile fish eggs carried into the pit lake by birds. The pit lake will not likely provide suitable spawning habitat for Arctic char or lake trout although grayling could spawn in the inlet stream. The lake will likely remain permanently oligotrophic, similar to Carat and other lakes in the area.

7.4.3 Recreation

There will be no recreational opportunities at the Jericho site, unless people chose to fish at Carat Lake (unlikely given the lack of access and proximity to Contwoyto Lake, which supports large game fish). However, should a guide-outfitter decide to make use of the site, some of the site facilities could be used for recreational purposes, such as hunting and fishing (the latter likely at Contwoyto Lake, since Carat Lake is too small to support sustained sport fishing). Since caribou frequent the site occasionally in large numbers; wildlife photography could also be promoted.

7.5 Monitoring After Abandonment

Monitoring after mine closure will be in two phases:

- immediately post closure, until Tahera is assured long-term facilities, such as waste rock dumps and the C1 stream diversion are stable; revegetation success will also be monitored during this period; and

- longer-term monitoring of water quality to ensure the predicted return to receiving environment guidelines from site runoff and maintenance of receiving environment water quality is achieved.

7.5.1 Post Closure Monitoring

During this period immediately after mine closure, sedimentation ponds, berms, and outfall (if required) will be maintained. Water quality will be monitored monthly as indicated below for parameters controlled by the Jericho Project Water Licence in place at the time of closure. An annual seepage survey will be conducted for two years post closure. If results indicate water quality is improving, annual surveys will cease and be replaced by surveys at Year 5 post closure and every 5 years after that until abandonment.

Rock dumps and infrastructure associated with the Stream C1 diversion will be inspected on closure and periodically thereafter by a qualified geotechnical engineer for stability and their report recommendations implemented. Engineering inspections will be annual initially, reducing in frequency as appropriate to structures and in accordance with water licence requirements until the water licence is cancelled. Stability and drainage characteristics of borrow pits will also be monitored after closure on the schedule discussed above, to ensure no sediment loss to water bodies. Performance during mine operations will be used as the main indicator of probable long-term stability. Adaptive management strategies will be implemented based on recommendations from geotechnical inspections if long-term stability may be problematic.

Eight water quality sites are proposed for monitoring and are shown on Appendix A, Drawing 2:

- Lake C1 at its outlet;
- Stream C1 at its mouth;
- Stream C3 outlet;
- Lake C3 at its southern (principal inlet);
- Carat Lake at its inlet;
- Carat Lake at its outlet;
- Jericho Lake at its inlet;
- Jericho River on Inuit owned land.

Monitoring will be monthly during the open water period (July, August, September) and once during late winter/early spring (April). Depending on results of the aquatic effects monitoring program for the mine, additional aquatic monitoring may be warranted.

7.5.2 Post Abandonment Monitoring

Post abandonment monitoring will be continued until Nunavut Water Board cancels the mine water licence. For mines without an acid generation problem, monitoring for at least five years after closure is typical; each mine is judged on its own merits however. Monitoring will include annual visual inspection of rock dumps and the Stream C1 diversion as well as the eight water quality monitoring sites sampled once annually in mid to late summer. All site monitoring may be reduced from annual after the initial period in discussions with the Nunavut Water Board. Monitoring reduction criteria will be the following, or as directed by the Board:

- Water quality at background for the past two years will trigger reduction of water quality monitoring to once every 3 years until the pit overflows at which time annual monitoring will resume until water quality is again at background for two years. At that time, cancellation of water quality monitoring will be requested.
- Geotechnical annual inspections will be requested to be reduced to once every five years after the initial period of five years indicates long-term stability of the remaining water and waste handling facilities at the mine. Prior to pit water overflow, a geotechnical inspection will be carried out and actions taken at that time should any problems be revealed.
- Monitoring of revegetation success will be dependent on vegetation trials undertaken as part of reclamation research.

Biological monitoring will not be continued unless indicated by runoff water quality. The trigger to cease biological monitoring will be runoff water quality from the site (as determined by grab samples during spring from ephemeral stream sites near waste rock dumps) achieving receiving environment guidelines or better prior to mine abandonment.

Once the open pit is close to filling, water quality will be determined and plans finalized for discharge of the water either in Stream C1 or an open channel, as previously discussed.

7.6 Global Warming Considerations

The western Arctic has warmed about 2ºC over the past 100 years. In that same time period human activities have caused an increase globally of about 0.5ºC (Environment Canada 1991a). By 2050 the amount of carbon dioxide in the atmosphere is predicted to double, which is also predicted to raise the mean annual global temperature between 1.5º and 4.5ºC (Environment Canada 1991). In the continuous permafrost zone the active layer may thicken and permafrost slowly melt. However, specific responses of permafrost and the active layer are difficult to predict, since they also depend on precipitation changes, vegetation, soil moisture, and snow cover (Williams 1979, Maxwell 1992, Harris 1987). Evidence at present suggests that winter warming will be greater than summer, but that winter temperatures will not rise above freezing in the western Arctic (Cohen, et al. 1994). Based on data compiled by the Geological Survey of Canada, Terrain Sciences Division (GSC 2000a), the Project site is in an area of high thermal response to warming, but also an area of low to minimal impact from permafrost thaw.

A lag occurs between changes at the ground surface, e.g. caused by increases in average temperature and changes in permafrost at depth, and will range from years to decades for thin permafrost up to centuries or millennia for thick permafrost (GSC 2000b). Permafrost at Jericho is 540 m thick and would thus be expected to change temperature only over a very long time.

Waste rock, ore, and coarse PK will be placed in areas with little overburden and will be bedrock controlled. Thus, thermokarst erosion will not be an issue. None of the dams will be required to retain water. The West Dam spillway will be cut into bedrock on the north abutment of the dam or breached and rock armoured. All remaining dumps and stockpiles will drain to the open pit or PKCA area.

8.0 AESTHETICS

Tahera will address, to the extent practical, the issue of aesthetics on closure. To maintain topographic consistency, the stockpiles have been designed so that their height does not exceed the height of surrounding landforms. All removable infrastructure will be taken off site or buried. No scrap will be left; it will be burned, buried, or taken away. All areas that can be practically revegetated will be. All remaining stained soils will be scraped up and remediated or removed from site. Evidence of past mining will still remain however. It will not be practical to level the waste rock dumps nor to completely refill the open pit prior to final abandonment. Waste rock dumps will be approximately the same elevation as the lower of the surrounding hills. The small diversion around Stream C1 will be required to ensure the bottom 100 m of the stream does not dewater and thus potentially harmfully alter fish habitat. The site will slowly green up, but such processes take decades on the Arctic tundra and therefore, bare rock and till will be visible for many years after mining.

The probable aesthetics of the reclaimed and abandoned mine site must, however, be viewed in the context of the setting. The Jericho Project is in a remote location with access limited to snowmobiles in the winter and aircraft year round. Prior to exploration activity in the early 90's, people did not use the site to any significant extent. This is evidenced by archaeological studies and the completely undisturbed state of the site when exploration commenced. Further, the site was not visited casually by anyone not connected to mining activities throughout the period from 1992 (when exploration commenced until the present time). Finally, the site is relatively small (a total of 162.3 ha disturbed by mining) in the context of the vastness of the Arctic.

9.0 COST

A detailed discussion of costs is provided in Appendix D (which see).

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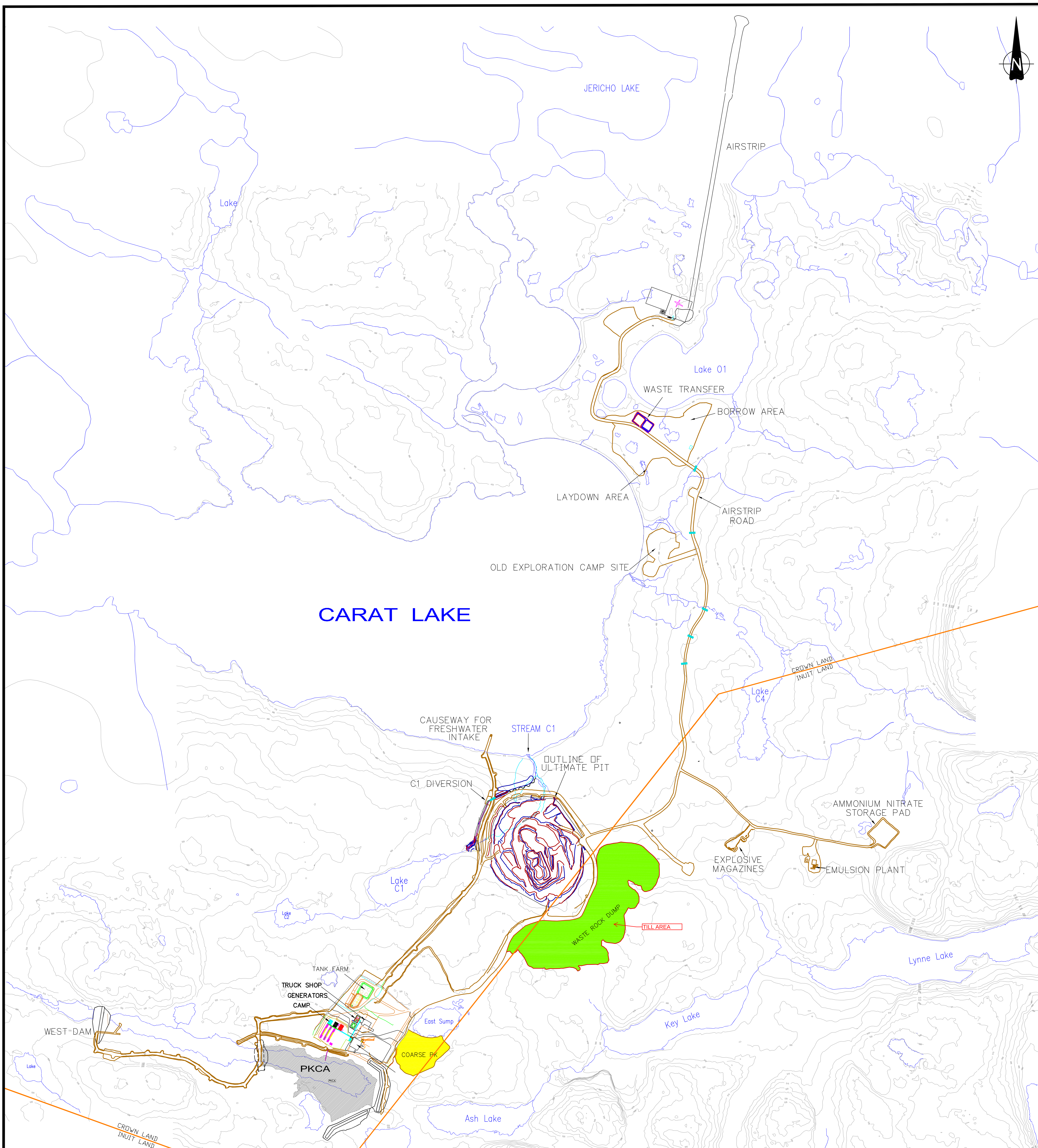
TAHERA
DIAMOND CORPORATION

APPENDIX A

DRAWINGS

**Site Arrangement
Year End 2006**



Legend

- Waste Dump
- PKCA
- Stockpile Pad
- Culvert

NOTE:
Base map provided by Tahera. Stockpiles and PKCA boundary provided by SRK Consulting.

AMEC Earth & Environmental

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CLIENT

TAHERA DIAMOND CORPORATION

PROJECT: JERICHO DIAMOND PROJECT	DWN BY: BWS	DATUM: NAD27	DATE: MARCH 2007
TITLE: SITE AS OF 31 DECEMBER 2006	CHK'D BY: BO	REV. NO.: A	PROJECT NO: VE51295
	PROJECTION: UTM Zone 12	SCALE: AS SHOWN	FIGURE No. DRAWING 1

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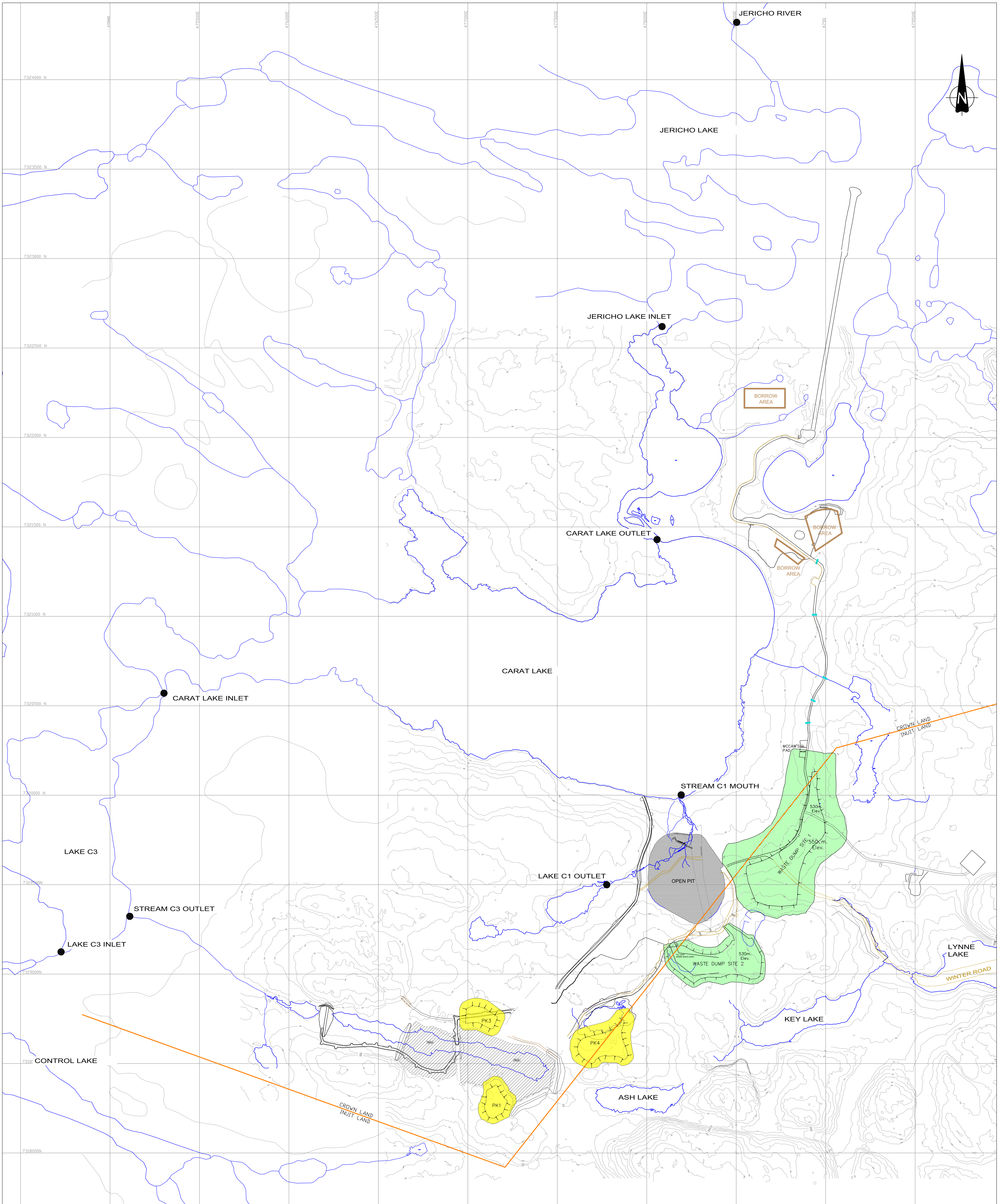
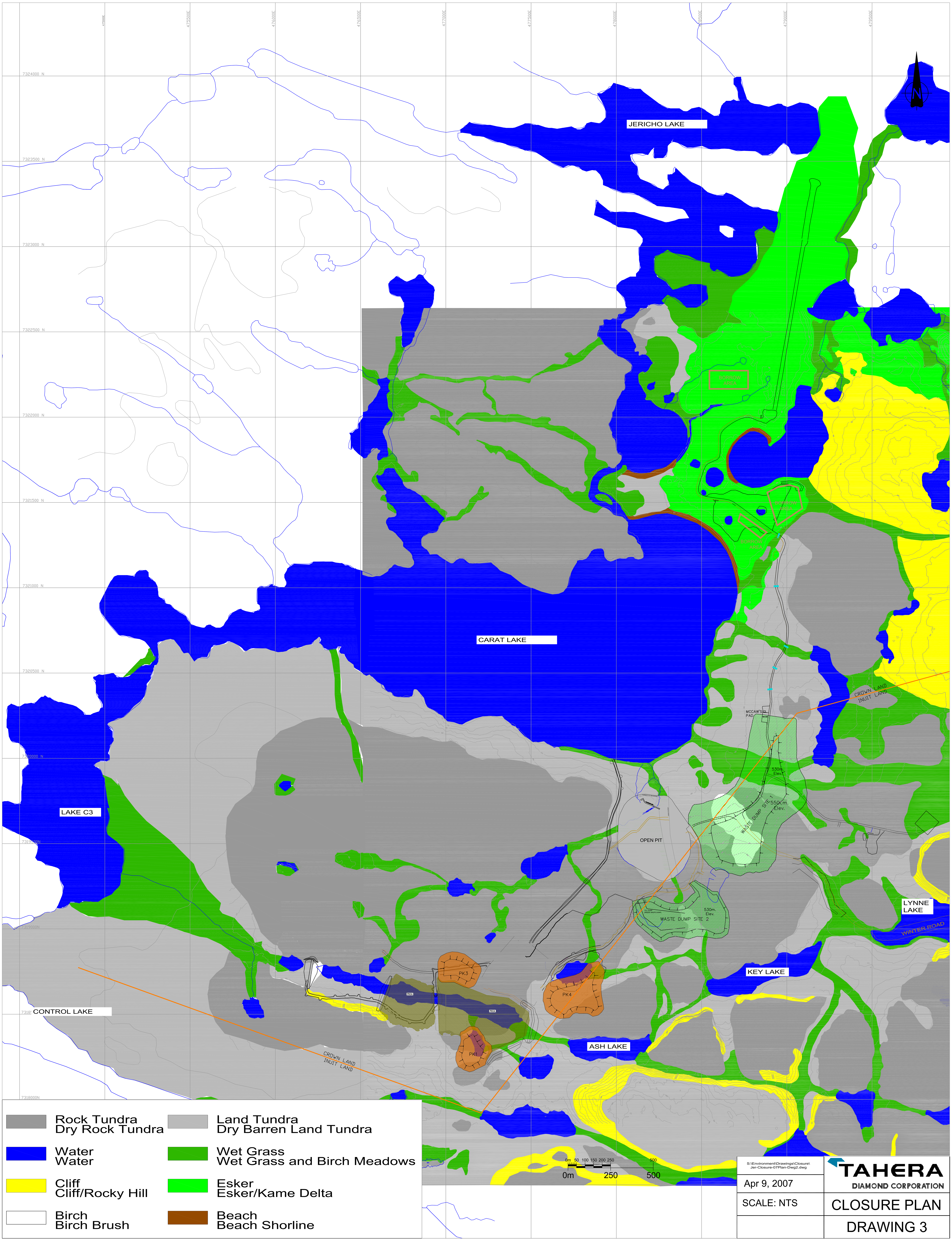
Conceptual Site Arrangement
Closure



S:\Environment\Drawings\Closure\Jer-Closure-07Plan-Dwg2.dwg	TAHERA DIAMOND CORPORATION
Apr 3, 2007	
SCALE: NTS	CLOSURE PLAN
	DRAWING 2

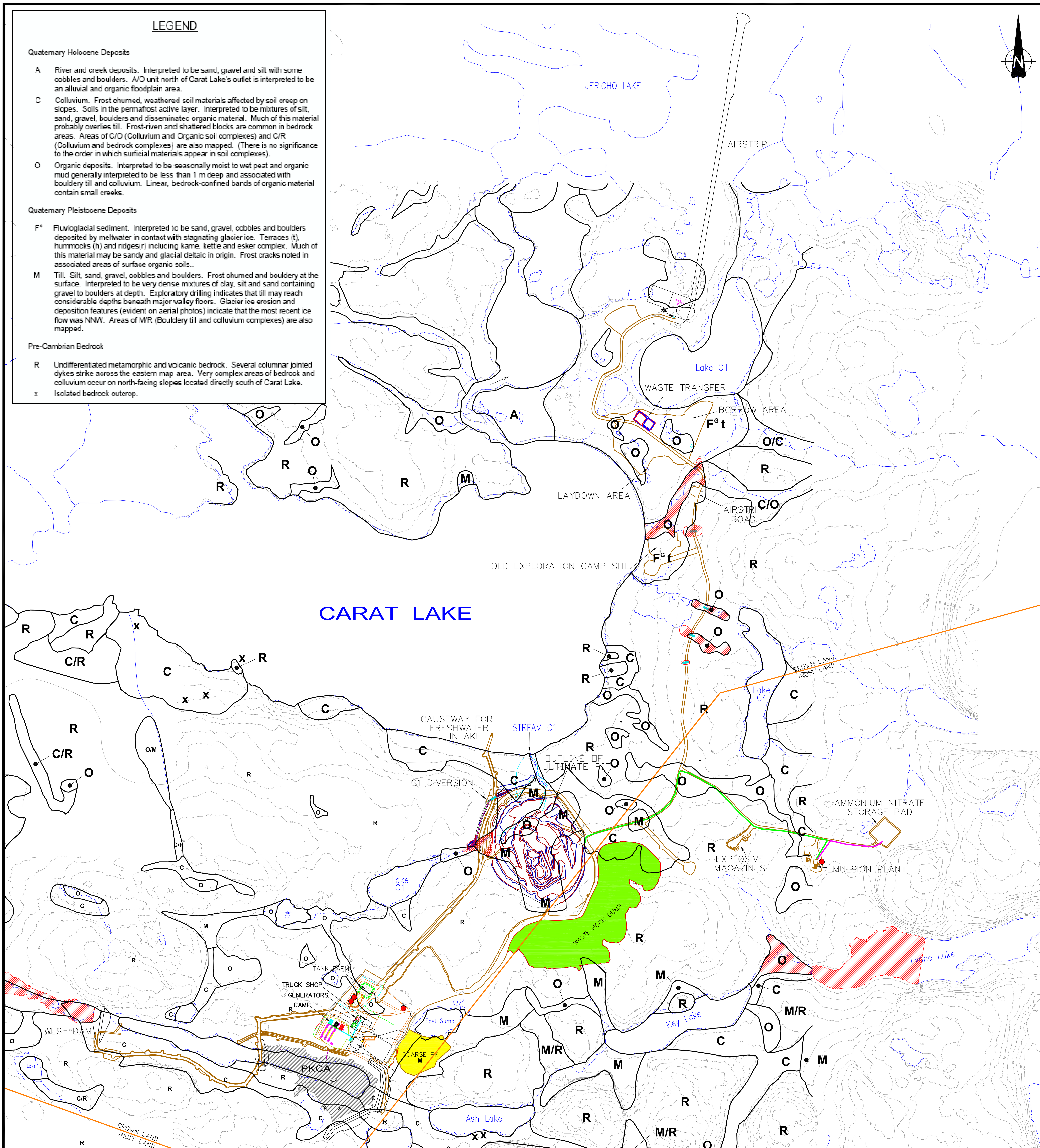
Ecological Zones Map



JERICHO LAKE
CARAT LAKE
LAKE C3
CONTROL LAKE
ASH LAKE
KEY LAKE
LYNNE LAKE
WINTER ROAD
CROWN LAND INUIT LAND
OPEN PIT
WASTE DUMP SITE 1
WASTE DUMP SITE 2
530m. Elev.
550 m. Elev.
MCCAW'S PAD
PK1
PK3
PK4
N
Rock Tundra
Dry Rock Tundra
Land Tundra
Dry Barren Land Tundra
Water
Water
Wet Grass
Wet Grass and Birch Meadows
Cliff
Cliff/Rocky Hill
Esker
Esker/Kame Delta
Birch
Birch Brush
Beach
Beach Shorline
0m 250 500
Apr 9, 2007
SCALE: NTS
TAHERA DIAMOND CORPORATION
CLOSURE PLAN
DRAWING 3

TAHERA
DIAMOND CORPORATION

Surficial Geology Map



Legend

- Waste Dump
- PKCA
- Stockpile Pad
- Spill Sensitive Area
- Culvert
- Spill Kit
- AN Truck Route
- Explosives Truck Route

NOTE:
Base map provided by Tahera. Stockpiles and PKCA boundary provided by SRK Consulting.

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Tel. (604) 294-3811 Fax. (604) 294-4664

CLIENT
TAHERA DIAMOND CORPORATION

PROJECT: JERICHO DIAMOND PROJECT	DWN BY: BWS	DATUM: NAD27	DATE: MARCH 2007
TITLE: ENVIRONEMNTAL SITE MAP	CHK'D BY: BO	REV. NO.: A	PROJECT NO: VE51295
	PROJECTION: UTM Zone 12	SCALE: AS SHOWN	FIGURE No. DRAWING 4

N:\Projects\51000\51200\VE51295 - Tahera Jericho Final EIS\Jericho\Water Licence\Contingency Plan\Drawings\cad\Environmental-Site-MJericho_Contingency-Plan_Site-as-of-2006-Dec-31.dwg - 34x44 - Mar. 22, 2007 3:44pm - brad.sparks

APPENDIX B
JERICHO ECOLOGICAL ZONES DESCRIPTIONS

Appendix B
JERICHO DIAMOND PROJECT
Vegetation Baseline Report, 1999
Plant Community Classification

In this section, the plant communities and associations found in plots on the Jericho Diamond Project are described. These are based on observable species groupings in conjunction with terrain features or ecological conditions in the immediate area.

It is important to realize that in many cases, these plant communities or associations are almost like a mosaic. They overlay terrain features, making it possible to have more than one association in a given area. For example, glacial erratic boulders may be scattered throughout a sedge community, or perched on a ridge and surrounded by heath tundra. The boulders bear their own plant associations of lichens, and the surrounding community may be completely different. Conversely, an expanse of heath tundra may include within it small sedge meadows, birch seeps, and bedrock outcrops, each with its own typical plant associations. The very mosaic nature of the plant communities in the arctic point out the difficulty of vegetation mapping (especially by remote sensing); in this environment, it is almost impossible to include these tiny enclaves.

In this paper, we have used the term “plant community” to refer to the major groups, and the term “plant association” to refer to subgroups within each major community. For example, the Sedge Community includes emergent plant associations, non-tussock sedge associations, and tussock sedge associations.

In order to save space, we have used common names where possible, including the scientific name the first time the name is used, and omitting it thereafter.

1. Sedge Communities

Sedge communities typically occur in drainage basins, depressions, or at the edges of lakes and ponds. They are typically wetlands, with standing or slowly flowing water during enough of the growing season that the soil remains saturated.

Sedges (*Carex* sp.) or arctic cotton (*Eriophorum* sp.) make up the dominant vegetation in these communities. Arctic cotton is in the sedge family, but has such a distinctive flower that it has its own common name. It is also known as cottongrass.

1.1 Emergent association

PHOTO 3, Plot 243

Emergent associations occur where plants grow in standing water, usually at the edge of a lake or pond. Some ponds are so shallow that rooted vegetation can occur throughout the pond basin. The depth limit for rooted emergent vegetation in this area seems to be about 30 cm.

Plants in this association are mostly non-tussock sedges (*Carex* sp.) or large cottongrasses (*Eriophorum angustifolium*).

The emergent association is rare in the Local Study Area.

1.2 Sedge association, non-tussock

PHOTO 4, Plot 237
PHOTO 5, Plot 220

The non-tussock sedge association occurs in the center or deepest part of a drainage basin, and consists of non-tussock-forming sedges or cottongrasses. Some species of *Carex* and *Eriophorum* grow in tight clumps called tussocks; in other species, individual plants are connected by underground rhizomes, and are spaced evenly, not clumped.

Non-tussock formers typically grow in the wetter parts of a basin, where water tends to remain on the ground longer, or tends to flow in shallow channels, producing an intermittent flow of slowly moving water a few centimeters deep.

Characteristic species of this association in the Local Study Area include: *Carex aquatilis*, *C. bigelowii*, *C. membranacea*, *Eriophorum angustifolium*, and *E. scheuchzeri*.

Occasionally woody plants like willows (*Salix arctica*, *S. arctophila*, *S. glauca* ssp. *callicarpaea*, *S. fuscescens*, *S. planifolia*, and *S. tyrellii*) occur in this association, but usually are quite small. Moisture-tolerant forbs like marsh five-finger (*Potentilla palustris*), *Saxifraga foliolosa*, bulblet saxifrage (*S. cernua*), Sudetan lousewort (*Pedicularis sudetica*) also occur here. Occasionally legumes, including the arctic crazyweed (*Oxytropis arctica)* and (rarely*) O. bellii* were encountered, usually growing on mounds.

Grasses are uncommon in this association as it usually is too wet, but *Calamagrostis neglecta*, and *Luzula confusa* were occasionally found here.

The non-tussock association blends into the tussock association wherever the ground is higher or drier in the drainage basins. In places the two, plus hummocky tundra, form a mosaic of different associations, with any mound providing drier habitat that supports species more typical of the heath tundra communities. (See Photo 5, with non-tussock association in the foreground, and the tussock association in the background.)

1.3 Sedge association, tussock

PHOTO 6, Plot 249 (also Phenology Plot 7)
PHOTO 7, Plot 238
PHOTO 8, Plot 238 (close-up of cottongrass tussock)

The tussock sedge association occurs at the edges of a drainage basin, where water only occasionally flows in a thin sheet over the ground. Standing water may be present in the spring or after a rain, but does not persist long.

The sedges and cottongrasses of this association usually form durable "tussocks", clumps of stems and leaves attached to a network of roots and growing in a flexible clump like a tuft of hair. These tussocks form a visible tufted pattern. (See Photo 8 for illustration of a tussock of cottongrass.)

Tussock zone sedge and cottongrass species include: *Carex aquatilis*, *C. membranacea*, *Eriophorum brachyantherum*, and *E. callitrix*. Non-tussock species may occur here, amidst the tussocks.

Heath (and other) species invade the tussocks, and mosses become established in the interstices between the tussocks. Commonly, bog rosemary (*Andromeda polifolia*) and cloudberry (*Rubus chamaemorus*) become established in the sides of the tussocks, while blueberry (*Vaccinium uliginosum*), cranberry (*Vaccinium vitis-idaea*), and Labrador tea (*Ledum decumbens*) grow from the tops. Lapland lousewort (*Pedicularis lapponica*), and bistort (*Polygonum viviparum*) also often grow in and around tussocks.

Dwarf birch (*Betula glandulosa*) and willows (*Salix arctica*, *S. fuscescens*, *S. arctophila*, and occasionally *S. herbacea* or *S. reticulata*) also gain footholds in the tussocks. The birches can attain sizes of over 20 cm, but the willows seldom exceed 10 cm in this association.

The tussock association is often transitional between the non-tussock association and the surrounding heath tundra. As the drainage basin ages, it receives organic material, especially at the edges, which impedes the flow of water, and actually raises the level of the land. This causes the upper layers of the soil to be drier, which allows other species to become established.

As they age, the tussocks lose their tufted shapes due to the growth of non-sedge species. They eventually become rounded humps and the association blends into hummocky tundra.

2. Birch Communities

These associations occur where there is a consistent and reliable supply of water throughout the growing season, but where water does not pool or stand on the ground. They are characterized by the fact that the dwarf birch (*Betula glandulosa*) is the dominant species. They vary in their location due to the amount of water available throughout the growing season.

The birch communities provide nesting habitat for small passerine (perching) birds that usually nest in trees in the southern parts of their ranges, shelter for roosting ptarmigans, and cover for other mammals, like the tundra voles and lemmings. Short-tailed weasels also utilize their cover for hunting.

2.1 Birch riparian association (also birch/willow riparian)

PHOTO 9, Plot 214
PHOTO 10, near Plot 244
PHOTO 11, Plot 206
PHOTO 12, Plot 206, willow close-up with moth galls

A birch riparian association is characterized by a thick growth of dwarf birch in the vicinity of a stream channel, often with a substantial flow of water that is sustained throughout the growing season. These birches (usually 20 – 60 cm tall) often grow so thickly that the density of sedges, grasses, and heaths under their shade is drastically reduced. The ground underneath is often covered only with leaf litter from the birches.

Where enough sunlight penetrates to permit other plants to grow, the ground cover is often crowberry (*Empetrum nigrum*), blueberry, and cranberry, as well as a few mosses. In most cases, these individuals look quite different than individuals of the same species growing out on the open tundra in full sunlight. They are taller, with larger leaves – demonstrating an adaptation known as “shade leaves”, leaf adaptation to lower light levels.

In the larger stream channels, the birch riparian association often includes willows, some of which can attain fairly large sizes, trunks some 10 cm or more in diameter, and heights up to 100 cm. These willows include *Salix glauca*, *S. planifolia*, and *S. tyrellii*. *Salix arctophila* also occurs here, but most often is prostrate, growing among the other willows.

In places this birch riparian association with fairly large willows occurs where water collects at the base of a cliff, even if there is not a lot of standing water. (See Photo 11, Plot 206 for an example, and Photo 12 for a closeup of a willow with moth galls)

2.2 Birch "seeps"

PHOTO 13, Plot 219

Birch "seeps" are rarely associated with constantly flowing streams, but usually occur where water flows out of a boulder field, at the edge of an esker, on the margin of a slope, or where the active layer has slipped. The flow of water is not generally visible on the surface of the land, but is reliable. They are quite visible as a low but solid growth of dwarf birches, often in a crescent shape on a hillside. This plant association is often associated with large boulder groups or at the edges of boulder fields or areas of felsenmeer (shattered bedrock that has been somewhat rearranged by glaciation, but retains its angular forms).

Where the birch "grove" is thick enough, only leaf litter and a few scraggly mosses occur beneath the birches. If sunlight penetrates, however, birch seeps can support an understory of heaths (blueberry, Labrador tea, mountain cranberry) crowberry, mosses, buttercups (*Ranunculus lapponicus*), large-flowered wintergreen (*Pyrola grandiflora*), and bublet saxifrage (*Saxifraga cernua*). Several willows (*Salix glauca*, *S. arctophila, S. herbacea*, *S. tyrrellii*) occur here in this protected environment, as well as sedges (*Carex aquatilis*, *C. bigelowii*, *Eriophorum scheuchzeri*) and grasses (*Arctagrostis latifolia*, *Hierochloe alpina*, *Calamagrostis inexpansa, C. neglecta,* and *Poa arctica*).

3. Heath Tundra Community

The heath tundra is the climax community in the Contwoyto Lake area, and covers most of the upland where the soil is stable or deep enough to support rooted plants. The term "heath" refers to plants of the family Ericaceae, and is used as a general term to describe this group of plants, which often grow in association with each other in the tundra.

The heath tundra community is characterized by a mixture of heaths, forbs, small xeric sedges, and grasses. The composition of the vegetation of the heath tundra community is governed by the amount of water in the soil, soil amount and type, and exposure to wind.

Terrain features are the most important cause of variations in the heath tundra community, especially those that affect the amount of water available to plant roots or those that cause the soil to be more exposed to winds in winter than in surrounding areas.

3.1 Upland heath tundra

PHOTO 14, Plot 242
PHOTO 15, Plot 225
PHOTO 16, Plot 225 (Close-up of alpine azalea)

This association occurs on most slopes and fairly well-drained level ground which is covered by a blanket of snow in winter, preventing wind erosion of the vegetation.

Characteristic plants of the upland heath tundra include Labrador tea, blueberry, mountain cranberry, and bearberry, black bearberry (*Arctostaphylos alpina*) on the drier sites, and red bearberry (*A. rubra*) where there is more moisture. Crowberry is often intermingled in the mat of vegetation, and dwarf birch is also an important component of this community, but grows in a scattered fashion, not in dense “groves”. Willows (*Salix glauca* ssp. *callicarpaea*, *S. arctica, S. tyrrellii)* also occur throughout the upland heath tundra, and are mostly small and prostrate due to the shallow snow cover in winter.

Arctic bluegrass (*Poa arctica*), alpine holygrass (*Hierochloe alpina*), wood rush (*Luzula confusa*), and dryland sedges like *Carex bigelowii, C. membranacea, C. rotundata, C. rupestris,* and *C. vaginata* grow scattered throughout the upland heath tundra, not in pure stands. Alpine holygrass occurred in almost every plot we studied, except where the ground was saturated.

In windswept areas where the snow cover is likely quite thin in winter, mat plants like alpine azalea (*Loiseleuria procumbens*) or *Diapensia lapponica* can become established. Mountain avens (*Dryas integrifolia*) also occurs in thin snow areas.

3.2 Heath tundra on frost scars

PHOTO 17, Plot 262
PHOTO 18, Plot 262 (Close-up of frost scar.)

The freeze-thaw cycle in arctic soils creates typical terrain features across the Arctic. One of the most common of these are “frost scars”, described by Britton (1966) in a paper on the vegetation of the Alaskan arctic tundra. A type of frost scar, mud boils are defined as “nonsorted circles developed in fine-grained materials” (van Everdingen, 1998). These are common on many gentle slopes in the Contwoyto area.

Mud boils form where conditions allow the establishment of convection currents in the active layer (French and Slaymaker, 1993). Circular structures form, with a center disk composed of exposed mineral soil, rocks, or a combination of these, surrounded by a raised ridge usually covered with vegetation. Particles in the center disk may be moving too swiftly to allow the establishment of rooted vegetation.

The vegetation on frost scars creates a different type of mosaic, several different associations all mixed together, impossible to separate, as far as mapping is concerned.

Outside the circular mud or frost “boils”, the plant association may be heath tundra or a sedge association. On the elevated ridges of the “boils”, heath tundra predominates, with a mixture of species more typical of dry sites mixed with the heaths – legumes such as arctic crazyweed (*Oxytropis arctica*), and occasionally liquorice-root (*Hedysarum alpinum*). In addition, mountain avens (*Dryas integrifolia*) and grasses such as *Arctagrostis latifolia, Trisetum spicatum,* arctic bluegrass, alpine holygrass also occupy the ridges.

The center disk of the boil is composed of particles moving rapidly in relation to the outer ring. This prevents most vegetation from becoming established. In some cases, there is little vegetation here; in others, the center disk bears mats of alpine milkvetch (*Astragalus alpinus*), tiny gnarled plants of Lapland rosebay (*Rhododendron lapponicum*), or a sparse growth of sedges.

3.3 Heath tundra on solifluction slopes

In places, the active layer creeps downslope over the permafrost, forming a distinct layer that resembles frosting applied to a cake while the cake is still warm, a sort of “festooned” pattern where one layer creeps over another. From above, these lobes can be seen overlying the original ground.

The face of the moving layer is rotating, with soil particles moving in a wheel-like motion around the end of the layer. This movement carries rooted vegetation with it, creating a thicker growth of plants in the face of the slowly moving ridge.

Some of the plants often found in the face of a solifluction lobe are dwarf birch, small willows (several species), blueberry, Labrador tea, mountain cranberry, Calamagrostis neglecta, alpine holygrass, .

Solifluction slopes are uncommon in the local study area, and usually occur on a small scale where they do occur.

4. Snowbank Community

PHOTO 19, near Plot 228, showing profile of snowbank
PHOTO 20, Plot 228
PHOTO 21, Plot 229
PHOTO 22, Plot 229 (Close-up of mountain heather.)
PHOTO 23, Plot 229 (Close-up of Richardson’s anemone)
PHOTO 24, near Plot 229, pellets from arctic hare

In the lee of a south or east-facing slope, deep snowbanks accumulate (Photo 19), and often do not disappear before July, drastically shortening the growing season for the plants beneath the snow. A characteristic plant association develops in these areas. Typical of most snowbank communities is the least willow (*Salix herbacea*), Labrador tea, and the white arctic heather. Mountain sorrel (*Oxyria digyna*), *Saxifraga punctata, S. nivalis*, and *Antennaria eckmaniana* are often also present.

The higher the bank or cliff which causes the snowbank to form, the deeper the snowbank, and more pronounced its effect on the local vegetation. We found particularly distinct snowbank communities at the west end of Long Lake, which is located to the southwest of the portal. Here, steep cliffs some 10 m tall cause snow accumulation and distinct local microclimates.

Wind turbulence in these valleys causes snowbanks to develop on both south and north-facing slopes. However, due to longer exposure to direct sunlight, the south-facing cliff bases (Photo 21) tend to become snow free earlier than those facing north (Photos 19 and 20). These south-facing slopes are protected from drying winds, and have a reliable source of moisture throughout most of the growing season. The plant community that develops here consists of a number of species that are much more common further south, near Lac de Gras, Jolly Lake, and Courageous Lake.

Among the normal snowbank indicator species, we found bog-laurel (*Kalmia polifolia*), mountain heather (*Phyllodoce coerula*) (Photo 22), Richardson's anemone (*Anemone richardsonii*) (Photo 23), *Sibbaldia procumbens*, and in places a species of violet tentatively identified as *Viola epipsala* ssp. *repens*.

Arctic hares and ptarmigans apparently use the shelter of these cliffs in harsh weather. Here, we found many fecal deposits of both species, as well as unusual fecal pellets of arctic hares. These pellets seem to be covered with a fine mud veneer, and are composed of much finer plant material than are the typical pellets. Each pellet we opened also contained one to three small pieces of gravel. The reason for the formation of these atypical pellets is unknown, and a cursory search of the literature revealed no descriptions that fit (Photo 24).

5. Avens Association

PHOTO 25, Plot 239

A fairly uncommon plant association occurs in "saddles" and on slopes where there is little soil, and a base of gravel ranging in particle size from 5 mm to 1 cm. (Since the mountain avens seems to dominate this association, we called it the "Avens association". It does not seem to fit clearly into the designation of "heath tundra", and is not a sedge association, but seems to have its own characteristics.)

Although mountain avens (*Dryas integrifolia*) is dominant in this association, but the least willow, reticulated willow (*Salix reticulata*), Lapland rosebay, alpine milkvetch (*Astragalus alpinus*) and arctic oxytrope (*Oxytropis arctica*) also occur. Arctic bluegrass (*Poa arctica*), *Deschampsia caespitos*a, and *Carex scirpoidea* are present. Several species of small willows occur here, including *Salix reticulata*, *S. herbacea*, *S. glauca*, and *S. arbusculoides*. Black bearberry (*Arctostaphylos alpina*), purple mountain saxifrage (*Saxifraga oppositifolia*), star chickweed (*Stellaria* sp.), and false asphodel (*Tofieldia pusilla* and *T. coccinea*) are sometimes present in small numbers.

Frost boils are common in this area, and these plants often arrange themselves typically on the frost boils, with the legumes, small sedges, and Lapland rosebay on the center disks, and heaths and avens on the surrounding ridges.

We found only two examples of this type of association. The best example is on the south-facing slope above the east end of Long Lake.

6. Lichen-rock Communities

Where there is a high percentage of boulders or fractured bedrock in the substrate, rooted vascular plants are uncommon, and the plant association is made up of lichens growing on and around the rocks. In the Jericho Project area, most rocks are about 80% covered with crustose lichens.

The species of lichen inhabiting the rock usually depends on the chemical composition of the rock, the amount of weathering or fracturing, and the exposure to wind abrasion. The lichen flora of rocks in the Jericho area is generally a flora typical of "acidic" rocks rather than calcareous rocks.

The following lichens constitute the "typical" lichen flora of local rocks, and can be found on boulders, felsenmeer and bedrock outcrops: rock tripe (*Umbilicaria* sp.), map lichen (*Rhizocarpon geographicum, R. geminatum*), sunburst (*Arctoparmelia centrifuga, A. incurvata*), bloodspot (*Haematomma lapponicum*), *Pseudophebe minuscula* and *P. pubescens* (which we called "brush-cut lichens"), Tremolecia atrata ("Halloween lichen") and grey and black crustose lichens.

The orange jewel lichen (*Xanthoria elegans*), occurs where siksiks use the boulders for lookouts; it is characteristic of calcareous rocks and places high in nitrogen, growing here on the urine and feces of the ground squirrels.

6.1 Boulders in heath tundra

PHOTO 26, Plot 233

This is a transitional association, scattered boulders (usually about 80% covered with lichens) surrounded by heath tundra. It is very common in the Local Study Area. The boulders are covered with the typical lichen association listed above, and the surrounding heath tundra is typical of the general heath tundra for the area.

Occasionally, a local effect can be observed around the boulders – a small increase in nutrients and water may occur due to runoff from the boulder and from fecal material deposited on it by birds and mammals. This may cause an increase in the lushness of the plants around the base of the boulder, and in a higher percentage of grasses immediately surrounding the boulder.

Scattered glacial erratic boulders also occur in sedge communities. When they do, the coverage of lichens on the boulders is about 60%, significantly less than those in heath tundra.

The microhabitats on these erratic boulders is likely not particularly important to any species of wildlife, with the possible exception of some insects or spiders.

6.2 Boulder field associations

PHOTO 27, Plot 223
PHOTO 28, Plot 223 (Close-up of boulders, lichens.)

The plant communities on boulder fields, boulder streams, and felsenmeer* are all similar, with the species of lichens determined primarily by the chemical composition of the rocks. Boulders are covered by a mosaic of crustose lichens (see list above) and the interstices between boulders, if small enough to provide protection, support an assemblage of foliose and fruticose lichens. Typical species between boulders include: *Cetraria* sp., *Cladina stellaris*, *Alectoria* sp. (“hair lichens”), and *Cladonia cervicornis, C. cornuta, C. coccifera,* and *C. uncialis.*.

As the mats of lichens webbing the boulders together become denser, dust and organic debris accumulate, and form a substrate that can support rooted plants. Mats of tundra slowly become established in the midst of the boulders. The fragrant shield fern (*Dryopteris fragrans*) often becomes established in protected niches. Crowberry and mountain cranberry are also common species in these mats. Prickly saxifrage often becomes established, rooting in cracks on the boulders.

6.3 Bedrock associations

PHOTO 29, Plot 204
PHOTO 30, Plot 204 (Close-up of lichens.)

Bedrock outcrops rounded and polished by the continental ice sheets are common in the local study area of the Jericho Project. These provide a substrate that is not only lacking in nutrients, but often exposed to the wind and subjected to great variations in temperature. Few rooted vascular plants can become established here, so the rock outcrops are left to the lichens. Most outcrops are approximately 80% covered with crustose lichens (See Photo 30). A few vascular plants like prickly saxifrage (*Saxifraga tricuspidata*) and some of the grasses find footholds in cracks in the rocks.

Cliff faces usually support a flora similar to rounded outcrops, with rooted plants clinging to crevices and mats of tundra established on ledges. Grasses (*Poa* sp., *Hierochloe* sp.) are common, as is prickly saxifrage, and sometimes *Saxifraga nivalis*.

Cliff faces usually funnel or concentrate the flow of water (either over the surface or through the active layer), creating a moist microclimate at their base. If they are too small to form snowbank communities, the base of cliffs often supports a lush growth of grasses (*Poa* sp., and *Luzula confusa*) or sedges (*Carex bigelowii, C. aquatilis,* and *C. podocarpa*) (See Photos 11 and 12).

* Felsenmeer is a”surficial layer of angular shattered rocks formed in either modern or Pleistocene periglacial environments (Van Everdingen, 1998), literally “frost-riven debris”, often slightly modified by ice (Bird, 1967).

Taller cliff faces may provide nesting sites for raptors. “Whitewash” (fecal material) from the birds and decaying organic matter from nest material and prey items creates small pockets of enrichment around the nest sites. These areas may have sufficient nitrogen compounds and calcium to support growths of bright orange jewel lichens (*Xanthoria* elegans).

7. Ridge Complex

Eskers and kame deltas are common in the Jericho area; the airstrip is built on a large esker that runs north from Carat Camp. These large systems encompass a number of plant communities, but some (such as the ridge crest communities) are characteristic only of the esker/drumlin/kame complexes, as they occur on the less stable sand/gravel substrates exposed to wind erosion.

7.1 Ridge crest communities

PHOTO 31, Plot 252 (Phenology Plot #4)
PHOTO 32, Plot 252 (Close-up of *Potentilla nivalis*)

Due to exposure to winds and the instability of the sand or gravel material of the esker or ridge crests, very specific plant communities develop there. These typically consist mostly of mats of vegetation (blueberry, crowberry, black bearberry, Labrador tea, mountain avens), semi-succulent plants (*Antennaria* sp., prickly saxifrage, *Draba glabella* and *D. lactea*), deeply-rooted cushion plants like moss campion (*Silene acaulis*), or clumps of grass (*Poa* sp. , *Arctagrostis latifolia*, *Festuca brachyphylla*, or *Arctophila* sp.). The tiny sandwort, *Minuartia rubella*, can also be found in some of these very dry, very unstable sites. A few legumes also can find a foothold here, including *Oxytropis arctica* and *Astragalus alpinus*.

Where the winds are particularly severe, due to topographical features and funneling, the snow cover in winter may be nonexistent and the soil may be so eroded and unstable that it cannot support any kind of rooted vegetation. In these areas, sand “blowouts” occur, which do not have any visible vegetation at all. More stable crests with thin snow cover may develop a thin veneer of black lichens.

7.2 Ridge slope communities

PHOTO 33, Plot 251 (Phenology plot #5)

The slopes of eskers can vary in exposure, orientation, and steepness, and the plant communities occupying them vary also. Slopes facing away from the prevailing winds may support a fringe of dwarf birches with an understory of crowberry, blueberry, Labrador tea, arctic heather, mountain cranberry, and occasionally large-flowered wintergreen and *Antennaria* spp. These lee slopes usually face south or southeast.

Snowdrifts collect on these slopes and help protect the vegetation. They also ensure a more reliable supply of water, enabling the dwarf birches to survive there. Snowbank communities may occupy the lower portions of lee slopes that accumulate deep snowdrifts. Windward slopes usually are covered with heath tundra.

8. Transitional Associations; Hummock zone

PHOTO 34, Plot 216

In some cases, the transition zone between two plant communities is occupied by an association that contains elements of each but that is clearly definable on its own.

An example of this is the hummock zone, which occurs in the transition between the sedge community and heath tundra. This association, because of its diverse microclimates, is a complex mosaic, with a high number of plant species, each occupying a specific niche.

A turf hummock is defined (Van Everdingen, 1998), as a “hummock consisting of vegetation and organic matter with or without a core of mineral soil or stones”. Occasionally, hummocks are ice-cored, especially in areas where there is considerable flow of water in the fall, when freezing and thawing occur each day.

Turf hummocks may originate as sedge tussocks are invaded by heaths. These are mounds developed initially from the tussocks of certain species of *Carex* and *Eriophorum* sedges, a tight but flexible mass of stalks, leaves, and roots. Bird (1967) states that this is the most common form of hummock in northern Canada.

Heath growth usually starts in the drier places on a tussock, with blueberry, Labrador tea, mountain cranberry, and occasionally red bearberry (*Arctostaphylos rubra*) rooting in the sides and top of the tussock, and gradually displacing the sedges. Mosses cover the ground between the tussocks, and add to their bulk by growing up the sides. Cloudberry (*Rubus chamaemorus*) and bog rosemary (*Andromeda polifolia*) become established in the moss, and gradually the structure ceases to resemble a tussock and becomes a mound of heaths and related species.

Moss mats that become established in sedge meadows may be an alternate source of hummocks (Pielou, 1994). The thickening growth of mosses insulate the ground in specific places, allowing ice lenses to develop when water percolates through the system in the fall. These enlarge each year, and, with the vegetation growth, cause the hummock size to increase. Plant species are similar, heaths, mosses, cloudberries, and a few forbs like bistort (*Polygonum viviparum*), Labrador lousewort and Lapland lousewort.

Toward the sides of the drainage basin or depression, there is less water in the soil, and colonization by heaths is more complete. Heaths fill the interstices between the mounds, and the surface becomes undulating, gradually merging with the surrounding heath tundra.

Photos

PHOTO 3. Plot 243
Sedge Community, emergent association, sedges in standing water.

PHOTO 4. Plot 237
Sedge Community, non-tussock association.

PHOTO 5. Plot 220
Sedge Community, non-tussock association with transition to tussock association in background.

PHOTO 6. Plot 249
(Phenology Plot #7) Sedge Community, tussock association.

PHOTO 7. Plot 238
Sedge Community, tussock association. (above)

PHOTO 8. Plot 238
Tussock association, single tussock of cottongrass. (left)

PHOTO 9. Plot 214
Birch Community, birch/willow riparian association.

PHOTO 10. Near Plot 244
Birch Community, birch/willow riparian association at natural rock "dam" in stream valley above Lake C-1.

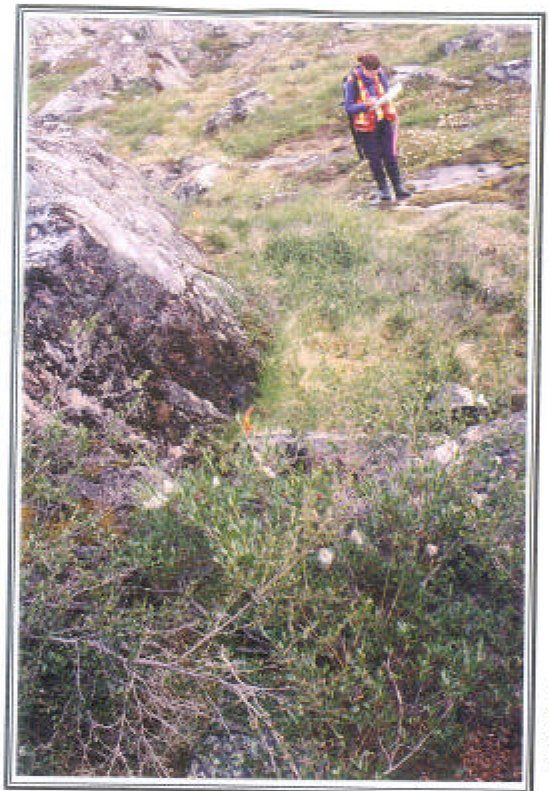

PHOTO 11. Plot 206
Willows at edge of heath tundra/sedge association at base of small cliff. (left)

PHOTO 12. Plot 206
Close-up of willow at base of small cliff. Red globes are moth galls. (below)

PHOTO 13. Plot 219
Birch Community, birch seep.

PHOTO 14. Plot 242
Heath Tundra Community on top of ridge with perched glacial erratic boulder.

PHOTO 15. Plot 225
Heath Tundra Community at base of small cliff near Long Lake. (above)

PHOTO 16. Plot 225
Close-up of alpine azalea in heath tundra. (left)

PHOTO 17. Plot 262
Heath Tundra Community with frost scars.
rock "dam" in stream valley above Lake C-1.

PHOTO 18. Plot 262
Close-up of frost scar.

PHOTO 19. Near Plot 228
Snowbank on north-facing slope, south side of Long Lake, photographed in late July.

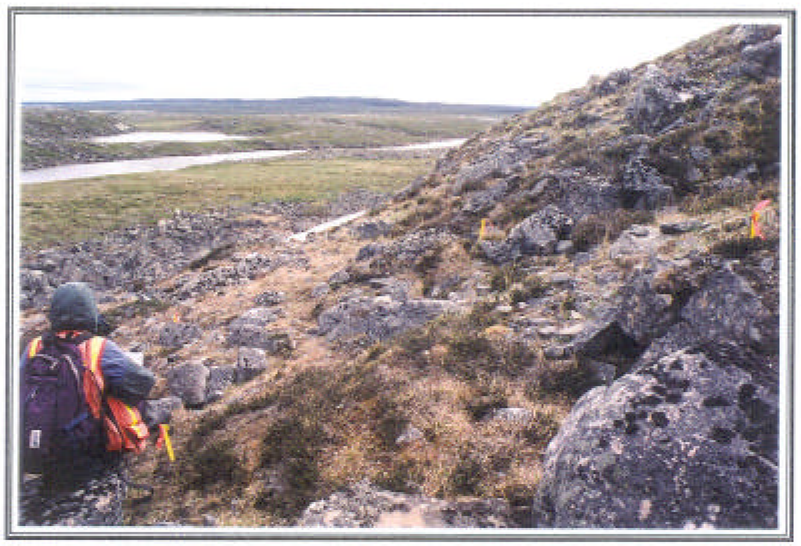

PHOTO 20. Plot 228
Snowbank Community adjacent to snowbank in Photo 19. North-facing slope above Long Lake.

PHOTO 21. Plot 229
Snowbank Community on south-facing slope, north side of Long Lake, base of cliff.

PHOTO 22. Plot 229
Close-up of mountain heather, typical snowbank community indicator species.

PHOTO 23. Plot 229
Close-up of Richardson's anemone, in snowbank community.

PHOTO 24. Near plot 229
Unusual fecal pellets of arctic hare, with apparent mud coating.
Each contains a small pebble.

PHOTO 25. Plot 239
Avens association on gravel saddle between ridges, northeast of the esst end of Long Lake.

PHOTO 26. Plot 233
Type of lichen-rock transition association, heath tundra with lichen-covered boulders.

PHOTO 27. Plot 223
Lichen-rock Community, lichens on boulders in boulder field.

PHOTO 28. Plot 223
Close-up of boulders with crustose lichens and foliose lichens webbing boulders together.

PHOTO 29. Plot 204
Lichen-rock Community, lichens on bedrock outcrop.

PHOTO 30. Plot 204
Close-up of lichens on glacially polished bedrock outcrop.

PHOTO 31. Plot 252
(Phenology Plot #4) Ridge Complex; esker crest association with mats of blueberry, avens, and crowberry.

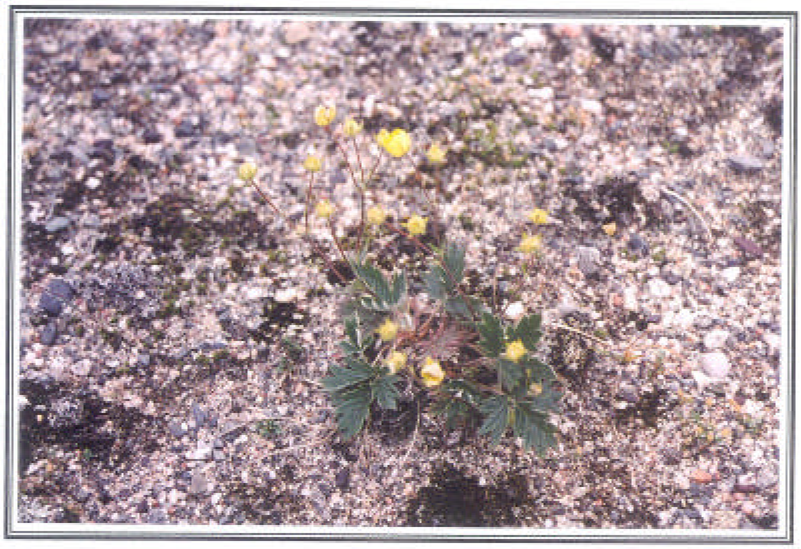

PHOTO 32. Plot 252
(Phenology Plot #4) Close-up of *Potentilla nivea* in esker crest association.

PHOTO 33. Plot 251
(Phenology Plot #5) Ridge Complex; esker slope association with dwarf birches, leeward slope.

PHOTO 34. Plot 216
Transitional association; turf hummocks invaded by heaths.

APPENDIX C
CHAPMAN REPORT ON IN-PIT TREATMENT

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Memorandum

To:	Project File	**Date:**	July 22, 2004
cc:	Kelly Sexsmith, SRK Cam Scott, SRK	**From:**	John Chapman
Subject:	Technical Memorandum R Jericho Post Closure Pit Lake Water Treatment	**Project #:**	1CT004.06

1 Introduction

1.1 Objectives

SRK Consulting has developed estimates of long-term post closure water quality in the Jericho Pit Lake (*Technical Memorandum Q: Post Closure Pit Lake Quality, SRK 2004, In: Abandonment and Restoration Plan, AMEC 2004)*. The current predictions suggest that concentrations of some contaminants may slightly exceed CCME guidelines for the protection of freshwater aquatic life. Given the proximity to the receiving environment, a contingency for post closure water quality management may be required to reduce contaminant concentrations in the pit lake to levels that are appropriate for discharge into Carat Lake.

The purpose of this memorandum is to provide “proof of concept” for use of an in-pit treatment system as a contingency to remove contaminants from the pit lake in the event water quality does not meet acceptable limits.

1.2 Background

Development of treatment strategies for water contained in pit lakes is dependant on site specific requirements. The evaluation and design of associated measures for treatment of the pit lakes should consider factors such as capacity, reliability, longevity, as well as monitoring and maintenance requirements.

Chemical treatment has a long track record. It is robust and reliable and is the technology of choice where the contaminant loads are high or there is no opportunity for experimentation. However, depending on the volume of water that has to be treated from a pit lake, the cost may be high. Biological treatment in some instances, where volumes are high and contaminant concentrations are low, have been shown to be cost effective and represent a viable alternative to conventional chemical treatment.

As discussed below, the current estimates of metal concentrations in the pit lake are within levels that may be treated with a biological treatment system. The intent would be to first revise the long-term estimates of pit water quality once actual seepage and runoff water quality data for the waste rock and pit wall runoff become available. If this data indicates that post-closure treatment may be required to meet discharge criteria, then verification would be completed during or shortly after operations cease, so that by the time the pit is flooded, the full scale system performance can be optimized. In the following sections, the likely performance of such a system is assessed and recommendations to verify the performance and develop specific design and implementation criteria are provided.

2 Biological Treatment Concept

A number of studies have been conducted on the use algae for the in-situ treatment of and pit lake water (Steinberg *et al.*, 2001; Pohler *et al.*, 2002; Poling *et al*., 2003). Typically, *in-situ* biological remediation involves the addition of nutrients to pit lakes to stimulate the growth of primary producers, mainly photosynthetic unicellular algae or phytoplankton. The algae remove metals from the top water layer through absorption and/or adsorption and eventual settling to the lake bottom where the decomposition of organic material creates biological oxygen demand that may in turn create suitable anoxic conditions for biological sulphate reduction (SRB). Under anoxic conditions, SRB can reduce sulphate to sulphide through a series of enzymatic reactions. The sulphide thus generated can form sulphide minerals with dissolved metals to reduce dissolved metal concentrations to very low levels. The cycling of iron from the sediment to the water column under anoxic conditions can also contribute to the co-precipitation of dissolved metals with Fe(III) oxy-hydroxide formed in the oxygenated zones of the pit lake.

Nutrient additions usually comprise phosphorous and nitrogen sources to stimulate phytoplankton growth. Nutrient additions to stimulate the growth of phytoplanktonic algae to promote dissolved metal removal have been successful at the Island Copper and at Landusky pit lakes (Adams, 2002). Successful results were also obtained from pilot-scale tests at Equity Silver mine (Martin *et al.*, 2003; Crusius *et al.*, 2003; McNee *et al.*, 2003). The growth of phytoplanktonic algae has also been stimulated by phosphorus addition at the Colomac Mine site within large contained areas exposed to ambient weather conditions (albeit that the primary purpose was ammonia removal), which demonstrated algae growth in a northern climate.

In a northern climate, heating by the sun causes the surface layer of water in a lake to warm up. The density of the warmer water in the surface layer is lower than the colder water at depth, resulting in a stratification of the lake during the summer months. It is this warmer surface layer of water that is productive. Phytoplanktonic growth would be supported to the depth of light penetration.

During fall, the surface water cools down to about 4 ^{o}C when it reaches its maximum density. This generally causes the now heavier water to sink to the bottom of the lake causing complete mixing of the lake. Typically lakes would also turn over in spring soon after ice-melt when the surface water temperature again approaches 4 ^{o}C.

In general, a similar sequence of events would be expected to occur in the pit lake. However, certain pit lakes may become permanently stratified if the water at depth is more saline, i.e. the water at depth consistently has a density that is higher than the surface water. The shape and depth of the pit lake, the thickness of the ice that forms during the winter and the energy of the flows into the pit lake are additional factors that will determine whether or not this condition, known as meromixis, would develop in the pit lake.

In the case of the Jericho pit lake, the post closure continuous flow through of water and the low salinity conditions would prevent the build-up of salinity and it is therefore unlikely that meromixis would develop. The kinetic energy input from the inflows would also promote mixing. Therefore, the water in the pit lake is likely to be mixed on a regular basis.

In concept, implementation of a biological treatment system in the Jericho pit lake in a post-closure situation would require that nutrients be dispersed throughout the productive surface layer of the pit lake throughout summer. This is generally done by discharging a liquid containing dissolved nutrients into the propeller wash of a small boat as it traverses the surface of the pit lake. The timing and the frequency of the nutrient additions would depend on the productivity and the rate of nutrient consumption to ensure that elevated nutrient concentrations are not released to the receiving environment.

In the next section, a brief assessment of the likely performance of biological treatment system is completed.

3 Application to Jericho Site

3.1 Site Conditions

The rate of growth of phytoplankton will depend on the depth of light penetration, solar radiation, the temperature in the surface layer, and, the availability of nutrients.

The water flowing into the pit is not expected to contain elevated levels of suspended solids, therefore light penetration is not expected to represent a constraint on phytoplankton growth. In the following sections, the climatic conditions at the site are compared to those at the Colomac site, where phytoplankton growth has successfully been demonstrated through nutrient additions.

3.1.1 Sunlight

Table 3-1 below compares the average sunshine hours for nearby meteorological stations, and the exposure profiles are shown in Figure 3-1. The Jericho site is located at a latitude of about 66^{o}N, and is therefore expected to have sunshine exposures similar to that of Kugluktuk of about 1,629 hours of sunshine per annum. The sunshine exposure for Colomac, at a latitude of 64^{o}N is expected to similar to that of Baker Lake, i.e. 1,843 hours per annum. Both Kugluktuk and Baker Lake had approximately 300 hours of sunshine during July and 200 hours of sunshine during August. Based on these comparisons, the Jericho and Colomac sunshine profiles, and peak sunshine hours are expected to be similar. Therefore, during these peak exposure months (June and July) primary production of phytoplankton at Jericho is expected to similar to that observed at the Colomac Site. While the overall annual exposure is lower, this is of no consequence since the difference occurs primarily in the fall and winter when no growth would be expected anyway.

Table 3-1
Total Bright Sunshine (hours)

Station	Latitude	Longitude	Annual
Baker Lake	64 18 N	96 05 W	1843
Kugluktuk (Coppermine A)	67 50 N	115 7 W	1629
Norman Wells A	65 17 N	126 48 W	1854
Yellowknife A	62 28 N	114 27 W	2277

(Source: Environment Canada 1951-1980 Climate Normals)

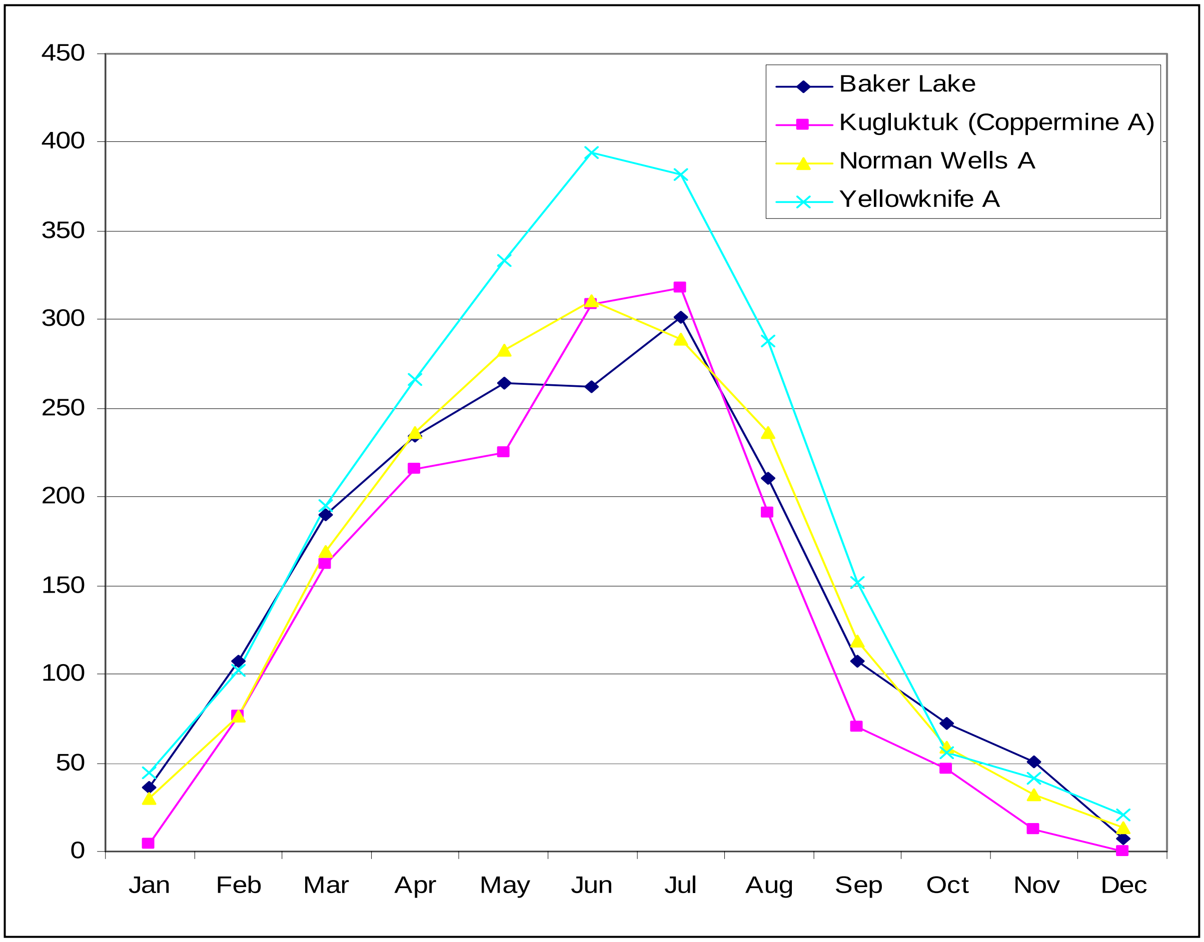

Figure 3-1 Average Annual Sunshine Profiles

3.1.2 Thermal Profile/Stratification

As discussed above, the solar radiation in the summer months is expected to be similar to that for the Colomac site. Therefore, the thermal stratification and peak temperatures are likely to be similar. At the Colomac Pit, thermal stratification occurs to a depth of about 5 meters, and the temperature increases to about 15 ^{o}C. (It should be noted that phytoplankton and metal removal occurs at temperatures as low as 4 ^{o}C at the Island Copper Pit Lake.)

It is therefore concluded that the climatic conditions at the site will be suitable for phytoplankton growth.

3.1.3 Nutrients

The treatment strategy requires that nutrients be added to the pit lake at concentrations that would stimulate phytoplankton growth. Baseline characterization of the receiving surface water quality indicated oligotrophic conditions (i.e. low nutrient conditions), which suggest that nutrient management within the pit lake will be key to the success of an in-situ treatment system.

3.2 Predicted Water Quality

Table 3-2 provides a summary of the initial estimates of key parameters for each source of water that will be directed to the pit lake. These comprise discharges from Ponds A, B, and C and runoff from the pit walls. The table includes the initial estimates of the pit water quality, as presented in Technical Memorandum F (SRK 2003), and revised estimates of pit water quality which consider the effects of partial freezing of the waste rock dumps (SRK 2004). The pit lake water quality, as shown in the second part of the table, represents estimated long-term steady state conditions. The long-term steady state concentrations are shown to indicate the effect of the net loadings to the pit lake, since it will be possible to remove most of the accumulated contaminants before discharge occurs.

Table 3-2
Assessment of Pit Water Quality for Different Assumptions of Source Concentrations

Flows and Concentrations of Water Sources to the Open Pit									
Source Concentrations	**Source**	**Annual Flow**	**T-Al mg/L**	**T-Cd mg/L**	**T-Cu mg/L**	**T-Fe mg/L**	**T-Pb mg/L**	**T-U mg/L**	**T-Zn mg/L**
Estimated Water Quality during Operations Period (from Revised Water and Load Balance)	Pond A	126,668	0.19	0.0005	0.050	0.28	0.0042	0.24	0.021
	Pond B	48,839	0.18	0.0004	0.045	0.27	0.0050	0.23	0.020
	Pond C	118,173	0.04	0.0025	0.0039	0.20	0.0065	0.11	0.022
	Pit Runoff	34,120	0.34	0.0001	0.0078	1.1	0.0033	0.066	0.013
Estimated Water Quality Post-Closure Period	Pond A	126,668	0.06	0.0002	0.017	0.09	0.0014	0.079	0.0072
	Pond B	48,839	0.06	0.0001	0.015	0.09	0.0017	0.076	0.0066
	Pond C	118,173	0.30	0.0006	0.0014	0.30	0.0032	0.052	0.0063
	Pit Runoff	34,120	0.112	0.00004	0.0026	0.37	0.0011	0.022	0.004
Baseline Data (avg. of 2003 Seeps)	Stream C1	224,045	0.093	0.00005	0.0034	0.31	0.00014	0.0010	0.0015
Predicted Water Quality in the Pit Lake									
Contributing Sources			**T-Al mg/L**	**T-Cd mg/L**	**T-Cu mg/L**	**T-Fe mg/L**	**T-Pb mg/L**	**T-U mg/L**	**T-Zn mg/L**
A+B+C+Pit+Ice+Stream C1 (at steady state)			0.13	0.0002	0.007	0.24	0.0013	0.038	0.004
CCME Aquatic Life Guidelines			*0.1*	*1.7E-05*	*0.002*	*0.3*	*0.001*	*na*	*0.03*
Health Canada Guidelines			*0.1*	*0.005*	*1.0*	*0.3*	*0.01*	*0.02*	*5*
Carat Lake Baseline Data			*0.052*	*0.00005*	*0.0020*	*0.025*	*0.00005*	*0.00020*	*0.0020*
Ratio of Pit Lake to CCME Aquatic Guidelines			*1.3*	*12*	*3.5*	*0.8*	*1.3*	*-*	*0.1*

Table 3-2 also provides a ratio of the estimated pit lake water quality to the CCME Guidelines for the protection of freshwater aquatic life. As shown, cadmium and copper are the primary contaminants of concern, whereas aluminium and lead may marginally exceed the guidelines. Iron and zinc would meet the CCME guidelines for the protection of freshwater aquatic life.

At neutral pH conditions, it is anticipated that the total aluminium is likely to be present as a suspended precipitate, which would in part be removed within the lake due to gravitational settlement. It is not expected to represent a concern in the downstream receiving environment. In the next section, the performance of a biological treatment system is estimated.

3.3 Biological Treatment Performance Assessment

In this section the Island Copper experience will be used to assess the potential performance that could be expected at the Jericho Pit Lake. The Island Copper in-situ pit lake treatment system for metals removal is a full scale system with several years of operational data that has been well documented. Although the Island Copper project is located at a latitude of only 51.7^{o}N, in the winter the site experiences significantly lower solar radiation and lower water temperatures than will be expected at the Jericho Pit Lake. Therefore, the Island Copper winter performance data can be used to provide a conservative indication of the potential performance at Jericho.

3.3.1 Contaminant Loading and Removal Rates

The metal concentrations and flows presented in Table 3-2 can be used to calculate specific loadings to the pit lake. The estimated contaminant loadings to the Jericho pit, calculated as grams per hectare of pit lake surface area per year, are shown in the first row in Table 3-3.

Table 3-3 also summarises the removal rates achieved at the Island Copper Mine (Poling et al. 2003). Note that the removal rates are given in units of g/ha/**day**, as opposed to the units of g/ha/**year** in which the loadings are reported. The annual average, winter (December to February) and summer (June to August) removal rates are shown. (Removal rates in test cells or limno corrals at the Equity Silver mine yielded similar rates of metal removal.) Typically the rate of removal at the Island Copper Mine decreases in the winter due to reduced sunshine and colder weather. In the winter, the surface water temperature in the Island Copper Pit Lake may decrease to below 5 ^{o}C. Apart from the latitude of the Island Copper site, the predominantly rainy winter (overcast) also limits solar radiation so that the winter conditions are significantly less conducive to phytoplankton growth than would be the case during the summer at the Jericho site. Therefore, estimating contaminant removals that may be achieved at Jericho using the winter rates observed at the Island Copper site will provide a conservative indication of the pit lake treatment performance.

The last row in Table 3-3 provides an estimate of the time that would be required to remove the annual metal loading from the Jericho Pit Lake, estimated from the Island Copper winter removal rates. As shown by the results, the cadmium removal would require the longest treatment time (at about 22 days). This would mean that 3 to 4 fertilizer applications spaced 10 days apart should be sufficient to achieve metal removals equivalent to the annual loadings.

Table 3-3
Estimated Contaminant Loadings and Removal Rates

Description	Units	T-Cd	T-Cu	T-Pb	T-Zn
Jericho Pit Lake Loadings	g/ha/year	6.6	227	41	145
Island Copper Removal rates					
Annual Average	g/ha/day	0.91	25	n/a	66
Low (Winter)	g/ha/day	0.30	18	n/a	40
High (Summer)	g/ha/day	1.6	37	n/a	160
Time to achieve removal (using winter rates from Island Copper)	Days	22	13	n/a	4

3.3.2 Retention Time

In the previous section it was shown that within a treatment period of less than 1 month it is possible to remove the equivalent of an entire years loading to the pit lake. The potential for contaminant release from the pit lake would depend on the retention time within the pit lake. Effectively, if the retention time exceeds the time required to treat the equivalent loading, the net release of contaminants would effectively be limited. On the other hand, if the retention time is much shorter than the treatment time, the risk for contaminant release will be significant.

The pit lake will have a total flooded volume of about 6.5 million m^3. For completely mixed conditions it can be shown that the retention time of the annual flow into the pit lake will be about 20 years. In the event that meromixis develops, the retention time in the surface layer would be approximately 1.5 years. In either event, the retention time significantly exceeds the treatment time indicating an insignificant risk for contaminant release.

3.3.3 Water Quality

The Island Copper Pit Lake metal loadings are significantly greater than those indicated for the Jericho Pit Lake (as can be inferred from the metal removal rates). The retention time of the surface layer in the Island Copper Pit Lake is approximately 1 year, compared to a more favourable minimum retention time of about 1.5 years at Jericho. Therefore metal concentrations at Jericho are expected to similar or lower than at Island Copper. At the Island Copper Pit Lake, copper concentrations are typically lowered from about 0.02 to 0.03 mg/L to less than 0.004 mg/L; lead from about 0.009 mg/L to less than 0.00005 mg/L; zinc from in excess of 5 mg/L to less than 0.002 mg/L; and cadmium from 0.03 mg/L to less than 0.001 to 0.002 mg/L. It should be noted that the surface water of the Island Copper Pit Lake is brackish, with a salinity of about 3 parts per thousand, because it is partially mixed with seawater. The resultant elevated chloride content, which strongly complexes cadmium and to a lesser extent copper and zinc, is limiting the extent of metal removal. In the case of the Jericho Pit Lake, chloride concentrations will be lower, and complexing reactions are not expected to affect metal removal. It is therefore likely that metal concentrations will be reduced below those observed for the Island Copper site.

Results from limno-corral tests conducted at the Equity Silver mine (McNee et al, 2003) indicated that copper decreased from about 0.005 mg/L to <0.001 mg/L and cadmium decreased from about 0.005 mg/L to < 0.0002 mg/L. Similar reductions in metal concentrations would be expected for the Jericho Pit Lake, which suggests that water quality approaching CCME guidelines may be achieved by in-situ biological treatment.

3.3.4 Fertilization and Nutrients

At the Island Copper Site, liquid fertilizer is applied at a frequency of about 10 days throughout the entire year. The program is designed to coincide with the phytoplankton growth cycle. Typically, dissolved otho-phosphate is maintained at less than 0.005 mg/L (as P) at the time of fertilization which decreases to less than 0.001 mg/L by the end of the 10 day fertilization cycle. Total nitrogen is maintained at less than 0.5 mg/L (as N).

It is anticipated that at Jericho, fertilization would be undertaken only during the ice free period and only for about 2 months of the year. The fertilization would be undertaken every 10 days during July and August, once the majority of the spring runoff has discharged from the pit, and the thermocline has established in the pit lake. A liquid fertilizer mix would be prepared, and dispensed from a small boat that would traverse the surface of the pit lake. The liquid fertilizer would be released to the propeller wash of the boat, which would disperse the fertilizer. Studies elsewhere have shown this to be an effective method of fertilizing. The volume of liquid fertilizer that would be added would be determined from the residual nutrient concentration in the surface layer, the composition of the fertilizer and the volume of the surface layer.

Discharges from the pit lake during the fertilization period would be minimal and could be controlled with an appropriate spillway design. Treated water would be released by gravity the following spring. Assuming nutrients levels would be maintained at level similar to those for the Island Copper Lake, nutrient levels are not expected to impact on the receiving environment, even though it is oligotrophic.

3.3.5 Conclusions

As discussed in the previous sections, biological in-situ treatment represents a feasible contingency in the event that unacceptable water quality results in the Jericho Pit Lake.

The technology and understanding of the metal removal processes is rapidly evolving and finding application elsewhere. However, at present, laboratory and field scale demonstration of the technology would be required to verify its application to the Jericho Pit. Considering the estimated time-scale to complete flooding of the pit lake (25 to 30 years), sufficient time is available to complete such a demonstration during or after operations. In the next section, recommendations for the demonstration in-situ biological treatment of the Jericho Pit Lake are provided.

4 Requirements for Demonstration

Water quality and flow monitoring during the first three to five years of operation will be required to refine the current estimates of long-term water quality in the pit lake, and therefore determine the need for the in-situ treatment. The demonstration program would be implemented if the refined predictions indicate that treatment is required.

As noted before, the technology is evolving rapidly and it will be necessary to stay abreast of developments through continued literature reviews. The following presents a program that would demonstrate the applicability of the technology to the Jericho site. However, adjustments may be required to accommodate future developments.

A program for the demonstration of the effectiveness of biological treatment as a contingency measure would comprise three phases as follows.

4.1 Phase I – Bench Scale Assessment

The objectives of the bench scale investigation address the following questions:

- Can phytoplankton blooms be established in water from the site (that would represent the estimated long term pit lake water quality)?
- What are the minimum nutrient requirements to initiate a phytoplankton bloom, and how frequently should fertilization occur to maintain phytoplankton growth?
- Will metal removal rates exceed metal loadings and will sufficiently low metal concentrations be achieved?

To address these objectives, it is recommended that a laboratory program be undertaken on site in large containers (20 to 200 L vessels) that are exposed to ambient solar radiation and that are maintained at a temperature equivalent to that which develops in the surface layer of the local lakes.

The vessels would be filled with seepage from the waste rock piles or simulated pit lake water, and fertilized with different concentrations of nutrients. The rate of phytoplankton growth, dissolved nutrient concentrations and contaminant concentrations would be monitored on a regular basis. Typically the tests would be completed over a 6 to 8 week period.

Typically this scale of testing provides good information on the nutrient demand and the rate of phytoplankton growth. However, metal removal rates and achievable water quality are more onerous to demonstrate at this scale due to the short duration of the tests.

Results from the phase of the program would be used to design a larger scale field test that would be undertaken in Phase II of the program.

4.2 Phase II – Field Scale Demonstration

The purpose of the field scale tests would be to provide large scale demonstration of metal removal rates and nutrient requirements. The larger scale would enable easy scale-up to a full-scale system. This phase of testing would follow the initial bench scale program.

Larger scale tests would then be undertaken to more accurately evaluate metal removal. The larger scale tests would comprise limno-corrals that would be established in the PKCA, water management pond or a local lake as soon as thermal stratification occurs. (Limno-corrals are simple open ended enclosures that comprise a circular vertical curtain suspended from a floatation ring to isolate a column of water from the surrounding water body. While the enclosure is open-ended at the base, isolation is achieved due to thermal stratification in the water body.) If the water quality in the waterbody does not reflect the pit lake water quality, the surface water layer within the limno-corral would be replaced with water at an appropriate quality. The surface layer would then be fertilized at a rate and schedule determined from the laboratory program. The water quality would be monitored to establish metal removal rates and terminal concentrations. The limno-corrals would also be equipped with sediment traps to verify the fate of the metals. Further testing would also be undertaken on the sediments to assess the potential for nutrient recycling.

4.3 Phase III – Full Scale Verification

The objectives of this phase of investigation would be to verify the results from the field scale demonstration and to treat the pit lake water so that it meets discharge criteria before reaching the spill point. This phase of the investigation would be undertaken during the flooding of the pit.

Once a sizeable water body has been established in the pit, it is recommended that the water quality profiling be undertaken on a regular basis to monitor the water quality and mixing regime of the pit lake. Since numerous seasons will be available before the water level reaches the spill elevation, it is recommended that intermittent fertilization programs be undertaken to verify metal removal and treated water quality. At this time, nutrient recycle rates can also be established to ensure that over-fertilization does not occur once full scale flow-through operations commence.

5 Conclusions and Recommendations

The evaluation of in-situ biological treatment as a contingency treatment process for the Jericho Pit Lake after closure presented herein suggests that in-situ biological pit lake treatment may achieve water quality approaching CCME guidelines. In addition, nutrient concentrations are not expected to significantly impact the receiving environment. As such, it is appropriate to consider biological treatment as a post closure treatment strategy to remove contaminants from the pit lake.

Water quality monitoring during the first three to five years of operations will be required to refine the current estimates of water quality in the pit lakes. If the refined estimates indicate there is a need for water treatment after closure, staged demonstration of the treatment process will be required to verify residual metal and nutrient concentrations.

6 References

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APPENDIX D
CLOSURE COST ESTIMATE TO 31 DEC 2006

Memo

To	**Nunavut Water Board**	File No.	**2AM-JER0401**
From	**Bruce Ott**	cc	**G. Missal** **C. Wray** **R. Jones**
Tel	**780-644-9129**		
Fax	**780-644-9181**		
Date	**30 March 2007**		
Subject	**Closure and Reclamation Cost Update**		

The RECLAIM model was used to update reclamation cost estimates to December 2006. The cost breakdown is similar to that used for the 2005 estimate submitted to NWB February 2006 (AMEC 2006). The 2005 estimate was based on the reclamation and closure cost estimate submitted with the Jericho Water Licence application (AMEC July 2004).

This memorandum lists the changes in disturbance and cost estimates from the 2005 Closure cost estimate. Changes were due to on going mine facilities construction as indicated. The memorandum references costs estimate produced with the RECLAIM model; the 2006 estimate is attached.

Item	2005 Estimate	2006 Estimate
Waste Rock Dump 2 Contour Area	99,240 m^2	147,660 m^2
Waste Rock Dump 2 Reclamation Cost	$141,923	$174,739
Contouring		
PK Dam Contouring	60,000 m^2	1,052,940 m^2
Road Contouring	86,275 m^2	94,753 m^2
Pad Contouring	16,640 m^2	166,240 m^2
Borrow Area A Contouring	3,480 m^2	6,475 m^2
Coarse PK Contouring	0 m^2	3,774 m^2
Total Contouring	232,611 m^2	1,388,002 m^2
Airstrip Scarify	36,000 m^2	68,700 m^2
Pad Cover	44,400 m^3	69,799 m^3
Fine PK Cover	0 m^3	2814 m^3
Scarify/Cover Total Cost	$400,620	$872,119
Closure Monitoring Cost	$531,500	$631,500
Total Reclamation Cost to 31 December	**$6,955,627**	**$7,620,373**

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WASTE ROCK DUMP RECLAMATION COSTS

Load and Haul Overburden

Cycle time: 992 loader (min/load)	4	min/load	
Cycle time: 992 loader (load/hr)	12	load/hr	
Cycle time 777 Off-Highway Truck (min/load)	15	min/load	
Cycle time 777 Off-Highway Truck (load/hr)	4	load/hr	
Number of 992 Loaders Used	1		
Number of 777 Off-Highway Trucks Used	3		
Total Cycles Available - 992 Loader	12	(load/hr)	
Total Cycles Avaialble - 777 Off-Highway Truck	12	(load/hr)	
Capacity (m^3/hr)	50	m^3/hr	
Capacity (LCMs/hr)	600	LCMs/hr	
Cacacity (ECMs/hr)	480	ECMs/hr	
Quantity Waste Dump 2 (1 not built)	29,790	m^3	
Area of Waste Dump 2 to contour @ 60m^2/m	147,660	m^2	
Total 992 Loader Hours Required	29,790 / 480 x 1 machine		62
Total 777 Off-Highway Truck Hours Required	29,790 / 480 x 3 machines		186

Equipment	Fuel/hr (Litres)	Total Hrs	Machine $ Cost/hr	Operator $ Cost/hr	Machine Cost $	Operator Cost $	Fuel Cost $	Total Cost $
D10	84	177	216	56.99	38,382	10,114	11,179	59,675
992	78	62	319	60.60	19,810	3,761	3,631	27,202
777	70	186	206	51.58	38,317	9,603	9,775	57,695
16G (allocation)	44	141	125	55.87	17,636	7,878	4,653	30,167
Cost to Reclaim Waste Rock Dumps					114,146	31,355	29,238	174,739

Note: Footprint perimeter of WRD#2 x 60m^2/m

Note: 2005 costs inflated 5%

CONTOURING COSTS

Reclaim Remaining Areas

Contour

Assume D10 can contour at a rate of		1000	m^2/hr
Open Pit			
	Distance to Contour Crest	6000	m
	Area to Contour	10	m^2/m
	Total Area to Contour	60,000	m^2
PK Dams			
	Distance to Contour	17549	m
	Area to Contour	60	m^2/m
	Total Area to Contour	1,052,940	m^2
Roads			
	Distance to Contour	18951	m
	Area to Contour	5	m^2/m
	Total Area to Contour	94,753	m^2
Pads			
	Distance to Contour	33248	m
	Area to Contour	5	m^2/m
	Total Area to Contour	166,240	m^2
Borrow Area A			
	Distance to Contour	1,295	m
	Area to Contour	5	m^2/m
	Total Area to Contour	6,475	m^2
Coarse PK Stockpiles		3774	m^2
Causeway grade down		9000	m^2
Total Area to Contour		1,388,002	m^2
Total D10 Hours Required		1,388	hrs

OTHER RECLAMATION COSTS

Reclaim Remaining Area				
Disturbance Area to Cover				
PK Dam Overburden				
Area to Cover	0	m^2		
Volume of Overburden @ 0.3 m			0	m^3
PK Dam Coarse Rejects				
Area to Cover	0	m^2		
Volume of Overburden @ 0.5 m			0	m^3
Roads/Airstrip - Scarify Only				
Distance 6 m roads	3,500	m		
Area to Scarify/Meter	6	m^2		
Areato Scarify	21,000	m^2		
Distance 10 m roads	16,160	m		
Area to Cover / Meter	10	m^2		
Area to Cover	161,600	m^2		
Distance 18 m roads	5,800	m		
Area to Cover / Meter	18	m^2		
Area to Cover	104,400	m^2		
Distance Airstrip	1,374	m		
Area to Cover / Meter	50	m^2	**Running surface only**	
Area to Cover	68,700	m^2		
Pads (including accommodations, fuel farm, crusher site, waste transfer, explosives facilities and laydowns)				
Area to Cover	232,664	m^2		
Volume of Overburden @ 0.3 m			69,799	m^3
Coarse PK Stockpiles (#4 only. #1 & 3 not constructed; #2 included with E dam)				
Area to Cover	8,979	m^2		
Volume of Overburden @ 0.3 m			2,694	m^3
Fine PK in PKCA				
Area to Cover	9,379	m^2		
Volume of Overburden @ 0.3 m			2,814	m^3
Total Volume to Cover				
			75,307	m^3
Capacity (ECMs/hr)				
	480	ECMs/hr		

Total D10 Hours Required	(66,376 + 98,200) / 1000	431
Total 992 Loader Hours Required	66,376 / 480 x 1 machine	157
Total 777 Off-Highway Truck Hours Required	66,376 / 480 x 3 machines	471

Equipment	Fuel/hr (Litres)	Total Hrs	Machine $ Cost/hr	Operator $ Cost/hr	Machine Cost $	Operator Cost $	Fuel Cost $	Total Cost $
	84							
D10	78	1,819	216	56.99	393,452	103,673	114,598	611,722
992	70	157	319	60.60	50,079	9,507	9,178	68,764
777	44	471	206	51.58	96,863	24,275	24,710	145,848
16G (allocation)		214	125	55.87	26,767	11,956	7,062	45,785
Cost to Reclaim Remaining Areas					567,161	149,411	155,547	872,119

Note: 2005 costs inflated 5%

SITE EQUIPMENT COSTS

Disassembly, Freight to Site, Assembly

	Cost/Load	# of Units	Pcs/Load	# of Loads	Total Cost $
D10	6,000	2	1.5	3	18,000
992	6,000	2	3.5	7	42,000
777	6,000	3	3.0	9	54,000
16G	6,000	1	2.0	2	12,000
Cat 345	6,000	1	1.0	1	6,000
Crane	12,000	1	1.0	1	12,000
Disassembly (allocation)					15,000
Assembly (allocation)					15,000
		10		23	174,000

Transport South is included under Transport Southbound at End of Reclamation

Disassembly of Facilities	Fuel/hr (litres)	Total Hrs	Machine $ Cost/hr	Operator $ Cost/hr	Machine Cost $	Operator Cost $	Fuel Cost $	Total Cost $
Crane	75	2,189	220	61.98	481,580	135,674	123,131	740,385
Cat 345	40	2,189	250	58.33	547,250	127,684	65,670	740,604
Welders/Riggers				64.73	n/a	566,724		566,724
Labourers				49.19	n/a	861,337		861,337
					1,028,830	1,691,420	188,801	2,909,051

	# Operators	Months	Days/Month	Hrs/Day
Cane Op	1	6	30.4	16
Excavator Op	1	6	30.4	12
Welders and Riggers	4	6	30.4	12
Labourers	8	6	30.4	12

Cat 345 excavator is fitted out with Hydraulic Hammer and Shears

Nuna Overheads	# Operators	Months	Days/Month	Hrs/Day	Operator $ Cost/Hr	Total Cost $
Site Supervisors	1	6	30.4	12	89.4	195,679
Foreman	2	6	30.4	12	73.34	321,053
Safety	1	6	30.4	12	63.72	139,470
Administrator	1	6	30.4	12	52.84	115,656
Operator	1	6	30.4	12	58.33	127,673
						899,531

Support Equipment	Months	Cost / Month	Total $ Cost
(Bobcat, Tractor Lowboy, IT 28)	6	30,000	180,000

Facilities Support	Months	Cost / Month	Total $ Cost
	8	90,000	720,000

DEMOBILIZATION COSTS

Transport South Bound at End of Reclamation		# of Loads	Cost / Load	Total Cost	
	Building	0			**Bury on site**
	Plant facilities	0			**Bury on site**
	Gen Sets	6			
	Fuel Tanks	0			**Decontaminate and bury on site**
	Mobile Equipment	23			
	Misc.	20			
		49	5,200	254,800	

Transportation	# of Trips	Cost / Trip	Total Cost
	94	800	75,200

Catering	# of People	Months	Days / Mon	Cost / Day	Total Cost $
Earthworks	5	6	30.4	45	41,040
Plant Decommissioning	12	6	30.4	45	98,496
Decontaminate fuel tanks	4	2	30.4	45	10,944
Decontaminate explosives buildings	4	2	30.4	45	10,944
Administration	6	6	30.4	45	49,248
					210,672

Monitoring		Cost / Year	# of Years	Total	
	Water quality (to Yr 10)	40,000	10	400,000	**Annual**
	Water quality (to Yr 20)	40,000	2	80,000	**Yr 15 & 20**
	Geotech	4,500	7	31,500	
	Airfare	2,500	40	100,000	
	Post Closure Inpit treat.	10,000	2	20,000	**Passive treatment**
				631,500	

Subtotal	6,927,612
Contingency - 10%	692,761
Total Cost Including Contingency	7,620,373

Note: Site monitoring per INAC Guidelines every 5 years after post closure Year 10.

APPENDIX E
PRE-CONSTRUCTION SITE PHOTOS

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Photo 1: Airstrip Access Road and Airstrip Looking North

Photo 2: Airstrip Looking South. Carat Lake is at the Top of the Picture

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Photo 3: Exploration Portal Area. Carat Lake is in the Background

Photo 4: Long Lake (PKCA site) Looking Southwest