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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.

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### 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  $\leq 5 * D85$  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									
			Fill Material Type						
Structure	Geomembrane (m²)	Geotextile (m²)	Bedding	Transition	Rockfill Shell		Coarse Tailings		
			(m³)	(m <sup>s</sup> )	(m³)	(m <sup>s</sup> )	(m³)		
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%.

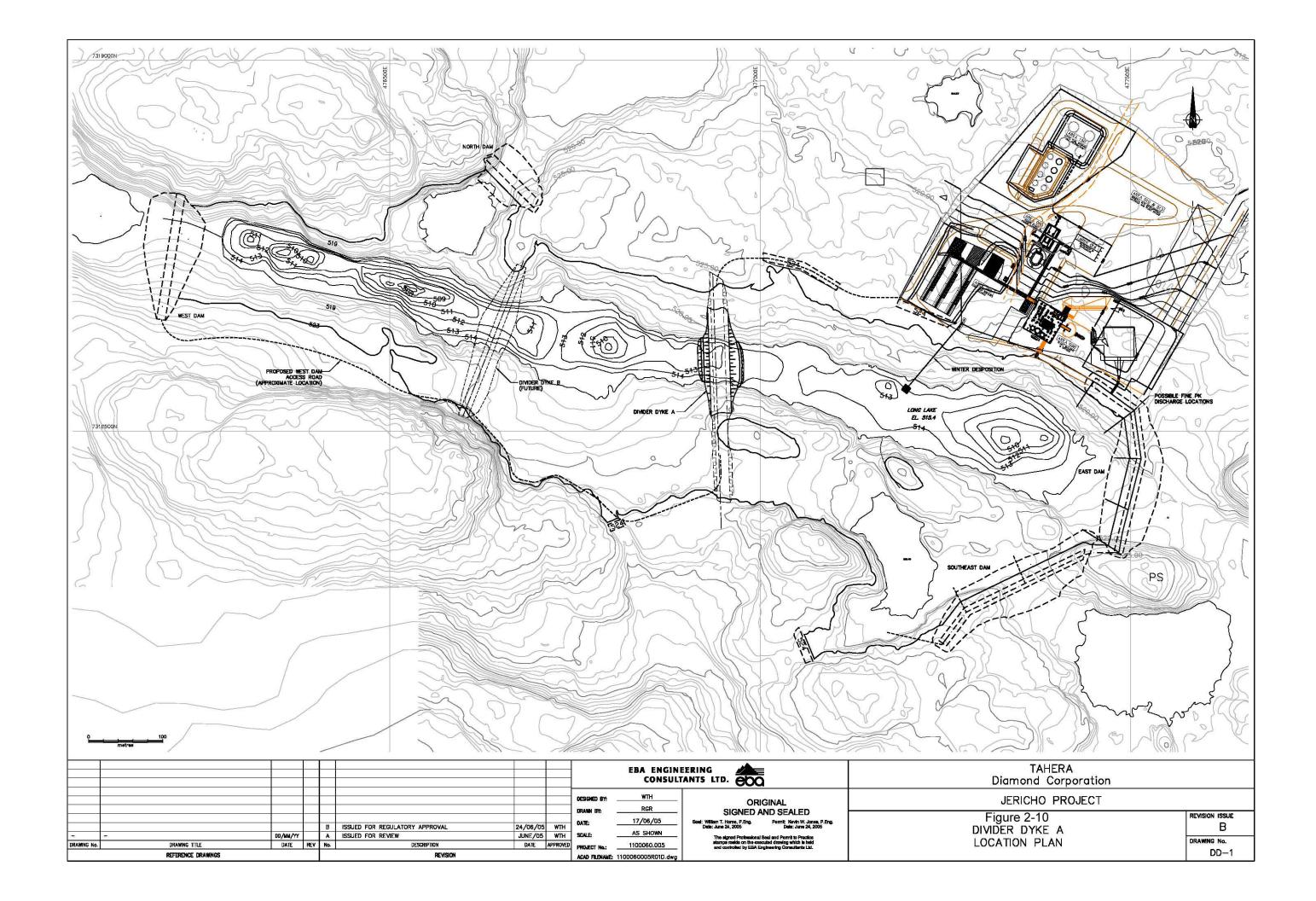
Local data suggests that the soils present in the exposed portions of Long Lake valley typically consist of granular till and colluvium. Lacustrine sediment is present on the lakebed however the deposit thickness is thin because of the small catchment area of the lake and coarse nature of the local soils. 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].

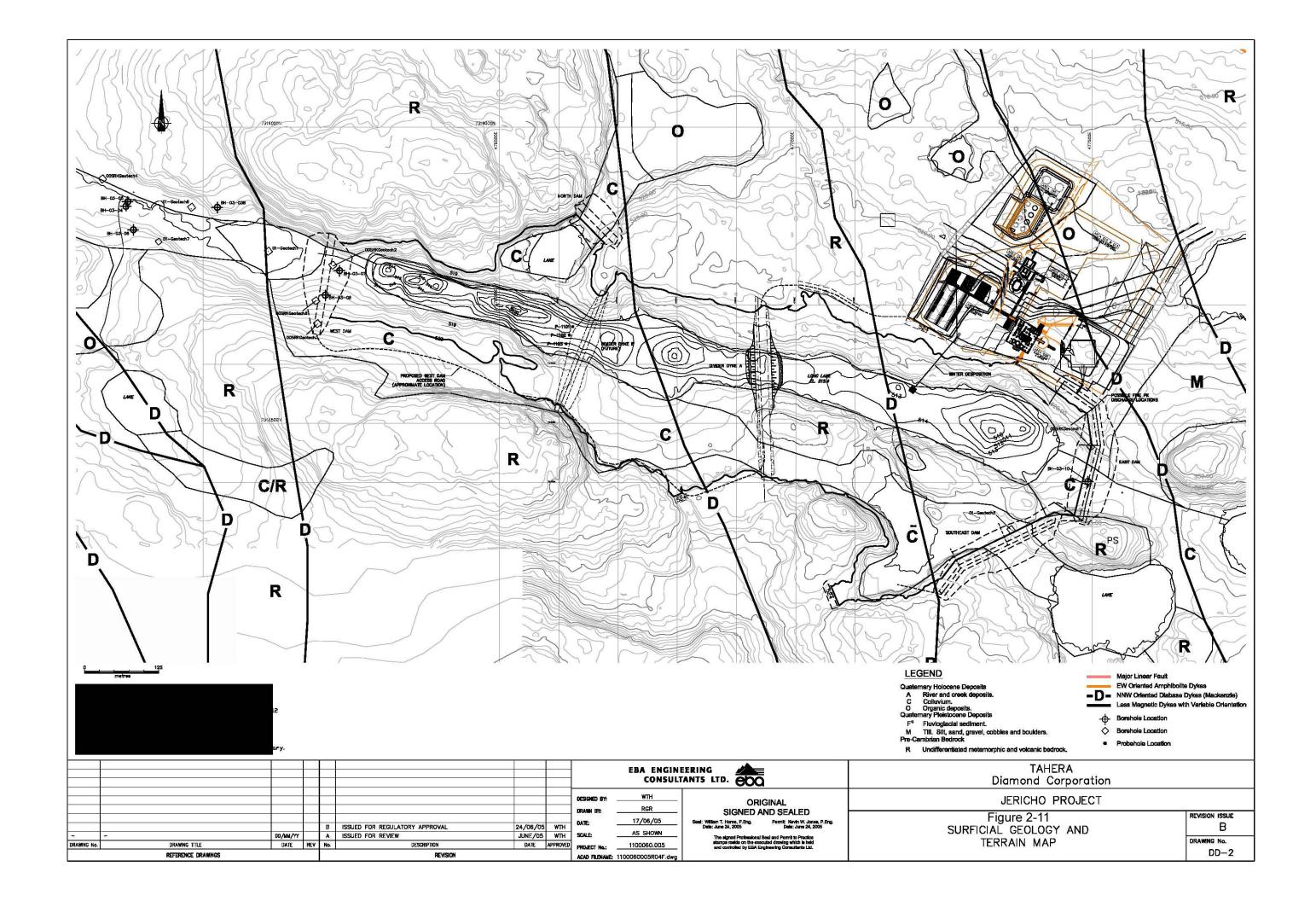
Table 2-6: Long Lake Divider Dyke Probe Results

TABLE 1
LONG LAKE DIVIDER DYKE PROBE RESULTS

	20.10 Eine Dividend in Troop Tessers					
Probe Lakebed		Solid Strata	Estimated Thickness of Soft Sediments			
Location	Elevation	Elevation	(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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# 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.

