APPENDIX III.4

WATER MANAGEMENT PLAN

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1.0 INTRODUCTION

Snap Lake Diamond Project activities such as underground mining, kimberlite processing, and camp operation will generate a volume and a quality of water that will require management. De Beers Canada Mining Inc. (De Beers) is committed to managing this water. To meet this commitment, De Beers has developed a preliminary water management plan. For the purposes of this plan, water management is defined as the collection, storage, treatment, and recycling of water generated at the project site, in a safe, efficient, and compliant manner.

This water management plan is conceptual. A detailed plan, based on final project engineering and final water licence and land use permit conditions, will be developed for each phase of the mine; construction, operation, closure, and post-closure. Subsequent detailed plans will be used to implement appropriate water management measures.

Water management planning requires a multidisciplinary understanding of water-related issues (*e.g.,* water quality, water quantity, contingency planning, environmental monitoring). Accordingly, elements of the water management plan are found throughout the environmental assessment (EA) (*e.g*., North Pile Management Plan [Appendix III.1], Emergency Response Plan [Appendix III.10], Accidents and Malfunctions [Section 13 of the EA], *etc*.). This plan outlines the proposed framework for ongoing detailed plans and refers to sections in the EA related to each discipline. Future water management plans will bring together all facets of water management into one “stand-alone” document to provide understanding of the issues and to ensure integrated management.

The water management plan contains three sections:

- a listing of water management objectives, strategies to implement objectives, and minimum water management standards;
- tabulated estimate of the water balance (gains and losses of water on site) and a brief description of each component of the water balance; and,
- an outline of the water management system.

2.0 WATER MANAGEMENT OBJECTIVES, STRATEGIES, AND STANDARDS

2.1 Objectives

The goal of water management is to minimize the impact of the Snap Lake Diamond Project on the aquatic ecosystem of Snap Lake. Based on this, there are two objectives of the water management plan:

1. to minimize the impacts of the project on the quantity of surface water; and,
2. to minimize the impacts of the project on the quality of surface and groundwater.

2.2 Strategies

The strategies to implement the objectives are listed below.

1. Minimize the impacts of the project on the quantity of surface water.

   Strategy:
   - reduce intake of fresh water from Snap Lake by recycling and reusing water to the greatest extent possible; and,
   - reduce groundwater inflow from Snap Lake and area into the underground mine to the greatest extent practical.

2. Minimize the impacts of the project on the quality of surface and groundwater.

   Strategy:
   - collect, transport, and treat minewater, camp sewage, and runoff water in contact with core project facilities;
   - manage potentially acid-generating (PAG) materials;
   - monitor quality of discharges; and,
   - adjust water treatment practices if monitoring results indicate discharge quality did not meet discharge criteria.

2.3 Standards

The following are the minimum standards that will be incorporated into water management planning:

- establish compliance with all applicable federal and Government of the Northwest Territories environmental legislation including:
  - Government of the Northwest Territories *Public Health Act and Regulations: Public Water Supply Regulations, Camp Sanitation Regulations, Eating and Drinking Places Regulations*;

  - Government of the Northwest Territories *Environmental Protection Act and Regulations*;
  - *Canadian Environmental Protection Act*;
  - *Mackenzie Valley Resource Management Act and Regulations;*
  - *Northwest Territories Waters Act*;
  - *Fisheries Act; and,*
  - *Freshwater Intake End-of-Pipe Fish Screen Guideline* (DFO 1995).
- cross-reference existing Northwest Territories guidelines relevant to water management such as:
  - *Guidelines for the Discharge of Municipal Wastewater in the Northwest Territories* (NWTWB 1992);
  - *Guidelines for Contingency Planning* (NWTWB 1987);
  - *Guidelines for Tailings Impoundment in the Northwest Territories* (NWTWB 1987); and,
  - *Guidelines for Abandonment and Restoration Planning for the Mines in the Northwest Territories* (NWTWB 1990).

3.0 WATER BALANCE

The primary information required for design of the water management plan was the water balance (*i.e.* the quantity of inflow [gains] and outflow [losses] to and from the site). Inflows will include groundwater seepage to the mine, surface runoff from various sources, and freshwater intake from Snap Lake. The groundwater entering the mine will be, proportionally, the largest inflow. Outflows will include the treated water and treated sewage discharge to Snap Lake, seepage from the north pile, the water management pond (WMP), and evaporation. Table III.4-1 lists each component and the estimated quantity of water for Year 1, 6, and 17 to 22 of mine operations. A description of each component is listed below. Section 4.0 of this plan outlines the details of how each component will be managed.

3.1 Groundwater Inflow

Hydrologic Consultants Inc. and Golder Associates Ltd. developed a computer model to predict the volume of water that will enter the underground mine for each week of operations. The model utilizes the numerical code MINEDW to solve three-dimensional groundwater flow equations. The model predicted that during construction and pre-production, water volumes entering the underground mine will be low (6,930 cubic metres per day [m^3/d]) and then, as the underground mine workings expand, the volume will gradually increase to approximately 24,000 m^3/d by Year 6 and continue near this volume until closure (Table III.4-1). The underground inflows constitute the majority of the volume of water that requires management.

Table III.4-1
Summary of Water Balance for Full-scale Mining (2005 - 2026)

Description	Year 1		Year 6		Year 17 to 22	
	Inflow [1] (m^3/d)	Outflow [1] (m^3/d)	Inflow [1] (m^3/d)	Outflow [1] (m^3/d)	Inflow [1] (m^3/d)	Outflow [1] (m^3/d)
Fresh Water from Snap Lake						
To camp (potable water)	200		200		200	
To mine (potable/industrial)	165		165		165	
To mill (potable/makeup water)	150		150		150	
Sewage treatment plant effluent		200		200		200
Used mine water to surface		165		165		165
Used process to paste		150		150		150
Totals	**515**	**515**	**515**	**515**	**515**	**515**
North Pile Internal Drainage						
PK water with paste	460		580		580	
Direct precipitation	260		500		890	
North pile dust suppression	30		30		30	
Decant to water treatment plant		190		280		610
PK pore water storage (permanent)		410		500		500
Seepage		20		50		90
Evaporation		130		280		300
Totals	**750**	**750**	**1,110**	**1,110**	**1,500**	**1,500**
North Pile External Drainage Collection						
Direct precipitation	5		40		60	
Runoff from adjacent catchments	30		140		140	
Evaporation		5		30		40
Decant to water treatment plant		30		140		140
Seepage		0		10		10
Totals	**35**	**35**	**180**	**180**	**200**	**200**
Water Management Pond						
Runoff from plant site	160		160		160	
Runoff from WMP catchment	170		170		170	
Direct precipitation	70		70		70	
Decant from north pile	0		0		330	
Evaporation		60		60		60
Seepage		30		30		30
Discharge to treatment plant		310		310		640
Totals	**400**	**400**	**400**	**400**	**730**	**730**
Water Treatment Plant						
Mine water pumped to surface	6,200		21,000		18,800	
North pile internal drainage	190		280		610	
North pile external drainage	30		140		140	
WMP decant	310		310		640	
Reclaim to process		800		800		800
Use as dust suppression		30		30		30
Treated water discharge		5,900		22,900		19,360
Sewage treatment plant effluent	200	200	200	200	200	200
Totals	6,930	6,930	21,930	23,930	20,390	20,390

[1] The inflows and outflows are estimated daily flows at the end of the given year of operation. Minewater flows are based on average annual flows.

m^3/d = cubic metres per day; WMP = water management pond; PK = processed kimberlite.

3.2 Surface Water Inflow

Water inflow on the surface is comprised of either fresh water drawn from Snap Lake, direct precipitation, and runoff from the mine site and adjacent catchments, or drainage from the north pile.

The amount of fresh water to be drawn from Snap Lake is estimated to be 515 m^3/d (Table III.4-1). The intent is to recycle water to the greatest extent practical and to reduce the amount of fresh water required.

Approximately 400 m^3/d of direct precipitation and runoff from core site facilities such as the plants, service complex, and accommodations will be routed and temporarily stored in the WMP (Table III.4-1). Direct precipitation information was gathered from federal and territorial climate records and on-site measurements. Detailed information on precipitation estimates may be found in the Section 9.3.1.3 of the EA.

Drainage from the north pile is comprised of runoff from direct precipitation, water used to suppress dust, and water decanted from the processed kimberlite (PK) (consolidation water). Drainage will be located within the north pile (internal) as well as on the outside slopes (external). The amount of drainage from the north pile will increase as the pile size increases. In Year 1 of operations, external and internal drainage from the pile is estimated at 785 m^3/d (*i.e.*, 750 + 35 m^3/d), and will increase to 1,700 m^3/d by Year 17 (Table III.4-1).

3.3 Outflow

The majority of water inflows on site will be collected, transported, treated, and released to Snap Lake. Thus, volumes of inflow will approximate outflow. The reductions to the outflow include seepage from the north pile and the WMP, recycling and reuse of water, and evaporation. Seepage and volume of recycled water that is re-used will be monitored. Evaporation of water from the north pile, sumps, collection ponds, and the WMP were estimated based on climate information discussed in the North Pile Development Plan (Appendix III.1) and Section 9.3.1.3 of the EA. Seepage of water from the north pile and the WMP were estimated based on bedrock permeability conditions, seepage analyses under thawed conditions, and thermal modelling. These are discussed further in Appendix III.1, Section 5.5.

4.0 WATER MANAGEMENT SYSTEM

The water management system is the infrastructure and practices that are designed to physically manage water. The design of the system is founded on the water management objectives, strategies, and standards and based on environmental and engineering considerations. Contingencies for unexpected events and emergencies will be built into the system (also see Appendix III.9 and Appendix III.10).

The water management system is straightforward:

- fresh water will be drawn from Snap Lake and piped to a storage location where it will be treated with chlorine and then distributed to camp facilities;
- seepage into the mine workings, runoff from the north pile and surface water in contact with core site facilities will be collected in sumps, ponds and ditches, and transported via pipeline to a water treatment plant;
- a water treatment plant will be installed on site to ensure water released to Snap Lake meets discharge targets;
- treated water will be recycled and reused to the greatest extent possible for process water, dust suppression on roads, airstrip and the north pile; and,
- sewage will be treated and liquid effluent will be released to Snap Lake in the same discharge pipe as the water treatment plant effluent.

The component and practices of water management system vary with each phase of the project. An outline of the system during each phase of the project will be described in detail following the description of the supply and distribution of water. The supply and distribution will be discussed separately since they remain consistent regardless of the phase of the project.

4.1 Water Supply and Distribution

Fresh water will be drawn from the north arm of Snap Lake. The estimated volume of water to be drawn from Snap Lake at the intake is 515 m^3/d (Table III.4-1). This is a conservative estimate; recycling of water should reduce the volume of fresh water required. Fresh water will be used as:

- potable water;
- process plant “makeup” water;
- fire suppression; and,
- dust suppression (initial construction only).

The freshwater intake and pump house will be located on the north shore of the northwest peninsula (Figure 3.1-4). The intake will consist of vertical filtration wells fitted with vertical turbine pumps that supply water on demand. The intake will be connected to the pump house with piping buried under a rock-filled embankment. The embankment will be constructed out from the shore to a depth of 7 metres (m) and will impact 810 square metres of lake-bottom. The embankment fill material will be composed of washed, not potentially acid-generating (non-PAG) granite and will be less than 600 millimetres in size. The water intake will not need to be screened to prevent fish entrainment because the rock filled embankment will act as a screen. Intake velocities will be below the federal regulatory criteria for the operation of water intakes. Maintenance of the intake will be minimal because of the absence of screens, which are typically the most labour intensive component of the intake. Maintenance will be limited to mechanical work on the pumps and accessories as required by the manufacturer.

Fresh water will be pumped via the main overland pipeline to the freshwater storage tank in the process plant. The pipeline will consist of insulated and heat-traced, high-density polyethylene pipe, buried under gravel fill adjacent to the service road. Water in the process plant will be used as “makeup” water for the processing of kimberlite (*i.e.,* water needed to “make up” for the volumes lost in the paste discharge from the plant) and for fire suppression. Water for fire suppression will be pumped from the storage tank through a pressurized system to adjacent areas of the process plant and to the accommodations, service complexes, power and water treatment plants, and the utilidors. The volume of water and duration of flow in the pressurized system will be standardized to national fire codes. An adequate volume of water will be maintained in the tank to ensure availability of water in the event of a fire.

Fresh water will be pumped from the process plant by overland pipeline to the potable water treatment plant. Water will be chlorinated and stored in a storage tank in the potable water treatment plant. Potable water will be sampled monthly to ensure it meets Northwest Territories health regulations for total and residual chlorine and microbiological parameters. Treated water will be piped back to areas in the process plant requiring potable water and to the accommodations and service complexes. Insulated and heat-traced pipes will be used to distribute water through the utilidors between the plants, service complex, and the camp. Potable water will be trucked to washrooms in the underground mine as needed.

4.2 Water Management System and Activities - Construction

The first water-management activity will be the mobilization and installation of a small-scale water treatment plant in 2003. The plant will consist of filtration components. Water will be pumped via pipeline out of the existing underground workings developed during the advanced exploration program (AEP) either directly to the treatment facility or to the WMP. Water from the AEP that is currently stored in the WMP will also be treated.

Water will be routed to the water treatment plant via overland pipes and filtered. Filtered solids from the water treatment plant will be collected and deposited in the WMP. Once the starter cell in north pile is constructed, filtered solids will be disposed of in the north pile. Treated water will be discharged to Snap Lake through a floating pipeline. The pipeline will be weighted at the end to reduce movement of the pipeline due to wind/waves and ice scour. A three-way diffuser will be installed at the end of the pipe. The diffuser will direct the discharge into multiple directions and increase mixing of effluent with Snap Lake water. The discharge location will be approximately 10-m deep, an adequate depth to prevent scour of lake-bottom sediments.

During the mine development period of 2003 to 2005, approximately 200,000 tonnes (t) of ore will be stockpiled on the surface adjacent to the mine portal and crushing facility. This ore will be crushed on surface and will be processed in the existing process plant and in the full-scale process plant once commissioned in 2005. The processing of the ore will be part of ongoing test work to refine process methods. Runoff from the stockpile along with other plant complex runoff will be directed through grading and ditches to the WMP and then to the water treatment plant prior to discharge to Snap Lake.

Performance of the water treatment plant will be optimized by comparison of the quality of water before and after treatment. Monitoring will occur at the discharge location and in other areas of Snap Lake. The monitoring program will be finalized in conjunction with water licence conditions and engineering recommendations related to the water treatment plant.

During the initial construction period, water for dust suppression on roads, airstrip and lay-down areas will be trucked directly from Snap Lake. Once the water treatment system is operational, water for dust suppression will be drawn from the pipeline that will discharge treated water to Snap Lake. During maintenance or upset conditions in the water treatment plant, water for dust suppression will be drawn from Snap Lake.

4.3 Water Management System and Activities – Operations

4.3.1 Water in the Mine – Quantity

The volume of water entering the underground workings will increase over time as more underground areas are exposed. To reduce the volume of water entering the mine, grout (cement compounds) will be injected into fractures and drill holes in the underground walls.

The volume of inflow to the mine will be recorded by meters and the observed flow will be compared with the predicted flow from the hydrological model. Periodically, the observed flows will be entered into the model and the model will be rerun to update predictions of future inflows. The updated predictions will be used to refine management actions appropriate to the expected volumes.

Water entering the active area of the mine and water seeping from inactive areas will be routed by ditches to a series of sumps. Temporary sumps will be developed in working areas that will allow initial settlement of coarse suspended solids from the water. From the temporary sumps, water will be directed through a combination of ditches, drain holes, and pipelines to main sumps equipped with multiple storage areas and pumps to direct water to the surface. Pipelines from the pumps will be routed along footwall drifts and up the conveyor incline to the surface and to the water treatment plant. Under upset conditions in the water treatment plant, water will be directed to the WMP.

Three pipelines will route sump water to the surface. The redundancy in the number of pipelines will provide the flexibility needed to handle the anticipated variation in flow over time. In the event of electrical or mechanical failures, pumps may be non-functional and flooding of sumps could result. To address this, a limited amount of storage capacity will be provided underground to prevent flooding of sumps and working areas.

During the pre-production period there will be two main sumps. They will be located adjacent to the north ramp and the south ramp and will be developed on the 190 level (Figure 3.3-1). As production proceeds and the mine expands, additional sumps and pump installations will be established on lower levels.

4.3.2 Water in the Mine - Quality

As water travels from the walls to the floor and ultimately the sumps, it will pick up residual explosives, grout, fine sediment, and cement materials. Coarse material suspended in the water will settle in the sumps, and will be removed and disposed of in inactive areas of the mine. Fine sediment remaining in the decanted water that will be sent to surface will be removed in the water treatment plant. For more information on the quality of water in the mine, refer to Appendix IX.1, and Section 9.2 of the EA.

Oil and grease from used explosives, accidental spills, or vehicle leaks will also collect in the sumps. Oil and grease will be skimmed from the sumps, brought to surface, and put in an oil-water separator located in the service complex. Once separated, the oil and grease will be burned in a waste-oil furnace and the water will be placed in the WMP for treatment.

4.3.3 Surface Water – Site Runoff

While there are no defined streams in the core facilities area, there are natural drainage areas that will be re-contoured in order to construct site facilities. Rockfill ditches and grading will direct the runoff from the re-contoured areas towards the WMP. Runoff water will be treated and discharged to Snap Lake.

Sedimentation traps will collect sediment generated from runoff in outlying areas such as access roads, the airstrip, ammonium nitrate storage, and the explosives manufacturing plant. The traps will be located at points of runoff concentration where overflow water will be allowed to flow to adjacent watercourses. Solids in the traps will be periodically removed and placed in the landfill. Any major spills on roads and the airstrip will be contained, collected, and remediated as described in the Spill Contingency Plan (Appendix III.9).

4.3.4 Surface Water - North Pile

The primary waste product from mine operations will be PK. After extraction of the diamonds in the process plant, the PK and the water used in processing will have combined to form a slurry-like product. The bulk of the water in the slurry will be removed by passing the slurry through a thickener. Water decanted from the thickener will be recycled and reused in the process plant or directed to the water treatment plant prior to discharge to Snap Lake. The de-watered PK will be sent to the paste plant where coarse PK will be added until it reaches a toothpaste-like consistency (73% solids). The paste will then be pumped to the underground as backfill or to the surface containment area (north pile).

The north pile is the surface containment facility for 12.1 mega tonnes (Mt) of PK and 175,000 t of PAG rock. It will also contain the landfill, land farm, and three granite quarries. Due to the size of the north pile and the multiple sources of waste (PK, PAG rock, non-hazardous waste, *etc.*), the north pile will require its own water management system that will feed to the site-wide management system.

Surface water related to the north pile is categorized in two ways: non-contact water and contact water. Non-contact water is water such as precipitation outside the north pile footprint that will not contact the north pile. Non-contact water will be directed away from the north pile footprint towards natural or re-contoured drainage courses and allowed to flow to Snap Lake without treatment. Contact water includes water in direct contact with the north pile and includes runoff (internal and external), seepage, and dust suppression water. On an annual basis, the amount of contact water will be approximately 5% of the total treated discharge to Snap Lake. The main features of the management system for contact water are discussed in detail in Appendix III.1 and are briefly outlined below.

4.3.4.1 Internal System

Three temporary collection ponds will be constructed within the north pile to collect consolidation water from PK, flush water from PK distribution pipelines, drainage water from PAG materials, and dust suppression water (Appendix III.1). The ponds will collect and store water during seasonal surges. They will also allow suspended solids in the water to settle-out and thus reduce the sediment load to the WMP. The ponds will be active at various periods during development and will move within the north pile as north pile development proceeds (see Appendix III.1).

Temporary collection pond 1 will be located within the starter cell and will hold approximately 25,000 m^3. Temporary collection pond 2 will be near the quarries and will hold approximately 200,000 m^3. Temporary collection pond 3 will be located in the west cell and will hold approximately 35,000 m^3. Water from the ponds will be pumped via overland pipelines to external ponds. A pond will be de-watered and filled with PK when an area of the north pile is reclaimed and the pond is no longer needed.

4.3.4.2 External System

Ditches around the perimeter of the north pile will direct and collect runoff from the outside slopes of the north pile and will intercept seepage from the northern toe and near surface of the north pile. The ditches will direct water to three external sedimentation ponds to be developed from two natural ponds and one wetland around the exterior of the north pile. These ponds do not contain fish and have no direct connection to Snap Lake (Section 9.5.1.5 of the EA). Sedimentation ponds 1, 2, and 3 will provide sediment control and will provide a storage space of 63,000, 40,000, and 8,000 m^3 respectively. Two additional sumps will be constructed on the north side of the north pile to control sediment. They will be lined to prevent seepage to Snap Lake.

Water will be directed through the ditches to ponds and sumps, then to the water treatment plant. After treatment, water will be discharged to Snap Lake. In the event of seasonal surges in runoff, during maintenance periods, or during upset conditions in the water treatment plant, water from the north pile external system will be temporarily directed to the WMP prior to treatment.

The water collection ponds, sumps, and pumps will be sized to handle the maximum volume of the 100-year 24-hour storm event or the 1-in-100-wet-year snowmelt. Preliminary calculations indicate that the system will be able to handle a 1-in-20-year snowmelt with all melt occurring in one month. Ditches will be sized to handle flow resulting from a 1-in-100-year, 24-hour storm event.

Ditches on the south side of the north pile will be 0.5-m deep and will have at least 0.2 m of freeboard. Ditches on the north side of the north pile will be approximately 1-m wide and 2-m deep and will have 1 m of freeboard. They will be lined with a geosynthetic clay liner on the downstream side of the ditch to reduce seepage losses to Snap Lake. Additional seepage control measures, such as grouting of pervious fractured rock zones, may be required if such zones are encountered. The partial lining of ditches and complete lining of sumps will reduce estimated seepage by approximately 90% (from approximately 350 m^3/d to 35 m^3/d).

Runoff collected in the internal and external systems will contain runoff from landfill, land-farm, and granite quarries, as these areas will be within the footprint of the north pile. The landfill will contain only inert solid waste and any runoff will be routed to the external system via pumping and pipelines and then to the water treatment plant. The land-farm will be fully lined and runoff from the land-farm is not anticipated. However, in the event excess oily water is encountered, it will be collected and taken to an oil-water separator at the service complex.

Water for dust suppression on the uncapped areas of the pile will be drawn from the water treatment plant at a rate of 55 m^3/d for six months per year. In winter, water may be sprayed on the pile to form thin sheets of ice that will reduce dust generation. If water quality is suitable, water may also be drawn directly from exterior collection ponds.

4.4 Water Treatment and Discharge to Snap Lake

4.4.1 Water Management Pond

During the AEP, water from the underground workings and PK were stored in the processed kimberlite containment (PKC) facility. During operation of the mine, the PKC will be utilized to receive and temporarily store seasonal surges in surface runoff and north pile runoff. The PKC has been renamed the “water management pond” (WMP as defined earlier) because of its revised function.

As noted above, the WMP will receive and temporarily store water from surface runoff. However, it may receive runoff from the north pile and water from the mine during maintenance or upset conditions in the water treatment plant when the plant cannot accept the flows directly.

The WMP and the internal and external collection ponds of the north pile will be drawn down during the summer months to maintain storage capacity for seasonal surges. During the first years of operation, the WMP will be capable of handling seasonal fluctuations in water level from extreme wet year conditions as well as expected and possible upper bound flows from the underground. As underground flows increase, dam 1 and dam 2 will need to be raised by 2 m each to increase storage capacity in the WMP. This may occur in year 2 but exact timing will depend on the observed inflows.

During the AEP, thermistors and piezometers were installed to monitor for seepage around the former PKC. Seepage was not detected. Monitoring of potential seepage areas will continue throughout construction and operation. Theoretically, seepage from the WMP is estimated to be 10 to 30 m^3/d; the amount of potential seepage will increase if the dams are raised.

4.4.2 Sewage Treatment Plant

Fresh water from Snap Lake (200 m^3/d) will be used for domestic potable water consumption. After use, sewage water will be collected in pipelines and directed for treatment to a sewage treatment plant. The sewage treatment plant will be part of the plant and camp complex. It will use sequencing batch reactor (SBR) technology (similar to the plant in use for the AEP). Because it will be a modular system, the SBR size will be modified as camp volume dictates.

The treated discharge will be combined with the discharge from the water treatment plant. The total liquid discharge from the sewage treatment plant will be approximately 200 m^3/d. The sludge from the sewage treatment plant will be incinerated and placed in the landfill.

Sewage discharge quality will be monitored. Parameters such as dissolved oxygen, pH, total suspended solids (TSS), temperature, and biological oxygen demand will be monitored in the plant to ensure the plant is operating appropriately.

4.4.3 Water Treatment Plant

Pilot plant test work showed that removal of suspended solids from minewater and surface runoff will result in water suitable for discharge. Based on the test work, the proposed full-scale water treatment plant will consist of a screened water feed, thickener, filter feed tank, and a bank of four filter units. It will remove TSS to a concentration of 5 milligrams per litre (mg/L).

The first module of the full-scale water treatment plant, with a capacity of 20,000 m^3/d, will be completed during 2004, and include the filtration components mobilized for initial construction phase water treatment in 2003. The plant will be modular so that the size of plant can be easily expanded to accommodate the expected increases in underground inflow.

Minewater will feed through screens to a cone-shaped thickener in the water treatment plant. The water from the thickener (known as the overflow) will be sent to the filter feed tank and then filtered. Solids (known as the underflow) will be removed and sent to the deep-cone thickener in the process plant. Then, they will be disposed of underground or in the north pile. Filtered water will be released to Snap Lake provided it meets discharge criteria. Systems for adding flocculent and coagulant will be installed at the outset in case to provide additional removal of solids if required.

Runoff from the north pile and site facilities will be sent directly to the filter feed tank since suspended solids levels will be low. There will, however, be capacity to direct this runoff directly to the thickener in the water treatment plant should elevated solids levels be detected. Solids from the filter (backwash) will be sent to the north pile.

Monitoring of water quality in the water treatment plant before and during discharge, as well as in Snap Lake at and away from the discharge location will be conducted. The monitoring program will be finalized in conjunction with water licence conditions and water treatment plant engineering recommendations.

Should plant operation show that solids removal alone is inadequate to achieve discharge targets ("worst-case" scenario), the water treatment plant would be upgraded to include a high-density sludge (HDS) system. The HDS plant would use conventional ferric co-precipitation with lime neutralization and possibly hydrogen peroxide (Section 2.0 of the EA). The plant may include precipitation reactors, a clarifier, and filters (refer to Appendix IX.8 of the EA for information on water quality and aquatic toxicity work related to water treatment options).

4.4.4 Discharge to Snap Lake

The discharge from the water treatment plant will be combined with the discharge from the sewage treatment plant and piped to Snap Lake. The pipeline will be installed and anchored to the bottom of Snap Lake at a depth of 10 to 12 m. The portion of the pipe in shallow water will be armoured to protect it from wind and wave action and ice scour.

A submerged, multi-port diffuser will be installed at the end of the pipe. The diffuser will have multiple vertical ports that can be adjusted to accommodate the variable flow rates that are expected. The ports will direct discharge vertically to maximize initial mixing of effluent with Snap Lake water. The diffuser will be elevated off of the lake bottom, and will direct water away from lake-bottom sediments to prevent scour.

4.5 Water Management System and Activities – Closure

At closure, water management will continue until water quality of surface runoff from core facilities and the reclaimed north pile can be discharged without treatment without impacting water quality in Snap Lake. Specific details on the Decommission and Reclamation Plan are found in Appendix III.11.

The north pile will be progressively capped with granite throughout the mine life. Final closure is planned to result in a landform and drainage patterns generally similar to the surrounding terrain. Runoff water from reclaimed surfaces will not require treatment. Monitoring will be carried out to confirm this. Accordingly, runoff from reclaimed parts of the north pile that meet discharge criteria would be allowed to drain into Snap Lake. In the post-closure period all pile runoff will report to Snap Lake via multiple drainage pathways.

The WMP dams will be de-commissioned after requirements to store water requiring treatment have been met. The dams will be breached and the impoundment re-contoured to resemble a lake. A stabilizing cap of inert granular material will be placed over the sediments in the WMP to provide erosion-protection prior to allowing the pond to refill with water.

5.0 REFERENCES

Department of Fisheries and Oceans. 1995. Freshwater Intake End-of-Pipe Fish Screen Guideline. Ottawa. 27p.

Northwest Territories Water Board. 1987. Guidelines for Contingency Planning. Yellowknife, Northwest Territories.

Northwest Territories Water Board. 1990. Guidelines for Abandonment and Restoration Planning for the Mines in the Northwest Territories. Yellowknife, Northwest Territories.

Northwest Territories Water Board. 1992. Guidelines for the Discharge of Municipal Wastewater in the Northwest Territories. Yellowknife, Northwest Territories.

Northwest Territories Water Board. 1987. Guidelines for Tailings Impoundment in the Northwest Territories.

6.0 UNITS AND ACRONYMS

UNITS

m	metres
m^3/d	cubic metres per day
mg/L	milligrams per litre
Mt	mega tonne
t	tonnes

ACRONYMS

AEP	advanced exploration program
De Beers	De Beers Canada Mining Inc.
EA	environmental assessment
HDS	high-density sludge
non-PAG	not potentially acid-generating
PAG	potentially acid-generating
PK	processed kimberlite
PKC	processed kimberlite containment
SBR	sequencing batch reactor
TSS	total suspended solids
WMP	water management pond