DE BEERS
CANADA
SNAP LAKE MINE

June 7, 2010

File: L020

Willard Hagen, Chair
Mackenzie Valley Land and Water Board
PO Box 2130
Yellowknife, Northwest Territories
X1A 2P6

Dear: Mr. Hagen:

Re: Snap Lake Mine
De Beers Canada Inc
Water Management Plan Submission for Water License #MV2001L2-0002

De Beers Canada Inc. (De Beers) would like to submit, for approval, to the Mackenzie Valley Land and Water Board (the Board) the updated Water Management Plan for Water License MV2001L2-0002.

Should you have any questions, comments or require further clarification, please don't hesitate to contact me at 767-8626 or e-mail me at the following address: Jason.Ash@ca.debeersgroup.com.

Sincerely,
DE BEERS CANADA INC.

Jason Ash
Permitting and Environmental Superintendent
Snap Lake Mine

Attachments

Copied to: S. Hayden (MVLWB)
B. Corrigan, D. McCallum (DBCI)
File

June 2010

WATER MANAGEMENT PLAN

De Beers
Canada
SNAP LAKE MINE

De Beers Snap Lake Mine

Water Management Plan

June, 2010

De Beers Canada Mining Inc.

Document History

Date	Revision	Description of Change
August 2004	Rev 1.0	Original Document
March 2005	Rev 1.1	MVLWB approved document for Construction
August 2009	Rev 2.0	Document for Operations
June 2010	Rev 2.1	Document for Operations

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UNITS

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

ACRONYMS

AEP	advanced exploration program
BSP	bulk sample plant
EAR	environmental assessment report
HDS	high-density sludge
non-PAG	not potentially acid-generating
PAG	potentially acid-generating
PK	processed kimberlite
PKC	processed kimberlite containment
PWTP	potable water treatment plant
SBR	sequencing batch reactor
SNP	surveillance network program
STP	sewage treatment plant
TSS	total suspended solids
WMP	water management pond
WTP	water treatment plant

1 INTRODUCTION

1.1 BACKGROUND

De Beers Canada Inc. (De Beers) owns and operates the Snap Lake Mine located approximately 220 kilometres North-East of Yellowknife, Northwest Territories, 30 km South of MacKay Lake, and 100 km South of Lac de Gras where the Diavik Diamond Mine, and the Ekati Diamond Mine are located (Figure 1-1).

An Environmental Assessment Report (EAR) for the proposed mine (De Beers 2002) was completed and submitted to the Mackenzie Valley Environmental Impact Review Board (MVEIRB) in February 2002. MVEIRB in turn completed a review, and recommended that the Mine proceed subject to the implementation of measures to mitigate environmental impacts (MVEIRB 2003). MVEIRB's Environmental Assessment Report was submitted to the Minister of Indian and Northern Affairs Canada in July 2003 and received Ministerial approval in October 2003. In 2004, De Beers received the necessary Water Licence, Land Use Permit, Land Leases, and Environmental Agreement to begin construction and operation of the Mine.

1.2 PURPOSE

The purpose of the Snap Lake Mine Water Management Plan (the Plan) is to provide a description of the management and design of water systems at the Snap Lake mine site. The plan describes water management activities during the operational phase, which commenced in 2008 and will continue through to closure. The Plan applies to full-scale operations.

The Plan updates prior water management information presented in the EAR for the Project (De Beers 2002). The update of the Plan will incorporate changes to the water management facilities and will take into account the most recent information available. The Plan is intended to complement other related documents, including the Aquatic Effects Monitoring Plan (De Beers 2006), Ore Storage, Waste Rock and Processed Kimberlite Management Plan (De Beers 2010), Spill Contingency Plan (De Beers 2010) and Domestic Waste and Sewage Management Plan (De Beers 2010).

1.3 REGULATORY HISTORY OF THE PLAN

The Plan was submitted to the MVLWB in August 2004 as required under Water License MV2001L2-0002 Part F Condition 4, for the Construction Phase. The Plan was revised and resubmitted in March 2005 for the Construction Phase. In August 2009, the Plan was revised for the Production Phase of the mine. On February 5, 2010 the MVLWB denied approval of the Plan requiring De Beers to resubmit the Plan on March 5, 2010. On March 1, 2010 De Beers requested an extension till June 5, 2010 to resubmit the Plan. The extension was granted on March 16, 2010.

Comments on the Plan received in late 2009 from various stakeholders have been addressed where possible and incorporated in this submission.

De Beers hereby resubmits this Water Management Plan to fulfil requirements of the Water Licence, MV2001L2-0002.

1.4 OVERVIEW

Mine activities during the operational phase program will include camp operation, underground mining, and milling kimberlite. These activities will require management of water quantity and quality to prevent adverse environmental effects. De Beers is committed to managing this water, and the Plan has been developed to meet the requirement of Water Licence MV2001L2-0002. For the purposes of the Plan, water management is defined as the collection, storage, treatment, and recycling of water at the mine site, in a safe, efficient, and compliant manner.

The water management system comprises the infrastructure and practices that are designed to manage water quantity and quality. The system design is founded on the water management objectives, strategies, and standards based on environmental and engineering principles. Contingencies for unexpected events and emergencies are built into the system and are described in the Plan, based on the Spill Contingency Plan (De Beers 2008). The water management system can be divided into two parts:

- The core facilities system contains facilities for water supply, potable water treatment and distribution, sewage collection and treatment; and
- The mine water system contains facilities for collection and conveyance of surface water runoff and of groundwater seepage into the underground mine workings, for storage and treatment of this water and for the return of treated effluent to Snap Lake.

The Plan for the operational phase will consider process water management.

The Plan contains four sections:

- a discussion of water management objectives, strategies to implement objectives, minimum water management standards, and roles and responsibilities;
- presentation of a water balance to describe inflows, outflows and internal water transfers related to project activities;
- a description of the management of core facilities water systems, including raw water and fire suppression water supply, potable water treatment, and sewage treatment and discharge; and
- a description of the management of mine water systems, including underground mine dewatering, North Pile Starter Cell drainage, Water Management Pond, Water Treatment Plant and discharge.

2 OBJECTIVES, STRATEGY, STANDARDS, ROLES AND RESPONSIBILITIES

2.1 OBJECTIVES

The goal of water management is to minimize the impact of the Mine on aquatic ecosystems including Snap Lake. Based on this, the two primary objectives of the water management plan are:

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

2.2 STRATEGIES

The strategies to implement the objectives are listed below:

1. Strategy to minimize the impacts of the Mine on the quantity of surface water:
   - reduce need for 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. Strategy to minimize the impacts of the Mine on the quality of surface and groundwater:
   - collect, transport, and treat minewater, camp domestic effluents, and runoff water in contact with core project facilities;
   - manage potentially acid-generating (PAG) materials;
   - monitor quality of discharges; and
   - adjust water management or treatment practices if monitoring results indicate that discharge quality do not meet discharge criteria.

2.3 STANDARDS AND SURVEILLANCE

The Water Management Plan will incorporate all necessary measures and procedures to comply with the requirements of Water Licence #MV2001L2-0002. A Surveillance Network Program (SNP) has been established to satisfy water licence requirements, and locations of mine site SNP stations are shown on Figure 2 in Appendix A. Specific requirements and standards for water monitoring and compliance include the following:

- *The total quantity of fresh water drawn from Snap Lake and used by the Mine shall not exceed 188,000 cubic meters annually (Ref. Water Licence #MV2001L2-0002, Part F, Item 1).*
- *All discharges to Snap Lake by the Licensee from the Water Treatment Plant (WTP) and Sewage Treatment Plant (STP) at SNP Station Number 02-17 shall meet the following effluent quality criteria (Ref. Water Licence #MV2001L2-0002, Part F, Item 9):*

Parameter	Maximum Concentration of any Grab Sample	Average Monthly Limit	Average Annual Loading
Total Suspended Solids	14 mg/L	7 mg/L	n/a
Ammonia (NH_3-N)	20 mg/L	n/a(a)	187,000 kg/yr
Nitrite (NO_3-N)	2.0 mg/L	1 mg/L	n/a(b)
Nitrate (NO_2-N)	56 mg/L	28 mg/L	219,000 kg/yr
Aluminum	2 mg/L	1 mg/L	n/a
Arsenic	0.040 mg/L	0.020 mg/L	n/a
Cadmium	0.002 mg/L	0.001 mg/L	n/a
Chromium	0.040 mg/L	0.020 mg/L	n/a
Copper	0.020 mg/L	0.010 mg/L	n/a
Nickel	0.100 mg/L	0.050 mg/L	n/a
Lead	0.009 mg/L	0.005 mg/L	n/a
Zinc	0.020 mg/L	0.010 mg/L	n/a

- *Total phosphorus loads from the WTP and STP discharging to Snap Lake must be controlled, as per approved operations plans, such that loads of total phosphorus does not exceed an annual loading of 256 kg per year in any calendar year during the life of the Project (Ref. Water Licence #MV2001L2-0002, Part F, Item 10).*

- *The calculated whole lake average of TDS at sampling locations comprising SNP Station Number 02-18 shall remain below 350 mg/L at all times (Ref. Water Licence #MV2001L2-0002, Part F, Item 11).*
- *Discharge from the STP shall be tested prior to mixing with the effluent from the WTP at SNP Station Number 02-16i and will meet the following effluent quality requirements (Ref. Water Licence #MV2001L2-0002, Part F, Item 15):*

Parameter	Maximum Concentration of any Grab Sample	Average Monthly Limit
BOD_5	25.0 mg/L	15.0 mg/L
Oil and Grease	5.0 mg/L	3.0 mg/L
Faecal Coliforms	20 CFU/100mL	10 CFU/100mL

- *The monthly average limit for Extractable Petroleum Hydrocarbons in the final effluent shall be 4.6 mg/L for F1 and 2.1 mg/L for F2 and the discharge shall be managed to prevent the appearance of any visible film from the discharge on the surface of Snap Lake in the vicinity of the outfall (Ref. Water Licence #MV2001L2-0002, Part F, Item 16).*
- *All discharges to the environment shall have a pH between 6.0 and 9.0, except surface runoff which shall have a pH between 5.0 and 9.0 (Ref. Water Licence #MV2001L2-0002, Part F, Item 17).*

The SNP includes a number of sampling stations on the mine site that are not explicitly referenced in the Water Licence. The locations of mine site SNP stations are shown on Figure 2 in Appendix A, and are discussed in Table 2-1.

Table 2-1 Summary of SNP Sampling Stations

SNP Station	Location	Medium	Frequency: Cont.	Daily	Weekly	Monthly	Quarterly	Annually	Other	Comments	Parameters
02-01	Final mine water collection sump	Mine Water (Effluent)	X								Package 1
					X						pH, turbidity, TDS, chloride, TSS, total ammonia, calcium
						X					Package 2
				X							Volume of water pumped
02-02	North Pile drainage collection ditch	Runoff (Effluent)	X								Package 1
					X					During spring freshet and heavy rainfall	TSS and turbidity
						X					Package 2
				X							Volume of water pumped
02-03 Inactive Station	Core facilities area collection ditch near Water Management Pond	Runoff (Effluent)	X								Package 1
					X					During spring freshet and heavy rainfall	TSS and turbidity
						X					Package 2
				X							Volume of water pumped
02-04	Uncontrolled surface runoff at culvert by Airstrip	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-05	Uncontrolled surface runoff at Bulk Sample Mine Rock Pad	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-06	Uncontrolled surface runoff at Quarry Site	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-07	Uncontrolled surface runoff at Road to Bulk Emulsion Plant	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-08	Uncontrolled surface runoff at Winter Access Road	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-09	Uncontrolled surface runoff at Emulsion Plant Area	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-10	Any other points where flow to Snap Lake or IL5 is observed	Runoff (Effluent)							X	Twice per week during spring freshet	Package 3
				X						Daily during heavy rainfall events	Package 3
02-11	Seepage well down gradient from Dam 1 near Snap Lake shoreline	Seepage (Water)				X			X	Whenever water present during WQ sampling	Water levels
							X			When water present	Package 2
02-12	Seepage well down gradient from Dam 2 at Water Management Pond	Seepage (Water)				X			X	Whenever water present during WQ sampling	Water levels
							X			When water present	Package 2
02-13	Seepage well down gradient from Dam 1 at Water Management Pond	Seepage (Water)				X			X	Whenever water present during WQ sampling	Water levels
							X			When water present	Package 2
02-14	Water Management Pond (stilling well near pumphouse)	Water							X	Immediately prior to pumping any water into the Water Management Pond	Package 2
			X								Flow (during pumping to WTP)
					X					During pumping	Package 2
							X				Package 2
				X							Volume of water pumped
02-15	Water Intake from Snap Lake	Water				X					E. coli, major ions, nitrate, TDS
							X				Microbial pathogens (*Giardia*, *Cryptosporidium* and total heterotrophic plate count)
								X			Package 2 minus total extractable hydrocarbons
				X							Volume of water pumped
02-16i	Sewage Discharge from STP prior to mixing with WTP effluent	Effluent	X								Package 1
									X	Every 6 days	BOD, nutrients, total oil and grease, TSS, E. coli / faecal coliforms
								X			ICP-MS metal scan (total and dissolved), total mercury, total arsenic
				X							Volume of water pumped
02-17	Final combined WTP and STP effluent	Effluent	X								Package 1
									X	Every 6 days	TDS, nutrients, TSS, turbidity, conductivity, chloride, calcium
						X					Package 2 plus E. coli / faecal coliforms, total oil and grease
							X				Acute lethality to rainbow trout and *Daphnia magna*, chronic toxicity to *Daphnia magna* and *Selenastrum capricornutum*
				X							Volume of water discharged from combined outfall from WTP and STP to Snap Lake
02-18	Whole lake TDS, Ca, Cl (several sites in Snap Lake basin)	Lake Water (Water)							X	Twice during ice-free period (late summer and prior to ice-up) and twice under ice cover (early winter and prior to ice out)	TDS, chloride, calcium, nitrate
									X		Package 4
02-20	Snap Lake on the edge of the mixing zone around the diffuser (3 stations)	Lake Water (Water)				X					Package 4
						X					Package 2 plus BOD, E. coli, total oil and grease (surface and one metre above bottom, or mid-depth if no conductivity peak)
									X	Once during ice-free period, once during ice-covered period	Chronic toxicity of the Daphnia magna and Selenastrum capricornutum (sample from the depth of maximum conductivity)
		Surficial Sediment						X		At the end of ice-covered period	Total metals (strong acid digestion), total organic carbon
02-21	Outlet from Snap Lake flowing into the Lockhart River system	Lake Water (Water)					X				Package 2 plus BOD and TDS minus BTEX
			X								Flow during ice-free period

Notes: (1) Field pH, sample temperature, conductivity and ambient wind and weather conditions shall be recorded at all locations at the time of sampling

(2) At every lake station, water clarity shall be measured using a Secchi disk at the time of sampling

Analyte Package Parameters:

Package 1: Flow, pH, turbidity, conductivity, temperature

Package 2: Turbidity, TSS, pH, conductivity, major ions (calcium, chloride, alkalinity, hardness, sulphate, sodium, potassium, magnesium, fluoride and total dissolved solids), nutrients (ammonium (NH3-N), dissolved phosphorus, nitrite (NO3-N), total Kjeldahl nitrogen, nitrate (NO2-N), total phosphorus, orthophosphate, total organic carbon), ICP-MC metal scan (total and dissolved – aluminum, cadmium, chromium, copper, lead, nickel and zinc), total mercury, total arsenic, total petroleum hydrocarbons, BTEX (benzene, toluene, ethylene and xylene)

Package 3: Package 2 plus flow measurements recorded as field (spot) measurements

Package 4: Temperature, dissolved oxygen, pH, conductivity (one meter intervals from the surface to one meter above the bottom

2.4 ROLES AND RESPONSIBILITIES

Roles and responsibilities for water management activities during the operational phase program are described in Table 2-2.

Table 2-2 Roles and Responsibilities for Water Management Activities

Position and Name	Roles and Responsibilities
Mine General Manager	Ensures adequate resources are made available to support the needs of the team.
Safety, Health and Environmental Manager	Assist with on-site coordination of technical and administrative activities.
Permitting / Environmental Superintendent	Provide follow-up with regulatory / licensing reporting requirements.
Environmental Coordinator	Develop and/or recommend the sampling program to identify and monitor possible contaminant levels; interpret data relative to the monitoring programs and implement adaptive management practices; suggest potential sample collection points and analytical requirements. Monitor water movement with the operational system of sumps or Water Management Pond to ensure short and long term adherence to the Water Licence.
Environmental Technician	Supports the Environmental Coordinator. Collect samples, Coordinate the sampling and monitoring program for the collection and analysis of samples to identify and monitor possible contaminant levels

Roles and responsibilities related to spill response are detailed in the Spill Contingency Plan (De Beers 2010).

3 WATER BALANCE

The site water balance provides a basis for design of the water management plan. The water balance describes the quantity of inflow [gains] to the site, outflow [losses] from the site, and the quantity of water conveyed internally within the mine site. A schematic diagram describing the site water balance is provided in Figure 3-1, and a general site plan showing the locations of water management facilities is provided in Appendix A. Major water management facilities considered in the water balance include:

- Site water systems, including:
  - Raw water intake;
  - Potable Water Treatment Plant (PWTP);
  - Domestic water supply to camp;
  - Sewage collection system;
  - Sewage Treatment Plant (STP);
  - Treated domestic effluent discharge; and
  - Core and outlying facilities runoff collection system;
- Mine water systems, including:
  - Underground mine workings;
  - North Pile drainage system;
  - Water Management Pond (WMP);
  - Water Treatment Plant (WTP); and
  - Treated mine water discharge via the diffuser assembly.

3.1 WATER INFLOWS

Water inflows considered in the mine water balance for the operational phase program include:

- Raw water withdrawn from Snap Lake for domestic and industrial water supply;
- Seepage into the underground mine workings;
- Direct precipitation to mine facilities; and

- Runoff to mine facilities from adjacent catchments.

The approximate amount of fresh water to be drawn from Snap Lake during the operational phase program is expected to be 150 m^3/d. Precipitation and runoff managed by the mine water management facilities will vary seasonally. Mine seepage is the largest contributor of Water inflows, representing over ninety percent of the total inflow volume.

Fire suppression water (QFS) is discussed in Section 4 but is not considered in the mine water balance because withdrawals are anticipated to be rare events.

3.2 WATER OUTFLOWS

Water outflows considered in the mine water balance for the operational phase program include:

- Treated water, discharged to Snap Lake;
- Treated water used for dust suppression;
- Losses to groundwater seepage from water management facilities; and
- Losses to evaporation from water management facilities.

The approximate amount of water used for dust suppression is estimated to be 300 m^3/d, during months when road surfaces are dry and unfrozen. The approximate amount of treated mine water to be discharged to Snap Lake during the operational phase program is estimated to increase with seepage into the underground workings, currently estimations indicate between 15,000 and 25,000m^3/d of treated water will be discharged to Snap Lake. Evaporation and seepage from the mine water management facilities will vary seasonally and are expected to be small, relative to mine seepage volumes.

Table 3-1 lists each component and the estimated quantity of water for the operational phase program. Water inflows and outflows are based on the site-specific hydrology described in Appendix B. Sections 4 and 5 of the Plan outline the details of how each water management facility will be managed.

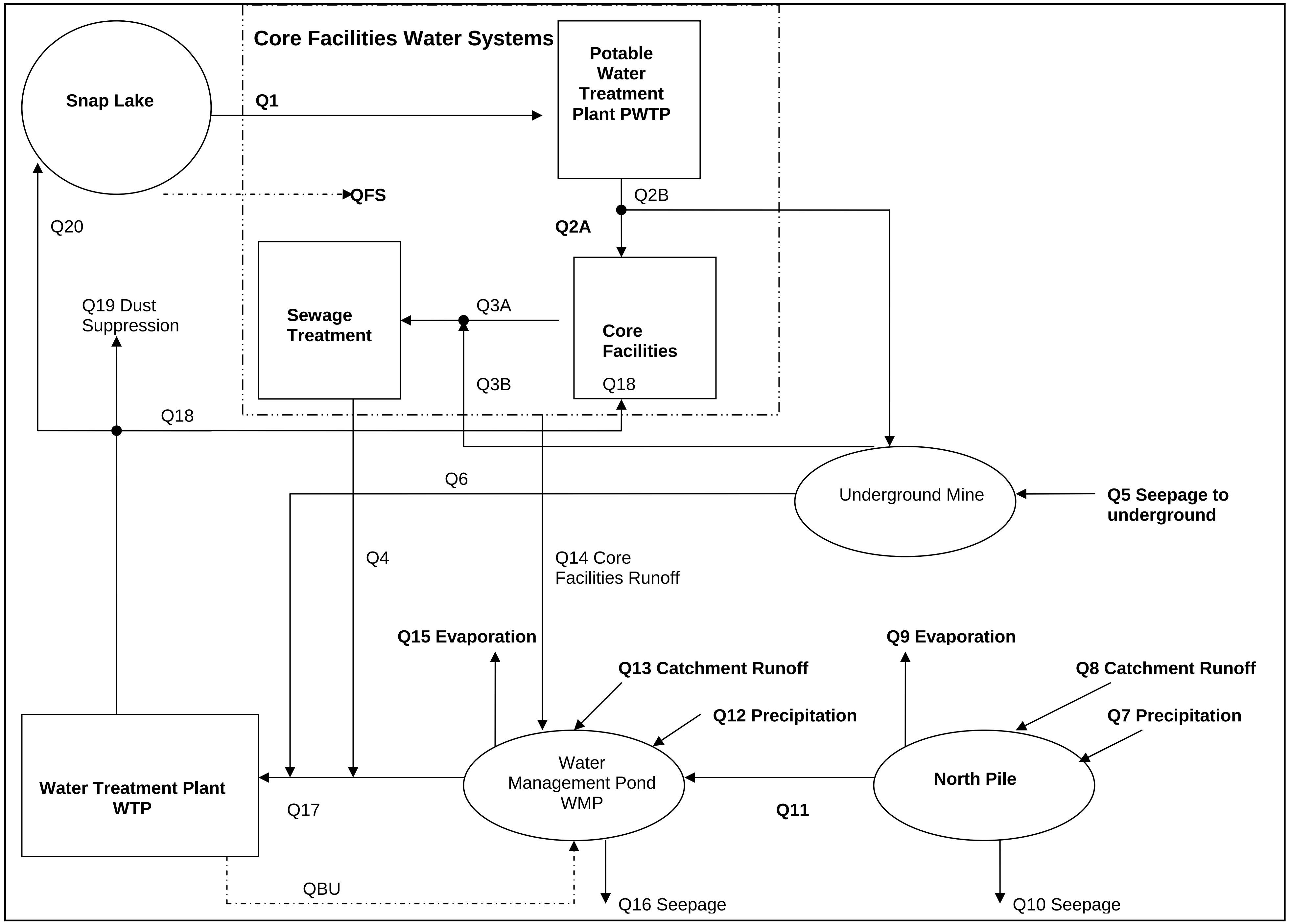

Figure 3-1 Water Balance Schematic Diagram

Table 3-1 Summary of Water Balance for Operational Phase (2009 and 2010)

	Snap Lake	Core Facilities Water Systems			Mine Area		North Pile Starter Cell					Water Management Pond (WMP)						Water Treatment Plant (WTP)		
Stream Description	Raw Water Withdrawal	Domestic Water Used	Sanitary Sewage to STP	Treated Effluent to Snap Lake	Mine Seepage Inflows	Minewater to WTP	Direct Precipitation	Runoff from Land Areas	Evaporation	Seepage	Drainage to WMP	Direct Precipitation	Runoff from WMP Catchment	Plant Site Runoff	Evaporation	Seepage	Pumped to WTP	Recycle to Process	Dust Suppression	Discharge to Snap Lake
Stream Number	Q1	Q2	Q3	Q4	Q5	Q6	Q7	Q8	Q9	Q10	Q11	Q12	Q13	Q14	Q15	Q16	Q17	Q18	Q19	Q20
Data Source	Note (a)	=Q1	=Q2	=Q3	Note (b)	=Q5	Note (c)	Note (c)	Note (c)	Note (d)	= Q7+Q8-Q9-Q10	Note (e)	Note (e)	Note (e)	Note (e)	Note (e)	=Q12+Q13+Q14-Q15-Q16	Note (f)	Note (f)	=Q4+Q6+Q11+Q17-Q18-Q19
Month-Year	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day	m³/day
Jan 09	100	100	100	100	15353	15353	0	0	0	0	0	15	0	0	0	5	10	800	0	14663
Feb 09	100	100	100	100	15284	15284	0	0	0	0	0	26	0	0	0	5	21	800	0	14605
Mar 09	100	100	100	100	15958	15958	0	0	0	0	0	27	0	0	0	5	22	800	0	15280
Apr 09	100	100	100	100	16516	16516	83	6	0	0	89	22	1	5	0	5	23	800	0	15928
May 09	100	100	100	100	16037	16037	10	419	0	0	429	31	54	346	0	5	426	800	0	16192
Jun 09	100	100	100	100	16537	16537	12	195	26	0	181	27	25	161	33	5	241	800	300	15959
Jul 09	100	100	100	100	17037	17037	19	95	66	35	13	20	12	78	88	16	182	800	300	16232
Aug 09	100	100	100	100	17537	17537	21	108	50	35	44	16	14	89	66	16	169	800	300	16750
Sep 09	100	100	100	100	18037	18037	18	90	17	35	56	15	12	74	22	16	107	800	300	17200
Oct 09	100	100	100	100	18537	18537	25	36	8	35	18	15	5	29	11	16	44	800	300	17599
Nov 09	100	100	100	100	19037	19037	0	2	0	0	2	12	0	1	0	5	8	800	0	18347
Dec 09	100	100	100	100	19537	19537	0	0	0	0	0	13	0	0	0	5	8	800	0	18845
Jan 10	150	150	150	150	20037	20037	0	0	0	0	0	15	0	0	0	5	10	800	0	19397
Feb 10	150	150	150	150	20537	20537	0	0	0	0	0	26	0	0	0	5	21	800	0	19908
Mar 10	150	150	150	150	21037	21037	0	0	0	0	0	27	0	0	0	5	22	800	0	20409
Apr 10	150	150	150	150	21537	21537	83	6	0	0	89	22	1	5	0	5	23	800	0	20999
May 10	150	150	150	150	22037	22037	10	419	0	0	429	31	54	346	0	5	426	800	0	22242
Jun 10	150	150	150	150	22537	22537	12	195	26	0	181	27	25	161	33	5	241	800	300	22009
Jul 10	150	150	150	150	23037	23037	19	95	66	35	13	20	12	78	88	16	182	800	300	22282
Aug 10	150	150	150	150	23537	23537	21	108	50	35	44	16	14	89	66	16	169	800	300	22800
Sep 10	150	150	150	150	24037	24037	18	90	17	35	56	15	12	74	22	16	107	800	300	23250
Oct 10	150	150	150	150	24537	24537	25	36	8	35	18	15	5	29	11	16	44	800	300	23649
Nov 10	150	150	150	150	25037	25037	0	2	0	0	2	12	0	1	0	5	8	800	0	24397
Dec 10	150	150	150	150	25537	25537	0	0	0	0	0	13	0	0	0	5	8	800	0	24895

(a) Camp and mine potable water demands are based on Table III.4-1 of EAR (De Beers 2002).

(b) Mine seepage water inflows are based on projections for 2004 and 2005 (Golder 2004a) and extrapolated.

(c) North Pile starter cell inflows and outflows are based on drainage areas and runoff coefficients presented by Golder (2004b). The total drainage area to the North Pile starter cell drainage system is 34.9 ha, plus 1.7 ha of sump area.

(d) Seepage rates from the North Pile area are based on initial estimates in Table III.4-1 of EAR (De Beers 2002) and pro-rated seasonally based on WMP seepage rates presented by Golder (2004a).

(e) Water management pond inflows and outflows are based on projections for 2004 and 2005 (Golder 2004a) and are assumed to apply through 2006. The total drainage area to the WMP is 23.0 ha, including 2.2 ha pond area.

(f) Recycled and Dust suppression water rates are based on Table III.4-1 of EAR (De Beers 2002).

4 SITE WATER SYSTEMS

Site water systems include facilities related to water supply, domestic water use and sewage treatments as well as the management of core facilities run off. Specific components of the system are discussed below and include the:

4.1. Raw Water Supply System;

4.2. Potable Water Treatment plant (PWTP); and

4.3. Sewage Treatment Plant (STP);and

4.4. The Core Facilities Run Off Management System.

4.1 RAW WATER SUPPLY SYSTEM

4.1.1 Objectives

The key objective of the water supply system is to reliably provide the quantities of water adequate to satisfy requirements of the potable water treatment plant and fire suppression systems, if necessary raw water may also be used for dust suppression.

4.1.2 Water Flows

The water supply is withdrawn from Snap Lake and is described by flow path Q1 on Figure 3-1.

4.1.3 Management Systems

Fresh water will be withdrawn from the west arm of Snap Lake via the submerged intake. Drawings of the existing water intake system are provided in Appendix A Figure 4. The planned water withdrawal from Snap Lake is expected to be approximately 150 m^3/d. Fresh water will be used for:

- potable water supply (Q1); and
- fire suppression (QFS) only in the case of fires or testing the system.

Fresh water will not be withdrawn for use in the Process Plant.

A single intake pipe will be used for domestic potable water use (daily use) and for fire suppression (emergency event). The peak domestic water withdrawal rate will be 150 m^3/d (2.3 L/s) and the peak fire suppression withdrawal rate would be 12,960 m^3/d (150 L/s). In the case of a fire water for the fire suppression system will be drawn directly from Snap Lake and distributed through the pressured system to the Process Plant, Service Complex, accommodations, fuel storage area, power and water treatment plants, and utilidors.

The water intake pump well is housed within a rock-filled embankment on the north shore of the northwest peninsula of Snap Lake. The pump well, consisting of vertical pump wells fitted with vertical turbine pumps which receives water through the single pipe buried under the rock-filled granite embankment. The intake pipe will exit at the bottom of the embankment into Snap Lake and will be fitted with a stainless steel screen. The screen selected will meet the Department of Fisheries and Oceans (DFO) 1995 criteria for the combined water withdrawal rate for fire suppression and domestic potable water use. As per the Fisheries Authorization, a habitat compensation plan was finalized with DFO for the habitat affected by the installation of the water intake embankment.

4.1.4 Control and Measurement

The raw water supply system is a pumped system and flow rates can be controlled by pumps and valves.

Operational procedures for water withdrawal are described by the mine Safety, Health and Environmental Operational Procedure SHEOP-0027. Water volumes withdrawn from Snap Lake are recorded by a flow meter inside the pump house. The meter is read every morning, and entered into a tracking spreadsheet by the Utility Operator.

The recommended calibration interval for the flow meter is 5 years or sooner if it is suspected to be in error.

Water quality and quantity parameters are monitored at SNP station 02-15 as detailed in Table 2-1.

4.1.5 Contingency Measures

The Mine includes pipelines for conveyance of many flows, including raw water and fire suppression water supply. The contingency procedures outlined below also apply to pipelines used to convey potable water, raw and treated domestic effluents, and raw and treated mine water. A line break or malfunction in any of these pipelines could be caused by:

- collisions with construction equipment;
- internal corrosion;
- uneven settlement along the line (frost or permafrost heave);
- poor materials or workmanship during installation; and
- heat trace failures on the lines.

Spills from pipelines can be prevented by implementing the following precautions:

- marking the locations of all overhead or buried lines;
- ensuring personnel are aware of all buried and overhead lines in their work areas;
- monitoring the flows and pressures in the lines;
- inspecting, maintaining and repairing the lines and related pumps, etc.;
- using cathodic protection systems for metal lines; and
- installing lines in non-permafrost areas; and
- monitoring of heat trace controls.

The mine operational plan for a pipeline failure would be to:

- Shut down the line;
- Identify the product spilled and initiate appropriate response;
- Repair any erosion resulting from the failure;
- Repair or replace the line;
- Reconnect and test the line; and
- Resume operations.

The intake of water for domestic use and fire suppression is an integral part of the operations at Snap Lake if for any reason there was a pipeline failure at this point in the water management system all resources would be used to repair. As such, it is not expected that such a failure would ever be prolonged.

4.2 POTABLE WATER

4.2.1 Objectives

The objective of the potable water system is to provide safe drinking water for personnel in the camp and mine.

4.2.2 Water Flows

Water will be pumped from Snap Lake to the potable water treatment plant (PWTP) as described by flow path Q1 on Figure 3-1. Potable water is stored in a fresh water storage tank for domestic use and will be either piped or trucked to users, as described by flow path Q2A and Q2B on Figure 3-1.

4.2.3 Management Systems

Raw water will be pumped from Snap Lake by overland pipeline to the PWTP. Water will be treated with Ultra-Violet light for disinfection, chlorinated and stored in a storage tank in the PWTP. Treated water will be piped to areas in the Process Plant requiring potable water and to the Accommodations and Service Complex. Insulated and heat-traced pipes will be used to distribute water through utilidors between the plants, service complex and camp. Potable water will be trucked to washrooms in the underground mine and other facilities as required.

4.2.4 Control and Measurement

The Potable Water Treatment Plant is operated by certified employees and operates under Government of Northwest Territories *Drinking Water Quality Regulations*.

The potable water system is a pumped system and flow rates are controlled by pumps and valves.

Operational procedures for the PWTP are described by the SHEOP-0028.

The flow meter in the PWTP is read each morning, and entered into a tracking spreadsheet by the Utility Operator. The recommended calibration interval for the flow meter is 5 years or sooner if it is suspected to be in error.

Water samples are taken in the plant and Service Building and tested for free residual chlorine and recorded. Residual chlorine levels are tested in the camp every day and recorded. Additional samples are collected on a weekly basis and sent to the Stanton Regional Hospital – Public Health Department for bacteriological testing.

Potable and raw water is sampled annually to ensure that it meets Northwest Territories health regulations for total metals, nutrients, major ions and bacteriological parameters.

4.2.5 Contingency Measures

The contingency measures for pipelines, as described in Section 4.1.5, also apply to the potable water distribution pipelines.

4.3 SEWAGE TREATMENT

4.3.1 Objectives

The objective of the sewage treatment facility is to ensure that sanitary sewage meets water quality standards for discharge to natural receiving waters.

4.3.2 Water Flows

Sewage will be collected and conveyed to the sewage treatment plant, as described by flow path Q3A and Q3B on Figure 3-1. Treated sewage will be sent to the Water Treatment Plant and discharged to via the diffused to Snap Lake, as described by flow paths Q4 and Q20 respectively on Figure 3-1.

4.3.3 Management Systems

Sanitary sewage water is collected and piped to the sewage treatment plant (STP). Although the mine has six plants that are available (two Sequencing Batch Reactor (SBR) plants and four Membrane Biological Reactors (MBR), one plant is currently sufficient to manage the raw domestic effluents of the Mine. The SBR have a nominal capacity of up to 300, while the MBR (s) have a capacity for 100 residents. .

Treated domestic effluents are discharged through a pipeline to the Water Treatment Plant. (WTP) Remaining biodegradable organic components will be dewatered in the STP, and then removed for burial in the landfill. Dewatered effluent from the sludge is recycled back to the STP.

Treated sewage discharge is combined with effluent from the WTP and discharged directly to Snap Lake.

4.3.4 Control and Measurement

Visual inspection of the STP is carried out daily.

A commitment to have trained and dedicated personnel operate the STP ensures that the plant is monitored on a consistent basis and allows operations to respond to non-compliances in a timely manner. Response measures may include:

- Adjustment to the system would be made in consultation with the manufacturer's technical expert;
- If unfavourable trends continue to appear in a monthly sampling result, on-site measurements of dissolved oxygen, total suspended solids, temperature and turbidity will take place and additional samples for laboratory analysis will be collected until effluent quality is satisfactory. The sampling frequency will be based upon the nature and severity of the problem;
- If the non-compliance trend continues whereby the operators are unable to bring the plant back on line within a timely manner, action will be implemented to have the technical representative brought to site to assist the operations group;
- Technical assistance from the manufacturer is available, by agreement, on a 24-hour, 7 day a week basis;
- Technical assistance and equipment from the manufacturer can be mobilized to site on 24-hour notice should repair, replacement or adjustments be necessary; and
- Spare parts for certain system components are available on site in case of equipment failure.

Water quality and quantity parameters related to domestic effluents are monitored at SNP stations 02-16i (treated sewage discharge from STP prior to mixing with WTP effluent), 02-17 (final combined WTP and STP effluent), 02-20 (Snap Lake on the edge of the mixing zone around the diffuser) and 02-22 (Snap Lake during diffuser construction), as detailed in Table 2-1.

4.3.5 Contingency Measures

System failures and/or spills may occur due to pipe blockage, electrical power outage, equipment malfunctions, operator error, or foreign material in the influent that cannot be processed by the SBR reactor.

At such times, raw or partially treated sewage may be discharged to the Water Management Pond (WMP) as described by flow path QBU on Figure 3-1. At the Snap Lake mine site, natural wetlands downstream of the STP provide tertiary treatment for treated sewage effluent if in the even that raw or partially treated sewage could not be discharged to the WMP then with Inspector approval De Beers could discharge into the wetlands. Part F Condition 13 of the water license provides limits on discharge criteria to the wetlands at SNP 02-19. (Appendix A Figure 5).

Spills of partially treated or untreated sewage that occur inside the plant would be responded to by:

- removing spilled materials (spills of untreated waste will be contained using a vacuum truck and necessary spill cleanup materials and re-routed to the front end of the system);
- spreading hydrated lime over the area (site sanitation);
- treating recovered sewage and any materials contaminated with sewage by incineration; and
- decontaminating workers.

Regular inspections of the STP inflow and outfall pipelines are undertaken by Maintenance. The contingency measures for pipelines, as described in Section 4.1.5, also apply to the pipelines used to convey raw and treated sewage.

4.4 CORE AND OUTLYING FACILITIES RUNOFF WATER MANAGEMENT

4.4.1 Objectives

The objectives of the core and outlying facilities runoff water management system are to:

- Collect runoff from the core facilities (camp and plant site) that may be contaminated by mine activities;
- Convey that runoff to the WMP for storage and subsequent treatment; and
- Convey uncontaminated surface runoff from outlying facilities to natural receiving streams after polishing to remove sediment.

4.4.2 Water Flows

Surface water runoff is seasonal. It generally commences with snowmelt in May and continues with snowmelt and rainfall runoff through October. Surface water runoff from the core facilities is conveyed to the WMP (flow path Q14 on Figure 3-1). Surface runoff that is conveyed to natural receiving streams is not considered in the mine water balance.

4.4.3 Management Systems

A site plan showing existing material stockpiles and surface water runoff, as well as layout for perimeter drainage ditches and sumps, is provided on Figure 3 in Appendix A. The design basis for core facility drainage was presented by Golder (2004c). In general, natural drainage for the plant site area flows from a local topographic high, east of the mine portal, and collects in the WMP to the west of the plant site area. Grading within the natural catchment area is designed to collect and promote positive drainage towards the WMP. Any core facility development located beyond the natural catchment area is contained within a perimeter drainage system to collect surface water runoff and active layer groundwater, and flow is conveyed back to the WMP from a terminal sump. Perimeter drainage measures include gravity flow ditches, sumps and pumps, and are protected for seasonal operating conditions.

In areas where the near-surface subgrade is in mineral soil with high hydraulic conductivity, or bedrock fractures are encountered, perimeter ditch and sump designs contain linings to limit seepage losses.

- Perimeter drainage, including drainage ditches and sumps, was established around the north, east and south sides of the plant site to collect surface water runoff and active layer groundwater for discharge to the WMP.
- The haul road width is 15 m with 1.2 m high safety berms. The haul road width complies with minimum requirements established by NT Mine Health and Safety.
- The storage pads have positive drainage to promote surface water runoff.

No PAG materials are stockpiled onsite; all are disposed within the North Pile footprint.

4.4.4 Control and Measurement

The core facility drainage system consists of gravity feed in the upper system. From terminal sumps, it is a pumped system and flow rates to the WMP can be controlled by pumps and valves.

The outlying facility drainage system consists of gravity feed through collection ditches, to polishing ponds and natural receiving streams.

Water quality and quantity parameters related to outlying facility drainage are monitored at SNP stations 02-04 (uncontrolled surface runoff at culvert by airstrip), 02-05 (uncontrolled surface runoff at Bulk Sample Mine Rock Pad), 02-06 (uncontrolled surface runoff at quarry site), 02-07 (uncontrolled surface runoff at road to bulk emulsion plant), 02-08 (uncontrolled surface runoff at winter access road), 02-09 (uncontrolled surface runoff at emulsion plant area and AN Bulk Facility Storage) and 02-10 (any other points where flow to Snap Lake or IL5 is observed), as detailed in Table 2-1.

4.4.5 Contingency Measures

The contingency measures for pipelines, as described in Section 4.1.5, also apply to the pipelines used to convey runoff from the core facilities to the WMP. Spills of potentially deleterious substances within the core facilities area are addressed by the Spill Contingency Plan (De Beers 2010).

5 MINE WATER SYSTEMS

Mine water systems include facilities related to mining and treatment of surface runoff that could be affected by mining activities. Specific components of the system are discussed below and include the:

5.1. Underground mine;

5.2. North Pile Starter Cell;

5.3. North Pile East Cell;

5.4. Water Management Pond (WMP);

5.5. Water Treatment Plant (WTP); and

5.6. Recycled Water.

5.1.1 Objectives

The objectives of the underground mine dewatering system is to:

- Collect mine seepage inflows in a controlled matter; and
- Convey water collected in sumps to the WTP.

5.1.2 Water Flows

During the production stage, mine water flows include the following components:

- Potable / industrial water inflow (flow path Q2B on Figure 3-1);
- Sanitary Sewage to STP (flow path Q3B on Figure 3-1);
- Seepage into underground workings (flow path Q5 on Figure 3-1); and
- Discharge from the mine to the WTP (flow path Q6 on Figure 3-1).

5.1.3 Management Systems

During the environmental assessment process, a hydrogeological computer model was developed to help predict the volume of water that would seep into the underground mine for each week of operations. In-flow rates are following the original environmental assessment estimates and are currently approximately 20,000 cubic meters per day. Water is pumped through three pipelines out of the underground workings directly to the WTP.

Grout (cement compound) is injected into fractures and drill holes in the underground walls to reduce the volume of water entering localized areas of the mine. However, this localized grouting does not prevent all seepage into the mine, and the volume of water entering the underground workings will increase over time as more underground areas are exposed.

Water seeping into the mine is collected in a series of sumps distributed throughout the mine. Sumps are developed in working areas that allows initial settlement of coarse suspended solids from the water. Water is directed through a combination of drain holes and pipelines to main settling sumps equipped with multiple storage areas and pumps to convey water to surface. From the main settling sump (MSS), the water is directed to the main pump station and discharged directly to the WMP.

As water travels from the walls to the floor and ultimately the sumps, it picks up residual explosives, grout, fine sediment, and cement (grout) materials.

The MSS came online in May 2010. The primary purpose of the MSS is to collect mine water and allow solids to settle thereby decreasing TSS in the mine water. It is estimated that the MSS will result in a forty to seventy percent reduction in TSS, this will not only decrease the wear on the underground pumps but also decrease TSS in the effluent discharged to Snap Lake. The MSS is located near the main crushing station; the subsequent sump is located in the footwall workings further down dip. As production proceeds and the mine expands; additional sumps and pump installations will be established on lower levels as required.

5.1.4 Control and Measurement

The volume of water pumped from various mine sumps is recorded by flow meters located throughout the mine and the observed flows are compared with the predicted flow from the hydro-geological model. In 2010, the observed flows will be entered into the model and the model will updated predictions of future inflows. The updated predictions will be used to refine this plan the expected volumes.

Water quality and quantity parameters related to underground mine water are monitored at SNP station 02-01 (final mine water collection sump), as detailed in Table 2-1.

5.1.5 Contingency Measures

Pump failures or seepage inflows larger than those anticipated, could temporarily exceed the combined storage and pumping capacity of the sump and pump system. This would flood the lower mine workings and could interrupt mining activities, but would not pose an environmental or safety hazard. Mine personnel and equipment could be moved to higher elevations until additional pumps could be used to dewater the flooded areas.

Inspections of the pipeline from the mine portal to the WTP are undertaken by the Maintenance Department. The contingency measures for pipelines, as described in Section 4.1.5, also apply to the pipelines used to convey mine seepage water.

If a mine water spill should occur on the surface, the faulty component(s) would be identified and repaired or replaced where necessary. Any spilled material would be cleaned up and disposed of in the North Pile Starter or East Cell.

5.2 NORTH PILE STARTER CELL

5.2.1 Objectives

The objectives of drainage facilities at the North Pile Starter Cell are to collect water that is affected by mining activities and convey it to the Water Management Pond.

5.2.2 Water Flows

External drainage around the North Pile includes the following components:

- Direct precipitation to the system (flow path Q7 on Figure 3-1);
- Runoff from adjacent catchments (flow path Q8 on Figure 3-1);

- Evaporation from the system (flow path Q9on Figure 3-1);
- Seepage from the system (flow path Q10 on Figure 3-1); and
- Discharge from the system to the Water Management Pond (flow path Q11 on Figure 3-1).

5.2.3 Management Systems

Detailed designs for the North Pile Starter Cell water management system were prepared by Golder (2004b).

Ditches around the North Pile starter cell were constructed in 2005 which direct and convey runoff from areas affected by operations of the Starter Cell, as well as from a limited area upstream of the Starter Cell that would otherwise drain through the affected area. Managed water will include runoff from granite quarries, as these areas are within the footprint of the North Pile.

The Starter Cell ditches convey water to four temporary sediment control and flow attenuation sumps constructed on the north side of the North Pile and two permanent sumps on the south side. The four ditches and sumps are labelled as “temporary” because they exist inside the ultimate footprint of the North Pile. Ditches are a minimum of 0.75 m deep, which will accommodate the 1:10 year, 24-hour rainfall event with additional allowances for freeboard and ice build up. The temporary sumps are designed to remain dry for most of the year, and receive surface water runoff from spring melt and seasonal storm events. The sumps are designed to store the entire estimated runoff from a 1:5 year freshet, which is greater than the 1:100 year, 24-hour storm event. Water is pumped via pipeline from the sumps to the WMP.

Ditches and sumps in mineral soil with high hydraulic conductivity are lined using a geo-synthetic clay liner to prevent seepage to Snap Lake. Additional seepage control measures, such as grouting of pervious fractured rock zones, was applied when such zones were encountered.

5.2.4 Control and Measurement

The North Pile Starter Cell drainage system consists of gravity feed in the upper system. From the terminal sump, it is a pumped system and flow rates to the WMP can be controlled by pumps and valves.

Water quality and quantity parameters related to the North Pile are monitored at SNP Station 02-02 (North Pile drainage collection ditch), as detailed in Table 2-1.

5.2.5 Contingency Measures

Regular inspections of the pipeline from the North Pile Starter Cell sumps to the WMP are undertaken by the Snap Lake Mine Process Plant, Maintenance and Environmental personnel. The contingency measures for pipelines, as described in Section 4.1.5, also apply to the pipelines used to convey North Pile starter cell runoff.

Any PK tailings or sediment slurry that has escaped from the system to a water body would be left in place until further advice has been received on the cleanup from an Environmental Consultant.

5.3 NORTH PILE EAST CELL

5.3.1 Objectives

The objectives of drainage facilities at the North Pile East Cell are to collect water that is affected by mining activities and convey it to the Water Management Pond.

5.3.2 Water Flows

The East Cell is currently under construction as such there is no water flow related to this facility at this time as such only the planned management of the system is discussed. The Plan will be updated once the East Cell's construction has been completed.

5.3.3 Management Systems

Detailed designs for the North Pile East Cell water management system were prepared by Golder (2008). The east cell is the second phase of construction in the North Pile.

Deposition into the East Cell will start following the filling of the Starter Cell which is expected in 2012. The construction of perimeter water control structures, comprising of ditches and sumps, was completed prior to initial embankment construction in preparation for the start of deposition activities in the East Cell. The facility is designed to promote drainage of water through the perimeter embankments for collection by the perimeter water control structures. Water collected in the perimeter sumps is transferred to the water management pond (WMP) on an on-going basis. Water that pools inside the North Pile is then transferred to the WMP.

Following from the expectation that the flow of water from Snap Lake may be excessive, the design of the perimeter water control structures includes the provision for the installation of a grout curtain. The grout curtain would be installed from the crest of the access road (*i.e.,* between the ditch and Snap Lake). The objective of the grout curtain is not to stop the flow of water from Snap Lake but rather to reduce it to a manageable rate and quantity.

The East Cell ditches convey water to three (SP 3-5) sediment control and flow attenuation sumps constructed on the north-east side of the North Pile. The sumps are designed to store the entire estimated runoff from a 1:5 year freshet, which is greater than the 1:100 year, 24-hour storm event (280 mm). Water is pumped via pipeline from the sumps to the WMP. The design quantity of water to report to SP3 during the freshet is 130,480 m3; SP4 is 8,960 m3 and capacity of SP5 is SP5 is 24,360 m3.

Ditches and sumps in mineral soil with high hydraulic conductivity are lined using a geo-synthetic clay liner to prevent seepage to Snap Lake. All ditches will have minimum depth of 0.8 m with an invert width of 1.0 m and ditches excavated in mineral soil will have side slopes of 2 horizontal to 1 vertical to prevent erosion. Additional seepage control measures, such as grouting of pervious fractured rock zones, was applied when such zones were encountered.

In recognition of the need for vehicular access around the East Cell perimeter water control structures, this embankment will have a nominal height of 2 m and a crest width of 5 m and will serve as an access road. Additional access will be gained through ramps installed in each sump to enable equipment access for maintenance during operations. The location of each ramp will be confirmed during construction based on the conditions encountered in the field.

5.4 WATER MANAGEMENT POND

5.4.1 Objectives

The objectives of the Water Management Pond are to:

- provide storage to accommodate temporary or seasonal increases in flow, or temporary shutdown of the water treatment plant; and
- to provide control of seepage and runoff from the mine and site.

5.4.2 Water Flows

Water Management Pond flow includes the following components:

- Inflows from the exterior of the North Pile (flow path Q11 on Figure 3-1);
- Direct precipitation to the system (flow path Q12 on Figure 3-1);
- Runoff from adjacent catchments (flow path Q13 on Figure 3-1);
- Inflows from the plant site (flow path Q14 on Figure 3-1);
- Evaporation from the system (flow path Q15 on Figure 3-1);
- Seepage from the system (flow path Q16 on Figure 3-1); and
- Discharge to the Water Treatment Plant (flow path Q17 on Figure 3-1).

5.4.3 Management Systems

During the Advanced Exploration Project (AEP), water from the underground workings and Processed Kimberlite (PK) were stored in the Processed Kimberlite Containment (PKC) facility. The PKC has been renamed the “Water Management Pond” (WMP as defined earlier) because of its revised function. The WMP will be used to temporarily store seasonal surges in surface runoff. The WMP can receive water from the catchment are, and North Pile, if necessary water from underground workings, the core facilities and Sewage Treatment Plant can be diverted to the WMP.

The WMP was created by two dams that were constructed in 2000. The dams consist of a rock fill embankment supporting an 80-mil textured HDPE liner on the upstream side. The liner is keyed into the underlying intact bedrock (using a mixture of sand and powdered bentonite) and compacted into a key trench to minimize the seepage beneath the dams. Suitable granular bedding and cover layers were placed on either side of the liners. As-built reports were submitted to the Mackenzie Valley Land and Water Board as required under the Snap Lake Class ‘A’ Water Licence MV2001L2-0002. Small seepage losses from the WMP are expected (Q16).

5.4.4 Control and Measurement

The capacity of the WMP and associated freeboard allowances were established as part of the approved design. Water balance calculations for the design were based on the assumed site conditions and operating parameters. Daily records of all measurable inflows to the WMP are maintained by site personnel. This information provides a basis for periodic reviews and updates of the water balance and projections of water storage and WMP level during the operational phase. Water quality sampling of inflows and water stored in the WMP is ongoing.

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 operations. The piezometers and thermistors are read bi-weekly, year round.

Routine monthly and yearly visual and survey monitoring of the dams are conducted. In addition, daily/weekly/monthly monitoring of the inflow from the underground workings, site weather conditions and WMP water levels are recorded. Bottom profiles of the WMP will be surveyed every two years to monitor storage loss due to sediment deposition.

Weekly inspections of the upstream face, crest and downstream face of the dams are carried out to identify water or ice level relative to the crest, erosion features, displaced or eroded rip rap, sinkholes, or visible seepage, tears in the liner or cracks in the dam structure. The dam crests are surveyed for settlement.

An annual geotechnical inspection is undertaken by geotechnical engineers during ice-free conditions and consists of the following tasks:

- walking visual inspection of the crest, upstream and downstream sides, followed by an inspection of the toe area for seepage;
- review of instrumentation data collected to monitor the performance of the dams;
- review of site-specific weather information, including monthly temperature and precipitation values;
- review of solids and water volumes disposed within the facility; and
- preparation of a report outlining physical conditions and recommendations for maintenance and additional monitoring.

Water quality and quantity parameters related to the WMP are monitored at SNP stations 02-11 (seepage well down gradient from Dam 1 near Snap Lake shoreline), 02-12 (seepage well down gradient from Dam 2 at WMP), 02-13 (seepage well down gradient from Dam 1 at WMP) and 02-14 (WMP stilling well near pump house), as detailed in Table 2-1.

De Beers has committed to raising the WMP by 2m prior to the operation of the East and West Cells of the North Pile. This commitment was made recognizing that an increases in the PK stored in the North Pile could result in increased inflows to the WMP. Currently, De Beers is developing the construction designs to increase the WMP by 4m starting in 2011. The resulting increase in the capacity of the WMP will be design dependent and therefore will not be commented on at this time. Once the design has been finalized the MVLWB will be notified as per Water License Conditions.

5.4.5 Contingency Measures

If routine or annual inspections identify unusual behaviour of, or significant damage to, the dam structures, or if significant water balance discrepancies are observed during the data reviews, appropriate remedial measures will be developed in consultation with the geotechnical engineer. Such measures include repairing erosion, re-levelling dam crest subsidence, placing seepage barriers, or constructing toe berms to stabilize the dam structure.

Following consultation with geotechnical engineers, the following actions may be taken in the case of system failure (i.e., serious structural damage or instability, or water holding capacity concerns):

- use stockpiled dam construction materials for repairs;
- use geo-composite liners (e.g., bentomat) for emergency repairs, and bentonite in bags to seal minor leaks;
- use earth-moving equipment to move fill materials to increase crest elevation to gain freeboard or provide a toe berm;
- pump and glaciate water on land within the WMP basin, during freezing conditions; or
- as a last resort, cease operation and draw down the WMP by flooding the underground workings.

If obvious signs of an impending failure are detected, access to the dams and downstream area will be prohibited. If necessary, this area will be evacuated. An urgent request for advice from the geotechnical engineers would be sought. Stabilizing actions such as placement of rockfill or other granular materials on the dam will be undertaken.

Rehabilitation of the failure area will include steps to minimize the release of process water followed by measures to contain and/or recover released seepage to the WMP. These remedial designs and measures would be specified by the geotechnical engineer and the Environmental Consultant, as needed.

5.5 WATER TREATMENT PLANT

5.5.1 Objectives

The objectives of the water treatment plant are to treat mine-affected waters to ensure that water quality guidelines are met, prior to release to Snap Lake.

5.5.2 Water Flows

Mine-affected water will be pumped to the Water Treatment Plant from the underground and Water Management Pond (flow paths Q6 and Q17 on Figure 3-1). Treated water will be discharged to Snap Lake (flow path Q20 on Figure 3-1). Recycled treated water will be used also be used onsite as described in Section 5.6 (flow path Q18 and Q19 on Figure 3-1).

5.5.3 Management Systems

The WTP includes a pumping station to decant water from the WMP. The treatment facilities consists of a temporary, portable (trailer mounted) filtration plant that was constructed in 2004 on a granite pad near the WMP causeway. The temporary WTP is expected to operate as required to augment the permanent WTP. It was designed to treat the relatively low flows in the mine pre-production period and the water stored in the WMP, and has a nominal capacity of 5,000 m^3/d In the event that monitoring of underground water inflows shows potential for higher than predicted levels, the plant can be expanded via additional filters and higher flow pumps. The permanent plant was commissioned in 2006. The WTP is capable of treating 35,000 m^3/day. Future capacity expansions would be carried out if and when required.

The process includes a bank of filtration units. Sulphuric acid is used for pH control/adjustment and to reduce potential ammonia toxicity.

The filters in the Water Treatment Plant(s) are regularly cleaned by backwashing with treated water. Backwash water containing suspended solids are pumped to the Process Plant. Treated water is discharged to Snap Lake via diffuser. This diffuser will direct the discharge through multiple ports and increase mixing of effluent with Snap Lake water.

5.5.4 Control and Measurement

The Water Treatment Plant is a pumped system and flow rates to and from the WMP can be controlled by pumps and valves.

Performance of the Water Treatment Plant will be optimized by comparison of the quality of water before and after treatment. The Water Treatment Plant(s) are equipped with instrumentation for continuous monitoring of effluent flow rate, ammonia, pH, temperature, conductivity and turbidity, in accordance with the requirements of the Water Licence. Measurements of these parameters will be used to adjust the addition rates of reagents in order to ensure discharge quality targets are met.

In-house measurements for total suspended solids, ammonia, temperature and turbidity will be conducted as required. Additional samples for laboratory analysis will be collected until effluent quality is satisfactory (usually following major adjustments to the WTP). The sampling frequency will be dependent upon the nature and severity of the problem.

Monitoring will also occur in other areas of Snap Lake as required by the Water Licence. These are discussed further in the Aquatic Effects Monitoring Plan (De Beers 2006).

System failures may occur due to pipe blockage, electrical power outage, equipment malfunctions, or foreign objects or material in the influent. Spills may occur due to pipe rupture or control system failure and overflow. Degradation of effluent quality may also result from equipment malfunction or operational error.

A regularly scheduled preventative maintenance program is in place.

Water quality and quantity parameters related to water treatment plant effluent are monitored at SNP stations 02-17 (final combined WTP and STP effluent), and 02-20 (Snap Lake on the edge of the mixing zone around the diffuser) as detailed in Table 2-1.

5.5.5 Contingency Measures

A high and low level alarm system is installed on the tanks in the WTP and the alarms are tripped in the Process Plant to provide immediate notice of system failure. The Process Plant is manned continuously so all alarms are dealt with expeditiously. If the water quality does not fall within the acceptable pH and turbidity range, the plant will automatically bypass to the WMP.

Regular inspections of the pipelines from WMP to the WTP and from the WTP to the Snap Lake outfall are undertaken by the Process Plant, Maintenance or Environmental personnel. The contingency measures for pipeline failures, as outlined in Section 4.1.5, apply to pipelines used to convey water to and from the WMP.

5.6 RECYLED WATER

5.6.1 Objectives

The primary objective in recycling water is reducing effluent discharge. De Beers is committed to recycling as part of its best practicing for waste management whether the waste is water, plastics or steel.

5.6.2 Water Flows

Recycled Water flow includes the following components:

- Water sent to the Core Facilities (flow path Q18 on Figure 3-1);
- Water used for Dust Suppression (flow path Q19 on Figure 3-1);

5.6.3 Management Systems

To reduce the amount of fresh water used, water is recycled for use in the process plant and for dust suppression. The use of recycled water has allowed De Beers to decrease the estimated amount of water withdrawn from Snap Lake. (De Beers 2002) Control and Measurement

Operational procedures for trucked water distribution are described by SHEOP-0029. This procedure applies to dust suppression activities.

5.6.4 Contingency Measures

Recycled water is normally drawn directly from the Water Treatment Plant. Water as a contingency water may also be withdrawn from Snap Lake by pumping at the freshwater pump house and by pumping water directly from the lake into the water truck. Where water is loaded from the pump house or emergency fire hook up, the volume will be recorded by the pump house meter. Where water is withdrawn directly from the lake, the withdrawal volume, location, time and end use will be recorded by the operator in the truck logbook. This flow path would be described as Q1 on Figure 3-1.

6 REFERENCES

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De Beers. 2006 . Aquatic Effects Monitoring Plan – Snap Lake Diamond Project. Prepared by Golder Associates Ltd. Submitted to the Mackenzie Valley Land and Water Board

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De Beers. 2010. Spill Contingency Plan – Snap Lake Mine. Submitted to the Mackenzie Valley Land and Water Board

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Golder. 2004a. Technical Memorandum Re: Water Level Projections, Water Management Pond, Snap Lake Diamond Project, Northwest Territories. Golder Associates Ltd. Project Number 04-1328-003/6300, prepared for De Beers Canada Mining Inc., dated 15 June 2004.

Golder. 2004b. Snap Lake Diamond Project Site Capture Program – Detailed Design Report, North Pile Drainage Ditch. Golder Associates Ltd. Project Number 04-1413-436/5100, prepared for De Beers Canada Mining Inc., 38 p. + appendices.

Golder. 2004c. Snap Lake Diamond Project Site Capture Program – Plant Site Infrastructure, Geotechnical Site Preparation. Golder Associates Ltd. Project Number 04-1413-436/5200, prepared for De Beers Canada Mining Inc., 50 p. + appendices.

APPENDIX A
DRAWINGS

Roster of Drawings related to Mine Water Management Plan

Drawing No.	Title
Figure 1	General Arrangement
Figure 2	SNP Stations – Mine Site
Figure 2a	SNP Station Description
Figure 3	North Pile General Arrangement Plan
Figure 4	Pump house Schematic
Figure 5	Wetlands Deliniation

FIGURE 1

1. Airstrip
2. Laydown area
3. Water Management Pond
4. Ore Stockpile
5. Process Plant
6. Snap Lake Mine Offices/Mine Dry/Maintenance Shops
7. Utilities Building (Diesel Power Generators, Water Treatment Plant)
8. Conveyor and Decline to Underground
9. Portal to Underground
10. Exploration test Pit
11. Vent Raise/Underground Heating Plant
12. Construction Shops/Warehouses
13. Fresh Water Pumphouse
14. Winter Road Access
15. Bulk Fuel Storage
16. Accommodations Complex
17. North Pile/Processed Kimberlite
18. Explosives Storage/Emulsion Plant

FIGURE 2

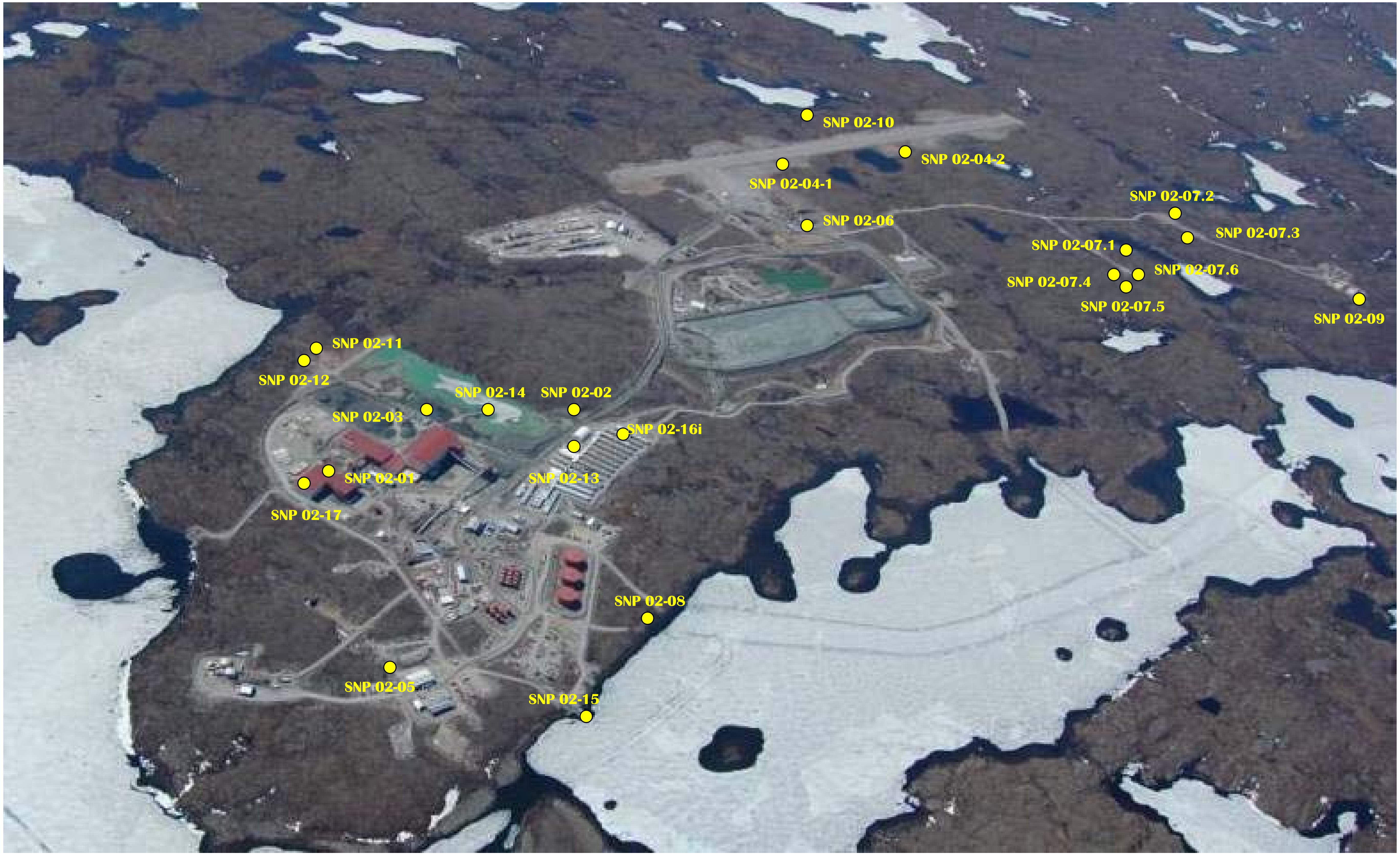
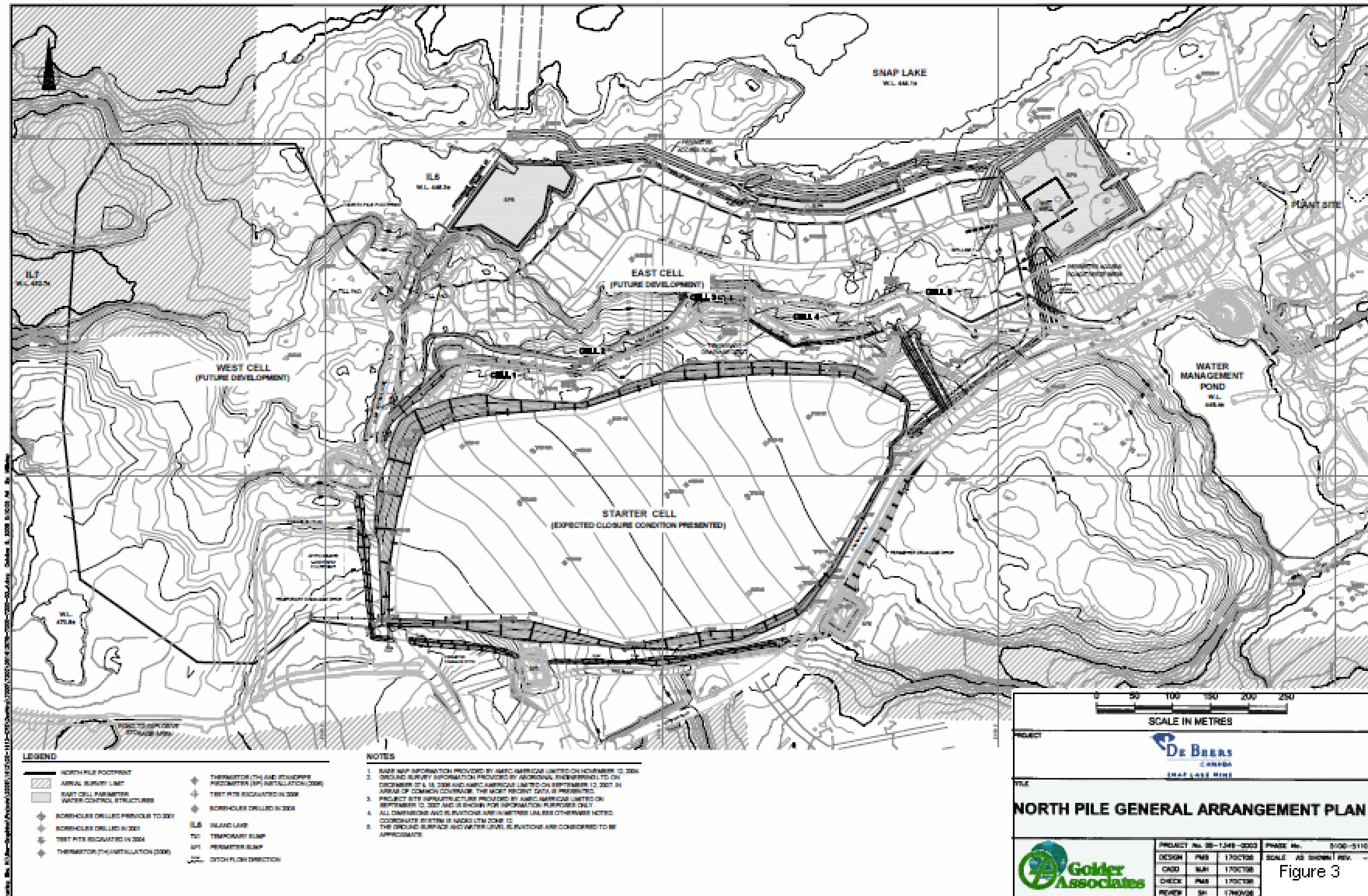

SNP 02-10
SNP 02-04-2
SNP 02-04-1
SNP 02-07.2
SNP 02-06
SNP 02-07.3
SNP 02-07.1
SNP 02-07.6
SNP 02-07.4
SNP 02-07.5
SNP 02-09
SNP 02-11
SNP 02-12
SNP 02-14
SNP 02-02
SNP 02-03
SNP 02-16i
SNP 02-01
SNP 02-13
SNP 02-17
SNP 02-08
SNP 02-05
SNP 02-15

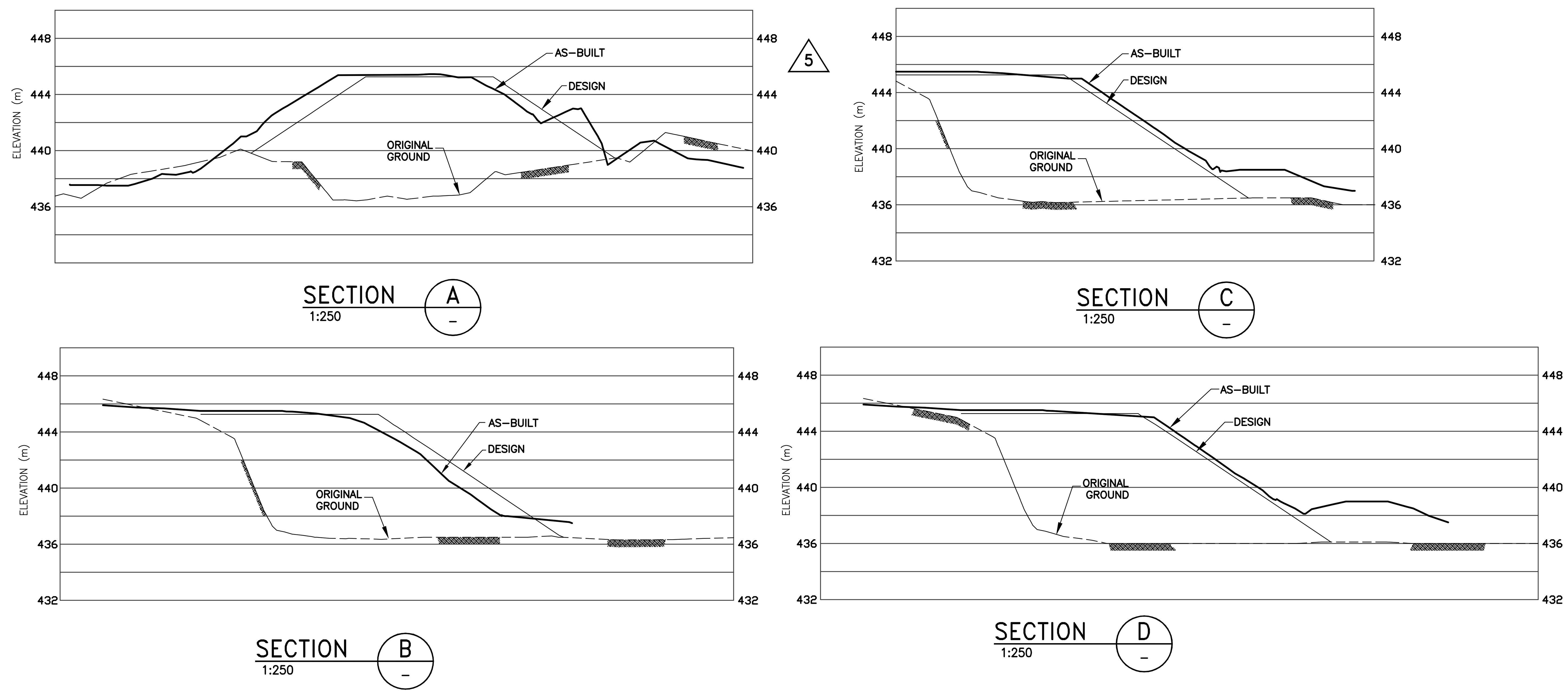
FIGURE 2A

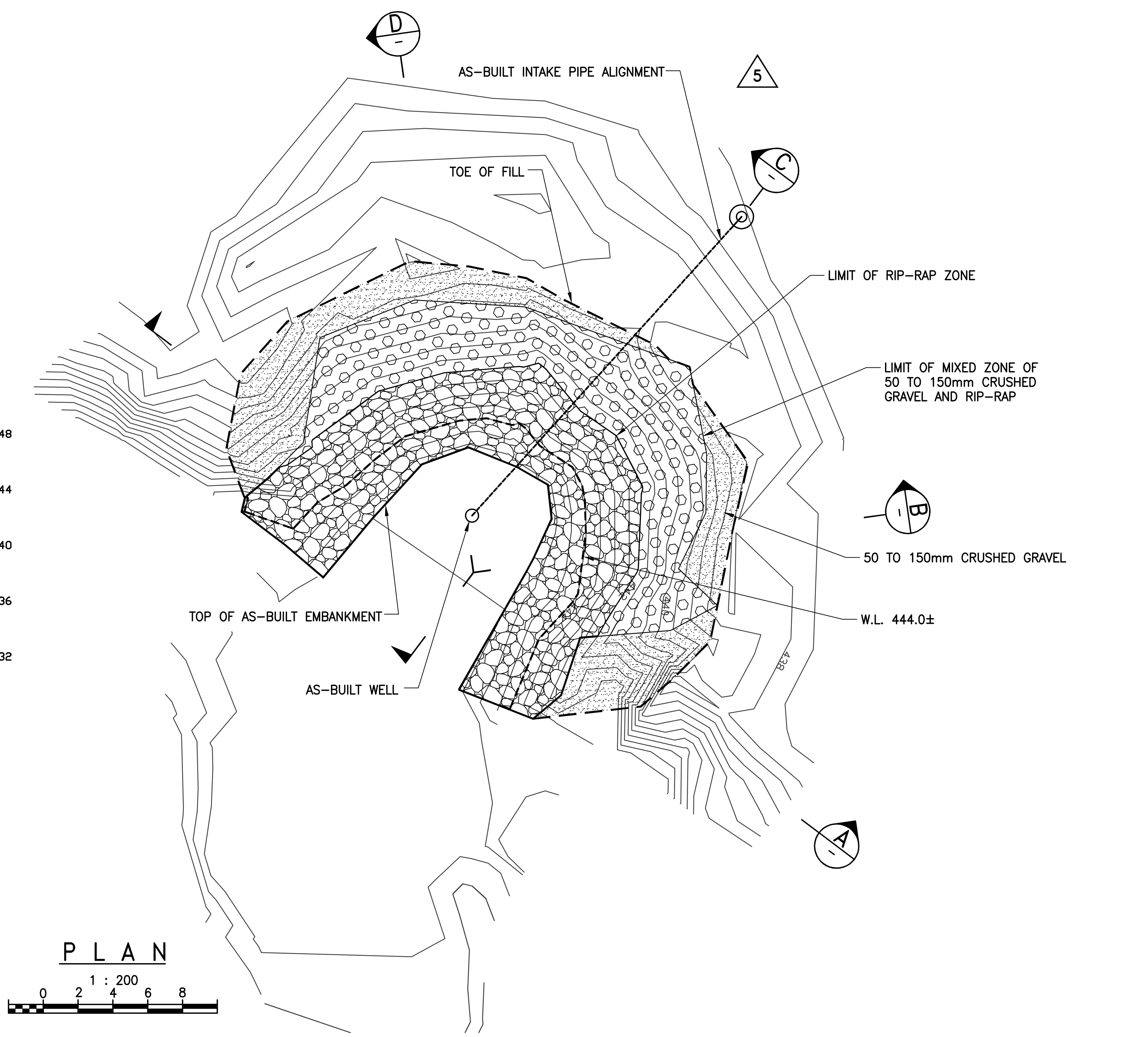
SNP STATIONS

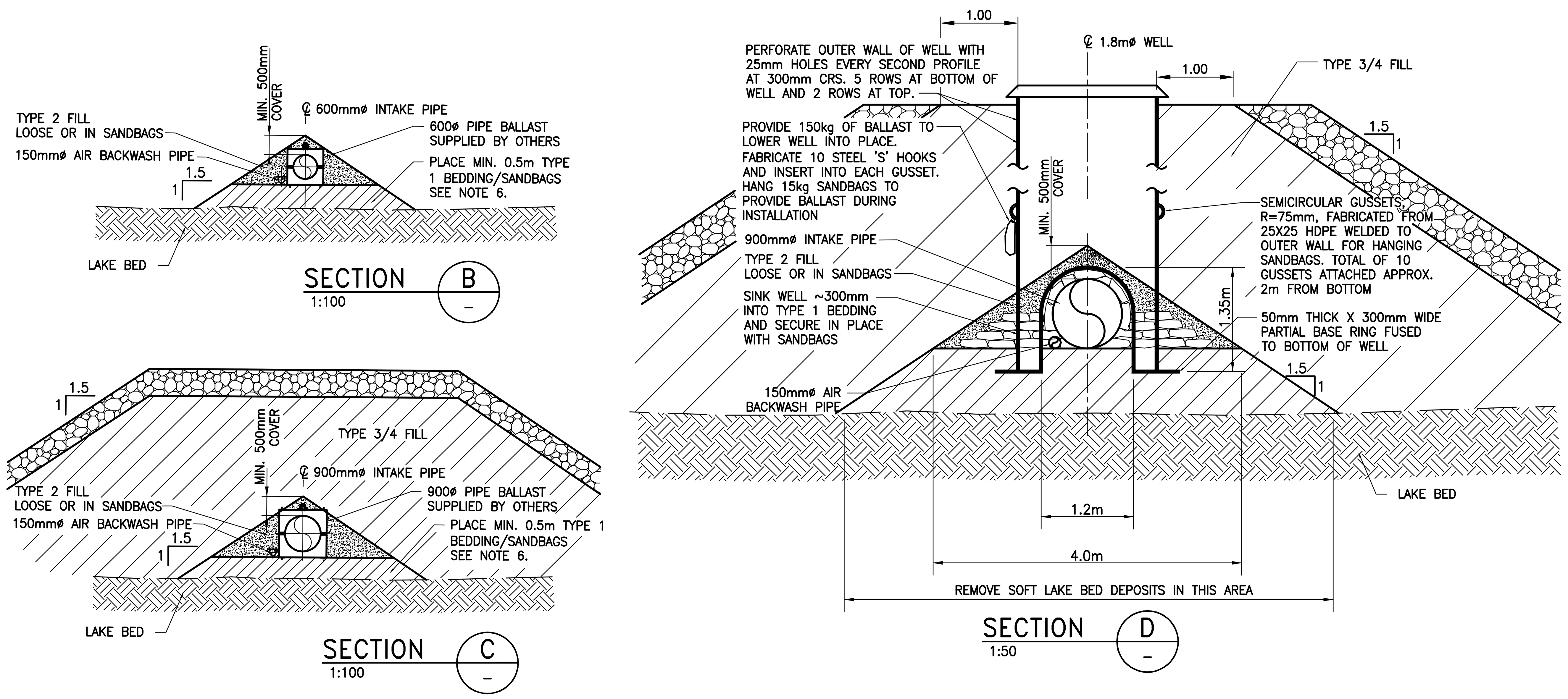
SNP STATION	SITE DESCRIPTION
02-01	Final mine water collection sump
02-02	North Pile drainage collection ditch
02-03	Core Facilities area collection ditch near Water Management Pond
02-04	Uncontrolled surface runoff at Culvert by Airstrip
02-05	Uncontrolled surface runoff at Bulk Sample Mine Rock Pad
02-06	Uncontrolled surface runoff at Quarry Site
02-07	Uncontrolled surface runoff at road to bulk Emulsion Plant
02-08	Uncontrolled surface runoff at Winter Access Road
02-09	Uncontrolled surface runoff at Emulsion Plant Area
02-10	Any other points where observable flow to Snap Lake or IL5 is observed
02-11	Seepage well down gradient from Dam 1 near Snap Lake shoreline
02-12	Seepage well down gradient from Dam 1 at Water Management Pond
02-13	Seepage well down gradient from Dam 2 at Water Management Pond
02-14	Water Management Pond (stilling well near the pumphouse)
02-15	Water intake from Snap Lake
02-16	Sewage discharge from Sewage Treatment Plant prior to mixing with Water Treatment Plant effluent
02-17	Final combined Water Treatment Plant and Sewage Treatment Plant effluent

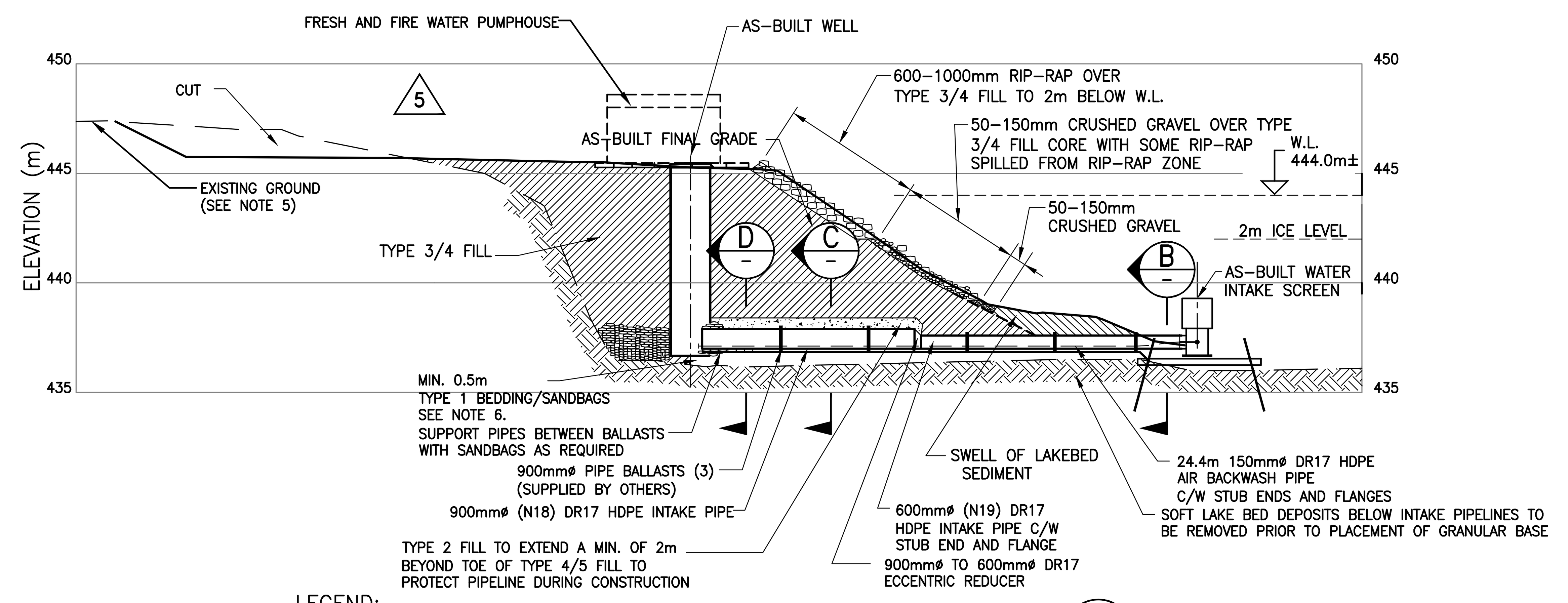
FIGURE 3

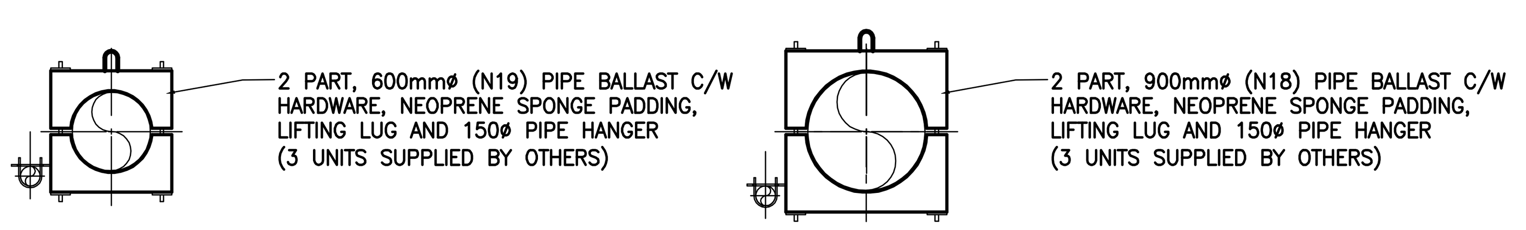

SNAP LAKE
EAST CELL
(FUTURE DEVELOPMENT)
WEST CELL
(FUTURE DEVELOPMENT)
STARTER CELL
(EXPECTED CLOSURE CONDITION PRESENTED)
WATER MANAGEMENT POND
PLANT SITE
IL6
IL7
0 50 100 150 200 250
SCALE IN METRES
LEGEND
NOTES
De Beers
NORTH PILE GENERAL ARRANGEMENT PLAN
Golder Associates
Figure 3











PIPELINE BALLAST WEIGHTS

DETAIL 1
1:50

NOTES:

1. ELEVATIONS ARE IN METRES REFERENCED TO GEODETIC DATUM.
2. GRID IS IN METRES REFERENCED TO UTM NAD83.
3. TOPOGRAPHY IS BASED ON SURVEYS BY SUB-ARCTIC SURVEYS LTD.
4. FOR EARTHWORKS SPECIFICATION SEE SPEC. No. 142221-121-SP-02300.
5. EXISTING GROUND: ON COMPLETION OF THE EXCAVATION AND PRIOR TO PLACEMENT OF FILL, SUBGRADE SURFACE SHALL BE INSPECTED AND APPROVED BY THE GEOTECHNICAL ENGINEER.
6. PRIOR TO PLACING THE PUMP WELL, INTAKE PIPE, AIR BACKWASH PIPE AND SCREEN ASSEMBLY, A LAYER OF TYPE 1 FILL SHALL BE SPREAD TO CREATE AN EVEN BED SURFACE. THE PIPE SHALL THEN BE PLACED LEVEL TYPE 1 BEDDING OR ON SANDBAGS FILLED WITH TYPE 1 BEDDING.
7. INTAKE SCREEN ASSEMBLY SHALL BE SUPPLIED BY THE OWNER. ONCE LOWERED INTO PLACE, THE ASSEMBLY SHALL BE INSPECTED BY DIVERS TO ENSURE STABILITY AND PROPER CONNECTION TO INTAKE AND BACKWASH PIPES.

LEGEND:

445.30 — FINISHED GRADE ELEVATION
443.0 — BATHYMETRY
SWALE

NAD 83

DRG.No: 2250 C008 C 00035 AAAL 200 ---
MINE / PROJECT / DISCIPLINE / SEQ NO / SOURCE CODE / REVISION / TYPE

REV	D/M/Y	REVISION	DR	CHK	APP	APP	APP	APP	ISS	D/M/Y	APP	ISSUED FOR
5	28/12/05	AS-BUILT	AZ		VRM	GM						
4	28/12/05	RE-ISSUED FOR COMPENSATION DESIGN PLAN	MHK									
4	15/08/05	REVISED EMBANKMENT FILL MATERIAL	MHK	VRM	VRM	GM						
3	05/07/05	ISSUED FOR CONSTRUCTION – CONTRACT 142221-C743	MHK	SS	VRM	GM						
3	03/06/05	ISSUED FOR CONSTRUCTION – CONTRACT 142221-C701	MHK	VRM	PG	MK						
2	05/05/05	ISSUED FOR COMPENSATION DESIGN PLAN	MK	VRM	VRM	GM						
1	28/04/05	ISSUED FOR TENDER C743	MK	SS	VM							
1	23/02/05	ISSUED FOR DFO APPROVAL	MK	KS	VM							
0	18/02/05	ISSUED FOR DFO APPROVAL	MK	KS	VM							
B	25/10/04	DRAWING NUMBER AND WELL SECTIONS REVISED	MK									
A	08/10/04	ISSUED FOR TENDER – CONTRACT 142221-700	FC									

REFERENCES

REF	SUBJECT	DRAWING NUMBER
2	CHAMCO FRESH & FIRE WATER PUMPHOUSE	V1010005-01 REV0
1	OVERLAND PIPELINES – PLAN, PROFILES AND DETAILS	-6000-121-0101

ENGINEER SEALED ORIGINAL ON FILE:
BY: V. MADDALOZZO
DATE: 28/12/05
REVISION: 5

STAMP/SEAL

APPROVED FOR CONSTRUCTION

A. LA GRANGE	G. MACLELLAN	W. YAU
CLIENT PROJECT MGR.	ENGINEERING MGR.	PROJECT MGR.

PROJECT PHASE: A. LA GRANGE

PROJECT NO.	ACTIVITY NO.	PACKAGE CODE
142221	4400	121-440-06

SCALE	BY		D/M/Y
AS SHOWN	DSN.	P.GLOVER	10/07/04
	DRN.	FC	10/07/04

DE BEERS CANADA

amec

SUBJECT: SNAP LAKE PROJECT
PHASE II PREPARATION
FRESHWATER INTAKE & PUMPHOUSE
SITE PLAN & SECTIONS

AREA

DRAWING NO. A1-142221-4400-121-0101 — REV. 5

W. YAU

CADD FILE ADDRESS
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ABORIGINAL ENGINEERING LTD

De Beers Canada

amec

Snap Lake Diamond Project

Wetlands Delineation

drn. bchill | June 9, 2007

Scale – 1 : 500

APPENDIX B
SUMMARY OF CLIMATIC DATA AT THE SNAP LAKE SITE

Foreword

The following discussion was presented in the Detailed Design Report for the North Pile Drainage Ditch at the Snap Lake Diamond Project (Golder 2004).

Introduction

Climatic and meteorological data has been gathered on site for the Snap Lake Mine since March 1998. In general, the additional data summarized herein is consistent with the information previously reported. Details of this information are presented under separate cover. Specific to this reporting, selected historical data for temperature, wind and rainfall are provided.

Temperature Observations

A summary of the monthly surface temperatures observed at the Snap Lake monitoring station are presented in Table B.1. This summary illustrates monthly temperature variability for the period from March 1998 through August 2008, which is consistent with the information previously used for thermal modeling carried out in 2001 and 2003.

Table B.1 - Observed Monthly Surface Temperatures at Snap Lake

Month	Surface Temperature (°C)		
	Minimum	**Average**	**Maximum**
January	-32.1	-22.4	4.2
February	-32.3	-24.7	-19.7
March	-25.6	-21.4	-16.9
April	-17.5	-12.4	-5.5
May	-8.6	-2.3	3.9
June	7.1	9.6	12.6
July	13.2	15.4	17.4
August	9.1	11.1	14.0
September	3.9	6.0	7.7
October	-7.7	-4.1	-0.4
November	-16.7	-14.3	-9.8
December	-29.4	-22.5	-17.4
Year	**-32.3**	**-6.8**	**17.4**

Note: Includes data from March 1998 through August 2008.

Other available data, which were originally considered for this project site, consist of an average of the Yellowknife and Lupin Extended AES climate stations, as summarized in Table B.2. The data are derived from the 1971-2000 30-year climate normals published by Environment Canada.

Table B.2 - Estimated Air Temperatures at Snap Lake

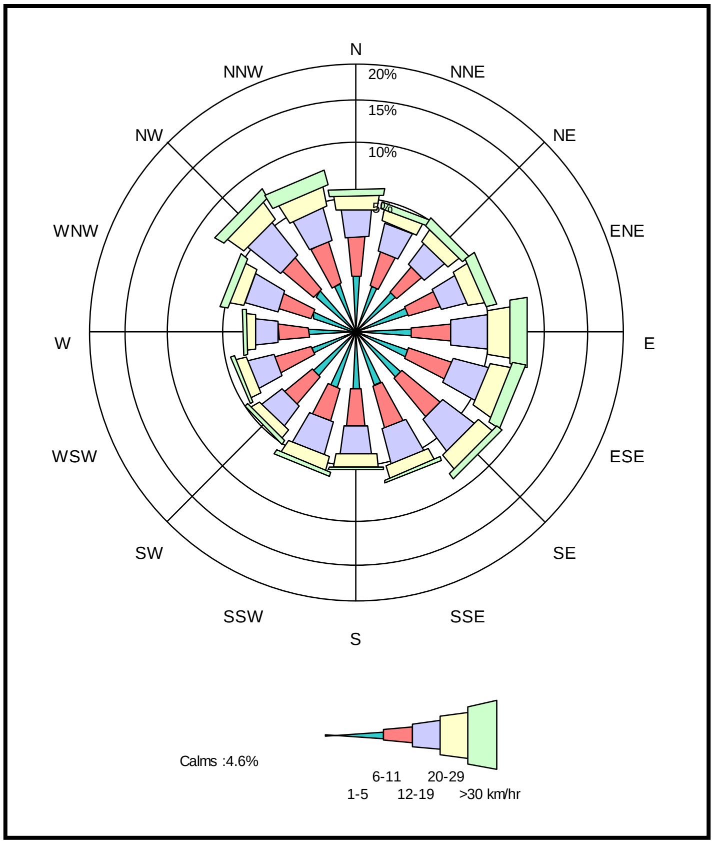
Month	Air Temperature (°C)		
	Extreme Hourly Minimum	Mean Monthly	Extreme Hourly Maximum
January	-50.1	-29.2	0.5
February	-52.6	-27.0	0.6
March	-48.3	-22.0	4.9
April	-41.1	-11.6	13.2
May	-28.4	-0.4	21.8
June	-11.2	9.2	28.9
July	-0.8	13.4	31.8
August	-3.6	11.5	29.2
September	-10.8	4.5	23.6
October	-31.7	-4.8	21.3
November	-43.5	-17.3	3.9
December	-47.5	-25.4	-0.9
Annual	**-52.6**	**-8.3**	**31.8**

Note: based on Yellowknife and Lupin Extended AES climate stations.

Wind Observations

Figure B.1 presents a summary “wind rose” of the winds that were observed at the Snap Lake monitoring station between March 1998 and August 2008.

Figure B.1 - Snap Lake Annual Windrose (March 1998 – August 2008)



Precipitation Observations

Precipitation data have been collected at the Snap Lake monitoring station from February 1998. The annual average rainfall is 158 mm (snowfall is not measured). This is comparable to the closest weather station, Lupin (144 mm), as well as other surrounding weather stations such as Yellowknife (153 mm), Baker Lake (143 mm) and Norman Wells (180 mm). A maximum hourly rainfall of 14.1 mm occurred in August 1998.

Furthermore, the mine site is expected to have precipitation characteristics that approximate an average of the Yellowknife and Lupin Extended AES climate stations. Precipitation data from these sites were also considered and are summarized in Table B.3 to Table B.7.

Table B.3 - Estimated Mean Monthly Rainfall, Snowfall and Total Precipitation

Month	Rainfall (mm)	Snowfall (mm)	Precipitation (mm)
January	0.0	28.0	28.0
February	0.0	25.5	25.5
March	0.1	25.4	25.5
April	2.0	15.6	17.6
May	13.0	5.8	18.8
June	21.4	0.2	21.6
July	33.7	0.0	33.7
August	38.2	0.2	38.4
September	26.7	4.6	31.3
October	12.7	34.7	47.4
November	0.3	48.7	49.0
December	0.1	35.9	36.0
Annual	**148**	**225**	**373**

Note: Snowfall and precipitation data are corrected for the snowfall undercatch by 1.70

Table B.4 - Extreme Annual Precipitation Estimates

Return Period (Years)	Extreme Annual Precipitation (mm)
2	341
5	398
10	441
20	484
50	535
100	572

Note: Snowfall and precipitation data are corrected for the snowfall undercatch by 1.70

Table B.5 - Estimated Probable Maximum Precipitation

Duration	Precipitation (mm)
1 day	383
30 days	450
Annual	988

Note: Based on AES Analysis for Diavik and Lac de Gras; annual value corrected for snowfall undercatch by 1.70

Table B.6 - Estimated Short-Duration Extreme Rainfall

Return Period (years)	Extreme Rainfall Intensity for Various Duration Events (mm/h)						
	5 minute	10 minute	30 minute	1 hour	2 hour	12 hour	24 hour
2	42.9	30.5	15.5	9.4	6.1	1.9	1.1
5	65.4	46.2	23.1	13.8	8.8	2.8	1.7
10	78.7	55.4	27.6	16.4	10.4	3.3	2.0
20	94.2	66.2	32.9	19.5	12.2	3.9	2.4
50	102.7	72.1	35.7	21.1	13.3	4.3	2.6
100	111.2	78.1	38.7	22.8	14.3	4.6	2.9

Note: Based on Yellowknife Airport values

Table B.7 - Estimated Long-Duration Extreme Rainfall

Return Period (years)	Extreme Rainfall Depth for Various Duration Events (mm)					
	1 day	3 day	5 day	10 day	30 day	60 day
2	20.2	27.5	31.4	37.3	61.1	90.0
5	29.6	38.9	43.6	52.5	82.1	118.8
10	36.5	46.5	51.9	63.6	95.6	137.1
20	43.9	54.0	60.0	75.2	108.8	155.4
50	54.6	64.1	71.5	91.9	126.5	178.5
100	63.8	72.2	80.5	105.9	140.3	196.2

Note: Based on Yellowknife Airport values

Lake Evaporation

Lake evaporation data considered for this mine site are summarized in Table B.8.

Table B.8 - Mean Monthly Lake Evaporation Estimates

Month	Estimated Lake Evaporation (mm)	Recommended Distribution of Annual Evaporation (%)
January	0	0
February	0	0
March	0	0
April	0	0
May	0	0
June	45	15
July	120	40
August	90	30
September	30	10
October	15	5
November	0	0
December	0	0
Total	**300**	**100**

Note: Based on Salmita and Koala mine sites

Hydrology

Hydrology data regarding natural basin runoff and runoff from various types of disturbed and reclaimed surfaces are summarized in Table B.9 and Table B.10, respectively.

Note: For design of water management systems at the North Pile starter cell, a runoff coefficient of 0.25 was applied to precipitation values to derive runoff quantities for various durations and return periods. This runoff coefficient was based on observations from the Diavik Diamond Mine. A recent (Golder 2004a) study of the Project Water Management Pond applied a runoff coefficient of 0.40 to more developed and compacted areas of the core facilities area. These values have been used in place of the conservative estimates presented in the EAR and in Tables B.9 and B.10.

Table B.9 - Runoff from Natural Surfaces

Parameter	Value
Small Basin 2 Year Wet Water Yield	273 mm
Small Basin 10 Year Wet Water Yield	353 mm
Small Basin 100 Year Wet Water Yield	458 mm
Small Basin 2 Year Flood	$Q = 1.60 A^{0.537}$ (Q in m^3/s; A in km^2)
Small Basin 10 Year Flood	$Q = 2.85 A^{0.537}$ (Q in m^3/s; A in km^2)
Small Basin 100 Year Flood	$Q = 3.20 A^{0.537}$ (Q in m^3/s; A in km^2)

Note: Based on runoff analysis

Table B.10 - Runoff from Various Types of Disturbed and Reclaimed Surfaces

Surface	Annual Water Yield	Rational Method Runoff Coefficient (3)
Mine and Plant Site (1) Roads (1) Rock and Paste Stockpiles (1)	2 Year: 324 mm 10 Year: 419 mm 100 Year: 543 mm	0.95
Reclaimed Surface (2)	2 Year: 273 mm 10 Year: 353 mm 100 Year: 458 mm	Use small basin equations from Table 2.9

Notes:
1) Based on conservative estimate
2) Based on runoff analysis
3) For use with rainfall intensities from Table B.9