Appendix 9

Groundwater Inflows and Inflow Water Quality Used for the Revised Doris North Project Amendment Package No. 3 to Water License No. 2AM-DOH0713 (SRK, November 2011)

SRK Vancouver
Suite 2200 - 1066 West Hastings Street
Vancouver, BC V6E 3X2

T: +1.604.681.4196
F: +1.604.687.5532

vancouver@srk.com
www.srk.com

Memo

To:	Bill Patterson	**Date:**	November 4, 2011
Company:	Hope Bay Mining Limited	**From:**	Dan Mackie and Tom Sharp
Copy to:	-	**Project #:**	1CH008.053
Subject:	Groundwater Inflows and Inflow Water Quality Used for the Revised Doris North Project Amendment Package No. 3 to Water License No. 2AM-DOH0713 - AMENDED		

Groundwater Inflows and Inflow Water Quality Used for the Revised Doris North Project Amendment Package No. 3 to Water License No. 2AM-DOH0713

This memo provides a description of the assumptions and methods SRK Consulting (Canada) Inc. (SRK) has used to estimate groundwater inflows and inflow water quality inputs to the water and load balance prepared for the revised Doris North Project, Nunavut.

Maniqap Imaa Immiqtuqvi Immap Qanugitnia Atuqtaunia taphumunga Nutanguqhimayuq Doris North Havanga Ihuaqhigiagut Katihimayut Nappaa 3 taphumunga Imaqmut Lasia Nappaa 2AM-DOH0713

Una tuhaqhit piqagutauyuq unniqtuqninik piniagahugiyauni pityuhitlu SRK-kut Qauyimayiuyut (Kanata) Nanminilgit (SRK-kut) atuqtai mikhauttaqninut maniqap imaqta immiqtuqvi immiqtuqvitlu immat qanugitni tapkununga imaq pitaqnitlu naamakhihimani hannaiyaqhimayut tapkununga nutanguqni Doris North Havanga, Nunavutmi.

ᓄᓇᐅᑉ ᐃᓗᐊᒍᑦ ᐃᒦᑦ ᑰᒃᑐᑦ ᐊᒻᒪᓗ ᐃᒥᖅ ᓄᓇᐅᑉ ᐃᓗᐊᓃᑦᑐᖅ ᖃᓄᐃᑦᑑᖕᒪᖔᖅ ᐊᑐᖅᑕᐅᒐᔪᖅᑐᖅ ᐋᖅᑭᐊᖅᑕᐅᓂᖅᐸᑕ ᐅᕗᙵᒐᙵᔪᑦ Doris North−ᒥ ᐱᓕᕆᕕᖕᒨᖕᒐᔪᑦ ᐋᖅᑭᐊᖅᑕᐅᒍᑎᒃᓴᖅᑭᓐᓅᖕᒐᔪᑦ No. 3_ᒥ ᐃᒥᖅᑲᕈᑎᒃᓴᖅ ᓚᐃᓴᑦ No. 2AM-DOH0713

ᐅᑯᐊ ᑎᑎᖅᑲᑦ ᐊᑐᐃᓐᓇᑦ ᐱᑕᖄᑦ ᐅᓂᒃᑳᖅᑲᖅᓯᑎᒃ ᖃᓄᐃᑦᑐᑦᓚᓇᒃᑕᖅᑲᒻᒪᖔᖅ ᐃᓱᒪᒋᔭᓂᒃ ᐊᒻᒪᓗ ᐋᑐᑎᔭᖏᑦ ᐅᑭᐊ ᐱᒃᑯᔨᔩᑦ SRK Consulting Inc.−ᑯᑦ ᑲᓇᑕᒥ, ᐊᑐᖅᑲᑦᑕᔪᒻᒪᑕ ᒪᓕᒡᓗᒋᑦ ᒥᒃᓴᐅᓴᖕᓂᖕᒋᑦᑎᒍᑦ ᓄᓇᐅᑉ ᐃᓗᐊᓂᖕᖔᖅᑐᖅ ᐃᒥᖅ ᐊᒻᒪᓗ ᑰᒃᑐᖅ ᐃᒥᖅ ᖃᓄᐃᑦᑑᖕᒪᖔᖅ ᐊᒻᒪᓗ ᖃᓄᐃᓪᓗᐊᖅᑎᕆᔪᒥᒃ ᐊᑐᖅᑕᐅᖅᑲᑦᑕᖅᑐᖅ ᑕᒪᒃᑯᓄᖕᒐᖕᒐᔪᓂᒃ ᐋᖅᑭᐊᖅᑕᐅᒐᔭᖅᒪᑦ ᐅᕗᖓᒐᖓᔪᑦ Doris North−ᒥ ᐱᓕᕆᕕᖕᒥ, ᓄᓇᕗᑦᒥ.

1 Introduction

Hope Bay Mining Ltd. (HBML) is submitting an application for amendment to Water License No. 2AM-DOH0713 to allow for an expansion of underground mining at the Doris North project. The area of expansion will extend into the talik, or unfrozen ground, underneath Doris Lake. Unlike the currently permitted Doris North mining area, which is completely within frozen ground to the north of Doris Lake, the expanded mine area will likely be subject to groundwater inflows.

This memo describes the basis for groundwater inflow and inflow water quality estimates used in the water and load balance presented as part of the permit amendment package.

2 Mine Plan & Schedule

The mine plan used as the basis for the estimates was provided by HBML and is shown on Figure 1. Mining areas included in this assessment include Doris Central Upper, Doris Connector Upper and Doris Lower as well as the development required to access these mining areas. The boundary between the Central and Connector areas is shown on Figure 1. The boundary between Doris Upper and Lower is defined by the diabase sill, also shown on Figure 1.

Mining of areas within the Doris Lake talik will occur over a period of two years, with a planned initiation date corresponding to the end of year two of mining at Doris North. The preferred mining method is still being assessed by HBML, but is anticipated to be some form of cut-and-fill. Access, including the main decline and spirals, will be developed first. Start and end dates for individual stopes are not specifically defined.

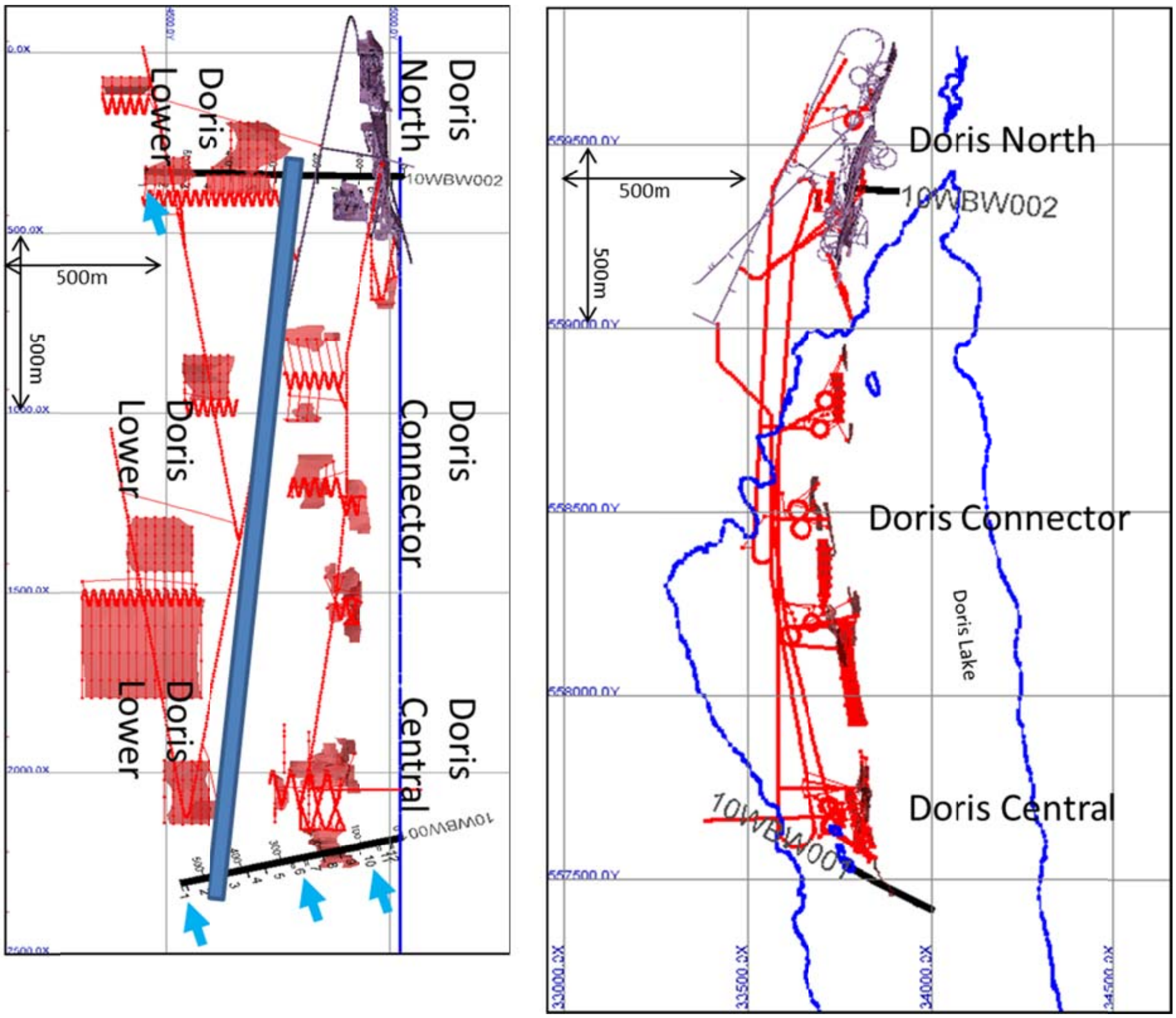

Figure 1: Map and Cross Section of Doris Mine Area

3 Available Hydrogeologic Information

Investigations related to mining of ore bodies under Doris Lake have been on-going since 2008. Information sources used as part of the groundwater assessment were as follows:

- SRK, 2009a. Geotechnical and Hydrogeological Assessment for the Doris North Open Pit and Doris Central Underground. Report prepared for Hope Bay Mining Limited. 143p plus appendices. SRK Project Number 2CH009.000, June 2009.
- SRK 2009b. Hope Bay Gold Project: Stage 2 Overburden Characterization Report. Report prepared for Hope Bay Mining Limited. 95p plus appendices. SRK Project Number 1CH008.002, June 2009.
- SRK 2011a. Hope Bay 2010 Westbay Program Data Report. Report prepared for Hope Bay Mining Limited. SRK Project Number 1CH008.013, February 2011.

- SRK, 2011b [inprep]. Hope Bay Updated Hydrogeologic Conceptual Models and Groundwater Inflow Estimates. Report in preparation to Newmont.

Hydrogeologic investigations have also been conducted during the 2011 ice drilling season. Data collected as part of these studies has included additional hydraulic testing and water quality sampling. Reporting has not yet been finalized for these investigations but data available at the time of preparation of these inflow quantity and quality estimates was incorporated.

4 Hydrogeologic Conceptual Model

The current hydrogeological understanding, or 'conceptual model' is based on information from hydrogeological field investigations completed by SRK in 2004, 2008 and 2010, ongoing thermistor monitoring at the site and updates to the geological model and mine plans by HBML, as were available in December 2010.

Based on available data, the hydrogeological system for the entire Hope Bay belt can be generally considered as a low flux, lake-dominated flow system. Regional flow is primarily controlled by the presence or absence of permafrost, which is widespread and deep away from lakes and considered to be essentially impermeable. Away from lakes, permafrost may exist to depths of 400 m below ground surface. Unfrozen zones under lakes (taliks) can provide connection between surface water and groundwater.

Definition of talik boundaries (the boundary between frozen and unfrozen ground) has been determined from thermistor strings installed at the various Hope Bay mining areas. In 2008, seven thermistor strings were installed specifically to define the presence and location of the boundary. Additionally, in 2010 a multi-level Westbay groundwater monitoring system (Well # 10WBW-001) was installed from a small island in the middle of Doris Lake to provide information in the vicinity of Doris Central, which is located approximately under the center of Doris Lake. In general, the talik boundary can be considered as a vertical plane extending downwards from the Doris Lake shoreline. Data collected from the Westbay well confirm that rock under Doris Lake is unfrozen and that the talik can be assumed to be connected to deeper groundwater.

Within taliks, the groundwater system is fracture-controlled. At the local scale, bedrock hydraulic conductivity is comprised of a relatively low bulk hydraulic conductivity background system intersected by discrete relatively high hydraulic conductivity fractures and, geologic structures. Fracture apertures may be more open at shallow depths, hence higher permeabilities due to lesser confining pressures or relationships with different lithologies. Assuming constant fluid properties, hydraulic conductivity may also be higher. Geologic structures are present in all mining areas that may influence groundwater pathways.

Hydraulic conductivity information available for estimating inflows is available from multiple field programs. These include:

- 25 packer injection tests conducted around the Doris Central area in 2008/09;
- 15 packer tests conducted during installation of the Westbay well in 2010;
- More than 30 additional tests conducted in 2011. Only some of the 2011 data was available when the inflow estimates presented herein were calculated; and
- 7 cone penetrometer (CPT) pressure-dissipation tests conducted in sediments lining the bottom of Doris Lake.

4.1 Sources of Inflows

Doris Lake represents a significant source of water that could have an influence on inflows. Once mining areas are established, the surface water elevation of the lake will be a primary control on gradient towards the development areas within the talik (head difference equal to lake elevation minus elevation of stope). Water within the lake will represent a large source of available recharge to the underlying bedrock groundwater system. Low permeability silt and clay sediments lining the bottom of the lake may impede the rate of recharge. Inflows to the mining areas within the talik are likely to come from three sources:

4.1.1 Fractured Bedrock

Water flowing along joints in the fractured rock will permeate into the underground workings. Hydraulic testing data suggests that shallow bedrock and/or the ore zone and surrounding altered zones may have relatively high hydraulic conductivities compared to greater depths and other lithologies (e.g., $9x10^{-8}$ m/s for shallow rock vs. $2x10^{-8}$ m/s for deep rock). Available data indicates that the diabase sill underlying the area of development has significantly lower hydraulic conductivity ($2x10^{-11}$ m/s) which may reduce the inflows to Doris Lower, at depths of 300 – 750 m below the lake. A summary of average hydraulic conductivities is presented later in this report.

4.1.2 Structures

Multiple geologic structures are present, some of which may have relatively high permeability and will intersect the development. Individual faults and permeable sections of the contact with the diabase dyke may produce water when intersected by mining development, either: stopes, ramps or cross-cuts, or both. The likelihood of intersecting such structures is considered high, though uncertainty exists regarding specifically where or if they will act as conduits.

4.1.3 Former Exploration Drill Holes

A large number of exploration drill holes have been completed within the Doris Central area. The condition of a majority of these is unknown. Many of these intersect the proposed mining areas. For drill holes completed prior to 2008, there is uncertainty as to if and how these drill holes were sealed upon completion.

As these exploration holes were collared on ice, surface casing was pulled. Therefore, there is no way to assess their condition. It is possible that many of these became plugged with lake sediments upon casing retrieval, if not purposely sealed, but the possibility cannot be ruled out that some drill holes may convey water when intersected by mining. The potential for inflow from open drill holes to Doris Central was discussed in the report 'Geotechnical and Hydrogeological Assessment for the Doris North Open Pit and Doris Central Underground, SRK, June 2009'.

5 Underground Water Management

Management of underground inflows will be on-going effort. Inflows from the fracture-controlled groundwater system are anticipated to be heterogeneously distributed and often discrete, as opposed to flows that would be anticipated from a more homogeneous porous media such as, for example, a sand aquifer. At this stage, a specific management plan has not been developed, but a number of different conventional strategies are under consideration. These include:

- Probe drilling ahead of development to identify areas of high water pressure or inflow and the capacity for pressure grouting.
- Grouting discrete fractures or structures as they are identified.
- Having equipment and materials available to plug exploration drill holes as quickly as possible.
- Planning development and stopes to avoid areas of known higher permeabilities or exploration hole densities.
- Installing water tight bulkheads at key locations.
- Scheduling the mining to minimize the total area open at a given time by sealing off areas that are mined out.
- Using a mined out stope to provide surge capacity.

It is likely that a number of these strategies will be implemented to provide flexibility in the manner of response. In practice, due to the heterogeneous nature of the fractured bedrock groundwater system, most inflow locations to the mine will not be known until mining is underway and, ultimately, management plans will aim to minimize the total inflow at any given time.

6 Methods

6.1 Inflow Quantity

Estimates of groundwater inflow quantity have been determined using available hydraulic conductivity data and a combination of analytical and numerical calculation methods. Inflows for use in the water balance included those from the bulk fractured bedrock system and exploration drill holes. Methods for each of these components are described below and followed by a description of how they have been incorporated into the water and load balance.

6.1.1 Bedrock Inflow

At this stage, the exact location of discrete structures or fractures along which flow may occur is generally uncertain, thus an "equivalent porous medium" approach has been used to estimate fractured bedrock inflows. This approach assumes that the fractured bedrock can be represented by a bulk hydraulic conductivity, similar to a porous medium such as sand. This approach is considered reasonable for mine-scale inflow estimates and has been applied at many other mine sites in Canada.

Inflow from fractured bedrock was assessed using the numerical groundwater code Feflow, a commercially available code produced by DHI-Wasy of Germany. Multiple model configurations were constructed to assess variation in inflow to underground workings of different geometric shape (i.e., length, vertical height and width) and depth below Doris Lake. Correlations between inflow rate, geometric shape and depth were then developed based on the numerical results to allow estimation of inflow to any given stope. The primary benefit of this approach is that it provides the ability to add inflows from individual stopes in any order or combination. Figure 2 illustrates the general numerical domain used to quantify stope inflow.

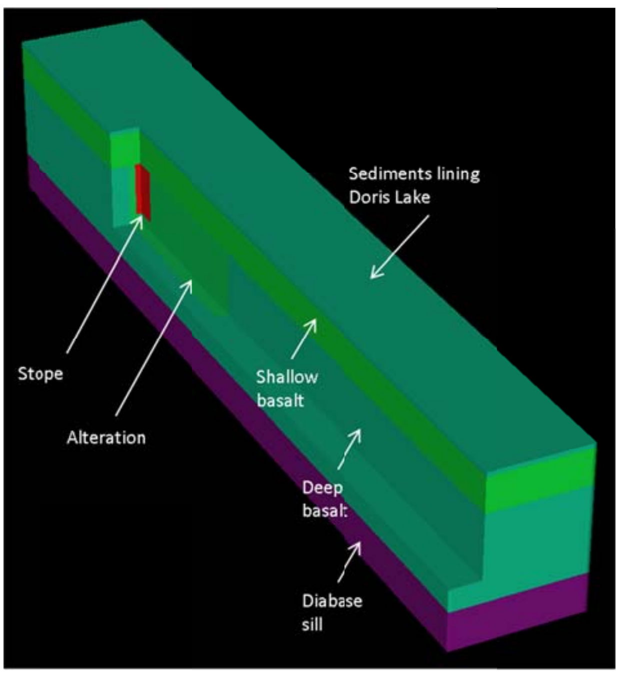

Figure 2: Inflow Numerical Model

Inflow to mine development (i.e., decline, ramps and spirals) was determined using the same numerical domain, but with development incorporated using what are called "discrete elements" in Feflow terminology. Discrete elements are essentially pipes of infinite hydraulic conductivity and a set cross-sectional area that can be inserted in the numerical mesh to simulate tunnels (e.g., the main decline).

Cumulative inflows were calculated by adding inflows for individual stopes and related access development plus the decline. The following assumptions and/or parameters were applied:

- Geometric mean of bedrock hydraulic conductivity for each hydrogeologic domain.
  - Shallow Bedrock (0 to 100m below lake bottom) 9×10^{-8} m/s
  - Deep Bedrock (100 to 300m below lake bottom) 2×10^{-8} m/s
  - Alteration/ore zone (100 to 300m below lake bottom) 5×10^{-8} m/s
  - Diabase sill (300 to 400m below lake bottom) 2×10^{-11} m/s
- Doris Lake is a fixed head boundary (i.e., an infinite supply of water at a given lake elevation).
  - Doris Lake sediments hydraulic conductivity 2×10^{-8} m/s
- Permafrost surrounding Doris Lake is impermeable.
- Stopes are fully developed (i.e., inflow estimates are for an entire stope area).
- The decline and ramps are fully developed (i.e., simulated for maximum length).
- Stope backfill has no effect on limiting inflow.
- No water management strategies are assumed to be implemented (i.e., inflow is unimpeded).

6.1.2 Results

Table 1 summarizes inflows to 10 individual stopes and development access. Values in the “Total Flow” column represent cumulative inflow to a given stope number plus inflow to any preceding stope (e.g., Total Flow for stope 10 equals the inflow to stope 10 plus inflow from stopes 1 to 9).

Table 1. Summary of Inflows

Stope -	Vol. m^3	Flow Stope (m^3/d)	Flow Backfill (m^3/d)	Flow Decline (m^3/d)	Flow Ramp (m^3/d)	Total Flow (m^3/d)
1	6,000	270	0	975	185	1430
2	45,000	553	270	975	370	2168
3	18,000	278	823	975	370	2446
4	45,000	411	1101	975	555	3042
5	35,000	442	1512	975	555	3485
6	76,000	661	1955	975	740	4330
7	78,750	461	2615	975	740	4791
8	725,760	1049	3076	975	925	6024
9	60,000	624	4124	975	925	6648
10	15,000	172	4748	975	925	6820

Source: U:\1CH008.053_GW Mgt & Phase 2 GW\020_Project_Data\SRK\3D Doris Model\HOPE BAY_Flow Estimation_20110416.GF.xls

<u>Notes on Table 1:</u>

- “Flow Stope” represents inflow to a given stope at full size
- “Flow Backfill” represents cumulative inflow to stopes up to that specific number (e.g., for Stope 3, the “Flow Backfill” represents flow into stopes 1 and 2, which are assumed to be mined and backfilled. Backfill has no effect on inflow rate.
- “Flow Decline” represents inflow to the main decline when fully developed.
- “Flow Ramp” represents inflow to spiral and ramp associated with a given stope.
- “Total Flow” is the cumulative inflow for any row in a table. Total flow for stope 1 represents inflow to that specific stope, the decline and ramps. Total flow for stope 10 represents cumulative inflow to all stopes, plus the decline and cumulative flow to all ramps and spirals.

6.1.3 Estimating Groundwater Inflows

Quantifying groundwater inflow to the mine workings is difficult because of uncertainty and variability in the parameters used to estimate groundwater flow. In this analysis, groundwater inflow is assumed to be only proportional to the hydraulic conductivity estimate because the boundary conditions of the model do not change. The most likely hydraulic conductivity for each hydrogeologic domain is the geometric mean of the observed hydraulic conductivities within a domain and this geometric mean hydraulic conductivity is used to be to estimate groundwater inflow.

6.1.4 Bedrock Inflow for Water Balance

Without a mining schedule, it is not possible to estimate the specific change in inflow over time. To account for increased mining areas developing over time, two inflow periods were assumed for the water balance:

- Period 1, corresponding to mining year 5, 50% of cumulative inflow was assumed = 3,500 m^3/day.
- Period 2, corresponding to mining year 6, 100% of cumulative inflow was assumed = 7,000 m^3/day.

6.1.5 Drill holes

Exploration drill holes were not explicitly included in the numerical model. Based on a general review of mine plans, assumed mining rates and exploration drill hole locations, two exploration drill holes are assumed to be the maximum number that might be intersected at a given time in a given stope. Flow through an open NQ-diameter exploration drill hole (75.7mm) was assumed to be 2,680 m^3/day from calculations based on the Darcy-Weisbach equation.

For the water balance model, 0, 1 or 2 drill holes were randomly turned on over a given model time step and assumed to flow unimpeded for a period of one week, at which point, it was assumed that the drill hole was plugged.

6.2 Inflow Quality

Estimates of groundwater quality that may be observed during operations are based on results from Westbay well 10WBW001, a multi-level monitoring system which was completed in 2010 within the Doris Lake talik of the Doris Central area. Westbay wells can be thought of as multi-level piezometers with multiple “screen zones” at various depths allowing sampling, water level measurement or hydraulic testing at each point. Each of the monitoring zones is hydraulically isolated at the top and bottom by pneumatic packers. Each zone has a measurement port from which samples can be collected using specialized wireline tools and a larger pumping port that can be used for zone development or hydraulic testing.

The Doris Central Westbay well was designed to provide pressure and temperature profiles throughout the talik under Doris Lake and to provide water samples from different depths to characterize the chemical profile and the interaction between deep connate groundwater and the fresh lake water at the surface. The deepest sampling zone was set below the diabase sill to provide water quality from that hydrogeological domain. The middle sampling zone was set in the area where water was lost during drilling and the packer testing indicated high hydraulic conductivities. Monitoring zones are numbered from the bottom up. Therefore, Zone 1 is at the bottom of the well, and higher numbered zones are shallower.

Three zones were selected for sampling at Doris Central to provide water quality samples from shallow, medium and deep talik water.

Table 2 below shows which zones were targeted and what they represent. Westbay well locations and monitoring zones are shown on Figure 1. Figure 3 is a cross section through 10WBW001 with geology, Westbay zones and hydraulic conductivity results indicated.

Table 2: Zones Targeted for Water Quality Sampling

Well	Zone	Vertical depth (m)	Deposit	Representative Of
10WBW001	10	57-97 m	Doris Central	Shallow talik water, near the upper parts of the proposed Doris Central stopes.
	6	221-246 m		Medium depth talik water, around the area of the proposed Doris Central stopes, possibly influenced by nearby faults.
	1	485-495 m	Doris Central Lower	Deep talik water, below the diabase.

Source:\01_SITES\Hope.Bay\1CH008.013_2010_Westbay_Installation\080_Reporting\20110125 Westbay Data Report\Tables\Table 2 Zones targeted for sampling.xlsx

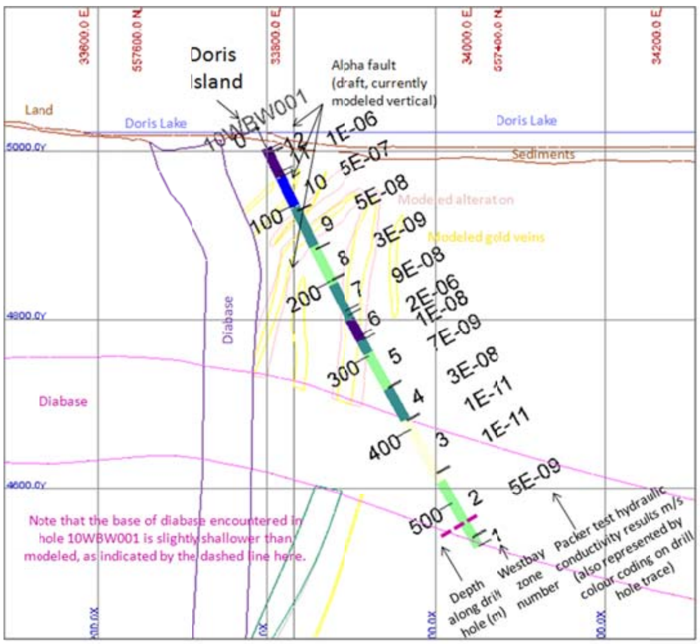

Figure 3: Cross section along drill hole 10WBW001, showing Westbay zones and related packer test results

6.2.1 Method for Purging Drilling Water from the Targeted Zones

The Doris Central well was drilled using fresh lake water, which must be removed from the Westbay zones to enable sampling of the natural groundwater. SRK field staff purged the drilling water from each of the target zones using an airlift pumping method, monitoring field parameters and taking laboratory samples to measure water quality changes as the drill water in the zone was replaced with formation water.

The procedure involved opening the pumping port in a target zone and then injecting compressed air into the internal Westbay PVC pipe above the pumping port. This caused water to flow from the zone into the Westbay internal pipe, displacing the water lifted from the well.

Water quality samples for lab analysis were collected during and at the end of the purging to allow assessment of purge progress, or stabilization of water quality, over time. Samples were also taken for QA/QC including duplicates, rinsate blanks, samples of the drilling water and water samples from the Westbay. A full description of the well and purging process is contained in the report '*Hope Bay 2010 Westbay Program Data Report, SRK, (in progress)*'. Table 3 lists purging information below.

Table 3: Purging Volumes and Methods Used

Zone	Volume of One Zone (L)	Volume Removed (L)	# of Zone Volumes Removed*
10	264	3014	11.0
6	168	Initially 8,096 L; after bulk sample 13,592 L	Initially 46.6; after bulk sample 79.3
1	96	3192	27.5

Source: \01_SITES\Hope.Bay\1CH008.013_2010_Westbay_Installation\080_Reporting\20110125 Westbay Data Report\Tables\Table 3 Purging volumes all targeted zones.xlsx

* Note that for zones purged using the airlift method, the volume of glycol water purged from inside the Westbay was subtracted from the calculation of # of zone volumes removed.

6.2.2 Sampling Methods

After sufficient volumes had been purged from the well, samples representing the groundwater were obtained using two sampling methods: the airlift pumping method and the Westbay sampler bottle method. When reviewing the water quality sample results, the method used to obtain the sample should be considered, as it has an effect on certain parameters:

- Grab samples of the airlift discharge taken at the surface have undergone considerable aeration before sampling. The addition of air to the water changes the concentration of the parameters (eg: alkalinity, redox, isotopes, and other parameters) for chemical analysis. The water samples that were collected during airlifting may not be representative of the formation water. However, as the inflowing mine water would likely be aerated through pumping in the mine, they do provide an interesting comparison with the measurement port samples.
- Measurement port samples collected directly from the zones down hole using a specialised tool do not come into contact with the atmosphere until they are poured into sample bottles at the surface. However, parts of the sample become highly aerated when they are depressurized through the sampler valve to fill the sample bottles. For most parameters, they are considered to be more representative of actual formation water than the airlifted samples.

6.2.3 Lab Analysis Methods

Samples were analysed for routine parameters, total dissolved solids (TDS), total metals, dissolved metals, nutrients, and stable isotopes.

Initial samples, taken during the purging process and at the end of the airlift, were analyzed using the traditional methods of ion chromatography, Inductively Coupled Plasma Mass Spectrometry (ICP-MS) and Inductively Coupled Plasma Optical Emission Spectrometry (ICP-OES). These samples had high detection limits and therefore some parameters were not included in the statistics for the summary water chemistry tables, discussed in the next section. To achieve better detection limits, the analysis method was changed after the initial sampling rounds. All subsequent groundwater samples collected were analyzed using High Resolution Inductively Coupled Plasma Mass Spectrometry (HR-ICPMS). These are labelled 'seawater' analysis in the water quality results table.

The stable isotope samples for oxygen and deuterium were analyzed by Gas Isotope Ratio Mass Spectrometry (GIRMS).

6.2.4 Mine Inflow Water Quality

The groundwater quality results for Zones 6 and 10 are assumed to be representative of the expected initial range in inflowing water quality at Doris Upper mine areas. The results from Zone 1 are assumed to be representative of the initial inflows to the Doris Lower mine areas. Over time, inflowing groundwater is assumed to trend towards the lake water quality. It is not currently possible to estimate the time frame over which this may occur.

To allow for flexibility in the future mining planning, it was assumed that the mine inflows could be from either Doris Upper or Doris Lower, or from a combination of both at any time over the life of the mine water discharge. To be conservative in representing these scenarios in the water and load balance, for each parameter the highest of the 75^{th} percentile concentration from either Zone 1 (Doris Lower) or Zones 6 and 10 (Doris Upper) was used.

Table 4 presents the 75^{th} percentile concentrations for all samples, each zone grouping, and the max of either zones 1 or 6 and 10, as was input into the water balance.

Table 4: 75th Percentile of Doris Central Sample Results

			DORIS CENTRAL			BOSTON	
Parameters		Units	ZONE 10 57-95m Below Lake	ZONE 6 221-246m Below Lake	ZONE 1 485-491m Below Lake	ZONE 6 271-380m Below Lake	Average Seawater*
			11-Apr-11	11-Apr-11	11-Apr-11	23-Apr-11	
Zone Volumes Developed		#	11	79.3	27.5	1.7	--
Field Parameters	pH	pH units	7.32	7.71	7.79	7.13	--
	EC	S/cm	>20	>20	>40	36	--
	DO	g/L	n/a	n/a	n/a	7.86	--
	Salinity	%	n/a	n/a	n/a	2.3	--
	ORP	mV	n/a	n/a	n/a	-80	--
Lab Parameters	pH	pH units	7.59	7.67	7.09	7.00	--
	Total Dissolved Solids (gravimetric)	mg/L	37800	36100	41200	25300	--
	Alkalinity, Total (as $CaCO^3$)	mg/L	119	49.8	2.7	35.4	--
Dissolved Metals	Chloride (Cl)	mg/L	18800	18300	19000	13000	19400
	Sulfate (SO_4)	mg/L	1730	1780	944	295	2700
	Aluminum	mg/L	<0.0050	<0.0050	<0.0050	<0.0050	0.001
	Arsenic	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	0.003
	Cadmium	mg/L	0.00013	<0.00005	<0.00005	<0.0001	0.0001
	Calcium	mg/L	1560	1400	4770	4500	411
	Chromium	mg/L	<0.0005	<0.00050	<0.00050	<0.0001	0.0002
	Cobalt	mg/L	<0.0005	<0.00050	<0.00050	0.00504	0.0004
	Copper	mg/L	<0.0005	<0.00050	0.0083	<0.0005	0.0009
	Iron	mg/L	5.8300	0.624	0.034	0.233	0.003
	Lead	mg/L	<0.0003	<0.00030	<0.00030	<0.0003	0.0000
	Magnesium	mg/L	1200	1270	71.2	404	1290
	Manganese	mg/L	1.20	1.22	0.731	0.840	0.0004
	Molybdenum	mg/L	0.0038	0.0311	0.0112	0.0878	0.01
	Nickel	mg/L	0.00073	0.00100	0.00163	0.0167	0.0066
	Potassium	mg/L	251	208	39	51	392
	Selenium	mg/L	<0.0020	<0.0020	<0.0020	<0.0020	0.0009
	Sodium	mg/L	8700	8270	7020	2400	10800
	Zinc	mg/L	0.0708	0.154	0.157	0.104	0.005
Isotopes **	δD	‰, V-SMOW	-106.52	-96.7	-135.4	-136	n/a
	δ18O	‰, V-SMOW	-13.49	-12.8	-18.63	-17.67	n/a

Source: \\VAN-SVR0\Projects\01_SITES\Hope.Bay\!Project_Data (Not Job Specific)\04 Groundwater Chemistry\6_Working and Graphs\2011-06-06 Water Quality Table Rev02.xlsm

*Average seawater composition from *1 Seawater composition from: http://www.seafriends.org.nz/oceano/seawater.htm#composition

** Isotopes reported are from Fall 2010 sampling event. Results from the April 2011 sampling event were not available at the time this report was prepared. For comparison, Doris Lake water has **δ**D ‰ of -159.7 and $\delta^{18}O$ ‰ of -19.25.

7 Conservatism and Limitations

At this stage of investigations, uncertainty remains in regards to expected inflows and inflow water quality. In order to address these limitations, conservative assumptions have been used. For inflows, the assumption of an equivalent porous media with an isotropic and homogeneous hydraulic conductivity is considered conservative in that much of the fractured bedrock will essentially have no flow. While discrete fractures or structures may exist, these features will be managed or controlled on an as-needed basis.

For inflow water quality, the volume of water within bedrock fractures in the vicinity of the mine workings is not infinite. Over time, it can be anticipated that water from Doris Lake will permeate into the subsurface, likely leading to relatively lower concentrations of many parameters.

The estimates provided herein are based on the available data. As further investigations are completed, additional information will become available allowing refinement of estimates. During operations, it is reasonable to assume that variations from these estimates could occur. Development of water management plans and strategies will reduce the risk related from these variations.

Regards

SRK Consulting (Canada) Inc.

Dan Mackie
Senior Consultant

Tom Sharp, P.E., Ph.D.
Principal Consultant