Hydrogeological Characterization Report
Pogo Mine
Alaska

Report Prepared for

Sumitomo Metal Mining Pogo LLC

Report Prepared by

SRK Consulting (U.S.), Inc.
SRK Project Number 147900.020

May 14, 2014

Hydrogeological Characterization Report
Pogo Mine
Alaska

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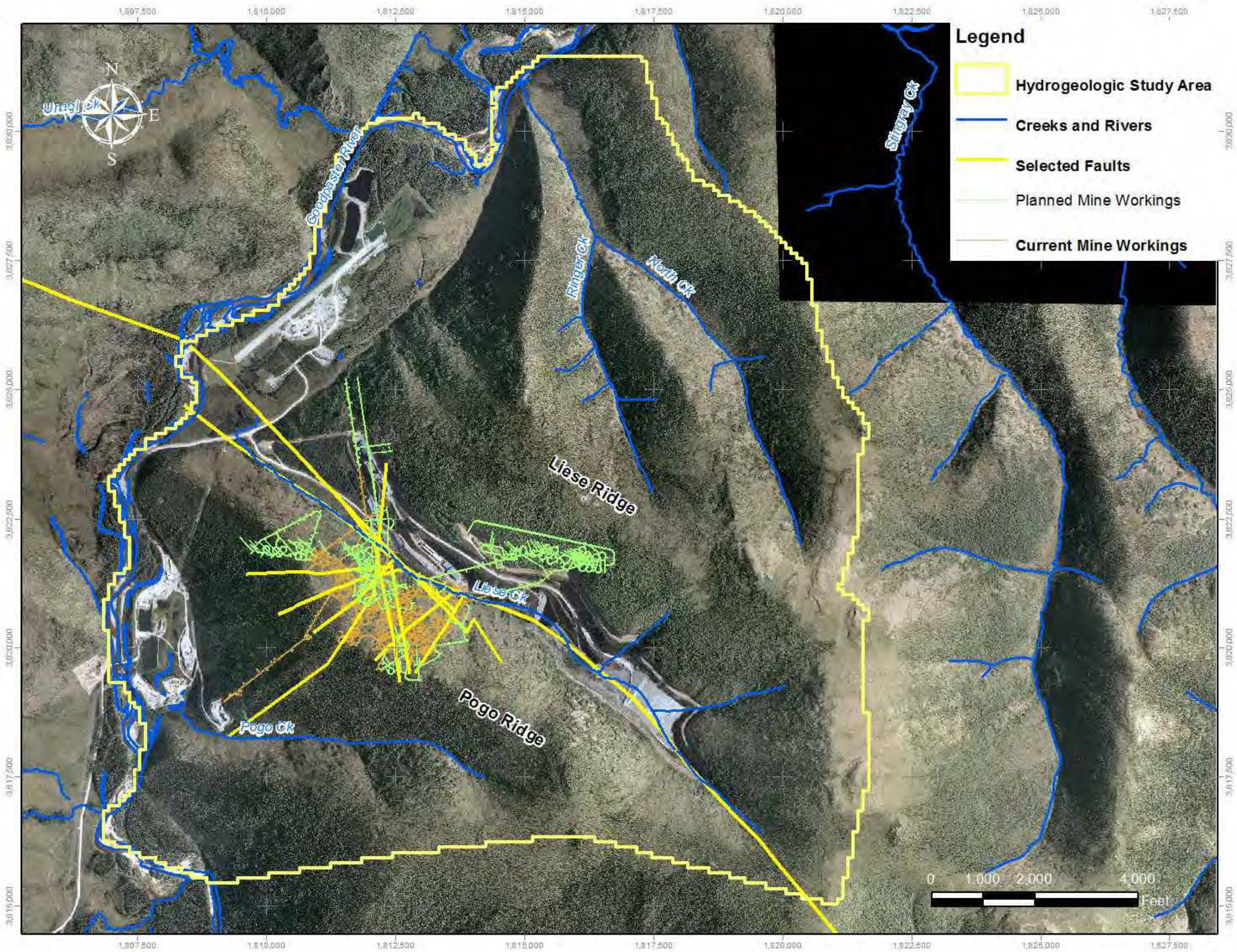
1 Introduction

Pogo has experienced groundwater inflows that have significantly affected mine production. With the development of East Deep orebody, there is concern that additional volumes of inflow could further affect mine production and require increases in the capacity of the mine water management system. SRK conducted a characterization of the hydrogeology of at the Pogo with the express purpose of estimating the inflow that is expected from the development of the East Deep orebody. The characterization was conducted to the extent necessary to construct a numerical groundwater flow model to predict that inflow. The area of the hydrogeological study is shown on **Figure 1**. The work carried out by SRK enabled characterization of:

- The hydrogeologic properties of the rock mass, lithologic contacts, and faults to establish the basis for predicting inflow to the East Deep orebody. The results of the work allows Pogo a basis with which to design upgrades to the underground water management system, and to upgrade the capacity of the water treatment plant (WTP); and
- The potential sources of inflow, with a focus on quantifying the recharge to the crystalline rock flow system beneath the alluvium of the Goodpaster River. The characterization focused on an evaluation of equilibrated hydraulic pressures and inflows related to the diorite dike along the southwestern (near) margin of the East Deep orebody, and the geologic faults that are or are suspected to be associated with the large inflows at high pressures intercepted in the underground working area.

SRK conducted field hydraulic testing and sampling programs during the summers of 2012 and 2013 to augment the large existing database of information developed during past investigations including environmental baseline, geotechnical and hydrogeological work to support design and feasibility studies, and subsequent hydrogeological studies to address increases in inflow to the underground mine working area. The SRK investigation culminated in the development of a numerical groundwater flow model to predict inflow to the East Deep orebody.

This document presents the findings of the characterization and modeling efforts. The body of the report serves as a summary of the findings, with the details provided in appendices. Appendices A and B are the field investigation reports for 2012 and 2013, respectively. Appendix C presents a SRK memorandum of an assessment of existing Pogo ground temperature data and the conditions of permafrost at Pogo. Appendix D is the groundwater modeling report.



srk consulting	SUMITOMO METAL MINING CO., LTD.	HYDROGEOLOGICAL STUDY
		HYDROGEOLOGICAL STUDY AREA
SRK JOB NO.: 147900.020	POGO UNDERGROUND MINE IN ALASKA	DATE: APR. 2014 · APPROVED: LC · FIGURE: 1 · REVISION NO. A
FILE NAME: 147900.020.Rev.A.Fig.1.Base.Map.Of.Hydrogeological.Study.Area.Defined.By.Numerical.Boundary.2014-03-28.dwg		

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2 Scope of the Project

The project was carried out by compiling a large amount of data from investigations done during early development of the Pogo mine and combining those data with specific targeted data collected by SRK during the field programs of 2012 and 2013. Much of the data collected during those two field programs focused on specific areas of the site critical to understanding current hydrogeologic conditions and which filled gaps in the coverage of data from the previous investigations. The work was conducted in concert with, and as an extension of, the ongoing Pogo exploration drilling projects conducted at the surface each field season between May and October.

Existing hydrogeological data compiled with the data SRK collected in 2012 provided the information needed for a preliminary conceptual model that explained the movement of groundwater through the site, the rates, mechanisms, and locations for recharge and discharge of groundwater, and the overall balance of water at the site in light of historic and ongoing pumping from the workings. The conceptual model served as the basis for the construction of a preliminary numerical groundwater flow model during the fall and winter of 2012/2013. From the initial numerical model, a second phase of data collection was identified to improve calibration and the confidence of the predictions of future inflow to the East Deep Expansion. The filling of “data-gaps” in the second phase targeted specific geologic and inflow structures and provided the areal coverage of water levels over the existing workings with which to calibrate transient (i.e., temporal) changes from groundwater drainage into the underground openings.

3 Previous Investigations

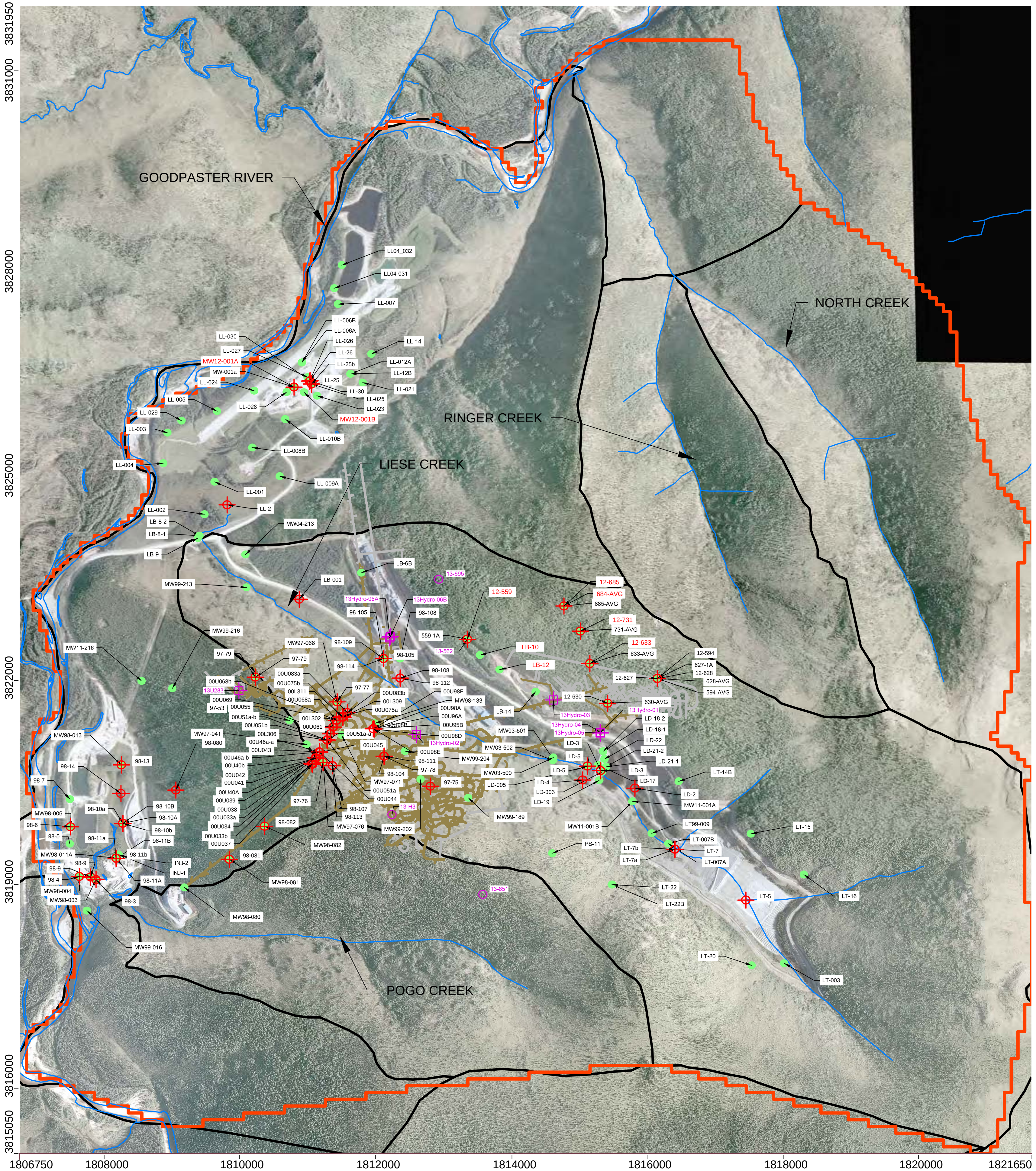
Large amounts of hydrogeologic data have been collected at the Pogo mine site. Reports from pre-mining studies including baseline environmental investigations, feasibility studies, plans of operation, and associated supporting studies were reviewed and the data from those documents extracted or provided through the Pogo EDMS database. The documents of previous investigations, included:

- Golder. Hydrogeological Investigations, February, 1998;
- Golder. Hydrogeological Regime Goodpaster River Valley and Proposal Exploration Adit, June 1998;
- Golder. Hydrogeological Modeling of Goodpaster River Valley, June, 1998;
- Golder. Technical Memorandum No. 1, Field Investigations and Results, October, 1998;
- Golder. Technical Memorandum No. 2, Characterization of Hydrogeological Regime, October, 1998;
- Golder. Technical Memorandum No.3, Hydrogeochemical Summary, October 1998;
- Golder. Technical Memorandum No. 4, Predicted Inflows to the Proposed Exploratory Adit, October 1998;
- Adrian Brown Consultants. Pogo Project Mine Inflow, July 2000;
- Amec. Geotechnical and Hydrogeological Characterization Program, February 2001;
- Amec. Pogo Feasibility Study, 2001 Geotechnical and Hydrogeological Characterization Program, December 2001;

Pogo Environmental and Geology departments provided substantial amounts of geologic, engineering, and environmental data, including:

- Vulcan geologic block model with lithology, veins, and structures;
- Vulcan mine developments of both the existing Liese Zone and planed East Deep;
- ACAD files of the advance of the 1525 exploration tunnel;
- Surface topography and facilities in ACAD and ArcGIS;
- Query tables from EDMS of environmental monitoring data including water levels and water chemistry;
- Well construction diagrams for selected monitoring wells; and
- Monthly mine water management data.

Those data, compiled with the data collected during the SRK field programs are described in Section 5. The locations of the wells, piezometers, and drill holes that formed the project database are shown on **Figure 2**.



LEGEND:

- EXISTING MINE
- PROPOSED MINE
- GROUNDWATER MODEL BOUNDARY
- MW-0 HOLES/WELLS WITH MEASURED WATER LEVELS
- MW-0 HOLES/WELLS WITH MEASURED HYDRAULIC CONDUCTIVITY
- 13-0 UNDERGROUND SHUT IN DRILLHOLES 2013
- CREEKS/RIVERS

NOTE:
PIEZOMETERS, WELLS AND UNDERGROUND SHUT-IN DRILLHOLES INDICATED WITH RED LABELS

N

NOT TO SCALE

srk consulting	SUMITOMO METAL MINING CO., LTD.	HYDROGEOLOGICAL STUDY **DRILLHOLES, WELLS, AND PIEZOMETERS USED IN HYDROGEOLOGICAL CHARACTERIZATION**
SRK JOB NO.: 147900.020 FILE NAME: 147900.020.Rev.A.Fig.2.Loc.Drillholes.2014-04-01.dwg	POGO UNDERGROUND MINE IN ALASKA	DATE: APR. 2014 · APPROVED: VU · FIGURE: 2 · REVISION NO.: A

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4 SRK Investigations

As described above, the objectives of the SRK field programs was principally to collect the data needed to establish a reasonable conceptual model of the hydrology and hydrogeology at the site, and establish locations for ongoing monitoring of surface and groundwater. A staged approach was employed whereby the data collected early in the program were used to further the understanding of the groundwater flow system, and to ultimately construct a numerical groundwater model. With the results of that model, gaps in the data were identified that became targets for data collection during the second field program. Each field campaign was documented with a field report. The report for the 2012 field work is presented as **Appendix A**. **Appendix B** presents the report of the 2013 field program.

4.1 Summary of the 2012 and 2013 Field Programs

The scope for the 2012 field program consisted of the following activities:

- Tests to estimate hydraulic parameters of the rock units, fault structures and veins encountered by core holes being drilled for detailed exploration of the East Deep area. Piezometers were installed into eight drill holes located on the ridge and southern flank of Liese Ridge to enable monitoring of the potentiometric surface;
- Pumping tests of water supply Well#1 and Well#2; these two wells were installed in early 2012 to supply the exploration core rigs drilling into the East Deep deposit;
- Installation and testing of an alluvial/bedrock well pair located near the air strip. The purpose of the wells was to evaluate the communication between the bedrock and Goodpaster alluvium, which is the area of groundwater discharge from the adjacent mountains, including Pogo and Liese Ridges;
- Hydraulic testing of three near-horizontal underground coreholes located on the 1170 and 1300 level access drifts to East Deep;
- Sampling and flow measurement of streams outside the area of past investigations, but within the project study area encompassed by the groundwater model domain; and
- A review of existing ground temperature data and an assessment of the current conditions of permafrost site. The work was documented in a memorandum, provided here as **Appendix C**.

The data were evaluated and combined with relevant data from previous investigations to form the basis for a conceptualization of the groundwater flow system represented by a "conceptual" groundwater model, and provide the data with which to construct a numerical groundwater flow model to simulate the flow system and predict future inflows to the underground mine openings. The initial model that served to identify the additional data needed to strengthen the model results. The scope of the 2013 field program was defined specifically to collect those needed data. The numerical model is documented in detail and presented here as **Appendix D**. The objectives for the 2013 field program were to: 1) Obtain potentiometric water levels in Pogo Ridge above the existing workings to provide current water table elevations for comparison against pre-mining elevations and used as a basis for transient calibration of the numerical model, and 2) conduct hydraulic testing of specific faults and contacts for refinement of the conceptual model and provide values for hydrostatic pressures and hydraulic conductivity of the targeted features. The work conducted for the 2013 field program consisted of the following activities:

- Installed piezometers in six surface coreholes. Five of the six were planned geology exploration drill holes, and one was a hole dedicated to the hydrogeologic characterization;
- Drilled and tested seven underground coreholes which were drilled for the project with specific targets to evaluate hydraulic conditions in principal faults and at the contact of the diorte intrusive with the country rock. The collar of each drill hole was fitted with a shut-in assembly to enable monitoring of hydrostatic head and valved to enable sample collection for water quality analysis ; and
- Established on-going water level monitoring in the surface piezometers and pressure and periodic sampling of the underground drillholes.

The locations of the installations and testing of piezometers and underground drill holes are presented in **Figure 3**.

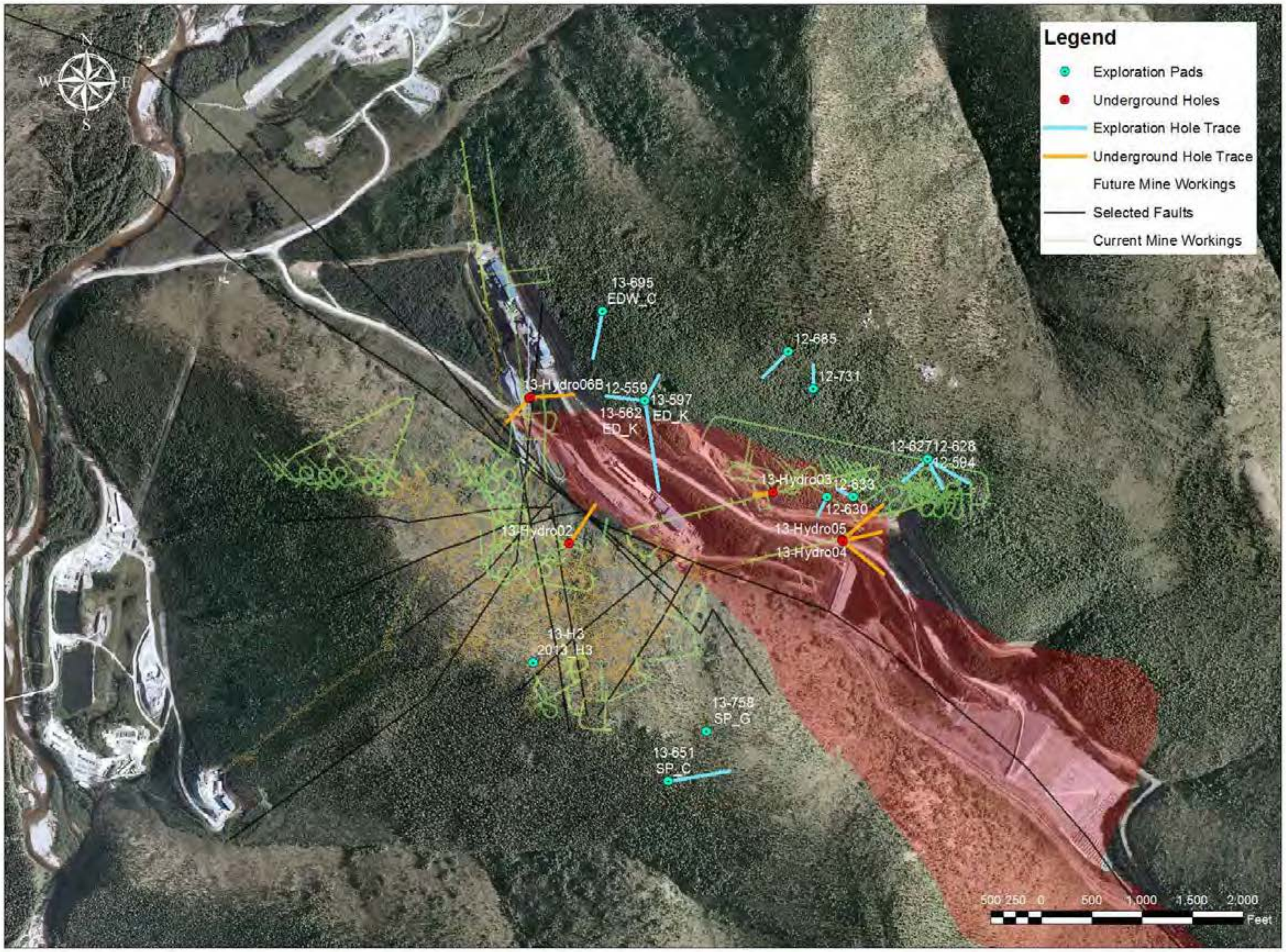
4.2 Key Findings of the SRK Field Programs

Values calculated from the hydraulic tests from both the surface and underground were relatively uniform and lie within the range of values obtained during previous investigations. A summary of the calculated values for hydraulic conductivity obtained from tests conducted by SRK is presented in **Table 1**. A detailed discussion of the test results is presented in Appendices A and B.

The structures targeted by the underground holes yielded estimates for hydraulic conductivity that are similar and within the range of values for the tests conducted in the surface holes that did not target structures. Further supporting the observation that large inflows have, to date, been conveyed by discrete smaller-scale structural features.

The potentiometric surface calculated from water levels in the piezometers installed in Pogo Ridge are not dramatically lower than those measured prior to the start of mining. The potentiometric surface in Pogo Ridge measured by piezometers 13-H3, 13-651, and 13-758 installed in 2013 has, based on those three locations, not dropped significantly since pre-mining water levels were measured in wells installed in 1998 and 1999.

There are no water level data from Liese Ridge dating back to before mining, so comparison over time is not possible in that area. Current water levels were measured in the SRK piezometers in Liese Ridge at greater depth than measured in Pogo Ridge. This is likely due to the largest discrete points of inflow in the mine that occur in the North Zone and within the western extremities of the Liese Zone, resulting in a lowered water table in piezometers over those areas.



srk consulting	SUMITOMO METAL MINING CO., LTD.	HYDROGEOLOGICAL STUDY
		LOCATIONS OF SRK 2012 AND 2013 SURFACE PIEZOMETERS AND UNDERGROUND TEST HOLES
SRK JOB NO.: 147900.020	POGO UNDERGROUND MINE IN ALASKA	DATE: APR. 2014 · APPROVED: LC · FIGURE: 3 · REVISION NO. A
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Table 1: Summary of Hydraulic Tests Conducted in 2012 and 2013 by SRK

Pad ID	Hole ID	Depth (ft)		Length of Test (ft)	Mid Point of Test (ft)	DTW After Test (ft)	Test Type	Number of Tests	GPM	Average Hydraulic Conductivity (ft/day)
		From	To							
2012 Field Program (Only surface holes had valid tests)										
2012_H1	594	396	1216	820	806	132.5	ALR	1	10.6	3E-02
2012_H1	594	706	1216	510	961	148.0	ALR	1	9.5	6E-02
2012_H1	627	301	1201	900	751	112.9	ALR	1	4.3	7E-03
2012_H1	628	205	465	260	335	73.2	ALR, PI, FH	3	2	1E-02
2012_H1	628	465	835	370	650	191.6	PI, FH	2	5.3	8E-03
2012_H1	628	835	1115	280	975	108.3	ALR, PI,FH, CRI/R	5	19	6E-03
2012_H1	628	1115	1515	400	1315		PI, FH	4	1	2E-03
2012_H2	630	400	917	517	658.5	113.2	ALR, PI, FH	3	5	6E-03
2012_H2	630	200	917	717	558.5	90.9	ALR	1	8	7E-03
2012_H2	630	907	1450	543	1178.5		PI, FH	3	0.8	2E-04
2012_H2	630	407	1450	1043	928.5	209.0	ALR	1	3.3	2E-03
2012_H3	633	307	636	329	471.5	116.8	ALR	1	5	7E-03
2012_H3	633	900	1171	271	1035.5	147.6	ALR, FH	3	4	7E-03
EDK	559	400	1066	666	733	316.6	CIR/R	2	10	7E-02
2013 Field Program										
2013_H3	13-H3	141	718	577	288.5	141	FH	1	--	5E-02
ED_K	13-562	240	2,800	2,560	1280	240	FH	1	--	7E-04
EDW_C	13-695	232	3,000	2,768	1384	232	FH	1	--	1E-04
SP_C	13-651	117	1,880	1,763	881.5	117	FH	1	--	8E-04
2013 Underground Drill Holes										
UG	13Hydro-01	0	464	464	232	80	FS/R	2	0.48, 1.17	2E-04
UG	13Hydro-02	0	500	500	250	100	FS/R	2	3.05, 0.97	8E-04
UG	13Hydro-03	0	218	218	109	65	FS/R	2	2.39, 0.66	7E-03
UG	13Hydro-04	0	425	425	212.5	265	FS/R	2	2.5, 0.85	1E-03
UG	13Hydro-05	0	600	600	300	230	FS/R	2	0.36, 1.15	7E-05
UG	13Hydro-06A	0	202	202	101	95	FS/R	2	3.31, 1.21	3E-02
UG	13Hydro-06B	0	453	453	226.5	120	FS/R	2	6.43, 1.35	2E-03

Note on Test Type:
- ALR Airlift Recovery
- PI Pressure Injection (Packer)
- FH Falling Head
- CRI/R Constant Rate Injection/Recovery (Packer)
- FS/R Flow Shut-in Recovery

5 Description of Hydrogeological Conditions and Conceptual Model

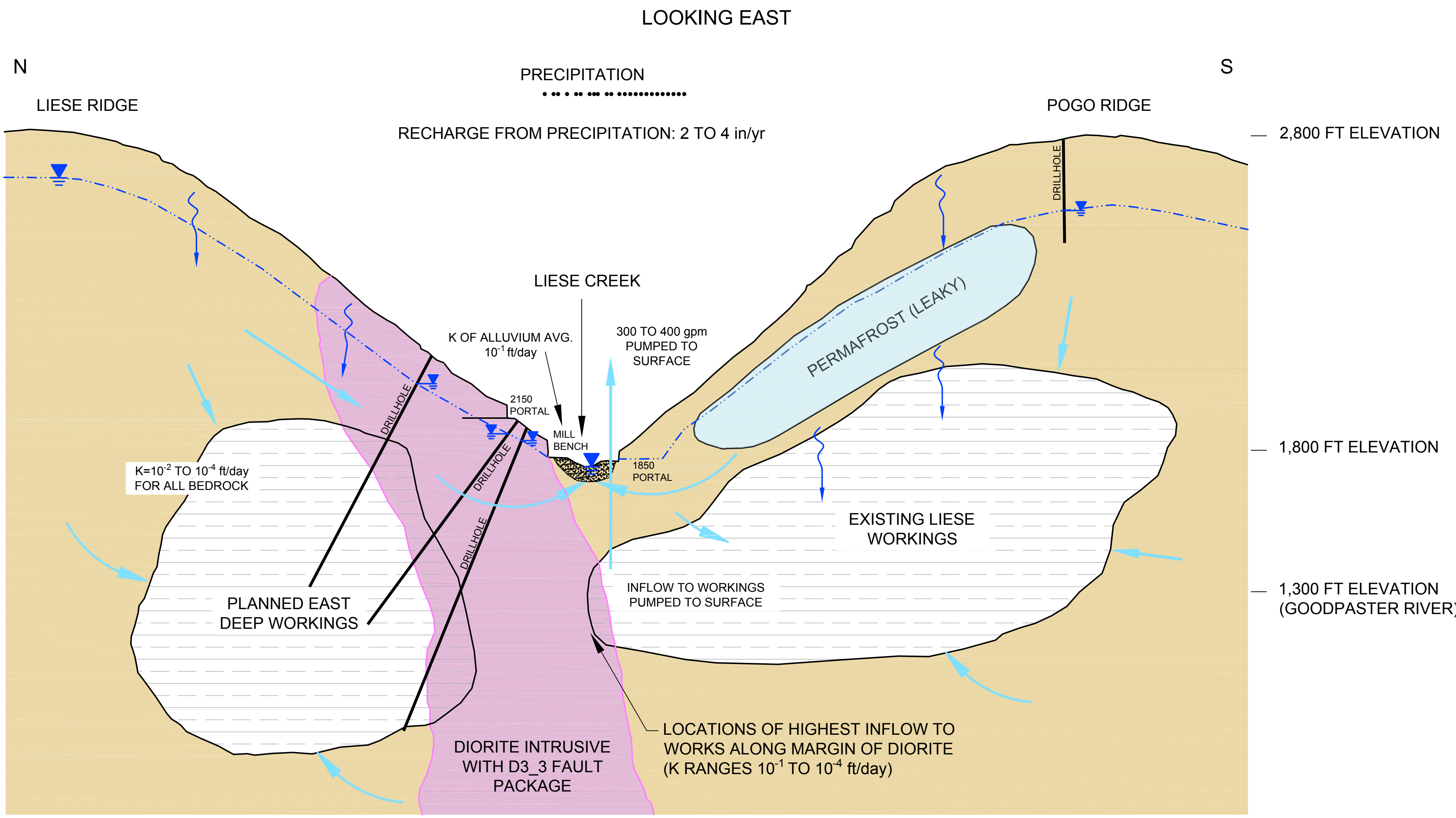
The conceptual model for the study area forms the basis for understanding the hydrogeologic system, and defines the geometry and inputs to a numerical model. The conceptual model summarizes the current understanding of the hydrogeology of the Pogo site based on data collected by others in previous investigations, and the two years of field work by SRK. Significant new understanding gained in 2013 includes the low permeability of the structures targeted by the underground drill holes, and the high water table in the rocks above the existing workings, indicating low rate of drainage into the mine, presumably from the extensive grouting program in place in the underground at Pogo. The conceptual model was also updated in 2013 with addition of the Ray Fault and the Z fault discovered during development of workings in the northwest side of the Liese Zone.

An additional finding from the 2013 field work that was incorporated into the conceptual model is the observation that underground drill holes that targeted the north margin of the diorite dike did not produce large quantities of water. Testing of those holes showed that the northern margin of the dike is no more permeable than the surrounding rocks.

The data collected by SRK were compiled with data from previous investigations to create a large database from which the hydrogeologic conditions at the site were quantified. A drill hole and well database is presented on **Table 2**, and the water levels collected from those holes and wells are presented on **Table 3**. The conceptual model is presented schematically in **Figure 4**.

Groundwater flow conditions at the Pogo site are defined by the relative balance of recharge as affected by the presence of permafrost, discharge to surface water, or as underflow off site, change in storage as expressed by changes in the potentiometric surface, and pumpage and discharge from the mine to the surface water system. A discontinuous permafrost occurs on south-facing slopes in the upland areas and in shaded areas at the foot of steep hill sides. Regional discharge is to the Goodpaster River, with local groundwater discharge to Pogo Creek and Liese Creek.

The water table beneath Pogo and Liese ridges generally mimics surface topography. As such, the direction of groundwater flow within the bedrock is in the same direction as the topographic gradient with recharge occurring predominantly through the south-facing slopes where permafrost is absent (see **Appendix C**). Recharge occurs through the north-facing slopes, but at a reduced rate that is controlled by the melt water off the bottom of the permafrost. The inferred water table and the directions of groundwater flow in the upland bedrock are presented in **Figure 4**. The figure shows the interaction of the various components of the groundwater flow system, highlighting how groundwater flows at the site, its flow paths into the workings, and how it interacts with surface water and permafrost.



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HYDROGEOLOGICAL STUDY

CONCEPTUAL MODEL OF THE GROUNDWATER FLOW SYSTEM AT POGO

POGO UNDERGROUND MINE IN ALASKA

SRK JOB NO.: 147900.020

FILE NAME: 147900.020.Rev.A.Figure.4.Concept.Model.Hydro.System.2014-03-31.dwg

DATE:	APPROVED:	FIGURE:	REVISION NO.
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The Goodpaster River flows from north to south and acts as a constant head boundary for groundwater flow in the river sediments. Water levels measured in the well pair at the airstrip installed and tested in 2012 showed that the bedrock has a slightly higher potentiometric level than do the Goodpaster River sediments (discussed in **Appendix A**), indicating that groundwater moves from the bedrock in the surrounding highlands to discharge to the river. The difference in water levels in the wells pair varies but remains less than one foot of difference. Further evidence of higher potentiometric levels in the bedrock is the presence of artesian flow from rock coreholes drilled at the foot of Pogo and Liese ridges along the edge of the river sediments. Though no pressure or flow data were collected from those holes, drillers and Pogo Geology staff confirmed that the holes flowed during the short time prior to being grouted.

Permafrost plays a role in the groundwater flow system at the Pogo site. Permafrost is discontinuous, with its occurrence confined to north-facing slopes, and deeper valleys in locations that are shaded from direct sunlight due to steep adjacent slopes. A evaluation of the presence and condition of the permafrost at the site is presented in **Appendix C**. Recharge to the groundwater flow system in areas where permafrost is absent is direct infiltration by precipitation. In areas that contain permafrost, recharge is lower, but not absent, owing to the permafrost in the area be a “warm permafrost” resulting from the bottom boundary releasing some melt water to infiltrate downward to the water table.

Liese, Pogo, North and Ranger Creeks are considered expressions of the groundwater table, and were modelled as such. Though four flumes were installed Liese Creek in late 2012 by Pogo, leakage (bypass) underneath the flumes rendered their data unreliable for use in the groundwater flow model. However, the problems have been corrected, and the flumes will provide flow data that will further the understanding of the interaction of groundwater and surface water systems and be applied to future model updates.

Two factors likely play a role in water levels in the piezometers installed above and near the active mining area of Liese Zone in Pogo Ridge in 2013 being relatively high, indicating that groundwater is not drained above the active mining area. One factor is the lack of significant discontinuities in the older workings. The largest points of inflow to date have been associated with D3_3 structural package. The D3_3 fault package consists of the D3, Liese, and Graphite faults that in places cuts the southern boundary of the diorite intrusive. This structural package traverses the northern portion of the Liese and North Zone workings and is not present under Pogo ridge. The area of larger inflows recently encountered in the western and deepest portions of the Liese Zone (825 and 627 stopes) is located near, and may be influenced by drainage from that structural package. In addition, the larger inflows from the package may be the reason the water levels in the piezometers in that area (piezometers installed into 13-562, 13-597, and 13-695) on the flank of Liese ridge reflect a more drained condition than those on Pogo Ridge.

Table 2: Compiled Values for Hydraulic Conductivity from Tests in Bedrock

Borehole ID	Coordinates			Total Depth (ft bgs)	Azimuth	Inclination	Test Interface		Test Midpoint Elevation (ft amsl)	Estimated Hydraulic Conductivity K (ft/d)	Associated Structure	Source of Data
	Easting	Northing	Elevation (ft amsl)				From (ft bgs)	To (ft bgs)				
98-105	1,812,104	3,822,341	1,696	807	0	-90	433	490	1,235	1.04E-01	Close to D3_3 and Diorite Margin	Golder, 1998
98-105	1,812,104	3,822,341	1,696	807	0	-90	433	807	1,076	2.51E-02	Close to D3_3 and Diorite Margin	Golder, 1998
98-105	1,812,104	3,822,341	1,696	807	0	-90	433	490	1,235	1.30E-01	Close to D3_3 and Diorite Margin	Golder, 1998
98-105	1,812,104	3,822,341	1,696	807	0	-90	490	807	1,048	1.04E-03	Close to D3_3 and Diorite Margin	Golder, 1998
98-114	1,812,104	3,822,341	1,696	593	215	-81	389	593	1,211	1.38E-03	Close to D3_3	Golder, 1998
12-630	1,815,408	3,821,683	2,371	1450	294	-83	400	917	1,717	3.57E-03	Close to Diorite Margin	SRK 2012 Field Program
12-630	1,815,408	3,821,683	2,371	1450	294	-83	407	1450	1,449	1.95E-03	Close to Diorite Margin	SRK 2012 Field Program
13Hydro-06A	1,812,199	3,822,644	1,067	202	225	27	UG hole	UG hole	1,113	6.20E-02	D3-3 Fault and Diorite	SRK 2013 Field Program
LD-2	1,815,811	3,820,432	2,160	45	0	-90	35	45	2,120	5.67E-01	Diorite	AGRA 1999
LD-5	1,815,111	3,820,756	2,040	100	0	-90	65	80	1,968	2.83E-01	Diorite	AGRA 1999
LT-5	1,817,444	3,818,785	2,340	124	0	-90	64	84	2,266	2.83E-01	Diorite	AGRA 1999
LT-5	1,817,444	3,818,785	2,340	124	0	-90	84	104	2,246	5.67E-01	Diorite	AGRA 1999
LT-5	1,817,444	3,818,785	2,340	124	0	-90	104	124	2,226	2.83E-01	Diorite	AGRA 1999
LT-7	1,816,398	3,819,532	2,200	109	0	-90	42	59	2,150	1.13E+00	Diorite	AGRA 1999
LT-7	1,816,398	3,819,532	2,200	109	0	-90	64	79	2,129	8.50E-01	Diorite	AGRA 1999
LT-7	1,816,398	3,819,532	2,200	109	0	-90	79	99	2,111	2.83E-01	Diorite	AGRA 1999
LT-7	1,816,398	3,819,532	2,200	109	0	-90	99	109	2,096	8.50E-01	Diorite	AGRA 1999
LT-7a	1,816,398	3,819,532	2,200	109	0	-90	88.5	98.5	2,107	1.37E-01	Diorite	AGRA 1999
LT-7a	1,816,398	3,819,532	2,200	109	0	-90	88.5	98.5	2,107	4.55E-01	Diorite	AGRA 1999
LD-2	1,815,811	3,820,432	2,160	45	0	-90	23.6	35	2,131	2.83E-01	Diorite	AGRA 1999
LD-3	1,815,307	3,820,688	2,060	74	0	-90	44	54	2,011	1.13E+00	Diorite	AGRA 1999
LD-4	1,815,041	3,820,551	2,125	64	0	-90	13	64	2,087	2.27E-01	Diorite	AGRA 1999
13Hydro-03	1,814,608	3,821,731	887	218	260	30	UG hole	UG hole	942	3.30E-03	Diorite	SRK 2013 Field Program
LD-3	1,815,307	3,820,688	2,060	74	0	-90	54	64	2,001	1.42E+00	Diorite and NE2 Fault	AGRA 1999

Borehole ID	Coordinates			Total Depth (ft bgs)	Azimuth	Inclination	Test Interface		Test Midpoint Elevation (ft amsl)	Estimated Hydraulic Conductivity K (ft/d)	Associated Structure	Source of Data
	Easting	Northing	Elevation (ft amsl)				From (ft bgs)	To (ft bgs)				
13Hydro-05	1,815,302	3,821,243	1,218	600	129	31	UG hole	UG hole	1,373	2.40E-04	Diorite and NE2 Fault	SRK 2013 Field Program
12-559	1,813,342	3,822,625	2,166	2250	171	-77	400	1066	1,452	3.36E-02	Diorite Margin	SRK 2012 Field Program
13Hydro-06B	1,812,207	3,822,663	1,062	453	86.4	18.4	UG hole	UG hole	1,133	2.80E-03	diorite, Z fault, N3 vein	SRK 2013 Field Program
00U98C	1,811,965	3,821,308	1,376	791	35	-5	0	791	1,342	7.40E-03	Graphite (D3_3)	ABC, 2001
00U98B	1,811,960	3,821,309	1,376	313	0	5	0	313	1,390	1.71E-01	Graphite (D3_3)	ABC, 2001
00U98D	1,811,969	3,821,303	1,377	803	68	0	0	803	1,377	1.04E-02	High N1, Graphite	ABC, 2001
98-109	1,812,104	3,822,341	1,696	746	215	-70	510	647	1,153	3.63E-03	Liese Creek	Golder, 1998
98-109	1,812,104	3,822,341	1,696	746	215	-70	470	647	1,171	3.89E-02	Liese Creek	Golder, 1998
98-109	1,812,104	3,822,341	1,696	746	215	-70	470	510	1,236	1.38E-01	Liese Creek	Golder, 1998
98-112	1,812,354	3,822,052	1,708	736	215	-57	330	504	1,358	1.12E-01	Liese Creek	Golder, 1998
13Hydro-02	1,812,596	3,821,217	1,090	500	33	23	UG hole	UG hole	1,188	1.10E-03	N1 Fault, Diorite, D3_3 Fault	SRK 2013 Field Program
13Hydro-01	1,815,297	3,821,248	1,215	464	76.4	21	UG hole	UG hole	1,298	8.10E-04	N2 fault	SRK 2013 Field Program
13Hydro-04	1,815,296	3,821,254	1,217	425	48.4	15	UG hole	UG hole	1,272	2.60E-03	N2 fault	SRK 2013 Field Program
12-594	1,816,140	3,822,047	2,660	1200	119	-68	706	1216	1,769	1.93E-01	NE2 Fault	SRK 2012 Field Program
12-628	1,816,140	3,822,047	2,660	1500	230	-78	835	1115	1,706	7.94E-03	None	SRK 2012 Field Program
12-627	1,816,140	3,822,047	2,660	1200	153	-75	301	1201	1,935	6.93E-03	None	SRK 2012 Field Program
12-630	1,815,408	3,821,683	2,371	1450	294	-83	907	1450	1,201	2.42E-04	None	SRK 2012 Field Program
12-628	1,816,140	3,822,047	2,660	1500	230	-78	1115	1515	1,374	2.00E-03	None	SRK 2012 Field Program
00U039	1,811,110	3,820,880	1,275	245	316	39	0	245	1,352	2.74E-04	None	ABC, 2001
00U40A	1,811,114	3,820,876	1,276	214	316	65	0	214	1,373	2.74E-04	None	ABC, 2001
00U041	1,811,114	3,820,876	1,277	233	136	89	0	233	1,393	2.74E-04	None	ABC, 2001
00U045	1,811,168	3,820,958	1,280	211	316	84	0	211	1,385	2.74E-04	None	ABC, 2001
98-107	1,811,355	3,820,762	2,370	967	34.5	-75	753	910	1,567	3.37E-04	None	1998. Tech Memo 1

Borehole ID	Coordinates			Total Depth (ft bgs)	Azimuth	Inclination	Test Interface		Test Midpoint Elevation (ft amsl)	Estimated Hydraulic Conductivity K (ft/d)	Associated Structure	Source of Data
	Easting	Northing	Elevation (ft amsl)				From (ft bgs)	To (ft bgs)				
00U98F	1,811,960	3,821,308	1,383	263	0	36	0	263	1,460	8.22E-04	None	ABC, 2001
98-113	1,811,355	3,820,762	2,370	1038	35	-64	981	1038	1,462	8.64E-04	None	1998. Tech Memo 1
00U034	1,811,056	3,820,790	1,271	324	316	37	0	324	1,369	1.10E-03	None	ABC, 2001
00U044	1,811,163	3,820,965	1,280	211	316	47	0	211	1,357	1.10E-03	None	ABC, 2001
98-104	1,812,118	3,820,903	2,186	1015.8	228.5	-73.5	527	826	1,537	1.73E-03	None	1998. Tech Memo 1
00U038	1,811,110	3,820,880	1,271	299	316	21	0	299	1,325	2.74E-03	None	ABC, 2001
00U033a	1,811,055	3,820,790	1,268	448	316	19	0	448	1,341	4.38E-03	None	ABC, 2001
00U037	1,811,062	3,820,783	1,273	303	136	73	0	303	1,418	5.75E-03	None	ABC, 2001
98-113	1,811,355	3,820,762	2,370	1038	35	-64	851	1038	1,521	6.31E-03	None	1998. Tech Memo 1
00U46a-a	1,811,164	3,820,964	1,271	426	316	6	0	426	1,294	7.40E-03	None	ABC, 2001
98-113	1,811,355	3,820,762	2,370	1038	35	-64	851	981	1,547	8.55E-03	None	1998. Tech Memo 1
97-78	1,812,118	3,820,903	2,175	1158	4	-90	382.5	579.5	1,694	8.64E-03	None	Hydrogeological Investigations 1998
00U033b	1,811,055	3,820,790	1,268	448	316	19	0	448	1,341	1.42E-02	None	ABC, 2001
00U069	1,811,416	3,821,430	1,242	191	316	47	0	191	1,311	1.45E-02	None	ABC, 2001
98-108	1,812,354	3,822,052	1,708	667	219.5	-74	510	667	1,142	1.81E-02	None	1998. Tech Memo 1
00U95B	1,811,956	3,821,306	1,378	268	316	17	0	268	1,418	2.00E-02	None	ABC, 2001
00U043	1,811,162	3,820,966	1,275	307	316	21	0	307	1,330	2.03E-02	None	ABC, 2001
00U40b	1,811,109	3,820,881	1,269	389	316	7	0	389	1,293	2.05E-02	None	ABC, 2001
00U46a-b	1,811,164	3,820,964	1,271	426	316	6	0	426	1,294	2.55E-02	None	ABC, 2001
00U042	1,811,116	3,820,874	1,276	267	136	71	0	267	1,402	2.77E-02	None	ABC, 2001
00U083a	1,811,577	3,821,544	1,216	253	316	22	0	253	1,263	4.52E-02	None	ABC, 2001
00U98A	1,811,946	3,821,299	1,378	303	316	10	0	303	1,404	4.60E-02	None	ABC, 2001
00U055	1,811,327	3,821,233	1,273	323	316	20	0	323	1,328	4.99E-02	None	ABC, 2001
00U083b	1,811,577	3,821,544	1,216	253	316	22	0	253	1,263	6.33E-02	None	ABC, 2001
00U98B	1,811,960	3,821,309	1,376	313	0	5	0	313	1,390	6.68E-02	None	ABC, 2001
00U061	1,811,365	3,821,332	1,256	221	316	21	0	221	1,296	6.99E-02	None	ABC, 2001
00U075a	1,811,502	3,821,484	1,219	281	316	19	0	281	1,264	8.33E-02	None	ABC, 2001
00U075b	1,811,502	3,821,484	1,219	281	316	19	0	281	1,264	8.71E-02	None	ABC, 2001
00U51a-a	1,811,277	3,821,141	1,278	359	316	6	0	359	1,297	9.23E-02	None	ABC, 2001
00U051a	1,811,277	3,821,141	1,280	250	316	23	0	250	1,329	1.46E-01	None	ABC, 2001
00U51a-b	1,811,277	3,821,141	1,278	359	316	6	0	359	1,297	2.16E-01	None	ABC, 2001
00U051b	1,811,277	3,821,141	1,280	250	316	23	0	250	1,329	2.48E-01	None	ABC, 2001

Borehole ID	Coordinates			Total Depth (ft bgs)	Azimuth	Inclination	Test Interface		Test Midpoint Elevation (ft amsl)	Estimated Hydraulic Conductivity K (ft/d)	Associated Structure	Source of Data
	Easting	Northing	Elevation (ft amsl)				From (ft bgs)	To (ft bgs)				
00U068a	1,811,414	3,821,432	1,237	262	316	21	0	262	1,284	2.66E-01	None	ABC, 2001
00U068b	1,811,414	3,821,432	1,237	262	316	21	0	262	1,284	3.51E-01	None	ABC, 2001
00U95B	1,811,956	3,821,306	1,378	268	316	17	0	268	1,418	1.62E-02	None	ABC, 2001
97-78	1,812,118	3,820,903	2,175	1158	4	-90	741	998	1,306	8.64E-03	None	Hydrogeological Investigations 1998
00L309	1,811,509	3,821,476	1,217	571	141	-69	0	571	950	1.89E-02	None	ABC, 2001
98-080	1,809,050	3,820,403	1,590	500	0	-90	195	390	1,298	8.64E-03	None	1998 Hydrogeological Regime Goodpaster River Valley
98-080	1,809,050	3,820,403	1,590	500	0	-90	195	390	1,298	8.64E-03	None	1998 Hydrogeological Regime Goodpaster River Valley
98-080	1,809,050	3,820,403	1,590	500	0	-90	355	500	1,163	8.64E-04	None	1998 Hydrogeological Regime Goodpaster River Valley
98-081	1,809,836	3,819,386	1,841	1000	0	-90	195	279	1,604	4.32E-02	None	1998 Hydrogeological Regime Goodpaster River Valley
98-081	1,809,836	3,819,386	1,841	1000	0	-90	345	500	1,418	1.73E-02	None	1998 Hydrogeological Regime Goodpaster River Valley
98-081	1,809,836	3,819,386	1,841	1000	0	-90	485	769	1,214	1.73E-02	None	1998 Hydrogeological Regime Goodpaster River Valley
98-081	1,809,836	3,819,386	1,841	1000	0	-90	740	1000	971	8.64E-03	None	1998 Hydrogeological Regime Goodpaster River

Borehole ID	Coordinates			Total Depth (ft bgs)	Azimuth	Inclination	Test Interface		Test Midpoint Elevation (ft amsl)	Estimated Hydraulic Conductivity K (ft/d)	Associated Structure	Source of Data
	Easting	Northing	Elevation (ft amsl)				From (ft bgs)	To (ft bgs)				
												Valley
98-113	1,811,355	3,820,762	2,370	1038	35	-64	680	837	1,688	2.07E-04	None	Golder, 1998
98-111	1,812,118	3,820,903	2,186	1045	215	-60	297	504	1,839	2.51E-04	None	Golder, 1998
98-082	1,810,357	3,819,873	2,090	1000	0	-90	72.5	113	1,997	2.59E-04	None	1998 Hydrogeological Regime Goodpaster River Valley
98-082	1,810,357	3,819,873	2,090	1000	0	-90	111.5	152	1,958	6.05E-04	None	1998 Hydrogeological Regime Goodpaster River Valley
98-082	1,810,357	3,819,873	2,090	1000	0	-90	36.5	74.2	2,034	8.64E-04	None	1998 Hydrogeological Regime Goodpaster River Valley
00U96A	1,811,956	3,821,307	1,381	228	316	37	0	228	1,450	1.10E-03	None	ABC, 2001
97-76	1,811,218	3,820,813	2,360	998	7	-90	571	798	1,676	1.73E-03	None	Hydrogeological Investigations 1998
12-633	1,815,145	3,822,267	2,541	1900	208	-80	900	1171	1,521	3.38E-03	None	SRK 2012 Field Program
00U98E	1,811,957	3,821,307	1,379	262	344	15	0	262	1,413	3.56E-03	None	ABC, 2001
98-113	1,811,355	3,820,762	2,370	1038	35	-64	418.4	525.4	1,946	3.80E-03	None	1998. Tech Memo 1
00L306	1,811,279	3,821,140	1,274	510	317.5	-77	0	510	1,026	4.11E-03	None	ABC, 2001
00L302	1,811,367	3,821,328	1,248	784	320	-64.5	0	784	894	4.38E-03	None	ABC, 2001
97-79	1,810,221	3,822,066	2,065	1395	253	-90	259	586	1,643	5.18E-03	None	Hydrogeological Investigations 1998
98-113	1,811,355	3,820,762	2,370	1038	35	-64	418.4	478.4	1,967	6.22E-03	None	1998. Tech Memo 1
12-628	1,816,140	3,822,047	2,660	1500	230	-78	465	835	2,024	6.50E-03	None	SRK 2012 Field Program
12-633	1,815,145	3,822,267	2,541	1900	208	-80	307	636	2,077	7.35E-03	None	SRK 2012 Field Program
00L311	1,811,508	3,821,477	1,217	485	319	-61	0	485	1,005	8.22E-03	None	ABC, 2001
97-77	1,811,425	3,821,704	2,039	911.5	96	-72	317	517	1,643	8.64E-03	None	Hydrogeological Investigations 1998

Borehole ID	Coordinates			Total Depth (ft bgs)	Azimuth	Inclination	Test Interface		Test Midpoint Elevation (ft amsl)	Estimated Hydraulic Conductivity K (ft/d)	Associated Structure	Source of Data
	Easting	Northing	Elevation (ft amsl)				From (ft bgs)	To (ft bgs)				
97-77	1,811,425	3,821,704	2,039	911.5	96	-72	507	764	1,435	8.64E-03	None	Hydrogeological Investigations 1998
98-113	1,811,355	3,820,762	2,370	1038	35	-64	478.4	525.4	1,919	1.04E-02	None	Golder, 1998
12-628	1,816,140	3,822,047	2,660	1500	230	-78	205	465	2,332	1.44E-02	None	SRK 2012 Field Program
97-76	1,811,218	3,820,813	2,360	998	7	-90	381	578	1,881	1.73E-02	None	Hydrogeological Investigations 1998
97-79	1,810,221	3,822,066	2,065	1395	253	-90	419	586	1,563	3.46E-02	None	Hydrogeological Investigations 1998
12-594	1,816,140	3,822,047	2,660	1200	119	-68	396	1216	1,913	9.06E-02	None	SRK 2012 Field Program
97-75	1,812,798	3,820,462	2,265	1368.5	215	-40	1106	1309	1,489	1.73E-01	None	Hydrogeological Investigations 1998
97-79	1,810,221	3,822,066	2,065	1395	253	-90	69	266	1,898	6.05E-01	None	Hydrogeological Investigations 1998
97-79	1,810,221	3,822,066	2,065	1395	253	-90	659	836	1,318	7.78E-01	None	Hydrogeological Investigations 1998
97-79	1,810,221	3,822,066	2,065	1395	253	-90	574	671	1,443	8.64E-01	None	Hydrogeological Investigations 1998
97-79	1,810,221	3,822,066	2,065	1395	253	-90	827	964	1,170	8.64E-01	None	Hydrogeological Investigations 1998
00U98E	1,811,957	3,821,307	1,379	262	344	15	UG hole	UG hole	1,413	3.84E-03	None	ABC, 2001
13-H3	1,812,235	3,820,041	2,520	718	0	-90	102	718	2,110	4.90E-02	None	SRK 2013 Field Program
13-562	1,813,342	3,822,625	2,166	2772.8	277	-82	238	2773	661	7.10E-04	None	SRK 2013 Field Program
13-695	1,812,922	3,823,509	2,192	2963.1	192	-81	196	2963	612	1.40E-04	None	SRK 2013 Field Program
13-651	1,813,573	3,818,867	2,578	1777.6	80	-71	74	1778	1,652	7.50E-04	None	SRK 2013 Field Program

Table 3: Compiled Pogo Site Water Levels in Wells and Piezometers

Monitoring Well ID	Coordinates			Screen Interval (ft)		Depth to Water Levels (ft)	Measured Water Elevation (ft amsl)	Hydrogeologic Unit	Date	Monitoring Wells used for Calibration			
	X	Y	Elevation (ft amsl)	From	To					Monitoring Well used for Pre-mining Steady State	Monitoring Well used for Mining Transient	Water Level used for Transient Calibration (ft amsl)	
												Maximum	Minimum
98-9	1,807,796	3,819,123	1,327.8	42	47	6.8	1,321	Goodpaster River Alluvium	Pre-mining	Yes	No		
98-10A	1,808,271	3,819,914	1,329.6	69	77	7.6	1,322	Goodpaster River Alluvium	Pre-mining	Yes	No		
98-10B	1,808,271	3,819,914	1,330.1	25	30	8.1	1,322	Goodpaster River Alluvium	Pre-mining	Yes	No		
98-11A	1,808,171	3,819,400	1,329.2	73	78	7.2	1,322	Goodpaster River Alluvium	Pre-mining	Yes	No		
98-11B	1,808,171	3,819,400	1,329.2	33	38	7.2	1,322	Goodpaster River Alluvium	Pre-mining	Yes	No		
98-5	1,807,487	3,819,613	1,329.9	25	30	7.9	1,322	Goodpaster River Alluvium	Pre-mining	Yes	No		
INJ-2	1,808,191	3,819,442	1,330.0	62	75	8.0	1,322	Goodpaster River Alluvium	Pre-mining	Yes	Yes	1324	1322
MW99-016	1,807,742	3,818,627	1,323.8	21	31	1.8	1,322	Goodpaster River Alluvium	Pre-mining	Yes	No		
INJ-1	1,808,208	3,819,454	1,330.0	62	75	7.0	1,323	Goodpaster River Alluvium	Pre-mining	Yes	No		
98-7	1,807,490	3,820,267	1,331.3	15	30	7.3	1,324	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-003	1,808,924	3,825,666	1,347.2	18	30	8.2	1,339	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-004	1,808,864	3,825,216	1,348.0	15	25	9.0	1,339	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-029	1,809,134	3,825,843	1,349.2	49	59	8.2	1,341	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-001	1,809,619	3,824,942	1,351.3	37	47	7.3	1,344	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-002	1,809,473	3,824,465	1,369.5	47	57	25.5	1,344	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-005	1,809,656	3,825,982	1,349.3	20	30	5.3	1,344	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-008B	1,810,174	3,825,448	1,351.5	38	43	6.5	1,345	Goodpaster River Alluvium	Pre-mining	Yes	No		

Monitoring Well ID	Coordinates			Screen Interval (ft)		Depth to Water Levels (ft)	Measured Water Elevation (ft amsl)	Hydrogeologic Unit	Date	Monitoring Wells used for Calibration			
	X	Y	Elevation (ft amsl)	From	To					Monitoring Well used for Pre-mining Steady State	Monitoring Well used for Mining Transient	Water Level used for Transient Calibration (ft amsl)	
												Maximum	Minimum
LL-024	1,810,204	3,826,283	1,352.3	20	30	7.3	1,345	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-009A	1,810,580	3,825,024	1,352.7	64	47	5.7	1,347	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-010A	1,810,663	3,825,865	1,351.8	55	65	4.8	1,347	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-010B	1,810,663	3,825,865	1,351.8	15	25	4.8	1,347	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-028	1,810,682	3,826,263	1,350.5	47	59	2.5	1,348	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-030	1,811,027	3,826,433	1,353.4	20	60	5.4	1,348	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-006A	1,810,906	3,826,701	1,354.1	40	50	5.1	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-006B	1,810,906	3,826,701	1,354.1	9	19	5.1	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-023	1,811,130	3,826,210	1,355.3	15	25	6.3	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-025	1,811,048	3,826,384	1,354.6	3	60	5.6	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-026	1,811,021	3,826,427	1,354.6	2	59	5.6	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-027	1,810,990	3,826,482	1,353.2	2	59	4.2	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-14	1,811,928	3,826,826	1,356.9	40	50	7.9	1,349	Goodpaster River Alluvium	Pre-mining	Yes	No		
MW12-001A	1,810,789	3,826,337	1,361.1	47	67	12.1	1,349	Goodpaster River Alluvium	Fall 2012	No	No		
LL-012A	1,811,621	3,826,531	1,355.1	65	75	5.1	1,350	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-021	1,811,801	3,826,404	1,355.8	34	44	5.8	1,350	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-12B	1,811,621	3,826,531	1,355.1	65	75	5.1	1,350	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL-007	1,811,435	3,827,559	1,356.2	19	29	5.2	1,351	Goodpaster	Pre-mining	Yes	No		

Monitoring Well ID	Coordinates			Screen Interval (ft)		Depth to Water Levels (ft)	Measured Water Elevation (ft amsl)	Hydrogeologic Unit	Date	Monitoring Wells used for Calibration			
	X	Y	Elevation (ft amsl)	From	To					Monitoring Well used for Pre-mining Steady State	Monitoring Well used for Mining Transient	Water Level used for Transient Calibration (ft amsl)	
												Maximum	Minimum
								River Alluvium					
LB-8-2	1,809,398	3,824,147	1,395.0	0	42	25.0	1,370	Goodpaster River Alluvium	Pre-mining	Yes	No		
LL04-031	1,811,383	3,827,794	1,390.0	0	60	7.0	1,383	Goodpaster River Alluvium	Mining	Yes	Yes	1383	1351
LL04-032	1,811,491	3,828,095	1,391.0	0	59	7.2	1,384	Goodpaster River Alluvium	Mining	No	Yes	1384	1353
MW03-501	1,814,608	3,820,857	1,951.0	0	53	15.0	1,936	Liese Creek Alluvium	Mining	No	Yes	1936	1917
MW03-502	1,814,603	3,820,839	1,949.0	0	37	12.0	1,937	Liese Creek Alluvium	Mining	No	Yes	1947	1928
MW03-500	1,814,608	3,820,882	1,955.0	0	60	16.0	1,939	Liese Creek Alluvium	Mining	No	Yes	1939	1919
LD-005	1,815,111	3,820,756	2,012.7	44	54	20.7	1,992	Liese Creek Alluvium	Pre-mining	Yes	No		
LD-003	1,815,329	3,820,673	2043.5	23	33	20.5	2,023	Liese Creek Alluvium	Pre-mining	Yes	No		
LD-21-2	1,815,385	3,820,746	2,050.0	39	77	21.0	2,029	Liese Creek Alluvium	Pre-mining	Yes	No		
LD-17	1,815,269	3,820,775	2,040.0	32	63	32.0	2,008	Liese Creek Alluvium	Pre-mining	Yes	No		
LD-21-1	1,815,385	3,820,746	2,050.0	0	21	21.0	2,029	Liese Creek Alluvium	Pre-mining	Yes	No		
LD-19	1,815,284	3,820,546	2,065.0	10	21	4.0	2,061	Liese Creek Alluvium	Pre-mining	Yes	No		
LD-18-1	1,815,343	3,820,973	2,085.0	0	108	89.0	1,996	Liese Creek Alluvium	Pre-mining	Yes	No		
MW11-001B	1,815,772	3,820,237	2,136.0	0	75	39.0	2,097	Liese Creek Alluvium	Mining	No	Yes	2097	2037
MW11-001A	1,815,772	3,820,237	2,136.0	0	39	32.0	2,104	Liese Creek Alluvium	Mining	No	Yes	2104	2045
LT99-009	1,816,057	3,819,767	2,172.4	0	29	19.4	2,153	Liese Creek Alluvium	Pre-mining	Yes	Yes	2153	2120
LT-007B	1,816,305	3,819,615	2183.33	27	37	8.8	2,175	Liese Creek Alluvium	Pre-mining	Yes	No		

Monitoring Well ID	Coordinates			Screen Interval (ft)		Depth to Water Levels (ft)	Measured Water Elevation (ft amsl)	Hydrogeologic Unit	Date	Monitoring Wells used for Calibration			
	X	Y	Elevation (ft amsl)	From	To					Monitoring Well used for Pre-mining Steady State	Monitoring Well used for Mining Transient	Water Level used for Transient Calibration (ft amsl)	
												Maximum	Minimum
LT-003	1,818,009	3,817,853	2479.5	17	27	17.7	2,462	Liese Creek Alluvium	Pre-mining	Yes	No		
LT-22B	1,815,473	3,819,011	2,660.0	0	25	0.0	2,660	Liese Creek Alluvium	Pre-mining	Yes	No		
LB-001	1,810,867	3,823,215		28	38	-1,529.2	1,529	Liese Creek Alluvium	Pre-mining	No	Yes	1533	1525
559-1A	1,813,342	3,822,625	2,166.0	400	1066	317.0	1,849	Bedrock	Fall 2012	No	No		
12-594 1	1,816,140	3,822,047	2,660.0	396	1216	245.7	2,414	Bedrock	Fall 2012	No	No		
12-627 1	1,816,140	3,822,047	2,660.0	1201	1909	228.9	2,431	Bedrock	Fall 2012	No	No		
12-628	1,816,140	3,822,047	2,660.0	205	1515	135.6	2,524	Bedrock	Fall 2012	No	Yes	2533	2511
12-630	1,815,408	3,821,683	2,371.0	200	417	53.3	2,318	Bedrock	Fall 2012	No	Yes	2318	2277
12-633	1,815,145	3,822,267	2,541.0	307	1171	148.0	2,393	Bedrock	Fall 2012	No	Yes	2393	2309
12-684 2	1,814,764	3,823,114	2,703.0	60	2505	134.0	2,569	Bedrock	Fall 2012	No	No		
12-685	1,814,764	3,823,114	2,703.0	60	1404	270.7	2,432	Bedrock	Fall 2012	No	Yes	2445	2421
12-731	1,815,007	3,822,745	2,867.0	40	2715	103.4	2,764	Bedrock	Fall 2012	No	Yes	2764	2669
97-53	1,810,726	3,821,429	2,253.5	0	1321	642.5	1,611	Bedrock	Pre-mining	Yes	No		
97-79	1,810,221	3,822,066	2,074.9	0	1395	371.9	1,703	Bedrock	Pre-mining	Yes	No		
98-105	1,812,104	3,822,341	1,696.1	0	603	110.1	1,586	Bedrock	Pre-mining	Yes	No		
98-108	1,812,354	3,822,341	1,708.2	0	967	87.2	1,621	Bedrock	Pre-mining	Yes	No		
LB-10	1,813,529	3,822,392	2,150.0	47	57	48.0	2,102	Bedrock	Pre-mining	Yes	No		
LB-12	1,813,818	3,822,177	2,150.0	50	60	45.5	2,105	Bedrock	Pre-mining	Yes	No		
LB-6B	1,811,782	3,823,604	1,825.0	59	69	52.5	1,773	Bedrock	Pre-mining	Yes	No		
LB-8-1	1,809,398	3,824,147	1,395.0	0	21	25.0	1,370	Bedrock	Pre-mining	Yes	No		
LB-9	1,809,375	3,824,115	1,395.0	40	50	27.4	1,368	Bedrock	Pre-mining	Yes	No		
LB-14	1,814,348	3,821,854	2,195.0	47	57	42.0	2,153	Bedrock	Pre-mining	Yes	No		
LD-18-2	1,815,343	3,820,973	2,085.0	0	54	89.0	1,996	Bedrock	Pre-mining	Yes	No		
LD-22	1,815,362	3,820,861	2,075.0	0	40	33.0	2,042	Bedrock	Pre-mining	Yes	No		
LT-007A	1,816,303	3,819,616	2,183.3	89	99	4.3	2,179	Bedrock	Pre-mining	Yes	No		
LT-14B	1,816,455	3,820,531	2,400.0	0	33	32.0	2,368	Bedrock	Pre-mining	Yes	No		
LT-15	1,817,519	3,819,761	2,560.0	0	22	12.0	2,548	Bedrock	Pre-mining	Yes	No		
LT-16	1,818,298	3,819,160	2,600.0	0	47	0.0	2,600	Bedrock	Pre-mining	Yes	No		
LT-20	1,817,529	3,817,822	2,635.0	0	19	7.0	2,628	Bedrock	Pre-mining	Yes	No		
LT-22	1,815,473	3,819,011	2,660.0	0	17	3.0	2,657	Bedrock	Pre-mining	Yes	No		
MW97-041	1,810,974	3,821,077	2,313.7	930	960	392.7	1,921	Bedrock	Pre-mining	Yes	Yes	1921	1864
MW97-066	1,811,421	3,821,703	2,012.7	0	855	353.7	1,659	Bedrock	Pre-mining	Yes	No		

Monitoring Well ID	Coordinates			Screen Interval (ft)		Depth to Water Levels (ft)	Measured Water Elevation (ft amsl)	Hydrogeologic Unit	Date	Monitoring Wells used for Calibration			
	X	Y	Elevation (ft amsl)	From	To					Monitoring Well used for Pre-mining Steady State	Monitoring Well used for Mining Transient	Water Level used for Transient Calibration (ft amsl)	
												Maximum	Minimum
MW97-071	1,811,492	3,821,214	2,210.0	726	796	295.0	1,915	Bedrock	Pre-mining	Yes	Yes	1916	1894
MW97-076	1,811,218	3,820,813	2,360.0	921	1001	433.0	1,927	Bedrock	Pre-mining	Yes	Yes	1927	1626
MW98-003	1,807,875	3,819,087	1,324.3	25	30	3.3	1,321	Bedrock	Pre-mining	Yes	No		
MW98-004	1,807,629	3,819,130	1,324.1	25	30	3.1	1,321	Bedrock	Pre-mining	Yes	No		
MW98-006	1,807,498	3,819,863	1,326.5	25	30	4.5	1,322	Bedrock	Pre-mining	Yes	No		
MW98-011A	1,808,171	3,819,400	1,326.5	73	78	4.5	1,322	Bedrock	Pre-mining	Yes	No		
MW98-013	1,808,247	3,820,775	1,331.9	64	74	5.9	1,326	Bedrock	Pre-mining	Yes	No		
MW98-080	1,809,175	3,818,970	1,590.0	460	500	253.0	1,337	Bedrock	Pre-mining	Yes	No		
MW98-081	1,809,836	3,819,386	1,840.6	416	456	310.6	1,530	Bedrock	Pre-mining	Yes	Yes	1532	1498
MW98-082	1,810,357	3,819,873	2,087.0	735	773	386.0	1,701	Bedrock	Pre-mining	Yes	Yes	1702	1362
MW98-133	1,811,980	3,821,387	2,027.0	620	660	263.0	1,764	Bedrock	Pre-mining	Yes	Yes	1764	1669
MW99-189	1,813,356	3,820,289	2,349.5	830	850	524.5	1,825	Bedrock	Pre-mining	Yes	Yes	1838	1825
MW99-202	1,812,654	3,820,563	2,203.0	895	925	422.0	1,781	Bedrock	Pre-mining	Yes	Yes	2192	1753
MW99-204	1,812,425	3,820,976	2,070.0	388	428	213.0	1,857	Bedrock	Pre-mining	Yes	Yes	1857	1843
MW99-213	1,810,090	3,823,389	1,472.0	450	500	16.0	1,456	Bedrock	Pre-mining	Yes	Yes	1464	1455
MW04-213	1,810,076	3,823,871	1,510.0	0	153	40.0	1,470	Bedrock	Mining	No	Yes	1470	1379
MW11-216	1,808,547	3,822,010	1,505.0	0	234	158.0	1,347	Bedrock	Mining	No	Yes	1421	1347
MW12-001B	1,810,938	3,826,262	1,359.3	130	160	10.3	1,349	Bedrock	Fall 2012	No	Yes	1349	1349
PS-11	1,814,595	3,819,473	2,665.0	24	34	4.0	2,661	Bedrock	Pre-mining	Yes	No		
MW99-216	1,808,999	3,821,901	1,678.0	450	500	297.0	1,381	Bedrock	Pre-mining	Yes	Yes	1476	1328
13-H3	1,812,235	3,820,041	2,520.0	97	718	139.2	2,381	Bedrock	Summer 2013	No	Yes	2423	2381
13-562	1,813,342	3,822,625	2,166.0	240	2773	240.0	1,928	Bedrock	Summer 2013	No	Yes	1928	1928
13-695	1,812,922	3,823,509	2,192.0	201	2963	200.5	1,992	Bedrock	Summer 2013	No	Yes	1996	1992
13-651	1,813,573	3,818,867	2,578.0	79	1778	78.9	2,503	Bedrock	Summer 2013	No	Yes	2504	2504
13Hydro-01 3	1,815,297	3,821,248	1,215.0	1215	1049	-182.3	1,397	Bedrock	Summer 2013	No	No		
13Hydro-02 3	1,812,596	3,821,217	1,090.0	1090	895	-255.7	1,346	Bedrock	Summer 2013	No	No		
13Hydro-03 3	1,814,608	3,821,731	887.0	887	778	-145.4	1,032	Bedrock	Summer 2013	No	No		
13Hydro-04 3	1,815,296	3,821,254	1,217.0	1217	1107	-606.3	1,823	Bedrock	Summer 2013	No	No		
13Hydro-05 3	1,815,302	3,821,243	1,218.0	1218	909	-507.5	1,725	Bedrock	Summer 2013	No	No		
13Hydro-06A 3	1,812,199	3,822,644	1,067.0	1067	975	-219.7	1,287	Bedrock	Summer 2013	No	No		
13Hydro-06B 3	1,812,207	3,822,663	1,062.0	1062	919	-272.2	1,334	Bedrock	Summer 2013	No	No		
13U283 3	1,809,979	3,821,867	568.0	568	568	-297.1	865	Bedrock	Summer 2013	No	No		

Notes:
1 Water levels recorded directly after packer testing. May not be representative of static conditions.
2 Water levels recorded directly after stub well installation. May not be representative of static conditions.
3 Negative Depth to Water Levels indicates height of water above the collar of horizontal underground borehole.

6 Numerical Model

The groundwater flow model is a mathematical representation of the components of the conceptual model of the flow system. Those components include:

- Sources of inflow to the mine that include precipitation, infiltration recharge, influence from permafrost, and surface water;
- Storage or water in the rock mass, both as fracture storage and (minimal) storage in rock porespace;
- The pathways or preferred conveyance of water, which at the Pogo site are faults and lithologic contacts;
- The direction and rate of exchange of water between surface water features and groundwater; and
- Discharge of water from the mine that represents removal of water from the groundwater system.

SRK populated the numerical model with quantified representative values of data obtained from the results of the 2012 and 2013 field programs and the results of previous investigations, the 3D geological/structural model developed by Pogo; and as-built and planned workings provided by Pogo.

SRK used the finite-difference code Visual MODFLOW-SURFACT version 3.0 (SWS 2011 and HGL 2006) to develop the groundwater-flow model to simulate inflow to the existing Pogo underground mine and proposed developments (East Deep, Liese Zone, and North Zone), and associated effects on the groundwater system. The model is based on equivalent porous media approach; however the major known geological structures are incorporated in the model as different hydrogeological units.

The descriptions of numerical groundwater flow model and results of calibration to measured water levels (both pre-mining steady state and transient during the mining) and groundwater inflow to existing underground developments are summarized in **Appendix C**.

The 3D groundwater-flow model, developed and calibrated by SRK, was used to make predictive simulations of:

- Passive inflow to the proposed underground mine and mine discharge requirements;
- Changes in water levels and propagation of drawdown during future dewatering; and
- Changes in groundwater discharge to river and creeks.

Predicted total inflow to the underground mine under Base Case scenario is shown in **Figure 5**. This figure shows the results of predictive simulations through the end of 2017, the time at which excavation of waste tunnels is to end. The model predicts that a maximum inflow rate of 440 gpm at the beginning of year 2016.

The model predicts a groundwater inflow rate of 419 gpm at the end of mining coming from:

- Depletion of groundwater storage – 32%;
- Intersection of groundwater flow originally discharged into Liese Creek and creek inflow – 34%;
- Reduction of groundwater contributing to the Goodpaster River – 17%;

- Increase of recharge from precipitation – 5%; and
- Increase of recharge from Liese Creek – 12%.

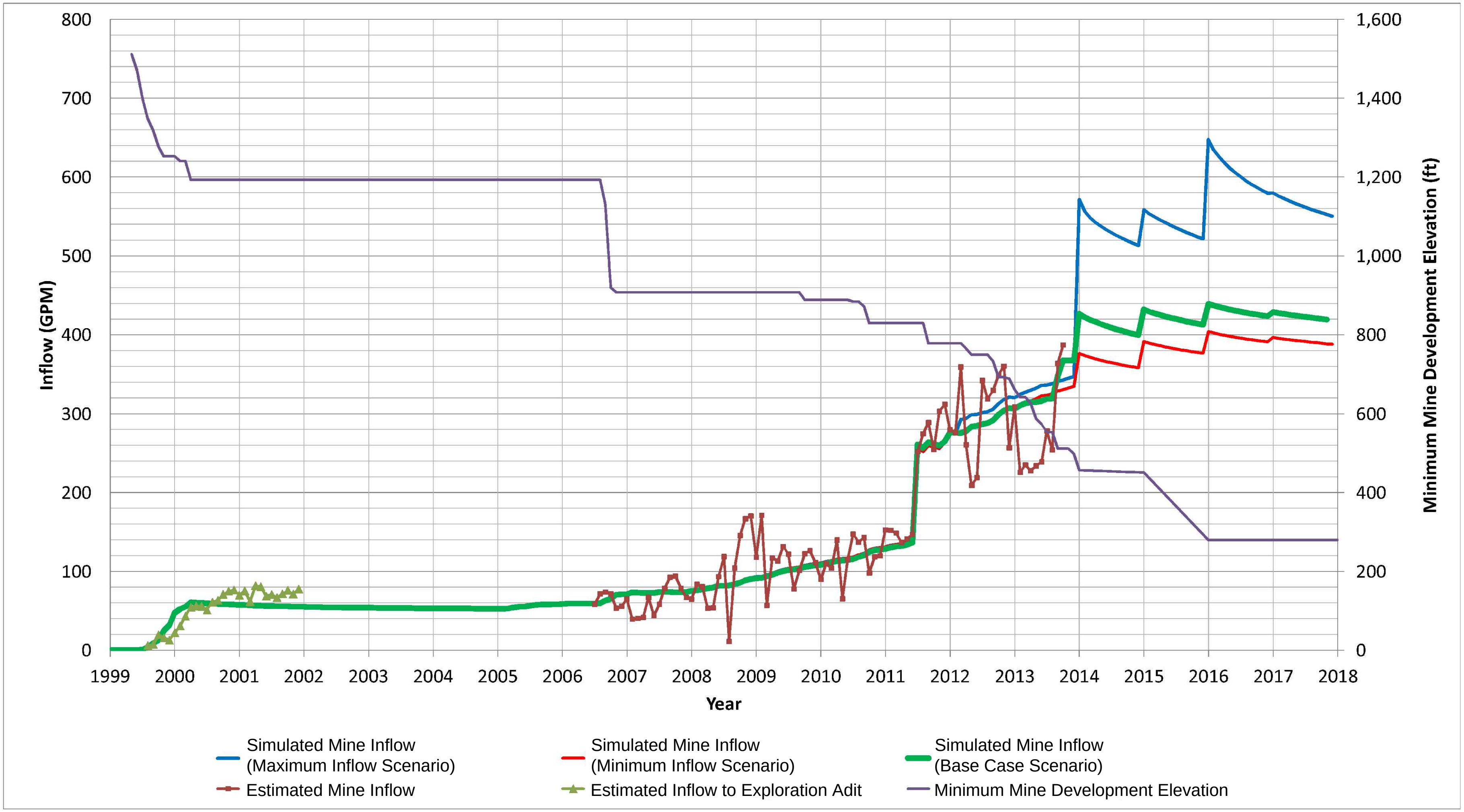
The model predicts the distribution of inflow between different parts of the mine at the end of mining: 93 gpm (or 22%) from East Deep, 14 gpm (or 3%) from the North Zone expansion, and 311 gpm (75%) from expansion of the Liese mine area. It should be noted that predicted inflows listed above are averaged and assume that the comprehensive grouting practice which has been successfully used at Pogo will continue to the end of mining.

Additionally to the Base Case, the sensitivity analysis of conductance of the drain cells and hydraulic conductivity intersecting the faults in East Deep area was completed to evaluate the possible range of total mine inflow. This analysis indicates that there are uncertainties due to the complexity in the permeability of the major faults, resulting in the uncertainties in predictions for total mine inflow. Sensitivity analyses predicts a range in total mine inflow between about 400 gpm and 650 gpm. The results of the inflow predictions superimposed on measured mine discharge are shown on **Figure 5**. This range is lower than predicted inflow by Golder's FRACMAN model (from 676 to 835 gpm with average inflow of 727 gpm) under conservative assumptions of constant head conditions above the mine workings used in this model (Golder, 2012).

The model predicts that the lowest water table elevation would be about 1,300 ft amsl at the North Zone. The cone of drawdown (50 foot contour) will propagate to a distance from 0.5 miles to 1.2 miles from the center of the underground working area.

The model predicts a reduction of groundwater discharge to:

- Goodpaster River of up to 71 gpm with no hydraulic gradient reversal from the river (no inflow to the mine workings from the river);
- Ringer/North and Pogo Creeks up to 6 gpm and 22 gpm, respectively; and
- Liese Creek (up to 113 gpm) in its lower reaches and an increased recharge to the groundwater system in its upper reaches of up to 51 gpm, resulting in a total impact to the creek of up to 164 gpm.



srk consulting

SUMITOMO METAL MINING CO., LTD.

HYDROGEOLOGICAL STUDY

RESULTS OF PREDICTIVE SIMULATIONS OF INFLOW

SRK JOB NO.: 147900.020

FILE NAME: 147900.020.Rev.B.Figure.5.Results.Of.Sensitivity.Analysis.2013-12-02.dwg

POGO UNDERGROUND GOLD MINE IN ALASKA

DATE:	APPROVED:	FIGURE:	REVISION NO.
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6.1 Limitation of Groundwater Flow Model

Analysis of the available geological and hydrogeological data and the results of the completed groundwater modeling indicate that there remain gaps in the understanding of the hydrogeological conditions at Pogo related to the location geological structures to be intersected by future underground developments and their hydrogeological parameters. Due to these gaps groundwater model developed by SRK has the following limitations:

- Inability to predict short-term inflows. The model is based on equivalent porous media approach (EPM), uses the averaged hydraulic conductivity values, and, as result of this, predicts an average long-term flow conditions. This means that inflows from individual discrete fractures and faults can be larger than predicted for short period of time;
- Inability to predict inflows from unknown faults with hydraulic parameters significant higher than observed up to date. The model is based on the known geological structures and calibrated to limited amount of hydrogeological parameter characterizing them. It is possible that total inflow can be larger than predicted in the case if unknown more transmissive than previously observed faults would be intersected; and
- Inability to predict inflows if Pogo mine grouting procedures would be significantly changed. The model is calibrated to mine inflow under existing grouting conditions and predicts inflow to the future developments, assuming that they will be constructed under the same successfully implemented grouting program.

7 Conclusions

The 2012 and 2013 field programs were designed to collect the specific information needed to evaluate the hydraulic behavior of certain characteristics of the groundwater system to help Pogo operations plan future water management, and to more reliably simulate the system with the numerical flow model. The model simulations evaluated the affect dewatering of the mine has on the water table within Pogo and Liese ridges, and the degree to which the drainage of the larger discrete flow features has on the flow system. Specifically, data were collected to complete the transient calibration and to provide more robust predictions of inflow to the planned East Deep development by:

- Documenting the change in the elevation of the water table in Pogo Ridge since mining commenced. This is being done during the current 2013 field program by installing a groundwater well into Pogo Ridge above the current workings; and
- Evaluating the drainage rates and hydraulic conductivities of the more significant discrete features of inflow in the flow system.

Continuous water levels are now being collected in nine surface piezometers and seven underground coreholes. SRK recommends that the monitoring continue as the data from these locations should provide further insight into mine inflow and facilitate an improved understanding of seasonal variations, the influence of geologic structures, and pressure response to grouting activities.

The grouting program that is currently in place serves to seal some or most groundwater from the working areas. Not allowing the mine to drain means that groundwater is not depleting and, unlike in some other mines that freely drain, a diminishment of inflow as a result of groundwater depletion over time from drainage is not likely. Grout sealing can leave the water behind the grout in place, available for inflow when or if other transmissive features are intercepted by mining. What this means is that unless discharge limits are substantially increased, and the capacity of pumping and piping increased, Pogo will have to continue grouting throughout the life of the mine. Probe holes into areas planned for mining can help in anticipating short term inflow controls and long term grouting requirements.

An important result of the hydrogeologic characterization is that the new monitoring of water levels in surface piezometers, pressures in the underground drill holes, and the added focus on quantifying all new large inflows that have been established provide a strong basis to increase the understanding of the behavior of groundwater flow system and correlating inflows to the geologic structural fabric at the site. The data collected from this monitoring also enable refinement of the numerical model, resulting more accurate predictions as new and often unexpected conditions are encountered. SRK recommends that the model be updated as new data and new conditions warrant.

8 References

AGRA 2000 Hydrology Section in Volume 3 of Pogo Environmental Baseline Document, March 20.

AMEC Earth & Environmental Ltd., 2001. 2001 Geotechnical and Hydrological Characterization Program: report submitted to Teck Corporation, December 2001.

Adrian Brown Consultants, Inc., 2001, Post-Mining Groundwater Chemistry Pogo Mine Alaska: report prepared for Teck Corporation, June.

Adrian Brown Consultants, Inc., 2001, Inflow to Pogo Mine Alaska: report prepared for Teck Corporation, March 30.

Adrian Brown Consultants, Inc., 2009. Pogo Mine Inflow Evaluation and Control Review: report prepared for Tek-Cominco Corporation, April 2009.

Dingman, S.L., Koutz, F.R. 1974. Relations among vegetation, permafrost, and potential insolation in central Alaska. Arctic and Alpine Research, 6, 37-42.

Golder Associates Ltd, 1998a. Draft report on hydrogeological regime Goodpaster River Valley and proposed exploration audit Pogo Project, Alaska, June 1998.

Golder Associates Ltd, 1998b. Draft report on hydrogeological investigations Pogo Project, Alaska, February 1998.

Golder Associates Ltd, 1998c. Technical memorandum No. 1 field investigation and results Pogo Project Alaska, October 1998.

Golder Associates Ltd., 1998d. Technical memorandum No. 2 characterization of hydrogeological regime, Pogo Project Alaska, October 1998.

Golder Associates Ltd, 2000, Groundwater Hydrology – Section 3.4 in Pogo Environmental Baseline Document, April 20.

Golder Associates Ltd, 2012, Groundwater Inflow Model for the Pogo Mine: Report submitted to Sumitomo Metal Mining Pogo LLC on September 27, 2012

HydroGeoLogic, Inc., 2006, MODFLOW-SURFACT Software (version 3.0).

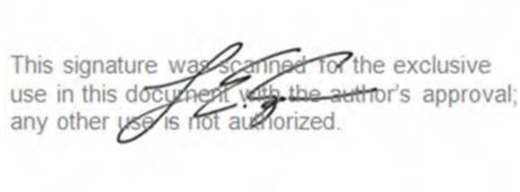
McDonald, M.C. and Harbauh, A.W., 1984, A modular three-dimensional finite-difference ground-water flow model: U.S. Geological Open-File Report 83-875, 528p.

Schlumberger Water Services, 2011, Visual MODFLOW-SURFACT (version 2011.1).

9 Date and Signature Page

Signed on this 14th of May. 2014.

Prepared by



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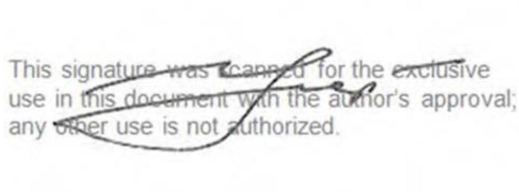

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All data used as source material plus the text, tables, figures, and attachments of this document have been reviewed and prepared in accordance with generally accepted industry practices.

Disclaimer

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Appendices

Appendix A: 2012 Field Report

Appendix B: 2013 Field Report

Appendix C: Permafrost Memorandum

Appendix D: Numerical Groundwater Flow Model