ALEXCO

ALEXCO KENO HILL MINING CORP.

TYPE A WATER LICENCE APPLICATION

QZ09-092

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

VOLUME 4

May 2010

Prepared by:

ACCESS
CONSULTING GROUP

www.accessconsulting.ca

ALEXCO

Alexco Keno Hill Mining Corp
1150-200 Granville Street
Vancouver BC V6C 1S4

December 23, 2009

Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, Yukon Y1A 3V1

Attention: Ms. Joelle Janes, Licencing Officer

Dear Ms. Janes:

Re: Bellekeno Mine Water Licence Application QZ09-092,
Response to Review for Adequacy and Supplemental Information

Thank you for your correspondence of December 10, 2009. In order to facilitate the Boards' review of our application, we are herewith providing our responses to selected questions from this letter, along with some supplemental information documents that are intended to provide more context to our application.

The supplemental information documents are:

- Closure costing report to Yukon Government by SJCI Consultants;
- Quartz Mining Licence QML-0009;

Other documents that we are including as components of our responses are submitted as attachments to the response.

We will submit our responses to the remainder of your questions in early January. We have enclosed a status table in this letter so that the responses can easily be tracked.

Response Status to Questions in December 10th Correspondence Concerning Water Use Application QZ09-092

Question	Status	Question	Status
1	Submitted Dec 23	34	To be submitted
2	Submitted Dec 23	35	To be submitted
3	Submitted Dec 23	36a	To be submitted
4	Submitted Dec 23 (includes Attachment A to responses)	36b	To be submitted
		36c	To be submitted
5	Submitted Dec 23	36d	To be submitted
6	Submitted Dec 23 (includes Attachment B to responses)	37	To be submitted
		38	To be submitted
7	Submitted Dec 23	39	To be submitted
8	Submitted Dec 23 (includes Figure 1 to responses)	40	To be submitted
		41	To be submitted
9	To be submitted	42	To be submitted
10	To be submitted	43	To be submitted
11a	Submitted Dec 23 (includes Attachment C to responses)	44	To be submitted
		45	To be submitted
11b	Submitted Dec 23	46	To be submitted
11c	Submitted Dec 23	47	To be submitted
11(d)i	Submitted Dec 23	48	To be submitted
11(d)ii	Submitted Dec 23	49	To be submitted
12a	To be submitted	50	To be submitted
12b	To be submitted	51	To be submitted
12c	To be submitted	52	To be submitted
13	Submitted Dec 23	53	To be submitted
14	Submitted Dec 23 (see digital Attachment D to responses)	54	Submitted Dec 23
		55	To be submitted
15	To be submitted	56	To be submitted
16	To be submitted	57	To be submitted
17	To be submitted	58	To be submitted
18	Submitted Dec 23	59	To be submitted
19	To be submitted	60	To be submitted
20	Submitted Dec 23 (see revised Table 7-2 in responses)	61	To be submitted
		62	To be submitted
21	Submitted Dec 23	63	To be submitted
22a	Submitted Dec 23	64	To be submitted

Response Status to Questions in December 10th Correspondence
Concerning Water Use Application QZ09-092

Question	Status	Question	Status
22b	To be submitted	65	Submitted Dec 23
22c	Submitted Dec 23	66	Submitted Dec 23
22d	Submitted Dec 23	67	To be submitted
22e	Submitted Dec 23	68	To be submitted
22f	Submitted Dec 23	69	Submitted Dec 23
22g	Submitted Dec 23	70	Submitted Dec 23
22h	To be submitted	71	To be submitted
22i	Submitted Dec 23	72	To be submitted
22j	Submitted Dec 23	73	To be submitted
23	To be submitted	74a	To be submitted
24a	To be submitted	74b	To be submitted
24b	To be submitted	74c	To be submitted
24c	To be submitted	74d	To be submitted
24d	To be submitted	75	To be submitted
24e	To be submitted	76	To be submitted
24f	To be submitted	77	To be submitted
24g	To be submitted	78	To be submitted
24h	To be submitted	79	To be submitted
25a	To be submitted	80	To be submitted
25b	To be submitted	81	To be submitted
25c	To be submitted	82	Submitted Dec 23
26	Submitted Dec 23 (see revised Table 6-7 in responses)	83	Submitted Dec 23
		84	To be submitted
27	To be submitted	85	To be submitted
28	Submitted Dec 23 (includes Figure 2 to responses)	86	To be submitted
		87	To be submitted
29	Submitted Dec 23 (see revised Figure 3-4 in responses)	88	To be submitted
		89	To be submitted
30	To be submitted	90	To be submitted
31	To be submitted	91	To be submitted
32	To be submitted	92	To be submitted
33	To be submitted	93	Submitted Dec 23

Should you have any questions, please contact our office at 867-668-6463.

Sincerely,
Alexco Keno Hill Mining Corp

Robert L. McIntyre, R.E.T.
Vice President, Business Development
Alexco Keno Hill Mining Corp

cc. external D. Buyck, NNDFN
cc. internal C.Nauman, B.Thrall, T.Hall, D.Whittle, Alexco Resource Corp.
E. Allen, T. Lunday, Access Consulting Group

Attachments:

- *Attachment A: ERDC permission to mine;*
- *Attachment B: Reliance on third party technical reports letters;*
- *Attachment C: Memo to Transport Canada June 1 2009, regarding proposed Lightning Creek crossing location;*
- *Attachment D: Water Quality database CD*

Schedule 4 Application Form

1. *Please explain the discrepancy between the water sources listed in question 4 of the Schedule 4 application form and page 3 of 14 of the information sheets. If MacKeno Creek and Flat Creek are to be considered for licensing, please update the Schedule 4 application form accordingly.*

   Please see amended Schedule 4 application.

2. *Please complete question 8 regarding the water use triggers for the water use licence application.*

   Please see amended Schedule 4 application.

General

3. *The application, as submitted, has remained silent on what Alexco Keno Hill Mining Corp. (Alexco) plans to do with the existing type B water licence QZ07-078. Water use licence QZ07-078 expires in 2018, whereas the requested expiry date proposed in the application for the type A water licence is 2025. If granted, all activities required for the operation of the proposed Bellekeno mine operations will need to be reflected in the type A licence. Please advise if there are any plans to cancel or amend the existing QZ07-078 if a type A water use licence were to be issued.*

   QZ07-078 will be amended or extended before its expiry date to support exploration/advanced underground exploration throughout the district. This licence will be amended to remove any reference to the Bellekeno licence requirements once the Type A licence is received and reviewed.

   Please refer to attached letter from Alexco President & CEO Clynt Nauman to Yukon Government (Attachment A), which provides authorization for subsidiary companies to use each others' facilities for care & maintenance, exploration and mining.

   As we develop the Keno Hill properties over the coming years, we look forward to working with the Board to develop the optimum strategy for licensing water use and waste deposit activities.

4. *Please identify any overlapping water uses, waste deposits, and activities that are being requested in this application and are already authorized under existing water licences QZ06-074 and QZ07-078.*

   29m3/day is currently authorized from Flat Creek under QZ07-078. In addition to this, the Bellekeno Mine project will require an additional 13.75m3/day in order to supply the expanded camp.

5. *It appears the Typical Waste Containment Facility Design Report was submitted in two separate sections of the application; the Main Application Report -Appendix C (exhibit 1.3.3) and the Construction Site Plan -Appendix J (exhibit 1.4.10). Please confirm if these are the same document, and if so, please be advised that the Appendix C version will be removed from the application's register to avoid duplication.*

   We confirm that these are indeed the same document, and concur that Appendix C can be removed to avoid duplication.

6. *The technical memo included in the Construction Site Plan -Appendix J contains a disclaimer that states: "This report and its contents are intended for the sole use of Alexco and their agents…" Furthermore, Environmental Conditions Report - Appendix H (exhibit 1.3.6.8) contains the following: "This report was prepared for the exclusive use of Elsa Reclamation and Development Company…"*

   All documents provided to the Board are available to the public, and therefore written approval from the authors must be provided in order for the Water Board to use the information for the purposes of licensing.

   Please see attached letters (Attachment B) from our consultants authorizing their reports' use by the Yukon Water Board.

7. *Page 1-16 of the Main Application Report (exhibit 1.3) refers to the development of the Keno City Socio-economic Mitigation Plan. I was unable to find this plan in the application package. Please advise if this plan is available, and if so, submit a copy for inclusion in the application.*

   The Keno City Socio-economic Mitigation Plan is found in Section 5.4.5.3 (page 5-40) of the Application.

8. *As requested in question 11 of the information sheets, please provide details and attach a map showing Settlement Land in relation to your project. Please provide the locations and approximate distances to the nearest parcels of Settlement Land located adjacent to the drainages downstream of the project area (South McQuesten River and Lightning Creek/ Duncan Creek/ Mayo River/ Stewart River systems). I was not able to locate the Settlement Land parcel on the referenced figure 1-2.*

   The nearest First Nations Settlement Lands downstream of the project are located within two catchments. The nearest settlement land downstream on the South McQuesten River is NND R20-B is located about 38 km downstream from Christal Lake (please see Figure 1 to these responses on page X). Treated effluent discharge from the mine reports to Lightning Creek, Duncan Creek, Mayo River and Mayo Lake, where the nearest settlement land is located about 58 km downstream from the Lightning Creek/Duncan Creek confluence (please see Figure 1 to these responses on page 4).

Clarification on Liability

9. *To be submitted.*

10. *To be submitted.*

Preliminary Design Drawings

11. *Please refer to question 33 of the application pertaining to watercourse crossings. In this section, reference is made to a construction of a bridge, and the design drawing is provided. On page 1-12 of the Main Application Report, however, it is stated that you are not seeking authorization for the bridge construction given that the width of creek is less than 5m at the ordinary high water mark. Furthermore, the application states that you are also considering the installation of a culvert to cross the creek.*

    a) *Please confirm the width of the creek at the ordinary high water mark at the point of the proposed crossing(s);*

       The width of the OWHM at the proposed bridge crossing (as per section 2.4 of the Application) is 7m (see Attachment C).

DISTANCE TO THE NEAREST PARCEL OF SETTLEMENT LAND LOCATED DOWNSTREAM OF PROJECT:

Distance between Christal Lake and Nacho Nyac Dun Settlement Land, R Block # R-20 A : 37.691 km

Distance between the Lightning Creek/Duncan Creek confluence and Nacho Nyac Dun Settlement Land R Block # R-2 B : 56.794 km

Distance measured along creeks/streams.

National topographic Data Base (NTDB) compiled by Natural Ressources Canada at a scale fo 1:50,000.
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First Nation Settlement Land data obtained from Yukon Geomatics, YTG., December 2009.

Datum: NAD 83
Projection: UTM Zone 8N

1:186,623 (when printed on 11 x17 inch paper)

0 0.5 1 2 3 4 5 km

N

Silver Trail Highway
Secondary/Local Road
Limited Use Road

Watercourse
Contours

▨ Nacho Nyak Dun Settlement Lands
Waterbody

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ACCESS

BELLEKENO MINE PROJECT
TYPE A WATER LICENSE APPLICATION

FIGURE Q 8

PROXIMITY TO FIRST NATION SETTLEMENT LANDS

Drawn By: MD	DECEMBER 2009	Verified by: RM

K:\Bellekeno\GIS\mxd\WUL_MLU_Applications\WUL_Aug_09\Modifications\Figure_Question8_FN_SettlementLand.mxd *b) Please confirm if the haul road (where the watercourse crossing is located) is accessible to the public;*

The haul road where the watercourse crossing is located will not be accessible to the public.

c) The YESAA assessment for the project did not appear to include the installation of a culvert, as described in the water licence application. I received confirmation from Government of Yukon that in order for the culvert to be included in the licence, the activity must be assessed, and a decision document issued. If you would like the Board to consider authorizing the construction of the culvert, please:

i) submit preliminary design drawings for the culvert;

ii) provide all information required in question 33 of the information sheets;

iii) describe the methodology for construction (i.e. sediment control, watercourse training, watercourse diversions, approximate timing, etc.); and

iv) submit the project to YESAA for assessment and provide a signed project confirmation form once the decision document has been issued.

At this point we are limiting our request to the bridge crossing identified in the application.

d) If you would like the Board to authorize the construction of the bridge, please:

i) indicate the approximate quantity of material (including rip-rap) to be placed within the watercourse channel;

Approximately 250 m^3 of mostly rip rap sized material will be placed as bridge abutments, which may encroach on the stream channel.

ii) resubmit the preliminary design drawing (figure 2-12) ensuring that it has been sealed by a P.Eng licensed to practice in Yukon (if the road is accessible to the public).

Please note that the preliminary design drawing can be issued as "not for construction"; please however, if approved, the Board typically asks for final design drawings prior to construction.

The road will not be accessible to the public.

12. *To be submitted.*

   a) *To be submitted.*
   b) *To be submitted.*
   c) *To be submitted.*

<u>Baseline Data</u>

13. *Environmental Conditions Report -Appendix E (exhibit 1.3.6.5) presents the flow path of the treatment plant discharge from Galkeno 300 as flowing into Christal Creek downstream of monitoring station KV-6. It is understood that this may no longer be the flow path for this adit drainage. It may now run along the Calumet Haul Road and discharge into Hinton Creek which is an upstream tributary of Christal Lake.*

The flow path for the treated Galkeno 300 adit discharge is as defined above. In 2007, ERDC constructed the Galkeno 300 sludge pond in accordance with water use licence QZ06-074. The discharge piping from the final settling pond was re-routed and piped to the Calumet Drive road way ditch. The existing road side hill ditch was excavated and cleared to contain the discharge flows to Hinton Creek which then flows into upper Christal Creek.

Please confirm if the adit discharge path is as defined above and, if applicable, provide information regarding when this change was effective.

14. *The Water Quality database (exhibit 1.3.3.6) appears to be missing flow measurements required as part of Water Use Licence QZ07-078 and QZ06-074. The database is also believed to be missing Water Quality Data collected in 2009. Please provide an updated database with most current water quality and water quantity data.*

Please see Attachment D in CD format – 2009 Keno Hill Water Quality Database.

15. To be submitted.

16. To be submitted.

17. To be submitted.

18. Please confirm whether water quality or quantity data exists for Duncan Creek. If the data exists, please provide this information for inclusion in the application.

Alexco has not collected water quality data from Duncan Creek. However, it is understood that the First Nation of NND has collected a limited amount of data from Duncan Creek as individual samples.

Environmental Monitoring Program

19. To be submitted.

20. On page 7-2 of the Main Application Report, it is stated that monitoring station KV-75 is to be included in the monitoring program, however it was omitted in table 7-2. Please update where necessary.

The Bellekeno East settling pond was built for the dewatering of the mine during exploration. This site, known as KV-75, has since been reclaimed. See revised table 7-2 on page 8.

21. Please provide the rationale for not including monitoring stations KV-49 and KV-50 in the list of proposed monitoring stations listed in table 7-2 of the Main Application Report.

KV-51 (Christal Creek d/s of Hinton Creek) encompasses the discharges at both KV-49 (Hinton Creek u/s of Christal Creek) and KV-50 (Christal Creek u/s of Hinton Creek). As these latter two stations are upstream of the various past mining operations at the Keno Hill property, they are considered not significantly impacted by site liabilities. However, they are included in Keno Hill Care and Maintenance Licence QZ07-078 for completeness and therefore are monitored for Care and Maintenance purposes and closure analyses.

Table 7-2 Proposed Monitoring Program Summary Within the Area of the Mill and Mine

Monitoring Station	Easting	Northing	Description	Internal Lab								External Lab								EEM Program		
				Inspect	Flow	pH	Temp.	Cond.	Total Zinc	Ammonia	Turbidity	Total ICP Metals	Dissolved ICP Metals	Ammonia	Hardness	pH	Cond.	TSS	LT50	Sediment	Benthic	Sub-Lethal Toxicity
Proposed Monitoring under new Type A Water Licence Application																						
KV-1	4742790	7092790	South McQuesten River u/s Christal Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-2	472076	7090036	South McQuesten River @ Pumphouse		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-6	483909	7088242	Christal Creek at Keno Highway		Q	Q	Q	Q				M	M		M	M	M	M		BA	BA	
KV-7	478657	7092413	Christal Creek at Hanson Road		M	M	M	M				M	M		M	M	M	M				
KV-8	465836	7088410	Christal Creek @ Mouth		Q	Q	Q	Q				M	M		M	M	M	M				
KV-37	490315	7087776	Lightning Creek u/s Hope Gulch		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-38*	488193	7087341	Lightning Creek u/s Thunder Gulch		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q		A		
KV-39	490252	7087783	Hope Gulch u/s Lightning Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-40	488982	7087503	Charity Gulch u/s Lightning Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-41	485429	7086764	Lightning Creek u/s bridge at Keno City		Q	Q	Q	Q				M	M		M	M	M	M		A		
KV-42	487363	7087062	Bellekeno 625 Adit		C	W	W	W	W	W	W	M	M	M	M	M	M	M				
KV-43	487318	7087147	Bellekeno 625 Treatment Pond Decant	D	D	D	D	D	D	D	D	W	W	W	W	W	W	W	M	A		SA
KV-44	487361	7087195	Bellekeno 625 Seep			Ms	Ms	Ms	Ms				Q	Q		Q	Q	Q	Q			
KV-45	485101	7087288	Onek Adit		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-51*	483600	7087010	Christal Creek d/s Hinton Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-52	483756	7087869	Mackeno Creek		M	M	M	M				M	M		M	M	M	M				
KV-65	487464	7086873	Thunder Gulch Upstream of Bellekeno		Q	Q	Q	Q				M	M	M	M	M	M	M				
KV-75	487594	7086161	Bellekeno East Pond Decant	*Pond has been reclamated*								*Pond has been reclamated*										
KV-76	487414	7087118	Thunder Gulch d/s of Bellekeno 625 adit			Q	Q	Q	Q				M	M	M	M	M	M	M			
KV-77	487742	7086013	Thunder Gulch upstream of Bellekeno East		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-78	487126	7087052	Bellekeno Waste Rock Storage Facility			Ms	Ms	Ms				Q	Q		Q	Q	Q	Q				
KV-79	483796	7087919	Christal Creek d/s MacKeno Tailings		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-80	483790	7087869	Christal Lake u/s Mackeno Tailings		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				
KV-36	483787	7086750	Bellekeno Mill Pond Discharge	D	D	D	D	D	D	D	D	W	W	W	W	W	W	W	M	A		SA
KV-81	483548	7086423	Lightning Creek, South of Mill Site		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q				

Codes:

C = Continuous
D = Daily
W = Weekly
M = Monthly
Ms = Monthly (May - Oct)
Q = Quarterly
A = Annually
SA = Semi Annually
BA = Bi Annually - every 2 years
* = Background
**To Be Determined

ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium

22. *The Water Quality Assessment Report (exhibit 1.3.6.7) prepared by Minnow Environmental Inc. included 10 recommendations regarding future modifications to the environmental monitoring program. The recommendations are presented below:*

a) *The locations of routine monitoring stations should be re-evaluated in terms of the information contained in this report. It would be appropriate to add additional routine sampling stations within the tributaries to more clearly delineate and track the spatial extent of mine influence on water quality (i.e., concentration gradient downstream), particularly in Flat Creek, Lightning Creek and No Cash Creek which have a relatively small number of sampling stations;*

Several regular monitoring stations have been added to the monitoring network based on the recommendations made by Minnow Environmental Inc. These include the following in the Flat Creek drainage:

- KV-61 (Porcupine Gulch at Calumet Road Crossing)
- KV-69 (Valley Tailing Decant and Seepage u/s Flat Creek)
- KV-70 (Flat Creek 20m u/s KV-69)
- KV-71 (Flat Creek 20m d/s KV-69)

These also include the following in the Lightning Creek drainage:

- KV-65 (Thunder Gulch u/s Bellekeno 625 Adit)
- KV-76 (Thunder Gulch d/s Bellekeno 625 Adit)
- KV-77 (Thunder Gulch u/s Bellekeno East)

The No Cash Creek drainage underwent an intensive water quality sampling survey in summer 2009, as part of the development of the district wide closure planning process. Once the data has been reviewed and the report prepared, it will be used to determine if additional regular monitoring stations are required along No Cash Creek as part of the district wide long term closure monitoring program.

b) *Monitoring at additional reference stations should be considered and the appropriateness of using KV-1 relative to the new reference station KV-72 should be evaluated;*

This recommendation is currently being assessed by Minnow Environmental as part of the district wide closure plan and long term closure monitoring requirements and will be submitted with the next installment of responses.

c) *The laboratory responsible for water quality analyses should be instructed to conduct total phosphorus analysis using the standard colourimetric method and a reasonable number of samples should be split and sent to a second laboratory for confirmation of total phosphorus concentrations;*

The first part of this recommendation has been passed on and confirmed by the lab as of May 2009. We will be proceeding with the split method of phosphorous testing commencing in 2010.

d) *Dissolved organic carbon (DOC) should be added to the routine monitoring parameter list as it is a known modifier of zinc toxicity and is currently not included in the monitoring program. Stations to be monitored for DOC should include KV1, KV37, KV39, KV41, KV6, KV16, KV29, KV30, KV7, KV8, KV21, KV47, KV9, KV-4 and KV5. In addition, DOC should be included in the parameter list at any new reference stations.*

This recommendation was partially implemented in May 2008, and has since been expanded to meet this recommendation for these and other reference stations.

e) *Future monitoring of metals should focus on total concentrations and determination of dissolved concentrations should be excluded;*

Both total and dissolved metals are included in the monitoring programs. Testing for dissolved metals is required under water licences QZ06-074 and QZ07-078 and the collection of this information adds value to analyses conducted for other Keno Hill studies.

f) *Analytical methods and associated method detection limits should be reviewed for arsenic, chromium, copper, cyanide, lead, mercury, nitrite, total phosphorus, selenium, silver, tin, uranium and zirconium to ensure that the reported MDL is consistently below the applicable water quality guidelines;*

The analytical methods presently used for arsenic, chromium, copper, cyanide, lead, mercury, nitrite, total phosphorus, selenium, silver, tin, uranium and zirconium are confirmed to have MDLs below the applicable water quality guidelines referenced by Minnow Environmental Inc in their Water Quality Assessment for United Keno Hill Mines.

g) *More frequent monitoring (5 to 8 samples/year) should be undertaken for analysis of aluminum, arsenic, chromium, copper, cyanide (WAD and total), manganese, mercury, nitrite, selenium and silver, particularly in the tributaries, Christal Creek (KV6, KV16, KV29, and KV30), Lightning Creek (KV39 and KV40), Flat Creek (KV47), and No Cash Creek (KV21). The increased monitoring frequency should span the duration of a year in order to evaluate these parameters as possible COCs;*

Presently, the above sites are monitored on at least a quarterly (4 times yearly) basis for ICP metals, with the exception of KV-29 which has been dry since the relocation of the Galkeno 300 decant. KV-6 and KV-21 continue to be monitored on a monthly (12 times yearly) basis. These sites are not, however, monitored for cyanide. Prior to the effective date of the Care and Maintenance licence, KV-16 and KV-30 were monitored on a near-monthly basis. There are no current plans to raise the level of monitoring from 4 times yearly to 5 or more as we hold the view that an additional sample will not make an appreciable improvement over the current water record. However, plans are being implemented to begin cyanide testing in 2010 for new mine development as required under the Metal Mining Effluent Regulations.

h) *Background benchmarks should be re-developed for all substances having a guideline once an adequate reference database has been developed with consistently low MDLs and including data for a greater number of reference stations;*

The above recommendation will be implemented once an adequate reference database has been compiled. Minnow Environmental is currently reevaluating the updated dataset and will be consulted to determine when and adequate reference database exists. We will submit a definitive response with the next round of responses.

i) *A long-term monitoring program should be developed to support the approved closure plan as well as operations under the Water Licence. An effective design should be statistically based and allow for meaningful change to be detected and responded to (i.e., adaptable). The program should be rationalized such that only relevant parameters and locations are monitored at a frequency relevant to detecting meaningful change over time; and*

We have accepted this recommendation and we have therefore engaged Minnow Environmental to develop a long term monitoring program, which we expect will be completed in the mid 2010 as part of the district wide closure plan.

j) *An approach should be developed to establish water use goals and expectations for tributaries downstream of the UKHM based on water uses and protection goals.*

We have accepted this recommendation and we have therefore engaged Minnow Environmental to develop a long term monitoring program, which we expect will be completed in mid 2010 as part of the district wide closure plan.

Please indicate whether these recommendations have been adopted and/or if they are incorporated into the proposed environmental monitoring program for the Bellekeno East Project. If they have not been adopted or proposed please provide a rationale for not accepting them.

23. *To be submitted.*

24. *To be submitted.*

Water Quality

25. To be submitted.

26. Table 6-7 of the Main Application Report provides proposed effluent quality discharge standards. Please complete the table by proposing criteria for Ammonia Nitrogen, Cadmium and Silver; or explain why effluent discharge standards for these parameters were not included.

See revised Table 6-7 below:

	Maximum Concentration
Parameter	**Grab Sample**
pH	6.0 to 9.5 pH Units
Suspended Solids	15 mg/L
Ammonia Nitrogen	5 mg/L
Arsenic (Total)	0.5 mg/L
Cadmium (Total)	0.05 mg/L
Copper (Total)	0.3 mg/L
Lead (Total)	0.2 mg/L
Nickel (Total)	0.5 mg/L
Radium 226	0.37 Bq/L
Silver (Total)	0.1 mg/L
Zinc (Total)	0.5 mg/L

27. To be submitted.

28. It appears that the reference to figure 3-4 on page 3-17 of the Main Application Report may be in error. If this is the case, please update accordingly.

The reference is in error. The figure to which this reference was made was not included in the original application. Please see Figure 2 to these responses on page 13.

29. Please reference all relevant monitoring stations for node inputs for figure 3-4 on page 3-19 of the Main Application Report (see figure 3-3 as an example).

See revised Figure 3-4 on page 14.

DRAFT Lightning Creek Mass Loading Model

Notes:
This map is for illustrative purposes only.
This is not a legal document.
Map does not depict all Elsa Reclamation and Development Corp.
and related companies claims in the district.
Data source: http://geomaticsyukon.ca.
Cadastral Data obtained from NRCAN via ftp://ftpyukoncm.nrcan.gc.ca.
Base data current as of Nov. 16, 2007.
Projection: UTM Zone 8 NAD83
NTS Sheet 105M/13 and 105M/14

Lightning Creek Mass Loading

500

Bars indicate relative loads for each of the three years, 2006 - 2008. Calculated loads appear in the text label alongside each symbol

🟪	2006
🟩	2007
🟦	2008

KV-33
Keno 700 Adit
2006: 331.4Kg/yr
2007: 374.5Kg/yr
2008: 420.3Kg/yr

KV-39
Hope Gulch u/s Lightning Creek
2006: 702.1Kg/yr
2007: 480.9Kg/yr
2008: 357.8Kg/yr

KV-37
Lightning Creek u/s Hope Gulch
2006: 57.2Kg/yr
2007: 93.7Kg/yr
2008: 624.4Kg/yr

KV-43
Bellekeno 625 Adit (after treatment)
2006: 12.5Kg/yr
2007: 17.9Kg/yr
2008: 2.9Kg/yr

KV-65
Thunder Gulch upstream of Bellekeno
no data available
2007: 10.3Kg/yr
2008: 31Kg/yr

KV-41
Lightning Creek u/s bridge @ Keno City
2006: 410.8Kg/yr
2007: 400.3Kg/yr
2008: 316Kg/yr

**LIGHTNING CREEK
MASS LOADING NODE INPUTS AND
METAL CONCENTRATION
SCHEMATIC**

showing average 2008
dissolved Zn concentrations

KV-33
Keno 700
Adit
(1.58mg/L Zn)

KV-39
Hope Gulch u/s
Lightning Creek
(0.186mg/L Zn)

KV-40
Charity Gulch u/s
Lightning Creek
(negligible contribution)

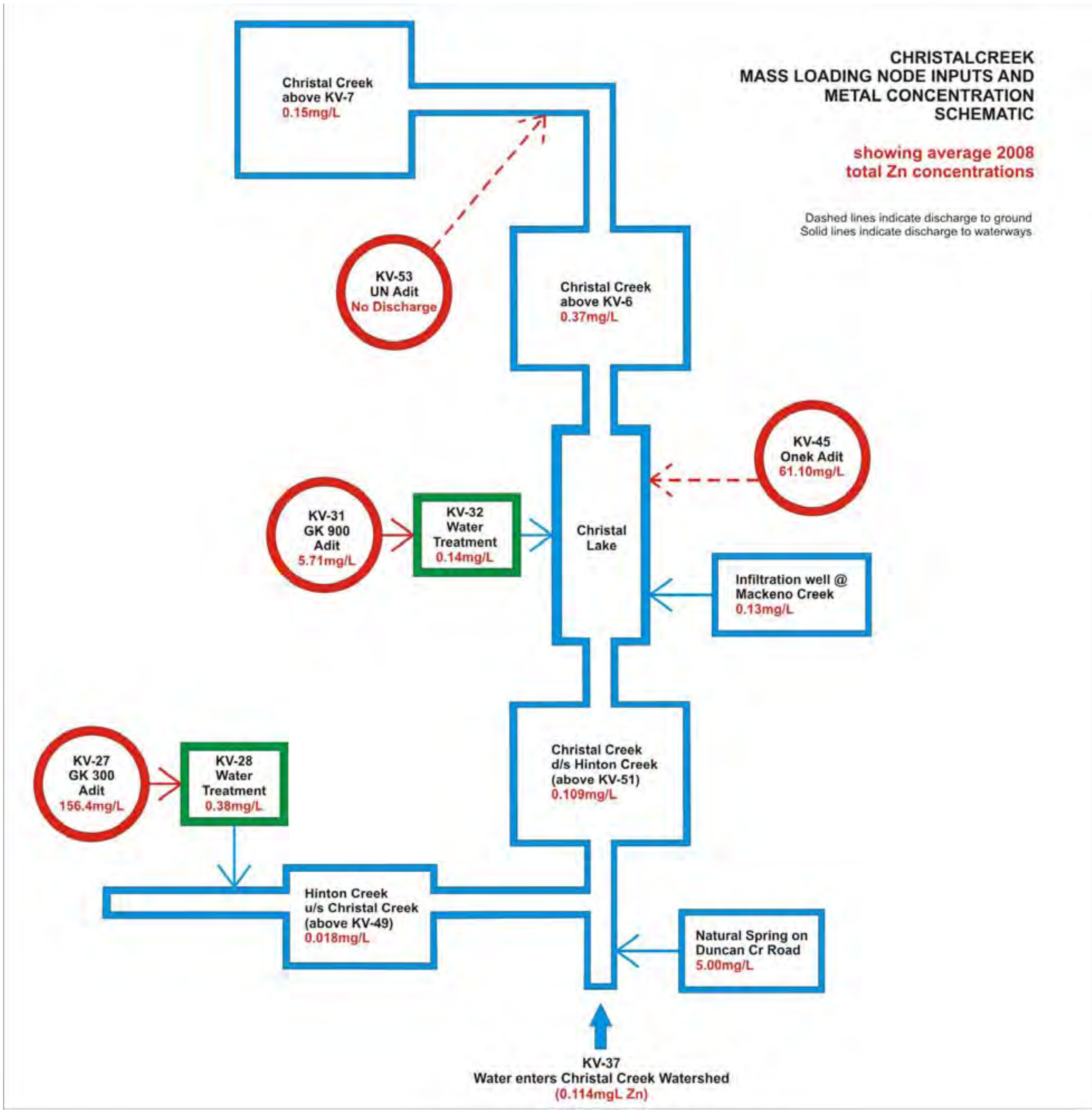
Lightning Creek
above KV-41
(0.015mg/L Zn)

Lightning Creek
above KV-37
(0.06mg/L Zn)

KV-43
Water
Treatment
(0.04mg/L Zn)

KV-65
Thunder Gulch
u/s BK600 Adit
(0.006mg/L Zn)

KV-42
Bk600
Adit
(6.193mg/L Zn)



Revised Figure 3-4: Christal Creek Mass Loading Node Inputs and Metal Concentration Schematic.

30. *Please refer to section 3 of the Main Application Report. Table 3-5 on page 3-21 does not appear to be the table referenced on page 3-20. Please identify where the table referenced on page 3-20 (table 3-5) is located.*

31. *To be submitted.*

32. To be submitted.

33. To be submitted.

34. To be submitted.

<u>Hydrology</u>

35. To be submitted.

36. To be submitted.

<u>Water Balance</u>

37. To be submitted.

38. To be submitted.

39. To be submitted.

40. To be submitted.

41. To be submitted.

42. To be submitted.

43. To be submitted.

44. To be submitted.

45. To be submitted.

46. To be submitted.

47. To be submitted.

Water Use

48. *To be submitted.*

49. *To be submitted.*

50. *To be submitted.*

51. *To be submitted.*

52. *To be submitted.*

53. *To be submitted.*

54. *On page 6-7 of the Main Application Report, it is stated that the water sources for the mill are: water drawn from the Dry Stack Tailings Facility, Galkeno 900, and Christal Lake. On page 1-14 and table 6-12, however, it states that water may also be obtained from Christal Creek. Please confirm the sources of water for the mill.*

> The confirmed sources of mill water include: water drawn from DSTF and mill pad runoff treatment pond, treated water from Galkeno 900 adit and Christal Lake and Christal Creek

Water Treatment

55. *To be submitted.*

56. *To be submitted.*

57. *To be submitted.*

58. *To be submitted.*

59. *To be submitted.*

60. *To be submitted.*

61. To be submitted.

62. To be submitted.

63. To be submitted.

64. To be submitted.

65. Please clarify where sludge produced during operations and closure at the Bellekeno mine and the Flame and Moth mill site will be disposed of.

Sludge produced from the Bellekeno water treatment system and any produced at the Flame and Moth mill site will be co-disposed in the DSTF.

66. Please clarify if treatment sludge from Bellekeno operations will be used with tailings for co-disposal at the dry stack tailings facility and/or for co-disposal with tailings in mine backfill.

Sludge from the Bellekeno water treatment will be co-disposed in the dry stack tailings facility and since a portion of the dry stack tailings will be used as backfill underground, a portion of the water treatment sludge will likewise be contained in the backfilled tailings and hence disposed underground.

67. To be submitted.

Deposit of Waste

68. To be submitted.

69. Please clarify if any new on-site septic fields will be constructed and if so, where they are proposed (i.e. Flame and Moth, Bellekeno East, etc.).

A new on-site septic field is planned for construction at the Flame and Moth mill site location. The nearest water body is Christal Creek located approximately 350 meters from the mill site location. Based on test pitting at the Flame and Moth location in 2009, the soil types are considered conducive to the development of septic fields.

70. *In licence QZ07-078, Alexco is licensed to obtain and treat up to 864m^3/day. Based on the current application, it is not clear how much water is being requested for treatment and discharge in the Type A licence.*

Please provide the maximum amount of water to be treated and discharged from the Bellekeno 625 treatment pond. Also, if applicable, please provide a further breakdown of the quantity of that water resulting from active mining of Bellekeno and the quantity of water related to the care and maintenance activities.

Once mining commences in Bellekeno, all water being pumped from underground can be considered as a result of active mining. Once mining commences there is no distinguishing between water related to care and maintenance activities and water related to active mining. The maximum amount of water expected to be discharged from the Bellekeno 625 system is estimated at 30 l/sec on an infrequent basis.

Keno Water Well Impacts

71. *To be submitted.*

72. *To be submitted.*

73. *To be submitted.*

Mass Balance Model

74. *To be submitted.*

Waste Rock

75. *To be submitted.*

76. *To be submitted.*

77. *To be submitted.*

78. *To be submitted.*

79. To be submitted.

80. To be submitted.

Mill Site and Dry Stack Tailings Facility

81. To be submitted.

82. Please explain the reference to "effluent sludge" on page 6-71 of the Main Application Report.

The term effluent sludge refers to water treatment sludge from the Bellekeno water treatment system that will be filtered and co-disposed in the dry stack tailings facility.

83. Please clarify the size of the tailings thickeners that are alternately listed as 6.1 m diameter and 3.05 m diameter, and 5 m and 1 m diameter for low pyrite and high pyrite tailings respectively. See pages 2-53, 2-54, 2-60 and 2-61 of the Main Application Report.

The correct sizes of the tailings thickeners in the mill are:
Low Pyrite: 6.1 m diameter
High Pyrite: 3.05 m diameter

84. To be submitted.

Bellekeno Mine Backfilling

85. To be submitted.

86. To be submitted.

87. To be submitted.

88. To be submitted.

89. To be submitted.

90. To be submitted.

Decision Document

91. To be submitted.

92. To be submitted.

93. Clauses 10, 11, and 15 of the decision document refer to an Environmental Effects Monitoring Plan. Please provide an update on the status of the development of this plan.

The Environmental Effects Monitoring (EEM) Program is a mandatory requirement under the Metal Mining Effluent Regulations (MMER). Alexco will initiate an EEM program according to MMER (http://www.ec.gc.ca/nopp/docs/regs/mmer/en/index.cfm) and as directed by the Metal Mining EEM Guidance Document (Environment Canada Report EEM/2002/1). Our intent is to have the MMER EEM requirements reflected in the Water Use Licence to avoid any unnecessary duplication.

In general, once MMER is triggered for the Bellekeno mine the company will initiate "Effluent and Water Quality Monitoring Studies" within six months of triggering MMER. The studies will include "Effluent Characterization", "Water Quality Monitoring" and "Sublethal Toxicity Testing". Sample collection points will include "End of Pipe" discharge (Bellekeno 625 Settling Pond Decant at KV-43) and in the receiver (Lightning Creek at KV-41) for Bellekeno Mine. We have sought clarification from Environment Canada with respect to compliance points for the MMER, which we expect to receive shortly. Reporting will follow section 1.3.3 "Effluent and Water Quality Monitoring Reports" of the EEM guidance document. All reporting would be provided to the Yukon Water Board.

With respect to Biological Monitoring requirements and according to the MMER-EEM Guidance document (Environment Canada Report EEM/2002/1), Alexco will submit a study design to Environment Canada within one year of triggering MMER. This design will include but not be limited to studies on potential effects the operation has on the fish population in the receiver, fish usability (fish tissue studies) and benthic invertebrates. Typically a Technical Committee is struck by EC to review and finalize the Study design. It is expected that this committee would include EC, YG, NND, and Alexco. All reporting would be provided to the Yukon Water Board.

ALEXCO

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE
APPLICATION QZ09-092 –
Response to Review for Adequacy and Supplemental Information

ATTACHMENT A
(Q-4)

December 23, 2009

ERDC

November 16, 2009

Department of Energy, Mines & Resources
Government of Yukon
P.O. Box 2703
Whitehorse, YT Y1A 2C3

Attention: Greg Komaromi, Assistant Deputy Minister

Dear Sirs:

Re: Quartz Mining Licence QML-0009

Elsa Reclamation and Development Company Ltd. (ERDC) and Alexco Keno Hill Mining Corp (AKHM) (previously named Alexco Resource Canada Corp.) are each wholly-owned subsidiaries of Alexco Resource Corp., and ERDC has granted to AKHM the right to either mine all minerals found in those Claims that are the subject of Quartz Mining Licence QML-0009 or perform activities and construct improvements collateral to mining, all as set out in the Application for Quartz Mining Licence QML-0009.

It is agreed by ERDC and AKHM that once a Production Unit (as defined in the February 7, 2006 Subsidiary Agreement among ERDC, Alexco, Canada and YG, all as defined therein) is nominated pursuant to the terms of such Subsidiary Agreement, then certain of the rights detailed in the first paragraph above may encompass a more restricted area consistent with the area of such designated Production Unit.

AKHM continues to hold those rights granted to it by ERDC (see correspondence dated June 10, 2008 previously submitted) to conduct exploration on all of ERDC's claims.

Sincerely,

ELSA RECLAMATION & DEVELOPMENT COMPANY LTD.

~~Per: Clynton~~ R. Nauman, President & CEO

The foregoing is hereby acknowledged and agreed by the undersigned this 16th day of November, 2009

ALEXCO KENO HILL MINING CORP.

Per: Clynton ~~R. Nauman, President &~~ CEO

Head Office

Elsa Reclamation & Development Company Ltd.
200 Granville Street, Suite 1150
Vancouver, BC V6C 1S4
Canada

T. 604 633 4888
F. 604 633 4887

ALEXCO

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT B
(Q-6)

December 23, 2009

CLEARWATER
CONSULTANTS
LTD.
Water Resources Engineering

December 18, 2009

Access Consulting Group
#3 Calcite Business Centre
151 Industrial Road
Whitehorse, Yukon, Y1A 2V3

Attention: **Mr Dan D. Cornett**

Reliance on Technical Reports – Bellekeno Mine Project

Dear : Mr. Cornett,

Clearwater Consultants Ltd. acknowledges that the material listed following with regards to the Bellekeno Mine Project and in support of the Water Licence Application may be relied upon by the Yukon Water Board and the federal and territorial regulatory agencies responsible for review of such material.

- Memorandum CCL-UKHM-1 dated May 16, 2008, "United Keno Hill Mines – Hydrological Update and Assessment" prepared for Access Consulting Group
- Memorandum CCL-UKHM-2 dated August 20, 2009, "Bellekeno Mine Project – Freshet Runoff Assessment" prepared for Access Consulting Group

If there is a need for clarification please contact the undersigned

Sincerely,

CLEARWATER CONSULTANTS LTD.

PROFESSIONAL
YUKON
PETER S. McCREATH
TERRITORY
ENGINEER

Peter S. McCreath P.Eng.
Principal and President

WARDROP
A TETRA TECH COMPANY

December 21, 2009

0953960200-LTR-R0001-00

Robert L. McIntyre, R.E.T.
Vice President, Corporate Affairs
and Communications
Alexco Resource Corp.
Suite 1150, 200 Granville St.
Vancouver BC V6C 1S4

Dear Robert

Subject Reliance on Technical Reports

Wardrop, A Tetra Tech Company (Wardrop) acknowledges that the technical reports titled “Bellekeno Project - Updated Preliminary Economic Assessment Technical Report”, dated December 2, 2009, and “Bellekeno Project - Development Plan”, dated November 9, 2009, for Alexco Resource Corp., with regard to the Bellekeno Project and in support of their “Water Use License” application submitted to the Yukon Water Board, may be relied upon by the Yukon Water Board, and the federal and territorial regulatory agencies responsible for the review of such reports.

If you require any further information or clarification, please contact Jason Amer (jason.amer@wardrop.com) or Hassan Ghaffari (hassan.ghaffari@wardrop.com) at 604-408-3788, extensions 245 and 248, respectively.

Sincerely

WARDROP ENGINEERING INC.

H - Ghaff

Jason Amer
Project Manager

Hassan Ghaffari, P.Eng.
Manager Metallurgy Vancouver

555 West Hastings Street, Suite 800
Vancouver, British Columbia V6B 1M1
Canada
Phone: 604-408-3788
Fax: 604-408-3722
E-mail: vancouver@wardrop.com

SteveJan Consultants Inc.
405 – 9 Adams Rd.
Campbell River, BC V9W 1R9
Tel/Fax: 250-926-0285
Cell: 250-850-9002

December 23, 2009

Mr Rob McIntyre
Vice President-Business Development
Alexco Resource Corp.
Suite 1150, 200 Granville St.
Vancouver, BC. V6C 1S4
Canada

Subject: Reliance on Technical Report by SteveJan Consultants Inc.
"Closure Liability Cost Estimates for Alexco's Bellekeno Mine Project at Two Early Milestones"

Dear Mr. McIntyre,

SteveJan Consultants Inc. acknowledges your request for use of the above report dated November 25, 2009 which was prepared for Yukon Energy, Mines and Resources (EMR).

It is understood that Alexco Resource Corp. would like to use the report as part of its submissions for a Water Use Licence application to the Yukon Water Board for its Bellekeno Mine Project.

Permission has been received from Mr. Bob Holmes, Director of Minerals Management Branch of EMR for Alexco's use of the report for this purpose.

The report can be relied upon by the Yukon Water Board and the federal and territorial agencies responsible for the review of such reports as part of the current Water Use Licence application review.

For any clarification or questions please contact the undersigned.

Respectfully yours,

<Original signed>

Steve Januszewski, P. Eng
Principal
SteveJan Consultants Inc.

c.c. Mr. Bob Holmes, Yukon Energy, Mines and Resources

ALEXCO

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE
APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT C
(Q-11a)

December 23, 2009

Alexco Keno Hill Mining Corp
#2 Calcite Business Centre,
Whitehorse, Yukon

June 1, 2009

Transport Canada
Technical and Environmental Services
Floor 3 344 Edmonton Street
Winnipeg, MB R3B 2L4

Via email to james.neary@tc.gc.ca

Attention: Mr. James P. Neary, Environmental Officer

Dear Mr. Neary,

Regarding: Proposed Lighting Creek crossing, Yukon Territory

Alexco Resource Corp has followed up on discussion that you & I had last month with respect to the issue of navigability of Lightning Creek in the area we intend to construct a crossing as part of our Keno City Bypass road for the Bellekeno Mine.

An inspection of the creek in the vicinity of the proposed crossing and the crossing location itself during spring flow conditions was undertaken on May 15th 2009 by R. McIntyre, R.E.T., CCEP, and E. Allen, B.Sc., both of Alexco Keno Hill Mining Corp. Along with observations made during that inspection as set out below, we have included a location map, along with photos taken during this inspection that demonstrate conditions.

We invite you to review these photos and consider revisiting your decision regarding the navigability of Lightning Creek.

The following approximate measurements were taken at the location shown on Fig 1:

Flow (measured by surface float method)	1.0 m/sec.
Wetted width:	4.5 meters
Width at Ordinary High Water Mark:	10 meters
Depth, in thalweg:	30 cm
Gradient:	5%

Detailed inspection reveals a small, high gradient, boulder-filled mountain stream with significant anthropogenic influences ranging from culverted crossings to placer mining (including entire upstream channel diversions from time to time under authority of a Type B Water Use Licence owned by Bardusan Placers Ltd. (Water Use Licence number PM04-408,). Two other placer operators also have mineral grants in the vicinity of the crossing, although there are no known other Water Use Licenses.

The proposed location for the crossing is approximately 350 meters downstream from the culverts shown in Plate 1 (Sourdough Trail crossing), and there are no stream inputs between these two locations. According to local anecdotal information, these twin 1400 mm (nominal) culverts have been in place for many years.

Please refer to Figure 1., Keno City Bypass New Road Construction, Proposed Lightning Creek Crossing Location and Photo Locations, for a depiction of the area and to orient the plates attached to this letter.

Thank you very much for your willingness to review your previous decision regarding the navigability of Lightning Creek in the vicinity of our proposed crossing. If there is any other information that we may provide you with, please do not hesitate to contact me.

Alexco Keno Hill Mining Corp

Robert L. McIntyre, R.E.T., CCEP
Vice President, Business Development

Cc D. Buyck, First Nation of Nacho Nyak Dun, Lands Branch
J. St Amand, A.Kyle, Yukon Government, Energy Mines & Resources

Attach –
Plates 1-6, site photos
Figure 1, location map

Plate 1. Lightning Creek looking downstream (west) to culverts on current Sourdough Trail crossing

Plate 2. View upstream (east) from current Sourdough Trail crossing

Plate 3. View downstream (west) from old Sourdough Trail crossing

Plate 4. View upstream (east) to old Sourdough Trail crossing

Plate 5. View upstream (east) from proposed new crossing

Plate 6. Proposed new crossing location, looking downstream (west)

For illustrative purposes only, not for construction, exact road location subject to change in accordance with field conditions.

ALEXCO KENO HILL MINING CORP.

Keno City Bypass New Road Construction
Proposed Lightning Creek Crossing Location
And Photo Locations

ALEXCO

DATE: 5/27/2009		
DRAWN BY:EA	CHECKED BY:RLM	SCALE: 1:1,500

FILE: \\dawson\d\project\allprojects\alex-05-01\bellekeno\fieldmaps\simple kc bypass.mxd

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT D

(Q-14)

December 23, 2009

SteveJan Consultants Inc.
405 – 9 Adams Rd.
Campbell River, BC V9W 1R9
Canada
Tel/Fax: 250-926-0285
Mobile: 250-850-9002

November 25, 2009

Mr. Bob Holmes
Director-Minerals Management Branch
Yukon Energy, Mines and Resources

Closure Liability Cost Estimates for Alexco's Bellekeno Mine Project at Two Early Milestones

Executive Summary

SteveJan Consultants (SJCI) has prepared this report with closure cost estimates for two early milestone stages of the proposed Bellekeno Mine project. It is understood these cost estimates will be used in the setting of security requirements in the upcoming Quartz Mining Licence, now being prepared by the Minerals Management Branch of the Yukon Government's Department of Energy, Mines and Resources (GY EMR).

The Bellekeno project is located within the former Keno Hill mining region near the hamlet of Keno City, in north-central Yukon. The project site is located approximately 45 km. east of the settlement of Mayo.

The two milestone times selected include:

1. Current Condition- considered to be September 30, 2009; and
2. Start-up Date as defined in the Quartz Mining Licence.

The following table outlines the total closure liability estimates for the two milestones. A number of components may not be the responsibility of the Company after a Production Unit nomination is made. As a result a second column has been included which provides adjusted total closure cost estimates without provisions for active water treatment or specified terrestrial items.

Summary of Closure Liability Cost Estimates for Bellekeno Mine Project to Start-Up Date

Milestone	Total Closure Liability	Total Liability w/o Active Water Treatment & Specified Terrestrial Items
1. Current Condition	$1,990,000	$620,000
2. Start-up Date	$3,313,000	$1,780,000

1. INTRODUCTION

1.1 Overview

SJCI has been involved in preparation of a number of closure cost estimates for GY EMR during mine exploration work on the Bellekeno site and the larger Keno Hill district undertaken by Alexco as well as preparation of closure cost estimates at various milestones of the proposed Bellekeno mine project including End of Construction and Final Closure following the End of Mine Life.

Alexco is currently advancing the Bellekeno site to a production decision. As part of that process, applications are currently in place for a Type A Water License from the Yukon Water Board and a Quartz Mining Licence (QML) from the Yukon Government. The project has been through the Yukon Environmental and Socio-Economic Assessment process with a Designated Office Evaluation Report and a subsequent Yukon Government Decision Document that recommended the project proceed subject to recommended terms and conditions.

This report was prepared for the account of the Yukon Government. SJCI is not responsible for any use of the materials within this report by any other party without the express written authorization of SJCI and GY.

1.2 Methodology Used in Conducting Review

The following points summarize the methodology used:

- The review was undertaken as a desktop exercise with information provided by previous closure cost estimate reports for the end of the proposed advanced exploration project and one for the End of Mine Construction milestones prepared by SJCI (for GY EMR), a couple of site visits by the author in May of 2008 and June of 2009, and reports on the project prepared by Access Consultants for Alexco, as listed in the section below;
- The first milestone was based on a previous closure cost estimate undertaken for the advanced exploration phase. It was adjusted to reflect recent work at the site, primarily consisting of construction of the concrete pad for the mill building but not including proposed additional disturbances (such as surface waste rock dumps) had the exploration project continued through to its planned conclusion; and
- The second milestone consisted of using the previous End of Construction costing and adjusting it to make it more reflective of the site at the Start-Up Date with the various production areas loaded, tailings facility in place, reagents and fuels in place, and the mine and mill in full operation.

1.3 Primary Reference Materials Utilized

The following reports and documents were utilized in preparing this report:

- *Closure Liability Cost Estimates for Alexco's Proposed Bellekeno Mine Development Project*, draft report prepared by SJCI for GY EMR, dated September 14, 2009;
- *Closure Liability Cost Estimate for Alexco's Bellekeno Advanced Underground Exploration and Development Project*, draft report prepared by SJCI for GY EMR, dated April 24, 2009;
- *Construction Site Plan, Bellekeno Project, Yukon*, prepared by Access Consulting for Alexco, dated July 2009; and

- *Preliminary Decommissioning and Reclamation Plan, Bellekeno Mine, Keno Hill Silver District*, prepared by Access Consulting for Alexco, dated July 2009.
- *YESAA Project Proposal For Type A Water Use & Quartz Mining Licence Applications Volume 1-Main Report Alexco Bellekeno Mine Development, Keno Hill Silver District, Yukon*, prepared by Access Consulting for Alexco Keno Hill Mining Corp, dated February 2009.

2. BASIC ASSUMPTIONS AND OUTLINES OF CLOSURE WORK TASKS FOR DETERMINING COST ESTIMATES

2.1 Major Assumptions

The following major assumptions were utilized in preparation of the detailed cost estimate tables:

- The two previous SJCI closure cost estimate reports (SJCI 2009) covering the milestones of end of Advanced Exploration and End of Construction were used to assist in preparation of the estimates at the two revised milestones.

- The start-up date milestone was based on the definition in the Draft QML which states "...'Start-Up Date' means 30 days following the day the Licensee begins milling ore, providing that the milling activity continues for a period of two successive days..." This was assumed to be the site after an initial running period of 30 days.

- The costing estimates assume the use of a third-party contractor to undertake the specified work. Alexco (through its wholly owned subsidiary ERDC) is currently working in the area on a multi-year care and maintenance contract of all the Keno Hill area mines for Canada. But for the purposes of this costing they are considered to be insolvent and therefore not able to undertake the closure works on the Bellekeno project while maintaining their work in the district for Canada. Another contractor that is not necessarily established and working in the area would be required for the Bellekeno project. The same contractor may or may not be undertaking the district-wide C&M program.

- Unit costs are based on previously utilized quantities, unit cost rates and lump sum cost estimates used in previous reports as well as generally accepted equipment unit rates from the Yukon Third Party Equipment Rental Rates publication (2008) with costs adjusted at the discretion of the author.

- Equipment and personnel mob and demob charges are usually not included in the setting of security levels for mine projects in the Yukon and are therefore not included in this cost estimate report.

- The major portion of the anticipated closure work tasks will be undertaken over one summer (6-month) season. However, a number of tasks will require a shorter, second summer season to complete the tasks. In addition, a number of activities will continue year-round including minewater treatment, environmental monitoring and maintenance. The overall management of the site is expected to last for 5 years (including period of active mine closure works), but realizing that mine water treatment will not commence until a year or two after the minewater pumps are shut down and the mine eventually begins to discharge minewater again at the Bellekeno 625 portal with some form of treatment possibly required for upwards of ten years.

- A Subsidiary Agreement is in place between Canada, the Yukon and ERDC for the reclamation of the historic Keno Hill mine workings which includes the Bellekeno site and on-going water treatment from its discharge to surface. It is understood that when Alexco "declares a production unit" of the Bellekeno site a number of responsibilities transfer from Canada to Alexco and thus to GY. However, a number are understood to remain with the federal government. The author is not familiar with the details of the agreement but incorporated suggested responsibilities as outlined in Alexco's DDRP and those that were stated in conversations with Alexco and GY staff in the course of finalizing the liability numbers included in this report. The initial costing prepared for the two milestones is the total cost, not considering that some of the responsibilities may have been transferred to Canada. And a second costing for each of the milestones includes a total costing without long-term water treatment of specified terrestrial items, as they may be retained by the federal government.

- The Plan does not provide for any asset values that may be realized during the decommissioning of the facilities especially as the items may be on very near new condition. Estimating asset delivery dates, monetary values and knowledge of financing arrangements/ownership details for the various assets is beyond the scope of such closure cost estimate reports. Thus, no estimate of possible credits for asset values is provided in this report.

- The approach is conservative as is considered appropriate for the closure plan financial cost estimation due to the role of the Yukon Government's Department of Energy, Mines and Resources being the lead regulatory agency overseeing the project and being responsible for setting appropriate securities.

- A contingency of 25% has been added to cover the uncertainty of the components and the details of the individual elements at all two milestone dates. Due to the extent of uncertainties that surround the current preliminary closure plan this level of contingency has been selected. It is calculated on the Total of Direct Costs for the two milestones before any Mitigative Contingencies are considered.

2.2 Current Situation Milestone Assumptions and Outline of Proposed Work

The previously prepared draft cost estimate for the end of the Advanced Exploration and Mine Development project has been revised to not include several components that have not been constructed including the planned surface waste rock storage facilities, but to include an expanded clearing and concrete pad for the mill building completed in September of this year. The author is not aware of any other changes to the Bellekeno project site since this spring when the site visit was undertaken.

Roads-It is understood there are 3 main roads that have been put in by Alexco for the previous advanced exploration and current mine development programs. A fourth road, that had led to the new Bellekeno East (B-East) portal area from the other side of Thunder Gulch along with a bridge across it is understood to have been recently removed in collaboration with the placer miner that is working the area immediately upstream of the crossing. There are also a number of secondary roads and trails around the site that enable access to a number of secondary locations as well as to historical drill sites on the minesite.

Mine Area-It is understood that there is approximately 1,000 m^3 of waste rock material in a temporary rock storage area near the B-East portal. The material is to be relocated underground for permanent disposal and the temporary storage area is to be removed. The three primary openings to the underground mine workings will all need to be sealed. The B-625 portal is to have a hydraulic plug installed and the B-East and 200 Level portals are to have coarse rockfill plugs installed, as they will both be above the ultimate flooded mine water level. In addition, a number of elements of the current developments at the B-East portal area have been included. No other work elements have been added to the B-625 area beyond the portal plug as the area has had minimal development by Alexco and the current disturbances there are limited to water treatment facilities which have been installed by ERDC as part of the Subsidiary Agreement, and will likely remain after the Bellekeno Mine is closed.

Waste Rock–A permanent AML waste rock storage facility was planned for B-East. Construction to date has consisted of constructing a depressed sand base and building a perimeter berm for the facility. Closure work will consist of pushing down the perimeter berm and re-contouring the material over the prepared sand base of the central portion of the facility.

Camp-Closure work will consist of removing 2 accommodations trailers to offsite.

Mill Area-Closure work will consist of breaking up the newly poured concrete pad for the mill building, covering it with overburden from the surrounding area and revegetating the recently partially cleared area for the proposed mill building and associated structures.

Tailings Area-It has been assumed that no work has been done in preparing the base for the proposed Dry Stack Tailings Facility, to be located adjacent to the Mill Building.

Site Management-The closure plan includes pre-treatment of the in-mine pool of water as proposed by Alexco. However, the Plan also includes 2 years of active minewater treatment after the mine begins to overflow water again, which is expected to occur 1-2 years after minewater pumps are shut down. Costing has also been provided for Alexco's proposed passive biological infiltration gallery for treating future minewater. Incremental additional monitoring and maintenance costs for active treatment and sludge settling at the existing facilities at B-625 As discussed with Alexco, there are 2 new water quality samplings sites that should be considered, with the current situation. These have been included at a sampling frequency of quarterly.

Contingencies-The Plan includes three years of additional active minewater treatment (to add up to a total of 5 years). Historically, the Bellekeno Mine has been shown to require long-term minewater treatment after its previous cycles of active mining, flooding, dewatering, flooding and current de-watered state (through active pumping). Although more than 5 years of active treatment may be required, this is considered to be a reasonable starting point for setting of securities, with opportunities for future adjustments as the mine project advances. The establishment of passive system is also encouraged, and may play a role in how long active treatment may be required.

2.3 Start-Up Date Milestone Assumptions and Outline of Proposed Work

Mine-As per the Current Situation, the closure plan at Mine Start-up will include pre-treatment of the in-mine pool of water as proposed by Alexco and 2 years of active minewater treatment after the mine begins to overflow water again, which is expected to occur 1-2 years after minewater pumps are shut down. Incremental active treatment cost is considered to be the same as was calculated for the Current Situation milestone. Costing has also been provided for Alexco's proposed passive biological infiltration gallery for treating future minewater. Costs for closure of the three mine openings are the same as for the Current Situation.

Waste Rock-As per the Current Situation the Temporary AML WRSF at B-East will be unloaded of material, dismantled, recontoured and revegetated The Plan also considers that 2 borrow areas will have been exploited as of this milestone.

Roads-The roads will consist of the roads considered in the Current Situation supplemented by 1) a new Keno City bypass road including a new culvert crossing of Lightning Creek, and 2) a new Christal Lake Road from Duncan Creek road to the new Mill area.

Camp-The Plan considers the camp will be at its maximum utilization during the latter half of construction of the Bellekeno mine facilities. As a result it considers removal of 5 trailers being required at this point.

Mill-The Plan considers the elements provided in the Alexco costing to be reasonable with several adjustments. These include the addition of a provision to clean and decontaminate areas of the buildings prior to dismantling (as the mill will have been in operation for up to a month), a provision for applying an overburden cap over the broken up concrete foundations of the now-removed mill buildings. It does not include a provision to treat mill area runoff waters as they will not yet have seen any significant contamination with ore materials outside the plant area.

Tailings Facility-The Plan considers the Dry Stack Tailings Facility area will have been prepared for tailings deposition and the first 30 days of mill production tailings will have been deposited. It is assumed to consist of 5000T and an area of less than 0.5ha. The tailings are to be removed and hauled back to the Bellekeno underground mine (for long-term storage below the long-term water level). The area will then be re-contoured and revegetated.

Site Management-The Plan considers an incremental increase consisting of a three year period of water quality sampling, associated with the mill area. Camp accommodations will be required for a work crew estimated to consist of 8 men over a 6-month work season to implement the closure works.

Contingencies-In addition to a 25% Contingency on Direct Cost Items, a provision of 3 years of additional active minewater treatment has been included as a Mitigative Contingency.

3 COSTING DETAILS

The detailed cost tables are provided in the two appendices attached to the end of this report. Highlighted sections are those that are related to the proposed active treatment and those that are of a terrestrial nature which may have continued responsibility by the Federal government.

In summary, the following table outlines the closure cost estimates under the various cost centers for the two milestone dates:

Table 3-1 Closure Liability Cost Estimates for Bellekeno Mine

Cost Center	Current Situation	Start-up Date
1. Mine	$337,000	$1,080,000
2. Waste Rock	$2,000	$35,000
3. Roads	$76,000	$179,000
4. Camp	$12,000	$27,000
5. Mill	$20,000	$486,000
6. Tailings Management	N/A	$43,000
7. Site Management	$715,000	$349,000
8. Contingencies	$828,000	$1,114,000
Total Cost	**$1,990,000**	**$3,313,000**
Total Cost w/o active water treatment or specified terrestrial items	**$620,000**	**$1,780,000**

In general, the Alexco DDRP closure costing format and costings were utilized in the preparation of the two cost estimates with adjustments as considered appropriate by the author.

The following section provides information in support of the cost estimates that were prepared, under the appropriate milestones.

3.1 Current Situation Costing Details

Mine-The costs for the hydraulic plug at B-625 as prepared by Alexco has been accepted for this report. The costs for blocking the other two horizontal portals (at B-East & 200 Level) will consist of rockfill plugs which have been costed based on placer tailings being available that will be screened to produce a coarse rockfill that will provide permanent physical blockage into the mine workings but that will enable air and water flow.

Waste Rock-The cost to relocate 1000m^3 of waste rock material back into the underground mine has been costed using a calculated production rate rather than using a unit cost basis. This method was considered more accurate than using a unit rate which was intended for use with moving materials on surface. The calculation involved estimating a cycle time for the underground Load-Haul-Dump (LHD) machine, a load factor and equipment rental rate.

Mill-The cost for breaking up the concrete of the mill building foundation was based on dimensions of 22m x 60m. The initially cleared area was assumed to be 0.75 ha.

Camp-The estimate of man-days is based on a crew of 4 men taking 90 days to implement all the closure works.

3.2 Start-Up Date Costing Details

Tailings-The Start-Up Date is specified to be after 30 days of production. As a result tailings will have been deposited in the DSTF. Costing considers picking the material up with a loader and hauling it back underground to the Bellekeno Mine. A cycle time of 1 hour has been estimated to load, haul, dump and return. A 20 minute time for a loader to scrape up and load the tailings material into the 15m^3 capacity haul truck has been estimated.

Camp-A total of 1440 man-days was estimated based on the use of a crew of 8 men for 6 months to undertake all the closure works. The crew would consist of 1 manager/supervisor, 2 equipment operators, 1 mechanic, 1 electrician, 2 laborers, and an Environmental Monitor.

4 OTHER CONSIDERATIONS

4.1 Post-Closure Monitoring and Maintenance

4.1.1 Monitoring and Reporting

The proposed mine development program includes the addition of several sampling locations for water quality.

Implementation of the Subsidiary Agreement program will provide monitoring of the overall district and a number of the sites dealing with the Bellekeno mine site. The new developments associated with b ringing the mine into production and especially the sites around the Flame and Moth sites will need to be added to the program, as per the new Water Licence.

The base case assumes 2 years of post-closure discharge water treatment after the mine re-floods so monitoring would primarily consist of sampling existing surface water sample sites. This should continue for a total of 3 full years to ensure acceptable long term levels have been reached. Provision for undertaking a 3 years of additional active minewater treatment has been provided.

Monitoring will consist of the following additional areas for consideration, beyond those already addressed in the Care & Maintenance Program:

- Water quality sampling as proposed in Alexco Type A Water Licence Application including water chemistry of water discharging the mine once it re-floods, for as long as required;
- Monitoring of road banks and stream crossings along new road cuts; and
- Physical inspection of the treatment plant system (incl. treatment plant, ponds, pumping system, etc) daily for as long as the process is required.

4.1.2 Water Quality Monitoring Program

The current Water Licence QZ06-074 to ERDC for overall site care & maintenance program of the district includes a number of sites around the Bellekeno Mine area.

Alexco has also been undertaking advanced exploration and preliminary mine development under Type 'B' Water Licence QZ07-078 which includes a number of additional sampling requirements.

An application for a Type 'A' Water Licence (QZ09-092) for the Bellekeno Mine project has recently been submitted to the Yukon Water Board.

A number of new sampling sites will be added with the new Water Licence, associated primarily with the new mill and tailings facilities that will be constructed at the Flame and Moth site located adjacent to Cristal Creek and Lake.

It has been assumed that water quality monitoring will consist of those sites not already included in the existing monitoring programs (QZ06-074 & QZ07-078).This would include at least 2 additional sample sites in the area of the proposed mill development area and a total of 6 new sites for water quality and two for toxicities that would be sampled for at least 3 years.

4.2 Contingencies

4.2.1 Mitigative Contingencies

A number of additional closure activities may be required that have not been previously considered. However, most of the closure activities at the Bellekeno site up to the Start-Up Date are of a low risk and possible mitigative measures in most cases are considered to be Unlikely to be required. Only risks that are considered Probable or Possible have been considered further in this evaluation.

In addition, this report assumes that the site will continue to be maintained as part of the on-going care and maintenance program that ERDC (or an alternate contractor) are undertaking for the federal government. Resources would likely be available to implement mitigation measures, if required.

One scenario that is considered to be at least Possible in the opinion of the author and therefore warrants including a provision for its possible undertaking is described below.

4.2.1.1 Need for Post-Closure Minewater Discharge Treatment

If and when mine dewatering is stopped, the Bellekeno Mine will refill with water and it may become necessary to treat minewater discharging out of the Bellekeno 625 adit for an extended period of time. (The water quality may be worse than has been experienced during the Exploration and Mine Development program due to the limited impact on new mine surfaces to date, versus that which will occur during operations as well as the production plans to place PAG waste rock and tailings underground that should eventually to be flooded below an elevated water table, but in the interim will continue to generate additional contaminated seepages). The minewater water discharge flows at B-625 may also increase, partially due to additional fracturing of rock causing additional groundwater to feed the mine workings. The Base Case had provided for 2 years of active lime treatment and is included in the Direct Costs portion of the two milestone dates. In addition, provision has been provided for Alexco to implement their proposed passive biological infiltration gallery to treat minewater in the long-term. However, as an additional protection it is proposed to add an additional 3 years of active lime treatment, to make a total of 5 years of treatment before release to the environment. This has been included as a Mitigative Contingency in the two milestones. The five year duration is considered reasonable especially when reviewing the history of treatment requirements at the Bellekeno Mine.

To provide a cost for this activity, an estimated cost to run the lime treatment plant for the B-625 discharge water has been prepared. The estimated cost is $15,677 per month, or $188,120 per year. This annual cost provides all aspects related to water treatment as can be seen on the side table in the "Cost Estimate" tab of Appendix A (as well as tab "1-BK Mine" of Appendix B).

The timeline and costing may require adjustment based on actual in-situ minewater and discharge water qualities and quantities (utilizing data that will have been collected during the current mine development program and into mine operations) as well as the success of Alexco's proposed mine pool treatment system and biological infiltration gallery. Ultimately, treatment will be required until long-term post-closure performance objectives for discharge water quality have been achieved.

4.2.2 Contingency

A contingency factor has been included for the possibility that implementation of the closure plan tasks may involve additional costs than were estimated during this first-order cost estimate. This is based on the uncertainty of what the final installed features will consist of, the uncertainty in determining the exact work tasks required for the closure and the uncertainty in estimating their quantities and unit costs. For the above reasons a contingency of 25% has been added to the cost of implementing a mine closure at the two milestones.

This cost estimate report considers the Bellekeno Mine Project up to and including its Start-up Date. A Net Present Value calculation has not been considered as most closure works would be undertaken shortly after final closure of the mine with major work being significantly completed within one summer work season.

5. CONCLUSIONS AND RECOMMENDATIONS

5.1 Conclusions

The report provides first-order liability cost estimates for the proposed Bellekeno Mine Project at the milestones.

The liability cost estimates for the proposed program were found to be $1.990M and $3.313M at the milestone dates of Current Situation, and at the Start-Up Date. With the provisions of 5 years of active water treatment and specified terrestrial items removed, the totals drop to $620,000 and $1.780M respectively.

Discussions with GY, Canada and Alexco will help to confirm responsibilities and accurate closure liability cost estimates and setting of security appropriate for GY as the lead regulator responsible for the site with the issuance of a Quartz Mining License for the new mine project.

5.2 Recommendations

5.2.1 Setting of Securities

GY EMR is in the process of issuing a Quartz Mining Licence to Alexco for the Bellekeno Mine Project. Discussions between GY EMR, Alexco and SJCI have determined the following stepped security values will be appropriate for the initial period leading up to commencement of mine production.

The required security will be submitted in three steps and will be based on this report as described below:

1. The initial security will be based on the Current Situation cost estimate as provided in Appendix A but with active water treatment (consisting of 2 years as a base case & 3 years as a Mitigative Contingency) removed. This amounts to a total of $620,000 being required. This amount that will be due within 30 days of the effective date of the new Licence.

2. The second milestone will be required upon the Company making a Production Unit nomination for the Bellekeno site as stipulated in the Subsidiary Agreement. At that point the appropriate security is the Current Situation as provided in Appendix A (without any historical terrestrial liability components) as above but with the water treatment costs added. This generates a cost estimate of $1.688M and security of that value being in place. To generate that total value, an incremental deposit of $1.068M will be required.
3. The third milestone is to be the Start-up Date. At that date the required considerations include the Grand Total Closure Cost as provided in Appendix B of this report but with no terrestrial liability component. An incremental deposit of $1.120M will be required. This results in a total security requirement of $2.808M. (This is based on the total closure liability of $3.313M minus the estimate of terrestrial items retained by the federal government amounting to $505K). To get the total security on deposit to this value an additional $1.112M will need to be added to the securities previously deposited (Items 1. and 2. immediately above).

5.2.2 General Recommendations

GY, Alexco and Canada should meet to discuss facilities and areas used for the on-going care and maintenance and the proposed Mine Project in the context of the Subsidiary Agreement. Responsibilities need to be understood by all parties and a joint Letter of Understanding or similar document should be the ultimate goal.

If not, the uncertainty of allocation of responsibilities will extend beyond the Bellekeno Mine Project into other potential projects as additional ore zones in the Keno Hill area are considered for exploration, development and mining. Agreement between the parties should provide clear guidance as to responsibilities. The new agreement will greatly assist all parties as the projects are moved forward and various permits and licenses need to be issued. This information will also be of assistance as Alexco prepares the district-wide closure plan.

The following tasks or action items are also recommended to be passed along to Alexco:

- Formalize agreements with adjacent placer mines regarding sharing of infrastructure, materials, etc. and include information on any agreements to GY for their consideration during project permitting;
- Provide a detailed design for the proposed waste rock storage facilities to be built at various locations throughout the area;
- Provide details of backfilling plans of mine working with tailings and PAG waste rock;
- Provide detailed plans on how the mine workings will be flooded with a hydraulic plug at the Bellekeno 625 portal. This should include proposed ultimate phreatic level in the Bellekeno Mine, modeling of a water balance for the flooded mine, design for the hydraulic plug, estimates of contaminant levels in discharge water, etc.; and
- Continue to optimize the 1) passive water treatment process of a biological infiltration gallery and 2) in mine pool process for future consideration at the Bellekeno site.

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REFERENCES

Yukon 2008, *Third Party Equipment Rental Rates-Fiscal 2008/09*, by Yukon Highways and Public Works, 2008

APPENDICES

Closure Liability Cost Estimates – Detailed Costing Sheets

A. Current Situation

B. Start-up Date

Estimated Reclamation Closure Cost Estimate
Bellekeno Mine Development Project as of 09SEP30

Item No.	Activity	Task Description	Equipment/Labor	Quantity	Units	Unit Cost	Activity Total	Subtotals	Comments
RECLAMATION COSTS - DIRECT CAPITAL									
1.0	**Roads**								
1.1	Extension to Main Road (B-E to existing road that crosses Thunder Gulch~1km total length)	Scarify road surface	D16H grader	12	hrs	$ 220	$ 2,640		
		Remove culvert crossing at Thunder Gulch		1	lump sum	$ 7,500	$ 7,500		
1.2	Access Road Extension B-E to B-625 (~60	Remove culverts & install swales		2	ea	$ 1,500	$ 3,000		
		Reslope banks & remove safety berm	Cat D8 Dozer	24	hr	$ 190	$ 4,560		
		Scarify road surface	Cat D16H grader	24	hrs	$ 220	$ 5,280		
		Erosion barriers (50% of length)		600	sq.m.	$ 3	$ 1,800		
1.3	*Powerline Haul Road Extension ('2.3 km length) **	*Remove 20 culverts (600mm) & install swales*		*20*	*ea*	*$ 1,500*	*$ 30,000*		
		Reslope left & right banks	*Cat D8 Dozer*	*32*	*hrs*	*$ 190*	*$ 6,080*		
		Scarify road surface for natural revegetation	*D16H grader*	*32*	*hrs*	*$ 220*	*$ 7,040*		
		Erosion barriers (50% of length)		*1*	*km*	*$ 3,000*	*$ 3,000*	*$ 46,120*	
1.4	Other roads & trails (5 km)	Rip road/trail surface for natural revegetation (50% width of regular road)	D16H grader	24	hrs	$ 220	$ 5,280		
							Sub-total	$ 76,180	
2.0	**Mine and Portal Pad Areas**								
2.1.1	Bellekeno East-Underground	Clean up of underground working for closure	U/G 6yd scooptram	26	hrs	$ 220	$ 5,720		to tram required mat'ls & eqmnt out of mine
			General Labour	32	hrs	$ 45	$ 1,440		"
			Trades Labour	24	hrs	$ 80	$ 1,920		"
			Cat 980 Loader	12	hrs	$ 190	$ 2,280		"
			A35 Haul truck	16	hrs	$ 190	$ 3,040		"
2.1.2	Bellekeno East-Surface								
	Temporary Rock Storage Area	Removal of waste rcok material (1000 m3) to u/g	U/G 6yd scooptram	42	hrs	$ 220	$ 9,240		assumed to be 2000T at bulk SG of 2.0
		Remove temp. mineralized rock storage pad	Cat 325 hoe		hrs	$ 190	$ -		
		(has already been removed)	A35 Haul truck		hrs	$ 190	$ -		
			Labourer		hrs	$ 45	$ -		
	Relocate buildings/trailers offsite	Remove salvageable materials	General Labour	24	hrs	$ 45	$ 1,080		
			Trades Labour	18	hrs	$ 80	$ 1,440		
			Cat 980 Loader	8	hrs	$ 190	$ 1,520		
			A35 Haul truck	8	hrs	$ 190	$ 1,520		haulage to landfill
		Prepare trailer structures for removal	General Labour	8	hrs	$ 45	$ 360		
			Trades Labour	4	hrs	$ 80	$ 320		
		Trailers (dry, shop, comp plant) move off-site	Misc	2	ea	$ 2,000	$ 4,000		
	Portal plug (rip rap plug)	Supply of screened coarse placer tailings materia	Coarse material	700	m3	$ 16	$ 11,200		portal measures 4.6m x 4.6m, 20m depth & pile out front 10mx8mx8m
		Installation of plug	General Labour	40	hrs	$ 45	$ 1,800		
			U/G 6yd scooptram	32	hrs	$ 220	$ 7,040		to move materials into portal for plug to help stack rocks up to back & in front
			Cat 325 hoe	16	hrs	$ 190	$ 3,040		
			Misc. materials	1	lump sum	$ 5,000	$ 5,000		
	Remove treatment ponds	Transfer sludges to VTA	vacuum truck	0	hrs	$ 100	$ -		
		(no longer there)	General Labour	0	hrs	$ 40	$ -		
		Fold up liner & haul to landfill (not applicable)	A35 Haul truck	0	hrs	$ 190	$ -		
			General Labour	0	hrs	$ 45	$ -		
	remove fuel tank & containment berm	Clean out tank residue		1	lump sum	$ 1,000	$ 1,000		
		Haul tank & liner for re-use or landfill	Cat 325 hoe	2	hrs	$ 190	$ 380		
			A35 Haul truck	4	hrs	$ 190	$ 760		
			Labourer	16	hrs	$ 45	$ 720		
	Surface Pad Area - General	Area clean-up & haul debris to landfill	Cat 325 hoe	20	hrs	$ 190	$ 3,800		
			A35 Haul truck	32	hrs	$ 190	$ 6,080		
			General Labour	40	hrs	$ 45	$ 1,800		
		Remove contaminated soil to landfarm in Mayo	Cat 325 hoe	12	hrs	$ 190	$ 2,280		
			A35 Haul truck	16	hrs	$ 190	$ 3,040		
		Re-contour entire area and slopes for area draina	Cat D8 Dozer	32	hrs	$ 190	$ 6,080		
		Rip area for natural revegetation	D16H grader	24	hrs	$ 220	$ 5,280		
2.2	**Bellekeno 625**								
2.2.1	Bellekeno 625 Concrete Portal Plug	Hydrogeological study & engineering for b'head, assuming current portal size is 2.5m x 2.5m	Misc	1	lump sum	$ 45,000	$ 45,000		
		Underground rehab for b'head tie-in into rock	Misc	1	lump sum	$ 50,000	$ 50,000		
		Construct concrete plug	General Labour	120	hrs	$ 45	$ 5,400		
			Underground Labour	200	hrs	$ 65	$ 13,000		
			Underground Truck 20t	120	hrs	$ 113	$ 13,560		
		Concrete batch	Misc	1	lump sum	$ 75,000	$ 75,000		
			Cat 950 Loader	80	hrs	$ 125	$ 10,000		
		Install instrumentation & discharge pipe	Misc	1	lump sum	$ 10,000	$ 10,000		
								$ 221,960	
2.3	**200 Level Portal**								
2.3.1	200 Level Vent Portal-Rockfill Plug	Design of rockfill plug	Misc	1	lump sum	$ 5,000	$ 5,000		
		Supply of screened coarse placer tailings material, assuming opening is 2.5m x 2.5m, 10m depth & pile out front is 5mx4mx4m	Coarse material	400	m3	$ 16	$ 6,400		
		Installation of plug	General Labour	24	hrs	$ 45	$ 1,080		
			U/G 6yd scooptram	24	hrs	$ 220	$ 5,280		to move materials into portal for plug to help stack rocks up to back & in front
			Cat 325 hoe	12	hrs	$ 190	$ 2,280		
			Misc. materials	1	lump sum	$ 2,000	$ 2,000		
							Sub-total	$ 337,180	
3.0	**AML Rock Storage Facilities**								
3.1	Temporary AML WRSF at B-East	push down perimeter berm, re-contour banks	Cat D8 Dozer	12	hrs	$ 190	$ 2,280		assumed to be 75m x 42m
3.2	Temporary Mineralized Storage Pile at B-625	no material currently stored in facility					N/A		
							Sub-total	$ 2,280	
4.0	**Valley Tailings Facility**								
4.1	Sludge Disposal Area	Incremental closure cost for VTA facility w sludges from BK				$ -	$ -	$ -	included in water treatment costing

Item No.	Activity	Task Description	Equipment/Labor	Quantity	Units	Unit Cost	Activity Total	Subtotals	Comments
5.0	**Other Surface Disturbances & Facilities**						Sub-total		
5.1	Camp Area (Downsize by remvoing 2 traili	Remove salvageable materials	General Labour	16	hrs	$ 45	$ 720		
			Trades Labour	8	hrs	$ 80	$ 640		
		Prepare trailer structures for removal	General Labour	8	hrs	$ 45	$ 360		
			Trades Labour	4	hrs	$ 80	$ 320		
		Transport 2 Trailers to off-site	Misc.	2	ea	$ 2,000	$ 4,000		
		Misc. materials and supplies		1	lump sum	$ 2,000	$ 2,000		
		Scrap/debris removal to landfill	Cat 980 Loader	8	hrs	$ 190	$ 1,520		
			A35 Haul truck	12	hrs	$ 190	$ 2,280		
								$ 11,840	
5.2	Mill Area - concrete pad for mill bldg & cleared area	Concrete demolition	235 Excavator w Hammer	24	hrs	$ 275	$ 6,600		Based on size of 22m x 60m
		Covering of pad w nearby o'burden mat'l	Cat D8 Dozer	16	hrs	$ 190	$ 3,040		
		Re-contouring area	Cat D8 Dozer	16	hrs	$ 190	$ 3,040		Based on area of 0.75 ha
		Revegetation -broadcast S&F	Reveg-b'cast S&F	0.75	ha	$ 2,250	$ 1,688		
								$ 14,368	
5.3	Surface exploration drill sites	clean-up of areas	General Labour	16	hrs	$ 45	$ 720		
		ripping of surfaces to assist natural reveg	Cat D8 Dozer	16	hrs	$ 190	$ 3,040		
								$ 3,760	
							Sub-total	$ 29,968	
6.0	**Miscellenous Components**								
6.1	Road barriers	Req'd to prevent access to open adits until sealed		2	ea	$ 1,000	$ 2,000		
6.2	Power distribution system	B-E system fed from B-625 via underground, cost covered above in 2.1.1		0	lump sum	$ -	$ -		
							Sub-total	$ 2,000	
						Sub-total-Direct Reclm Capital Co		$ 447,608	
7.0 POST-CLOSURE TREATMENT MONITORING AND MAINTENANCE									
7.1	**Post-Closure M/W Treatment**	In-mine pool treatment	Misc.	1	lump sum	$ 10,000	$ 10,000		based on Alexco PDRP, Sec. 5.1.2
		2 years of active treatment after mine floods using existing B-625 system		2	*yrs*	*$ 188,120*	*$ 376,240*		*as per break-out on right*
7.2	**Transition to Passive M/W Treatment**	Construct biological infiltration gallery	Cat 325 hoe	40	hrs	$ 190	$ 7,600		
			Cat 980 Loader	40	hrs	$ 190	$ 7,600		
			A35 Haul truck	80	hrs	$ 190	$ 15,200		
			General Labour	60	hrs	$ 45	$ 2,700		
			Misc.	1	lump sum	$ 5,000	$ 5,000		
		Operate infiltration gallery-all-inclusive cost (5 ys)	Misc.	5	yrs	$ 10,000	$ 50,000		
7.3	**Monitoring & Reporting**								
	WQ sampling-surface	Existing program as per QZ06-074					$ -		
		Additional sampling at 2 mill area sites, qrtrly, with no p-c m/w treatment		3	yrs	$ 4,000	$ 12,000		Cost only for 2 new sampling sites
		WQ sampling Years 1-2 (monthly & quarterly)		24	mo	$ 2,000	$ 48,000		
		WQ sampling Year 3 (quarterly)		4	qrtrly	$ 2,000	$ 8,000		
		Toxicites (1 site KV-43, monthly for 3 yrs)		36	mo	$ 300	$ 10,800		
		Environmental Monitor (5 yrs)-above needs for C&M prgrm		3	mo	$ 6,000	$ 18,000		
	Annual Reporting	Prepare annual report on treatment & monit		5	yrs	$ 1,000	$ 5,000		
	Record Keeping & Document Control	Incl safekeeping of all final documentation		1	lump sum	$ 2,000	$ 2,000		
	Inspections	Geotechnical and Reclamation (5 years)		5	lump sum	$ 3,000	$ 15,000		
7.4	**Infrastructure Maintenance**								
	Portal plugs B-E, B-625, B-200L	Maintenance in Yrs 1, 3 & 5 after closure		3	ea	$ 2,000	$ 6,000		
7.5	**Reclamation Maintenance**								
	Erosion Control	Along reclaimed roadways (25% of total road lengths, above)		2.0	km	$ 3,000	$ 6,000		
	Re-seeding	Maintenance seeding and fertilizing (25% of original areas incl areas hydroseeded, above)		0.1875	ha	$ 2,250	$ 422		
							Sub-total	$ 605,562	
					Total-DIRECT COSTS			**$ 1,053,169**	
8.0 RECLAMATION COSTS - INDIRECT							$ -		
8.1	Project Management & Engineering	7% of direct costs					$ 73,722		
8.2	Survey	Survey control and as-built drawings		1	lump sum	$ 3,000	$ 3,000		
8.3	Vehicle for Supervisor/Mgr., Security	3mo total for summer decom/reclm program		3	months	$ 2,500	$ 7,500		
8.4	Camp Costs	For summer decom/reclm crew (4 persons)		360	manday	$ 70	$ 25,200		
						Total-INDIRECT COSTS		**$ 109,422**	
RECLAMATION COSTS - TOTAL	Total direct and indirect costs					**Total-DIRECT & INDIRECT COSTS**		**$ 1,162,591**	
9.0 PROVISIONS AND CONTINGENCIES									
9.1	**25% Contingency**	Calculated on Total of Direct Costs					$ 263,292		
				TOTAL-Reclamation Costs & Contingency				**$ 1,426,000**	
9.2	**Mitigative Contingencies**								
9.2.1	Need for post-closure minewater discharge treatment	Provision for 3 additional yrs of active treatment (5 in total) until it is demonstrated to no longer be req'd		3	yrs	$ 188,120	$ 564,360		as per break-out on right
		Removal of sludges volumes to VTA	Vacuum Truck		hrs		$ -		considered part of above costing
		Additional WQ samplings (analyses)			yrs		$ -		"
		Additional monitoring & maintenance labor			mo		$ -		"
		Additional camp costs			manday				"
9.2.2	Additional Provision for items in AMP	Worsened minewater water quality		1	lump sum		$ -		Not required, up to Start-Up Date
		treatment		1	lump sum		$ -		Not required, up to Start-Up Date
							Sub-total	**$ 564,360**	
					Subtotal - Mitigative Contingencies			**$ 564,360**	
						TOTAL COST		**$ 1,990,000**	

* *pending results of discussions with INAC & GY re terrestrial liability*

** *contingency cost incorporated into summary table*

Grand total closure cost wthout 5yrs active treatment or highlighted terrestrial items $ 620,000

Nov. 25, 2009 Update

Bellekeno Mine
Closure Liability Cost Estimate Summary
At Start-Up Date

Item No.	Mine Component	Cost
1	**BELLEKENO MINE**	**$1,080,000**
1.1	Bellekeno East Underground	$42,000
1.2	Reclaim Bellekeno East Portal Site	$96,000
1.3	Reclaim Bellekeno 625 Adit Site	$73,000
1.4	*Bulkhead Installation * (2.6m x 2.6m)*	*$237,000*
1.5	Bellekeno 625 Water Treatment Active & Passive Treatment	$608,000
1.6	200 Level Vent Raise (~2.5 x 2.5m)	$24,000
2	**WASTE ROCK**	**$35,000**
2.1	Rehandle existing temporary explorn AML waste rock u/g - 2000t (~1000m3)	$20,000
2.2	Reclaim Borrow Areas (2 areas, each of 2 ha)	$15,000
3	**ROADS**	**$179,000**
3.1	Access Road Extension Bellekeno East to Bellekeno 625 (~600 m)	$15,000
3.2	*Powerline Haul Road (~2.3 km) **	*$54,000*
3.3	Keno City Bypass (~650 m)	$23,000
3.4	*Mill Site Access Including Christal Lake Rd. (1.9 km) **	*$81,000*
3.5	Other Roads and Trails (~5 km)	$6,000
4	**CAMP**	**$27,000**
5	**MILL**	**$486,000**
5.1	Mill and Ancillary Facilities	$323,000
5.2	Mill Pad (~3 ha)	$96,000
5.3	Ore / Tailings Stockpile Pads	$13,000
5.5	Runoff Collection Pond (4,700 m3)	$42,000
5.6	Diversion Ditches to Collection Pond	$12,000
6	**DRY STACK TAILINGS FACILITY**	**$43,000**
6.1	DSTF Area Restoration incl Haul First Tailings to U/G	$43,000
7	**SITE MANAGEMENT** (includes monitoring & maintenance during decommissioning & 3 year post mine closure period)	**$349,000**
7.1	Project G & A	$29,000
7.2	Onsite Management	$121,000
7.3	Compliance Monitoring and Reporting	$178,000
7.4	Contaminated Site Assessment Plan	$6,000
7.5	Closure Maintenance	$15,000
	TOTAL CLOSURE COSTS	**$2,199,000**
	Contingency Costs (25%)	**$550,000**
	Contingency Water Treatment at B-625 (3 yrs after mine flooding)	**$564,000**
	GRAND TOTAL CLOSURE COSTS - START-UP DATE	**$3,313,000**

** pending results of discussions with INAC & GY re terrestrial liability*

Grand total clsr cost w/o 5yrs active water treatment or highlighted terrestrial items	**$1,780,000**

Bellekeno Mine
Closure Liability Cost Estimate
Unit Cost and Rate Table

EQUIPMENT RATES		
Bulldozer-small (Cat D6)	$130	per hr
D8K Dozer	$190	per hr
D9H Dozer	$260	per hr
D250E Haul Truck	$220	per hr
Tandem Haul Truck	$110	per hr
A35 Haul Truck	$190	per hr
Cat 325 Hoe	$190	per hr
Cat 235 Excavator	$240	per hr
235 Excavator w Hammer	$275	per hr
Cat 16H grader	$220	per hr
Cat 950 Loader	$125	per hr
988B Loader	$250	per hr
Tractor Trailer (lowbed)	$130	per hr
30 ton Crane	$160	per hr
Hiab Flatdeck truck	$125	per hr
Underground LHD 4-6yd Placement	$220	per hr
Underground Truck 20t	$113	per hr
Misc Mine Infrastructure	$100	per hr
Vacuum Truck	$100	per hr
Gas Powered Pump	$100	per day
Pickup Truck	$2,500	per month

PERSONNEL RATES		
Blaster	$60	per hr
General Labourer	$45	per hr
Underground Labourer	$65	per hr
Trades Labourer	$80	per hr
Underground / Site Supervisor	$95	per hr
Medical Safety	$50	per hr
Technician	$75	per hr
Design Engineer	$130	per hr
Environmental Scientist	$95	per hr
Project Manager	$9,700	per month
Environmental Monitor	$6,000	per month
Camp Labourer	$4,000	per month
Site Caretaker	$6,100	per month
Analytical Costs-Bio-Assay, Toxicity	$300	Unit cost
Analytical Costs-WQ	$500	Unit cost

REVEGETATION RATES		
Revegetation Seed Mix	$13	per kg
Revegetation Seed Mix - 50kg/ha	$510	per ha
Fertilizer	$1	per kg
Fertilizer - 250kg/ha	$250	per ha
Tree Seedlings	$1,750	per ha (1,000 seedlings per ha)
Seed/Fertilizer Application	$1,500	per ha
Revegetation cost per ha. Including application cost	$2,260.00	per ha

CONTRACTOR UNIT RATES & CAMP COST		
Custom Rate A (Load, haul and place overburden cover on AML Waste Rock)	$4.50	cu.m
Custom Rate B (Load, haul and dump mineralized rock stockpile in BK East Decline)	$4.50	cu.m
Compact and Contour Cover	$2	cu.m
Excavation of Soil	$5	cu.m
Supply and place Geotextile	$7	sq m
Load, haul and place soil cover	$8	cu.m
Haul & Place rock cover	$8	cu.m
Drill, Blast and Screen Rip Rap	$22	cu.m
Load and Haul and Place Rip Rap	$13	cu.m
HDPE Liner Install	$10	sq m
Erosion barriers	$3	sq m
Freight run to Whitehorse	$1,000	per load
Camp Cost	$70	per day per person
Power and Heat	$5,500	per month
Sundry equipment maintenance	$5,000	yearly
General Administrative expenses	$2,000	per month
Employee Transport Costs	$3,000	per month

Note: Custom Unit Rates have been developed specifically for Bellekeno Mine, taking into account such factors as haul distance, grade, machinery required, time required, etc

Bellekeno Mine
Closure Liability Cost Estimate
At Start-Up Date
Table 1 - Bellekeno Mine

Item No.	Reclamation Component	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost	
1.1	**Bellekeno East Underground**							
	Removal of underground equipment (e.g. paste plant, switch gea electrical, hydraulic control structures)	Underground LHD 4-6yd Placement	per hr	60	$220	$13,200		
		A35 Haul Truck	per hr	60	$190	$11,400		
		Trades Labourer	per hr	120	$80	$9,600		significant trades labour work will also be required
		General Labourer	per hr	120	$45	$5,400	$39,600	
	Project Management	7% of Total Cost	%		7.00%	$2,772	$2,772	
	Sub-Total						**$42,000**	
1.2	**Reclaim Bellekeno East Portal Site**							
	Remove shop and other buildings (explosives and cap magazine)	Misc	lump sum	1	$15,000	$15,000		(explosives & cap magazines will not be located at BC, but other bldgs will be). Remove to off-site
	Disconnect services and remove mobile buildings to off-sit	Misc	lump sum	1	$5,000	$5,000		
	Supply rockfill for portal barrier (4.6m x 4.6m x 20m L + pile)	Load and Haul and Place Rip Rap	cu.m	700	$35	$24,500		
	Labour for portal barrier	General Labourer	per hr	40	$45	$1,800		
	Characterize settling ponds sediments	Analytical Costs	lump sum	2	$500	$1,000		
	Remove sludges from settling ponds to VTA	Vacuum Truck	per hr	20	$100	$2,000		
		General Labourer	per hr	20	$45	$900		
	Remove settling ponds liners to landfill	A35 Haul Truck	per hr	2	$190	$380		
		Cat 325 Hoe	per hr	4	$190	$760		need an excavator to help pull up and fold up the liner, and load onto truck'
		General Laboure	per hr	16	$45	$720		assume 2 men for 1 day
	Clean out fuel tank residue (press. wash, dispose of sludges)	Misc	lump sum	1	$3,000	$3,000		
	Haul fuel tank and liner for reuse or landfill	Cat 325 Hoe	per hr	12	$190	$2,280		
		A35 Haul Truck	per hr	6	$190	$1,140		
		Trades Labourer	per hr	15	$80	$1,200		
		General Laboure	per hr	20	$45	$900		
		Tractor Trailer (lowbed	per hr	6	$130	$780		
	Area cleanup and haul debris to landfill	Cat 325 Hoe	per hr	20	$190	$3,800		
		A35 Haul Truck	per hr	20	$190	$3,800		
		General Laboure	per hr	40	$45	$1,800		
	Test area soils for contamination	Environmental Monitor	per hr	8	$90	$720		
	Laboratory Analysis for soils testing	Analytical Costs	lump sum	4	$500	$2,000		At least 4 samples will be required
	Haul any contaminated soils to nearest Land Treatment Facility	Cat 325 Hoe	per hr	16	$190	$3,040		
		A35 Haul Truck	per hr	16	$190	$3,040		
	Recontour and scarify area and slopes to establish drainage	D8K Dozer	per hr	24	$190	$4,560		
		Cat 16H grader	per hr	20	$220	$4,400		
	Install Signage	Misc	lump sum	1	$1,000	$1,000		
	Mob/Demob (entire mine)	Misc	lump sum	1	$0	$0	$89,520	Mob & Demob is not included in GY mine security calculation so it has been deleted here
	Project Management	7% of Total Cost	%		7.00%	$6,266	$6,266	
	Sub-Total						**$96,000**	
1.3	**Reclaim Bellekeno 625 Adit Site**							
	Remove lab	Misc	lump sum	1	$5,000	$5,000		
	*Remove electrical substation **	*Misc*	*lump sum*	*1*	*$10,000*	*$10,000*		
	*Remove elec. transmission single poles & line (KC to BK625) **	*Misc*	*km*	*2*	*$10,000*	*$20,000*		
	Remove shop/loadout facility, compressor shack	Misc	lump sum	1	$5,000	$5,000		
	Area cleanup and haul debris to landfill	Cat 325 Hoe	per hr	20	$190	$3,800		
		A35 Haul Truck	per hr	20	$190	$3,800		
		General Laboure	per hr	40	$45	$1,800		
	Test area soils for contamination	Environmental Monitor	per hr	8	$90	$720		
	Laboratory Analysis for soils testing	Analytical Costs	lump sum	4	$500	$2,000		at least 4 samples will be required
	Haul any contaminated soils to nearest Land Treatment Facility	Cat 325 Hoe	per hr	16	$190	$3,040		
		A35 Haul Truck	per hr	16	$190	$3,040		
	Recontour and scarify area and slopes to establish drainage	D8K Dozer	per hr	24	$190	$4,560		
		Cat 16H grader	per hr	20	$220	$4,400		
	Install Signage	Misc	lump sum	1	$1,000	$1,000	$68,160	
	Project Management	7% of Total Cost	%		7.00%	$4,771	$4,771	
	Sub-Total						**$73,000**	
1.4	**Bulkhead Installation * (2.6m x 2.6m)**							as per Alexco costing
	Hydrogeologic study & engineering for concrete bulkhead	*Misc*	*lump sum*	*1*	*$45,000*	*$45,000*		
	Underground Rehab for bulkhead	*Misc*	*lump sum*	*1*	*$50,000*	*$50,000*		
	Construct concrete plug	*General Labourer*	*per hr*	*120*	*$45*	*$5,400*		
		Underground Labourer	*per hr*	*200*	*$65*	*$13,000*		
		Underground Truck 20t	*per hr*	*120*	*$113*	*$13,560*		
	Concrete Batch	*Misc*	*lump sum*	*1*	*$75,000*	*$75,000*		
		Cat 950 Loader	*per hr*	*80*	*$125*	*$10,000*		
	Install Instrumentation (e.g pressure gauge)	*Misc*	*lump sum*	*1*	*$10,000*	*$10,000*	*$221,960*	$237,497
	Project Management	*7% of Total Cost*	*%*		*7.00%*	*$15,537*	*$15,537*	
	Sub-Total						***$237,000***	
1.5	**Bellekeno 625 Water Treatment Active & Passive Treatment**							
	*Contingency treatment operation (3 yrs after mine flooding) ***	*Misc*	*per year*	*3*	*$188,120*	*$564,360*		
	2 years active Minewater treatment- as base case	*Misc*	*per year*	*2*	*$188,120*	*$376,240*		
	Remove salvageable equipment	General Labourer	per hr	16	$45	$720		
		Trades Labourer	per hr	16	$80	$1,280		
	Load & return extra reagents/chemicals	General Labourer	per hr	8	$45	$360		
		Misc	lump sum	1	$2,000	$2,000		
	Dismantle building incl debris to landfill	Cat 235 Excavator	per hr	4	$240	$960		
		Cat 950 Loader	per hr	10	$125	$1,250		
		Tractor Trailer (lowbed)	per hr	30	$130	$3,900		
		Trades Labourer	per hr	10	$80	$800		
		General Labourer	per hr	30	$45	$1,350		
	In mine pool treatment	Misc	lump sum	1	$40,000	$40,000		
	Characterize settling ponds sediments/sludge	Analytical Costs	lump sum	2	$500	$1,000		
	Remove sludge from settling ponds	Vacuum Truck	per hr	40	$100	$4,000		
		General Laboure	per hr	40	$45	$1,800		
	Remove settling ponds liners to landfill	A35 Haul Truck	per hr	4	$190	$760		
		Cat 235 Excavator	per hr	4	$240	$960		
		General Laboure	per hr	16	$45	$720		
	Design of infiltration gallery, incl testwork, design report preparatio attaining all permits & approvals	Misc	lump sum	1	$30,000	$30,000		
	Construct infiltration gallery	A35 Haul Truck	per hr	80	$190	$15,200		Where are details of gallery sizing, materials, location, etc?
		bioreactor nutrients	lump sum	1	$5,000	$5,000		Need to get the gravel and special 'bio-reactor' material from somewhere
		Cat 950 Loader	per hr	60	$125	$7,500		
		General Laboure	per hr	60	$45	$2,700		cost to build= $30,400
	Operate infiltration gallery (5 yrs)	Misc	yearly	5	$10,000	$50,000		
	Site levelling	D9H Dozer	per hr	20	$260	$5,200		
	Scrap hauled to solid waste facility	Cat 235 Excavator	per hr	8	$240	$1,920		
		D250E Haul Truck	per hr	12	$220	$2,640		
	Misc. Supplies & Tools	Misc	lump sum	1	$10,000	$10,000	$568,260	
	Project Management	7% of Total Cost	%		7.00%	$39,778	$39,778	
	Sub-Total						**$608,000**	
1.6	**200 Level Vent Raise (~2.5 x 2.5m)**							
	Design of rockfill plug	Misc	lump sum	1	$5,000	$5,000		to measure 2.5mx2.5mx10m depth, with pile out front 5mx4mx4m
	Supply of screened coarse placer tailings materials	Coarse material	m3	400	$16	$6,400		
	Concrete Batch	General Laboure	hrs	24	$45	$1,080		
		Underground LHD 4-6 yd Placement	per hr	24	$220	$5,280		to move materials into portal for plug
		Cat 325 hoe	per hr	12	$190	$2,280		to help stacks rocks up to back and in front
	Misc. Supplies & Tools	Misc. materials	lump sum	1	$2,000	$2,000	$22,040	
	Project Management	7% of Total Cost	%		7.00%	$1,543	$1,543	
							$24,000	
	Total Estimated Cost in Reclaiming Bellekeno Mine at S/U						**$1,080,000**	

** pending results of discussions with INAC & GY re terrestrial liability*

*** contingency cost incorporated into summary table*

B-625 Active Water Treatment Cost	
manpower 2 h/d, 30 d/mo @ $45/h	$2,700
vacuum truck 3 hrs every 3 days @$100/h	$3,000
lime @ BK 625 = 20% of total ($7,500)	$1,500
power	$720
mntce of facilities 2 h/mo @$80/h	$160
replacement of equipment, parts @ $2k/yr	$167
monitoring of system 2 h/d, 30d/mo @$45/h	$800
analyses-internal 2/w @$250 each	$2,000
std-by (operator-on call) 2 h/d, 30d/mo @$45/h	$2,700
winter road access-Grader 2h/w x 6/12mo @ $220/h	$880
misc. supplies	$200
camp costs 1/2 manday/d, 30d/mo @ $70/d	$1,050
Treatment operation at B-625, Total $/month	**$15,677**

Bellekeno Mine
Closure Liability Cost Estimate
At Mine Start-up Date
Table 2 - Waste Rock Storage

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
2.1	**Temporary AML WRSF - Bellekeno East**						
	Rehandle existing temporary explorn AML waste rock u/g - 2000t (~1000m3)	Underground LHD 4-6 yd Placement	per hr	42	$220	$9,240	
	Remove liner and haul to solid waste facility	D250E Haul Truck	per hr	2	$220	$440	
		Cat 325 Hoe	per hr	4	$190	$760	
		General Labourer	per hr	8	$45	$360	
	Site recontouring	D8K Dozer	per hr	20	$190	$3,800	
	Revegetation	Revegetation cost per ha. Including application cost	per ha	1.8	$2,260	$4,068	$18,668
	Project Management	7% of Total Cost	%		7.00%	$1,307	$1,307
	Sub-Total						**$20,000**
2.4	**Reclaim Borrow Areas (2 areas, each of 2 ha)**						
	Stabilize slopes	D8K Dozer	per hr	24	$190	$4,560	
	Revegetation	Revegetation cost per ha. Including application cost	per ha	4	$2,260	$9,040	$13,600
	Project Management	7% of Total Cost	%		7.00%	$952	$952
	Sub-Total						**$15,000**
	Total Estimated Cost in Reclaiming Waste Rock Storage Areas at Start-up Date						**$35,000**

Bellekeno Mine
Closure Liability Cost Estimate
At Start-up Date
Table 3 - Roads

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
3.1	**Access Road Extension Bellekeno East to Bellekeno 625 (~600 m)**						
	Remove 2 culverts and install swales		lump sum	2	$1,500	$3,000	
	Reslope left & right banks	D8K Dozer	per hr	24	$190	$4,560	
	Scarify road surface	Cat 16H grader	per hr	16	$220	$3,520	
	Revegetation of banks & slopes	Revegetation cost per ha. Including application cost	per ha	0.6	$2,260	$1,356	
	Erosion barriers (50% of length)	Erosion barriers	sq m	600	$3	$1,800	$14,236
	Project Management	7% of Total Cost	%		7.00%	$997	$997
	Sub-Total						**$15,000**
3.2	***Powerline Haul Road (~2.3 km) ****						
	Remove 20 culverts and install swales		*lump sum*	*20*	*$1,500*	*$30,000*	
	Reslope left & right banks	*D8K Dozer*	*per hr*	*32*	*$190*	*$6,080*	
	Scarify road surface	*Cat 16H grader*	*per hr*	*40*	*$220*	*$8,800*	
	Revegetation of banks & slopes	*Revegetation cost per ha Including application cost*	*per ha*	*2.3*	*$2,260*	*$5,198*	*$50,078*
	Project Management	*7% of Total Cost*	*%*		*7.00%*	*$3,505*	*$3,505*
	Sub-Total						***$54,000***
3.3	**Keno City Bypass (~650 m)**						
	Remove culverts and install swales		lump sum	4	$1,500	$6,000	
	Reslope left & right banks	D8K Dozer	per hr	16	$190	$3,040	
	Scarify road surface	Cat 16H grader	per hr	8	$220	$1,760	
	Revegetation of banks & slopes	Revegetation cost per ha. Including application cost	per ha	0.7	$2,260	$1,469	
	Lightning Creek culvert removal	Cat 235 Excavator	per hr	16	$240	$3,840	
		Tractor Trailer (lowbed)	per hr	8	$130	$1,040	
	Restoration of creek channel, sloping banks	Cat 235 Excavator	per hr	16	$240	$3,840	
		General Labourer	per hr	16	$45	$720	$21,709
	Project Management	7% of Total Cost	%		7.00%	$1,520	$1,520
	Sub-Total						**$23,000**
3.4	***Mill Site Access Including Christal Lake Rd. (1.9 km) ****						
	Remove 40 culverts and install swales		*lump sum*	*40*	*$1,500*	*$60,000*	
	Reslope left and right banks	*D8K Dozer*	*per hr*	*12*	*$190*	*$2,280*	
	Revegetation of banks & slopes	*Revegetation cost per ha. Including application cost*	*per ha*	*1.9*	*$2,260*	*$4,294*	
	Scarify road surface	*Cat 16H grader*	*per hr*	*40*	*$220*	*$8,800*	*$75,374*
	Project Management	*7% of Total Cost*	*%*		*7.00%*	*$5,276*	*$5,276*
	Sub-Total						***$81,000***
3.5	**Other Roads and Trails (~5 km)**						
	Scarify road surface	Cat 16H grader		25	$220	$5,500	$5,500
	Project Management	7% of Total Cost	%		7.00%	$385	$385
	Sub-Total						**$6,000**
	Total Estimated Cost in Reclaiming Roads at S/U						**$179,000**

Bellekeno Mine
Closure Liability Cost Estimate
At Start-up Date
Table 4 - Camp

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
4	**Camp Downsize**						
	Clean-up, disconnect services and dismantle 5 trailer units and tranport to off-site	Misc.	each	5	$5,000	$25,000	$25,000
	Project Management	7% of Total Cost	%		7.00%	$1,750	$1,750
	Sub-Total						**$27,000**
	Total Estimated Camp Downsizing Costs						**$27,000**

Bellekeno Mine
Closure Liability Cost Estimate
At Start-up Date
Table 5 - Mill

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
5.1	**Mill and Ancillary Facilities**						
	Remove equipment (crushers, conveyors, mill equipment, trailer units, other ancillary facilities - fine ore bin)	General Labourer	per hr	600	$45	$27,000	
		Trades Labourer	per hr	350	$80	$28,000	
		Cat 950 Loader	per hr	150	$125	$18,750	
		Cat 235 Excavator	per hr	50	$240	$12,000	
		Tractor Trailer (lowbed)	per hr	120	$130	$15,600	
	Load and return extra reagents/chemicals	General Labourer	per hr	75	$45	$3,375	
		Misc.	lump sum	1	$5,000	$5,000	
	Decontaminate buildings & structures	General Labourer	per hr	200	$45	$9,000	
	Dismantle Mill Building	Cat 950 Loader	per hr	70	$125	$8,750	
		Tractor Trailer (lowbed)	per hr	70	$130	$9,100	
		Trades Labourer	per hr	300	$80	$24,000	
		General Labourer	per hr	1,000	$45	$45,000	
	Concrete demolition-various pads	235 Excavator w Hammer	per hr	60	$275	$16,500	
		Blaster	per hr	60	$60	$3,600	
		D9H Dozer	per hr	20	$260	$5,200	
	Crane support	30 ton Crane	per hr	200	$160	$32,000	
	Haul scrap to solid waste facility	Cat 235 Excavator	per hr	50	$240	$12,000	
		D250E Haul Truck	per hr	100	$220	$22,000	
	Misc. supplies & tools	Misc.	lump sum	1	$5,000	$5,000	$301,875
	Project Management	7% of Total Cost	%		7.00%	$21,131	$21,131
	Sub-Total						**$323,000**
5.2	**Mill Pad (~3 ha)**						
	Test area soils for contamination	Environmental Monitor	per hour	16	$90	$1,440	
	Laboratory analyses for soils testing	Analytical Costs	unit cost	12	$500	$6,000	
	Haul any contaminated soils to nearest Land Treatment Facility	Cat 325 Hoe	per hr	16	$190	$3,040	
		A35 Haul Truck	per hr	16	$190	$3,040	
	Regrade embankment shoulders	D8K Dozer	per hr	24	$190	$4,560	
	Re-contour area to bury any footing & provide drainage	Cat 16H grader	per hr	24	$220	$5,280	
	Haul and place overburden cap (0.25m)	Load, haul and place soil cover	cu. m.	7,500	$8	$60,000	
	Revegetate	Revegetation cost per ha. Including application cost	per ha	3	$2,260	$6,780	$90,140
	Project Management	7% of Total Cost	%		7.00%	$6,310	$6,310
	Sub-Total						**$96,000**
5.3	**Ore / Tailings Stockpile Pads**						
	Concrete demolition & burial	235 Excavator w Hammer	per hr	20	$275	$5,500	
		D9H Dozer	per hr	20	$260	$5,200	
	Haul ore/tailings residues to DSTF (20 m3)	Cat 950 Loader	per hr	10	$125	$1,250	$11,950
	Project Management	7% of Total Cost	%		7.00%	$837	$837
	Sub-Total						**$13,000**
5.4	**Water Treatment Plant Operation**						
	Construct infiltration gallery	A35 Haul Truck	per hr	80	$190	$0	
		bioreactor nutrients	lump sum	1	$5,000	$0	
		Cat 950 Loader	per hr	60	$125	$0	
		General Labourer	per hr	60	$45	$0	
	Operate active water treatment for 2yrs of freshet (base cas	Misc.	lump sum	2	$33,200	$0	
	Operate infiltration gallery (5 yrs)	Misc.	yearly	5	$10,000	$0	$0
	Project Management	7% of Total Cost	%		7.00%	$0	$0
	Sub-Total						**$0**
5.5	**Runoff Collection Pond (4,700 m^3)**	now 2500 m3					
	Pump down impounded water	General Labourer	per hr	36	$45	$1,620	
		Gas Powered Pump	per day	2	$100	$200	
	Misc. supplies & tools	Misc	lump sum	1	$1,000	$1,000	
	Characterize pond sediments/sludge	Analytical Costs	unit cost	2	$500	$1,000	
	Remove sediment/sludge from settling pond	Vacuum Truck	per hr	16	$100	$1,600	
		General Labourer	per hr	16	$45	$720	
	Breach dyke, relocate and contour materials	Excavation of Soil	cu.m	3,000	$8	$24,000	
	Stabilize slopes with erosion barriers	Erosion barriers	sq m	3,000	$3	$9,000	
	Remove discharge pipeline	Misc.	lump sum	1	$5,000	$5,000	
	Revegetate	Revegetation cost per ha. Including application cost	per ha	0.5	$2,260	$1,130	$45,270
	Project Management	7% of Total Cost	%		7.00%	$3,169	$3,169
	Sub-Total						**$48,000**
5.6	**Diversion Ditches to Collection Pond**						
	Recontour	D9H Dozer	per hr	24	$260	$6,240	
		Cat 325 Hoe	per hr	12	$190	$2,280	
	Revegetate	Revegetation cost per ha. Including application cost	per ha	1	$2,260	$2,260	$10,780
	Project Management	7% of Total Cost	%		7.00%	$755	$755
	Sub-Total						**$12,000**
	Total Estimated Mill Closure Cost at Start-Up						**$492,000**

Bellekeno Mine
Closure Liability Cost Estimate
At Start-Up Date
Table 6 - Dry Stack Tailings Facility Area

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
6.1	**DSTF Area Restoration incl Haul First Tailings to U/G**						
	Load tailings (~5000T) and haul to underground for storage	Cat 950 Loader	per hr	55	$125	$6,875	
		A35 Haul Truck	per hr	150	$190	$28,500	
	Re-contour surface for closure	D8K Dozer	per hr	12	$190	$2,280	
	Revegetate	Revegetation cost per ha. Including application cost	per ha	1	$2,260	$2,260	
	Project Management	7% of Total Cost	%		7.00%	$2,794	$2,794
	Sub-Total						**$43,000**
	Total Estimated DSTF Closure Cost at Start-up Date						**$43,000**

Bellekeno Mine
Closure Liability Cost Estimate
At Start-Up Date
Table 7 - Site Management

Item No.	Work Item Description	Equipment / Labour	Units	Quantity	Unit Cost	Cost	Total Cost
7.1	**Project G & A**						
	Pre-closure planning and organization	Project Manager	per month	3	$9,700	$29,100	
	Sub-Total						**$29,000**
7.2	**Onsite Management**						
	Project Management and Engineering - Included in costs for each closure component						
	Site vehicle	Pickup Truck	per month	8	$2,500	$20,000	
	Camp Costs	Camp Cost	per day per person	1,440	$70	$100,800	
	Sub-Total						**$121,000**
7.3	**Compliance Monitoring and Reporting**						
	Water Quality Monitoring (above baseline as per QZ06-074, covered under on-going C&M contract or district-wide closure plan)						
	Years 1-2 (monthly & quarterly)	Misc.	per month	24	$3,000	$72,000	
	Year 3 (quarterly)	Misc.	quarterly	4	$3,000	$12,000	
	Toxicities (2 sites-KV43 & KV81, monthly for 3 yrs)	**Misc.**	**monthly**	**36**	**$600**	**$21,600**	
	Disbursements (non-labour/non-analytical)	Misc.	per qrtr	12	$500	$6,000	
	Environmental Monitor (Yrs 1-3 post-closure)	Misc.	per month	9	$6,000	$54,000	
	Geotechnical Inspection (yrs 2 & 3 post-closure)	Misc.	yearly	2	$6,000	$12,000	
	Sub-Total						**$178,000**
7.4	**Contaminated Site Assessment Plan**						
	Develop Plan	Misc.	lump sum	1	$3,000	$3,000	
	Assessment Reporting	Misc.	lump sum	1	$3,000	$3,000	
	Sub-Total						$6,000
7.5	**Closure Maintenance**						
	Misc. site maintenance	Misc.	per year	3	$3,000	$9,000	
	Revegetation maintenance (25% of area revegetated)	Revegetation cost per ha. Including application cost	per ha	3	$2,260	$5,820	
	Sub-Total						**$15,000**
	Total Estimated Cost for Site Management with Closure at Start-up Date						$349,000

QUARTZ MINING LICENSE QML- 0009

This License is issued pursuant to s.135(2) of the Quartz Mining Act, S.Y. 2003, c.14

Mining License No:	QML-0009
Issued to:	Alexco Keno Hill Mining Corp. Suite 1150 – 200 Granville Street Vancouver, British Columbia V6C 1S4
Project Name:	Bellekeno Mine Project
Location:	NTS 105M-13 & 105M-14; Latitude: 63° 55'N, Longitude: 135° 29'W Mayo Mining District
Effective Date:	The date upon which the signature of the Minister is affixed
Expiry Date:	December 31, 2025
Scope of Authorization:	Development and production associated with an underground mine and conventional flotation mill with a concentrate recovery process for the retrieval of silver, lead and zinc and other mineral by-products of the milling as set out in this License

Dated this 17th day of November, 2009

Minister of Energy, Mines and Resources

Two (2) Original Signed Copies

QML – 0009
Table of Contents

PART I
GENERAL PROVISIONS

1.0 Definitions

1.1 In this License,

"Act" means the *Quartz Mining Act*, S.Y. 2003, c.14;

"applicable closure plan" means the Preliminary Reclamation and Closure Plan or a reclamation and closure plan, as described in paragraph 9.2 of this License, whichever is the approved plan at the relevant time;

"approved plan" means a plan described in Schedule B that is approved by the Chief under this License and includes any terms and conditions specified by the Chief in the approval;

"borrow material" means rock, sand, gravel and other similar materials obtained by excavation, other than pre-existing surface materials, that is to be used for the construction of roads and other engineered structures, works and installations;

"Chief" means the Chief of Mining Land Use designated under the Act;

"day" means a calendar day;

"dry stack tailings facility" means the area and related infrastructure to be located on quartz claims 38642 (Moth), 56401 (Frances 5) and 38643 (Flame) that is to be used for storing the dewatered materials that are produced as a result of milling ore, including ground rock, unrecoverable ore and water and chemicals used to assist in milling the ore, and which are to be described in the dry stack tailings development and operation plan as described in Schedule B of this License;

"engineer" means a professional engineer as defined in, and licensed under, the *Engineering Professions Act*, R.S.Y. 2002, c.75;

"environmental management system" means the organized approach to managing environmental emergencies established by a hazardous materials management plan, a spill contingency plan and an emergency response plan, as each is described in Schedule B of this License;

"environmental protection plans" means a waste management plan, a monitoring and surveillance plan, a waste rock management plan, a noise abatement plan, a traffic management plan, a wildlife protection plan, a heritage resources protection plan, a spill contingency plan, a hazardous materials management plan, and an emergency response plan as each is described in Schedule B of this License;

"General Site Plan" means the Construction Site Plan, Revision 1 prepared by Alexco Keno Hill Mining Corp., dated November, 2009;

"License" means Quartz Mining License QML-0009;

"Licensee" means the person to whom this Licence is issued;

"mill" means the building to be located on quartz claims 38642 (Moth), 56401 (Frances 5) and 38643 (Flame) and fitted with machinery for processing ore, including a crusher, mill ore stockpiles, concentrate load-out and support infrastructure;

"mine" includes the underground workings and all related mine infrastructure, as to be described in the development and operation plan for the mine and including the waste rock storage facility, the roads connecting underground workings and support infrastructure, such as fuel tanks, repair and maintenance shops, explosives storage buildings, backfill and ventilation facilities;

"Minister" is the Minister of Energy, Mines and Resources;

"non acid generating or metal leaching" means non acid generating or metal leaching rock as determined in accordance with Appendix B of the General Site Plan;

"operations plans" means the mine development and operations plan, the mill development and operations plan, the dry stack tailings development and operations plan and the Lightning Creek Bypass Road construction and development plan, as each is described in Schedule B of this License;

"ore" means rock containing minerals that will be processed to extract silver, lead and zinc and other mineral by-products of the processing;

"permanent closure" means the closure of the Undertaking as evidenced by the cessation of development and production as authorized by this Licence for any period of time that is not a temporary closure;

"potentially acid generating or metal leaching" means potentially acid generating or metal leaching rock as determined in accordance with Appendix B of the General Site Plan;

"Preliminary Reclamation and Closure Plan" means the Preliminary Reclamation and Closure Plan prepared by Access Consulting Group, dated July, 2009;

"pyritic circuit" means that portion of the milling process that is designed to remove the iron sulphide from the ore for separate treatment and disposal;

"Regulation" means the *Quartz Mining Land Use Regulation*, O.I.C. 2003/64;

"site" means the area where the Undertaking is taking place;

"start-up date" means the day thirty days following the day the Licensee begins milling ore and continues to mill ore for any period of time over two successive days;

"temporary closure" means:

(a) prior to the Start-up Date, the closure of the Undertaking as evidenced by the cessation of development authorized by Part II or Part III of this License for more than a continuous six month period, unless otherwise agreed to in writing by the Chief; or

(b) after the Start-up Date, the closure of the Undertaking as evidenced by the cessation of development and production authorized by this License for a period longer than two consecutive months;

"underground workings" means the area below the surface that will be excavated to extract waste rock and ore on quartz claims 55426 (Wildcat), YA17397 (Lem 3),16097 (David), 14081 (Whipsaw), 14327 (Eureka), 38730 (Silver Fr.), 16087 (Extension), 12838 (Tundra), 56443 (Apex Fr.), 16170 (Nod Fr.) 55120 (Chance), 55327 (Sam) including all stopes, declines, adits, shafts, vents and related supports and infrastructure;

"Undertaking" means all development and production authorized by this License related to the extraction of silver, lead and zinc from the mineral claims identified in Schedules A;

"waste rock" means rock excavated from underground workings that will not be processed in the mill; and

"waste rock storage facility" means an area to be identified in the waste rock management plan described in Schedule B where waste rock is placed either temporarily or permanently, whether the rock is non acid generating or metal leaching or potentially acid generating or metal leaching.

1.2 Any term not defined in this License that is defined in the Act has the same meaning as in the Act.

1.3 Schedules A and B form part of this License.

2.0 Coming into Effect

2.1 The authorizations, obligations, and requirements set out in Parts I and II of this License come into effect on the Effective Date.

2.2 The authorizations, obligations, and requirements set out in Part III come into effect on the date the Chief approves the Environmental Protection Plans and if the Environmental Protection Plans are approved on different dates, on the date the last plan is approved by the Chief.

3.0 Term and Limitations on the Undertaking

3.1 This License expires on December 31, 2025.

3.2 The Licensee is authorized to carry out the Undertaking only
(a) on the mineral claims listed in Schedule A; and
(b) in accordance with the conditions set out in this License and the Approved Plans.

4.0 Extensions of Time Limits

4.1 If the Licensee submits a written request to extend a time limit imposed by this License no less than five days before the expiry of the time limit in question, the Chief may extend the time limit. The new time limit will replace the time limit imposed in this Licence solely with respect to the written request.

5.0 Plans and Reports

5.1 When the Licensee is required to submit a plan under this License, the Licensee must
(a) submit the plan in writing to the Chief;
(b) ensure that the plan meets the requirements for that type of plan as directed by the Chief in writing; and
(c) not undertake any of the activities described in the plan until the plan is approved in writing by the Chief.

5.2 If the Licensee wants to amend an approved plan, it must submit the proposed amendment to the Chief as if the amendment was a plan under paragraph 5.1 of this License. If the Chief approves the amendment, the Licensee agrees that the amendment and any terms and conditions set out by the Chief in his/her approval will be considered to be an approved plan or a part of an existing approved plan, whichever is appropriate in the circumstance.

5.3 If the Chief directs in writing and with reasons that an approved plan be amended, the Licensee must prepare the required amendment and submit it to the Chief as if it was a plan referred to paragraph 5.1 of this License.

5.4 All plans and reports submitted by the Licensee with respect to the design or construction of any engineered structures, works or installations related to the Undertaking must be under the stamp or seal of an engineer.

6.0 Correspondence

6.1 Any written communication, notice or report required to be given by the Licensee pursuant to this License may be provided by personal delivery to the persons identified below, by facsimile, electronic mail or by registered mail to the addresses set out below.

To the Licensee:

President, Alexco Keno Hill Mining Corp.
Suite 1150 – 200 Granville Street
Vancouver, British Columbia
V6C 1S4
crnauman@alexcoresource.com
Fax: (604) 633-4887

To the Chief:

Director, Mineral Resources
Department of Energy, Mines and Resources
P.O. Box 2703
Whitehorse, Yukon
Y1A 2C6
Robert.Holmes@gov.yk.ca
Fax: (867) 456-3899

6.2 Either the Licensee or the Chief may change its address for service while this License is in effect by notifying the other in writing. All written communications, notices or reports will be considered to have been received by the Licensee or the Chief, as the case may be, 10 days after the mailing thereof, or if personally delivered or sent by facsimile or by electronic mail, on the day of delivery.

7.0 Other Applicable Legislation

7.1 The Licensee must conform to all applicable laws, licenses, permits, approvals or authorizations issued to the Licensee in relation to the Undertaking.

7.2 No term or condition of this License limits the application of any applicable laws.

PART II
INITIAL DEVELOPMENT, FINANCIAL SECURITY, AND APPROVAL OF SPECIFIC PLANS

8.0 Initial Development

8.1 Subject to paragraphs 8.2 to 8.6 of this License, the Licensee is authorized to engage in development as set out in the General Site Plan.

8.2 The Licensee must not move or store equipment on land that has not previously been undisturbed unless the land is capable of fully supporting the equipment without rutting or gouging the surface of the land.

8.3 The Licensee must retain and stockpile all organic material that it strips from the land for effective reuse during reclamation.

8.4 The Licensee must test samples of all borrow material that may be used for fill or construction prior to use in accordance with the protocol set out in Appendix B of the General Site Plan for determining the acid rock drainage or metal leaching potential of the material.

8.5 The Licensee may only use borrow material for fill or construction that does not demonstrate a potential for acid rock drainage or metal leaching.

8.6 If borrow material that is potentially acid generating or metal leaching must be disturbed during development or production, the Licensee must submit a mitigation plan to the Chief for approval 30 days prior to any disturbance of the material.

9.0 Reclamation and Closure Plan

9.1 The Licensee must undertake reclamation at the site during and after development in accordance with the Preliminary Reclamation and Closure Plan.

9.2 No later than twelve months after the effective date, the Licensee must submit to the Chief a reclamation and closure plan that details the activities to be undertaken to reclaim the site during and after development and production.

9.3 The Licensee must undertake reclamation at the site in accordance with the plan referred to in paragraph 9.2 of this License as of the date that plan becomes an approved plan.

9.4 The Licensee acknowledges that on the date the plan referred to in paragraph 9.2 of this License becomes an approved plan, paragraph 9.1 of this License will no longer have any effect under this License.

9.5 The Licensee must:

(a) submit to the Chief an updated version of the plan referred to in paragraph 9.2 of this License every two years commencing the third anniversary of the Effective Date; and
(b) undertake reclamation at the site in accordance with the updated plan as of the date each updated plan becomes an approved plan.

9.6 The Licensee acknowledges that on the date an updated reclamation and closure plan becomes an approved plan, the previous reclamation and closure plan shall cease to be an approved plan.

10.0 Permanent Closure and Temporary Closure

10.1 The Licensee must provide written notice to the Minister of permanent closure at least 60 days prior to the Licensee bringing about permanent closure.

10.2 Immediately upon permanent closure, the Licensee must implement the applicable closure plan as it relates to permanent closure.

10.3 The Licensee must provide written notice to the Chief of the Licensee's decision to bring about temporary closure within one week of the closure.

10.4 Immediately upon temporary closure, the Licensee must implement the applicable closure plan as it relates to temporary closure.

10.5 The Licensee acknowledges that the Minister may, after giving the Licensee a reasonable opportunity to be heard on the matter, declare a temporary closure. Immediately upon receiving notice of the Minister's declaration, the Licensee must implement the applicable closure plan as it relates to temporary closure.

10.6 If the Licensee is required to implement the applicable closure plan in respect of a temporary closure, the Licensee may not undertake development or production that would otherwise be authorized by this License until authorized to do so in writing by the Chief.

10.7 If temporary closure lasts longer than five continuous years from the date notice is received under paragraph 10.3 of this License or a declaration made under 10.5 of this License, permanent closure will be presumed to have occurred and the Licensee must implement the applicable closure plan as it relates to permanent closure unless otherwise directed by the Chief or unless the Chief allows a delay in the implementation.

10.8 Within thirty days of commencement of temporary closure, whether determined by notice or declaration, the Licensee must provide to the Chief:
(a) written notice indicating for which engineered structures, works or installations a the site it has already provided to the Chief as-built drawings of the engineered structures, works or installations; and
(b) copies of as-built drawings for those engineered structures, works or installations for which no such drawings have been previously provided to the Chief.

10.9 The Licensee must notify the Chief in writing at least thirty days in advance of its desire to end temporary closure and resume development and production.

11.0 Financial Security

11.1 The Licensee must furnish and maintain security with the Minister in the amount of $2,808,000, as outlined in the following schedule:

(a) $620,000 within 30 days of the effective date;

(b) $1,068,000 no later than 30 days after the designation of any portion of the site as a production unit, as set out in Article 6 of the Subsidiary Agreement, an agreement made between Elsa Reclamation & Development Company Ltd., Alexco Resource Corp., Her Majesty the Queen in Right of Canada, as represented by the Minister of Indian Affairs and Northern Development and the Government of Yukon, dated February 7, 2006; and

(c) $1,120,000 no later than 60 days after receipt of the notice to the Chief of the start-up date referred to in paragraph 15.4 of this License.

11.2 The Licensee agrees that the amount of security set out in paragraph 11.1 of this License will be reviewed by the Minister when the Licensee first submits a reclamation and closure plan and each time this plan is subsequently updated by the Licensee as set out in section 9.0 of this License.

11.3 The Licensee acknowledges that as provided for in s.4 of the *Security Regulation* the Minister may periodically review the amount of security furnished and maintained by the Licensee and may amend the amount of security, in a greater or lesser amount than that identified in paragraph 11.1 of this License, based upon each reclamation and closure plan submitted by the Licensee and the criteria set out in s.3 of the *Security Regulation*.

11.4 When the Minister determines that additional security must be provided as set out in paragraph 11.3 of this License, the Licensee must furnish and maintain with the Minister the additional amount of security required within 60 days of receiving written notice from the Minister of the increase, provided that the Minister has, prior to issuing the notice, given the Licensee an opportunity to be heard respecting the need for and amount of security.

11.5 The Licensee acknowledges that the written notice of the Minister referred to in paragraph 11.4 of this License will, upon issuance, amend paragraph 11.1 of this License with respect to the amount of security and the requirement to furnish and maintain security in accordance with the payment schedule included in the notice will be considered a requirement of this License as of the date of the notice.

12.0 Environmental Protection Plans

12.1 The Licensee must submit to the Chief the environmental protection plans.

12.2 The Licensee must implement the environmental protection plans as of the date each plan becomes an approved plan.

12.3 The Licensee must immediately implement the environmental management system where an accidental spill or release of dangerous or hazardous substance or material occurs.

13.0 Operation Plans

13.1 The Licensee must submit the operations plans to the Chief.

14.0 Reporting and Inspections

14.1 The Licensee must ensure that an annual inspection of the physical stability of all engineered structures, works and installations located at the site is conducted by an engineer by August 1 of each year of the term of this License, including the dry stack tailings facility, the waste rock storage facility, the underground workings and any diversion structures or dams.

14.2 Within 60 days of the inspection referred to in paragraph 14.1 of this License, the Licensee must submit to the Chief a written report prepared by the engineer that conducted the annual inspection documenting the results of the inspection, including a
(a) summary of the stability, integrity and status of all of the inspected structures, works, and installations; and
(b) any recommendations for remedial actions made as a result of these investigations and evaluations.

14.3 The Licensee must take immediate steps to implement any of the recommendations for remedial action made as a result of the inspection referred to in paragraph 14.1 of this License and provide the Chief with a written statement detailing how and when each of the recommendations for remedial action will be addressed.

14.4 The Licensee must
(a) evaluate data gathered as a result of implementation of the monitoring and surveillance plan on a semi-annual basis;
(b) develop and implement a program to take immediate steps to address any results from the monitoring and surveillance activities that indicate any change in environmental performance of the Undertaking or non-compliance with the Act, the Regulation, this License or any of the approved plans; and
(c) provide the Chief with a statement detailing the program referred to in paragraph (b) and summarizing the action taken to address the change or non-compliance.

14.5 On or before March 31 of each year of the term of this License, the Licensee must submit an annual report, in writing, containing the information to be directed by the Chief in writing covering the period of January 1 to December 31 of the prior year.

PART III
FINAL DEVELOPMENT AND MINE OPERATIONS

15.0 Development and Operation of the Mine

15.1 Subject to paragraphs 15.2 to 15.15 of this License, the Licensee is authorized to engage in development and production as set out in the following plans once they become approved plans:
- (a) the mine development and operation plan;
- (b) the mill development and operation plan;
- (c) the dry stack tailings plan; and
- (d) the road (Lightning Creek) development and operation plan.

15.2 When the Chief requests in writing, the Licensee must provide information to the Chief to confirm whether the rock to be deposited in any permanent non acid generating or metal leaching waste rock storage facility is non-acid generating or metal leaching and the Licensee must not deposit any further material in this facility until the Chief has authorized the deposit in writing.

15.3 The Licensee must not remove more than 500,000 tonnes of waste rock, in total, from the underground workings of the Undertaking during the term of this License.

15.4 The Licensee must provide written notice to the Chief of the start-up date at least three months prior to that date. The Licensee may not mill ore for a period that exceeds two successive days unless the (3) month notice has been provided to the Chief.

15.5 The Licensee must not process ore other than that obtained from the underground workings located at the site.

15.6 The Licensee must not mill at a rate exceeding
- (a) 250 tonnes per day of ore based upon a 12 month average for the first two years after the start-up date; and
- (b) 400 tonnes per day of ore based upon a 12 month average for the remainder of the term of this License.

15.7 The Licensee must not extract more than 613,000 tonnes of ore from the mine over the term of this License.

15.8 The Licensee must not store more than 25,000 tonnes of potentially acid generating or metal leaching waste rock in the temporary acid generating or metal leaching waste rock storage facility.

15.9 The Licensee must not store more than 100,000 tonnes of potentially acid generating or metal leaching waste rock in the permanent potentially acid generating or metal leaching waste rock storage facility.

15.10 The Licensee must deposit all tailings from the pyritic circuit underground at a location below the eventual level of flooding to be described in the reclamation and closure plan.

15.11 The Licensee must submit to the Chief, at least 60 days prior to the commencement of the construction of the dry stacked tailings facility, detailed construction designs and quality assurance and quality control procedures, prepared by an engineer, for the construction for the dry stacked tailings facility.

15.12 The Licensee must not place more than 500,000 tonnes of tailings on the dry stacked tailings facility during the term of this Licence.

15.13 At least ten days prior to commencing construction of the Lightning Creek Bypass Road, the Licensee must provide the Chief with written notice of its intention to start the construction.

SCHEDULE A
CLAIMS COVERING THE MINE AND MINE FACILITIES

GRANT NUMBER	CLAIM NAME	GRANT NUMBER	CLAIM NAME
59645	DAISY FRACTION	59494	BOBBIE 10
55426	WILDCAT	12838	TUNDRA
YC42578	K 30	56401	FRANCES 5
YA17395	LEM 1	83011	ADAM FRACTION
YC56120	K 93	55544	HUSKY 8
YC42580	K 32	55319	ELI
YA17397	LEM 3	38819	ASTORIA
YC56121	K 94	59338	VALLEY
55445	SOLOMAN	16105	BETTY
16097	DAVID	59316	BRISTOL
YC42628	K 80	38643	FLAME
YC42627	K 79	56403	FRANCES 7
YC56115	K 88	56582	OVERTIME 2
YC42629	K 81	16557	WESTON
59387	PUEBLO	15207	TICK
55312	MONTY	55542	HUSKY 6
55546	HUSKY 10	55540	HUSKY 4
56402	FRANCES 6	16375	VENTURE
56533	BES	15374	NANCY
16554	IKWOGGY	55029	PREMIER
16585	LUCKY	16569	MONTE CARLO
55599	FRANCES 3	56575	ACRE FRACTION
13073	RAM	56443	APEX FR.
55271	ROSEMARY	16170	NOD FR.
59465	SUDDO 9	59452	FALLS 16
14081	WHIPSAW	55600	FRANCES 4
14327	EUREKA	55120	CHANCE
38730	SILVER FR.	16561	ARIZONA
55065	TIPTOP	59463	SUDDO 7
56534	SEGLE	83012	CATHY FRACTION
38642	MOTH	55327	SAM
16087	EXTENSION		

SCHEDULE B – PLANS TO BE SUBMITTED FOR APPROVAL AS APPROVED PLANS

Waste Management Plan – A plan that describes the mitigations and methods used to manage solid and liquid wastes and special wastes to ensure protection of the environment and human health.

Monitoring and Surveillance Plan - A plan that describes methods and techniques for collecting monitoring information regarding conditions of engineered structures and environmental conditions at the Undertaking, as well as quantitative thresholds which trigger the implementation of adaptive management strategies.

Waste Rock Management Plan - A plan for the management of waste rock that provides details of the various waste rock streams and how these categories of waste rock will be managed throughout the mine life.

Noise Abatement Plan – A plan that describes methods to reduce and control noise levels for the mill facility and the transportation of ore to the mill along the Lightning Creek Bypass road, the Duncan Creek road and the Christal Lake road.

Traffic Management Plan – A plan that describes the mitigation measures or practices pertaining to the control of vehicle access, whether private or public vehicles, on the various roads included in the Undertaking.

Wildlife Protection Plan – A plan that describes the mitigation measures or practices pertaining to wildlife attractants, vehicle use, habitat management, wildlife harassment and wildlife health.

Heritage Resource Protection Plan – A plan that describes measures to identify and protect historic sites, historic objects, and works of archaeological, paleontological, pre-historic, historic, scientific or aesthetic value.

Spill Contingency Plan – A plan that describes the measures designed to minimize the potential impact to the environment following a fuel or chemical spill.

Hazardous Materials Management Plan – A plan provides details of the storage and handling of various hazardous chemicals utilized in the Undertaking.

Emergency Response Plan – A plan that provides details of plans and responsibilities for response to emergency situations that may be encountered.

Mine Development and Operations Plan – A plan that details the construction, operation, maintenance and monitoring of the mine.

Mill Development and Operations Plan – A plan that details the construction, operation and monitoring of the mill.

Dry Stack Tailings Facility Development and Operations Plan – A plan that details the construction, operation and monitoring of the dry stack tailings and related infrastructure.

Lightning Creek ByPass Road Development and Operations Plan – A plan that details the construction and operation of the road which connects the underground to the mill via Lightning Creek.

Alexco Keno Hill Mining Corp
1150-200 Granville Street
Vancouver BC V6C 1S4

January 19, 2010

Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, Yukon   Y1A 3V1

Attention: Ms. Joelle Janes, Licencing Officer

Dear Ms. Janes:

Re: Bellekeno Mine Water Licence Application QZ09-092,
Response to Review for Adequacy and Supplemental Information

Thank you for your correspondence of December 10, 2009. In order to facilitate the Boards' review of our application, we are herewith providing our responses to the remainder of questions from this letter.

Documents that we are including as components of our responses are submitted as attachments to the response.

As noted in our submission and letter to the Water Board on December 23rd, these responses address the balance of outstanding questions from the Board's Review. We have enclosed a status table in this letter so that the responses can easily be tracked.

Response Status to Questions in December 10th Correspondence Concerning Water Use Application QZ09-092

Question	Status	Question	Status
1	Submitted Dec 23	22e	Submitted Dec 23
2	Submitted Dec 23	22f	Submitted Dec 23
3	Submitted Dec 23	22g	Submitted Dec 23
4	Submitted Dec 23	22h	**Submitted Jan 19**
5	Submitted Dec 23	22i	Submitted Dec 23
6	**Submitted Jan 19 (see Attachment A to responses)**	22j	Submitted Dec 23
7	Submitted Dec 23	23	**Submitted Jan 19**
8	Submitted Dec 23	24a	**Submitted Jan 19**
9a	**Submitted Jan 19 (includes Attachment B to responses)**	24b	**Submitted Jan 19**
9b	**Submitted Jan 19**	24c	**Submitted Jan 19**
9c	**Submitted Jan 19**	24d	**Submitted Jan 19**
10	**Submitted Jan 19**	24e	**Submitted Jan 19**
11a	Submitted Dec 23	24f	**Submitted Jan 19**
11b	Submitted Dec 23	24g	**Submitted Jan 19**
11c	Submitted Dec 23	24h	**Submitted Jan 19**
11(d)i	Submitted Dec 23	25a	**Submitted Jan 19**
11(d)ii	Submitted Dec 23	25b	**Submitted Jan 19**
12a	**Submitted Jan 19**	25c	**Submitted Jan 19**
12b	**Submitted Jan 19 (see Attachment C to responses)**	26	Submitted Dec 23
12c	**Submitted Jan 19 (see Attachment C to responses)**	27	**Submitted Jan 19**
13	Submitted Dec 23	28	Submitted Dec 23
14	Submitted Dec 23	29	Submitted Dec 23
15	**Submitted Jan 19**	30	**Submitted Jan 19**
16	**Submitted Jan 19**	31	**Submitted Jan 19**
17	**Submitted Jan 19**	32	**Submitted Jan 19**
18	Submitted Dec 23	33	**Submitted Jan 19 (see Attachment D to responses)**
19	**Submitted Jan 19 (see revised figures 3-1 and 7-1)**	34	**Submitted Jan 19**
20	Submitted Dec 23	35	**Submitted Jan 19**
21	Submitted Dec 23	36a	**Submitted Jan 19**
22a	Submitted Dec 23	36b	**Submitted Jan 19**
22b	**Submitted Jan 19**	36c	**Submitted Jan 19**
22c	Submitted Dec 23	36d	**Submitted Jan 19 (see Attachment E to responses)**
22d	Submitted Dec 23	37	**Submitted Jan 19**

Response Status to Questions in December 10th Correspondence Concerning Water Use Application QZ09-092

Question	Status	Question	Status
38	**Submitted Jan 19**	68b(ii)	**Submitted Jan 19**
39	**Submitted Jan 19**	68b(iii)	**Submitted Jan 19**
40	**Submitted Jan 19 (includes Revised Table 6-5)**	68b(iv)	**Submitted Jan 19**
41	**Submitted Jan 19 (includes Revised Figure 6-1)**	69	Submitted Dec 23
42	**Submitted Jan 19 (see Table 1 to responses)**	70	Submitted Dec 23
43	**Submitted Jan 19 (includes Revised Figure 6-2)**	71	**Submitted Jan 19**
44	**Submitted Jan 19**	72	**Submitted Jan 19 (see Revised Figure 1 to Main Application Report Appendix M)**
45	**Submitted Jan 19**	73	**Submitted Jan 19**
46	**Submitted Jan 19**	74a	**Submitted Jan 19 (see Revised Table 3 to Main Application Report Appendix I)**
47	**Submitted Jan 19**	74b	**Submitted Jan 19**
48	**Submitted Jan 19**	74c	**Submitted Jan 19 (see Figure 5 to responses)**
49	**Submitted Jan 19**	74d	**Submitted Jan 19 (see Table 3 to responses)**
50	**Submitted Jan 19**	75	**Submitted Jan 19**
51	**Submitted Jan 19**	76	**Submitted Jan 19**
52	**Submitted Jan 19**	77	**Submitted Jan 19**
53	**Submitted Jan 19**	78	**Submitted Jan 19**
54	Submitted Dec 23	79	**Submitted Jan 19**
55	**Submitted Jan 19**	80	**Submitted Jan 19**
56	**Submitted Jan 19 (includes Figure 1 to responses)**	81	**Submitted Jan 19**
57	**Submitted Jan 19 (includes figures 2 and 3 and Table 2 to responses)**	82	Submitted Dec 23
58	**Submitted Jan 19**	83	Submitted Dec 23
59	**Submitted Jan 19**	84	**Submitted Jan 19**
60	**Submitted Jan 19**	85	**Submitted Jan 19**
61	**Submitted Jan 19**	86	**Submitted Jan 19**
62	**Submitted Jan 19**	87	**Submitted Jan 19**
63	**Submitted Jan 19**	88	**Submitted Jan 19**
64	**Submitted Jan 19**	89	**Submitted Jan 19**
65	Submitted Dec 23	90	**Submitted Jan 19**
66	Submitted Dec 23	91	**Submitted Jan 19**
67	**Submitted Jan 19**	92	**Submitted Jan 19**
68a	**Submitted Jan 19 (includes Figure 4 to responses)**	93	Submitted Dec 23
68b(i)	**Submitted Jan 19**		

Should you have any questions, please contact our office at 867-668-6463.

Sincerely,
Alexco Keno Hill Mining Corp

Robert L. McIntyre, R.E.T.
Vice President, Business Development
Alexco Keno Hill Mining Corp

cc. external D. Buyck, NNDFN
cc. internal C.Nauman, B.Thrall, T.Hall, D.Whittle, Alexco Resource Corp.
E. Allen, T. Lunday, Access Consulting Group

Attachments:

- *Attachment A: Reliance on third party technical reports letters;*
- *Attachment B: excerpt from SRK 2007 Baseline Environmental Report;*
- *Attachment C: Preliminary Engineering and Management Plan DSTF, Bellkeno Mine;*
- *Attachment D: Bellekeno 625 Adit water quality results;*
- *Attachment E: excerpt from 1996 UKHM Site Characterization Report*
- *Attachment F: Bellekeno Mine Waste Rock Disposal Area stamped drawings*
- *Attachment G: Galkeno 900 Sulphate-Reducing Bioreactor Interim Report*

Schedule 4 Application Form

1. *Submitted Dec. 24, 2009*

2. *Submitted Dec. 24, 2009*

General

3. *Submitted Dec. 24, 2009*

4. *Submitted Dec. 24, 2009*

5. *Submitted Dec. 24, 2009*

6. *The technical memo included in the Construction Site Plan -Appendix J contains a disclaimer that states: "This report and its contents are intended for the sole use of Alexco and their agents…" Furthermore, Environmental Conditions Report - Appendix H (exhibit 1.3.6.8) contains the following: "This report was prepared for the exclusive use of Elsa Reclamation and Development Company…"*

   All documents provided to the Board are available to the public, and therefore written approval from the authors must be provided in order for the Water Board to use the information for the purposes of licensing.

   Please refer to Attachment A to these responses.

7. *Submitted Dec. 24, 2009*

8. *Submitted Dec. 24, 2009*

Clarification on Liability

9. *Segregation of responsibility for pre-existing and new environmental liabilities, both terrestrial and aquatic, need to be explicitly identified for the proposed Bellekeno project so that the Board clearly understands which liabilities are the legal responsibility of Alexco.*

   Please provide a concise summary of:

a) *the pre-existing environmental liabilities prior to Alexco's development of the Bellekeno project;*

Liabilities which existed before the development of the Bellekeno project include those liabilities associated with the Existing State of the Mine as defined in the 2006 Subsidiary Agreement:

> "'Existing State of the Mine' means the state of the Mine, known or unknown, existing prior to Initial Closing, it being understood that additional environmental issues with respect to the Existing State of the Mine may become apparent, be determined, discovered, or arise after Initial Closing but shall still be encompassed by this definition."

Known aquatic and terrestrial liabilities are described in SRK's 2007 Baseline Environmental Report. These liabilities are the responsibility of the Government of Canada (see response to [c], below). Relevant sites include Bellekeno and Flame and Moth; liabilities for these sites are attached as Attachment B to these responses.

b) *the post-closure environmental liabilities associated with the development of the Bellekeno project; and*

To date, post-closure liabilities generated beyond those documented in the 2007 Baseline Assessment (noted in [a], above) include:

Future liabilities generated as a result of the Bellekeno development will be documented as development progresses. Bellekeno mine environmental impacts are mitigated through the Preliminary Decommissioning and Reclamation Plan (PDRP) (exhibit 1.4.5).

c) *the assignment of the liabilities (legal responsibility) identified in a and b post-closure.*

In accordance with the terms and conditions of the 2006 Subsidiary Agreement, pre-development liabilities (noted in [a], above) will be the responsibility of the Government of Canada. Post-closure liabilities generated beyond those which were documented in the 2007 Baseline Assessment (those noted in [b], above) will be the responsibility of Alexco.

10. *Page 6-75 of the Main Application Report indicates that "Liabilities resulting from sludge produced by the Bellekeno mine and mill operations will be kept separate from sludge resulting from other site treatment operations to the satisfaction of the appropriate government agency". Please clarify how sludge liabilities will be kept separate.*

    Liabilities resulting from sludge produced by the Bellekeno mine and mill will be kept separate from sludge produced at other treatment sites through the use of different disposal locations. After the start of operations at Bellekeno, sludge produced at the treatment site will be disposed of at the dry stack tailings facility. Similarly, sludge produced at the Flame and Moth mill site will be disposed of directly to the dry stack tailings.

    Sludge produced by the other Keno treatment sites will continue to be disposed of according to the Water Licence QZ06-074 Sludge Management Plan. At present this includes disposal in cells at the Valley Tailings Facility and the Galkeno Upper Sime Pit for Galkeno 300 sludge.

<u>Preliminary Design Drawings</u>

11. *Submitted Dec. 24, 2009.*

12. *Question 36 of the information sheets refers to waste rock storage areas. A technical memo sealed by a P. Eng, accompanied by generic preliminary design drawings was included for the temporary storage of potentially AML waste rock at the Bellekeno East site.*

    Please provide sealed preliminary design drawings for the following:

    a) *the permanent waste rock storage facility for potentially AML waste rock for the selected location along the northeast flank of Sourdough Hill;*

       At this stage, there is considered sufficient excess capacity for the potentially-AML rock storage facility currently located at Bellekeno East; if further storage space is required, approval will be sought under Quartz Mining Licence QML-0009.

    b) *the Dry Stack Tailings Facility as described on page 6-71 of the Main Application Report; and*

       Please refer to Attachment C to these responses.

c) *the water management infrastructure at the Mill Site and Dry Stack Tailings Facility (i.e. collection channels/ ditches, diversions, water treatment and polishing pond, etc.).*

Please refer to Attachment C to these responses.

Baseline Data

13. Submitted Dec. 24, 2009

14. Submitted Dec. 24, 2009

15. Environmental Conditions Report -Appendix G (exhibit 1.3.6.7) presents the methodology for developing background (baseline) water quality data for the mining district. Please comment on the rationale for combining water quality data from KV-1 and KV-37 instead of developing a separate background water quality for South McQuesten River and for Lightning Creek/ Duncan Creek watersheds. Please advise if sufficient data is currently available to provide specific background levels for the 2 watersheds.

Data for KV-37 were considered to be too limited to permit development of a separate background benchmark for this area. Combining data for the two areas at least partially accounted for natural among-area variability, which can be considerable among Yukon drainages, regardless of stream size. The application of a combined data set allowed for a higher degree of confidence that substances found at concentrations outside of the background data range in mine-exposed areas were indicative of mine influence (i.e. not just naturally outside of the range of a particular reference area). Overall, the values used in the 2008 report were adequate for the purposes of that report and the report conclusions would not be substantially altered by incorporation of additional data for KV-1 and KV-37 for the period 2007-2009.

The conclusions drawn and the methods used for developing background levels are considered adequate for the purposes of assessing environmental water quality impacts by the Bellekeno mine development.

16. *Please review most current data for KV-37 and comment on whether or not it supports the background water quality developed for the district using data up to 2007, as done by Minnow in the Environmental Conditions Report –Appendix G (exhibit 1.3.6.7).*

    As noted above, review of new data for KV-37 shows that this data supports the conclusions presented by Minnow (2008).

17. *Page 6 of exhibit 1.3.6.7 discusses the validity of selecting KV-1 as a reference station and discusses the additional collection of additional information at KV-72. Furthermore, the report suggests that a comparative assessment be conducted of the data used in KV-1 and the additional data collected in KV-72 be conducted.*

    Please provide an update on the status of KV-1 and KV-72 with respect to which is to be utilized for background water quality for South McQuesten River.

    Monitoring was initiated further upstream on the South McQuesten River at KV-72 when it became evident that water quality was changing at KV-1 due to a source/disturbance between KV-71 and KV-1 that is unrelated to UKHM historic disturbances (possibly associated with discharge from Cache Creek). Thus the KV-72 data are a better representation of natural background water quality for the South McQuesten River. For this reason, it is appropriate to include KV-72 data in the derivation of a reference benchmark for the tributaries (along with KV-37 data) until sufficient data are available for additional reference tributaries (also see response to Questions 15 and 16).

    For evaluation of water quality in the South McQuesten River downstream of drainages from the Keno Hill mines, it is appropriate to use KV-1 data to take into account water quality influences upstream of the Keno Hill mines.

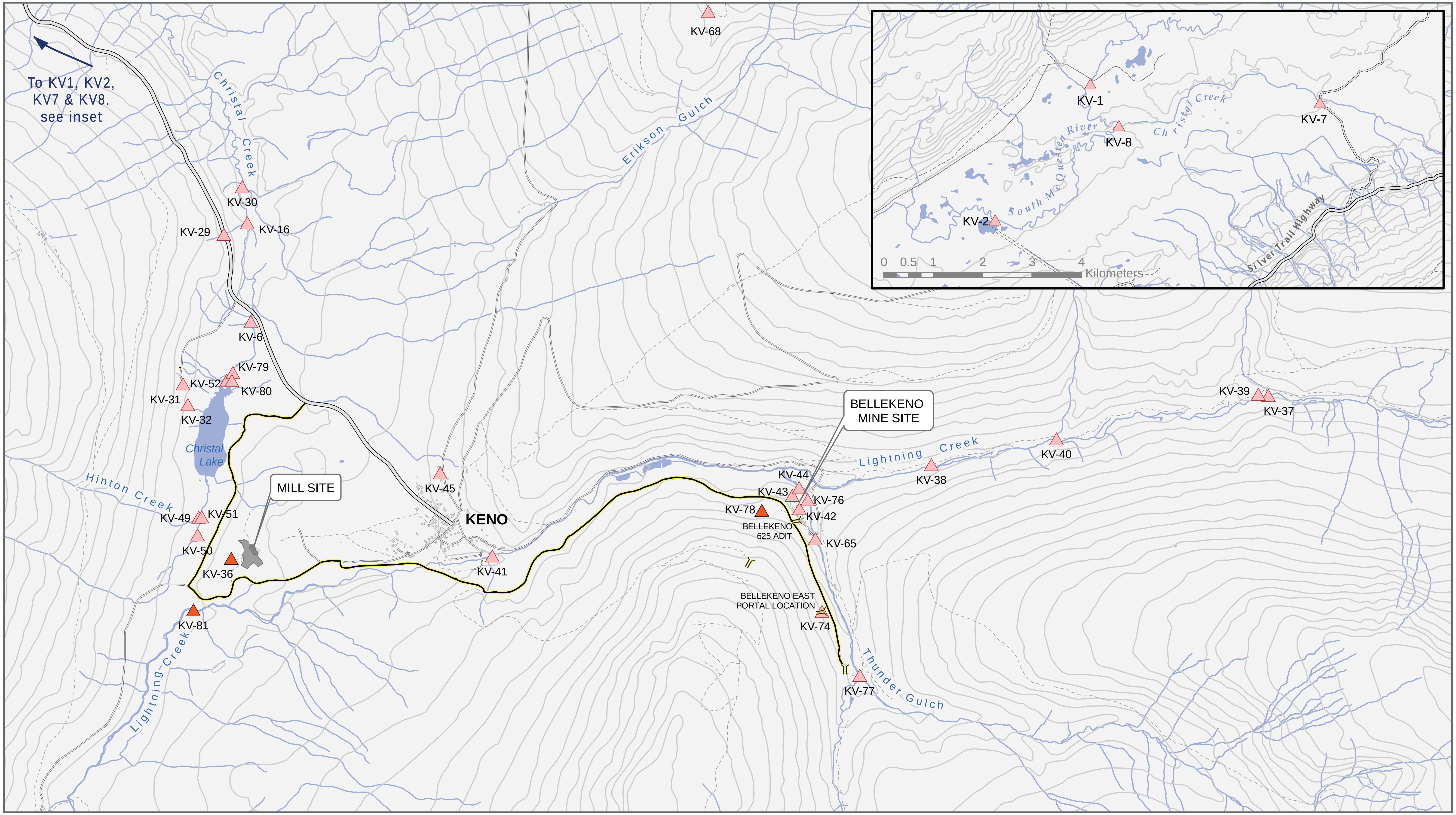
18. *Submitted Dec. 24, 2009*

Environmental Monitoring Program

19. *Please refer to the Main Application Report –Appendix J, figure 3-1 (exhibit 1.3.10). Monitoring stations KV-50 and KV-51 are described as being Christal Creek downstream of Hinton Creek and upstream of Hinton Creek respectively. Please confirm that the monitoring stations are correctly labeled.*

    When comparing figure 3-1 to figure 7-1 of the Main Application Report, it appears that Hinton Creek is inconsistently represented. Please update the figures where necessary.

> Please refer to revised Figures 3-1 and 7-1 to the Main Application Report on pages 7 and 8 of these responses.



National topographic Data Base (NTDB) compiled by Natural Ressources Canada at a scale fo 1:50,000.
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Datum: NAD 83
Projection: UTM Zone 8N

0 125 250 500 750 1,000 metres

N

Adit	Haul Road	Contours
Existing Water Quality Stations*	Silver Trail Highway	WaterCourses
New/Proposed Water Quality Station*	Secondary	Structures
Reference; Table 3-2	Track,	WaterBodies

ALEXCO

ACCESS CONSULTING GROUP

BELLEKENO MINE PROJECT
TYPE A WATER LICENSE APPLICATION

REVISED FIGURE 3-1
SURFACE WATER QUALITY MONITORING STATIONS

Drawn By: MD	AUGUST 2009	Verified by: RM

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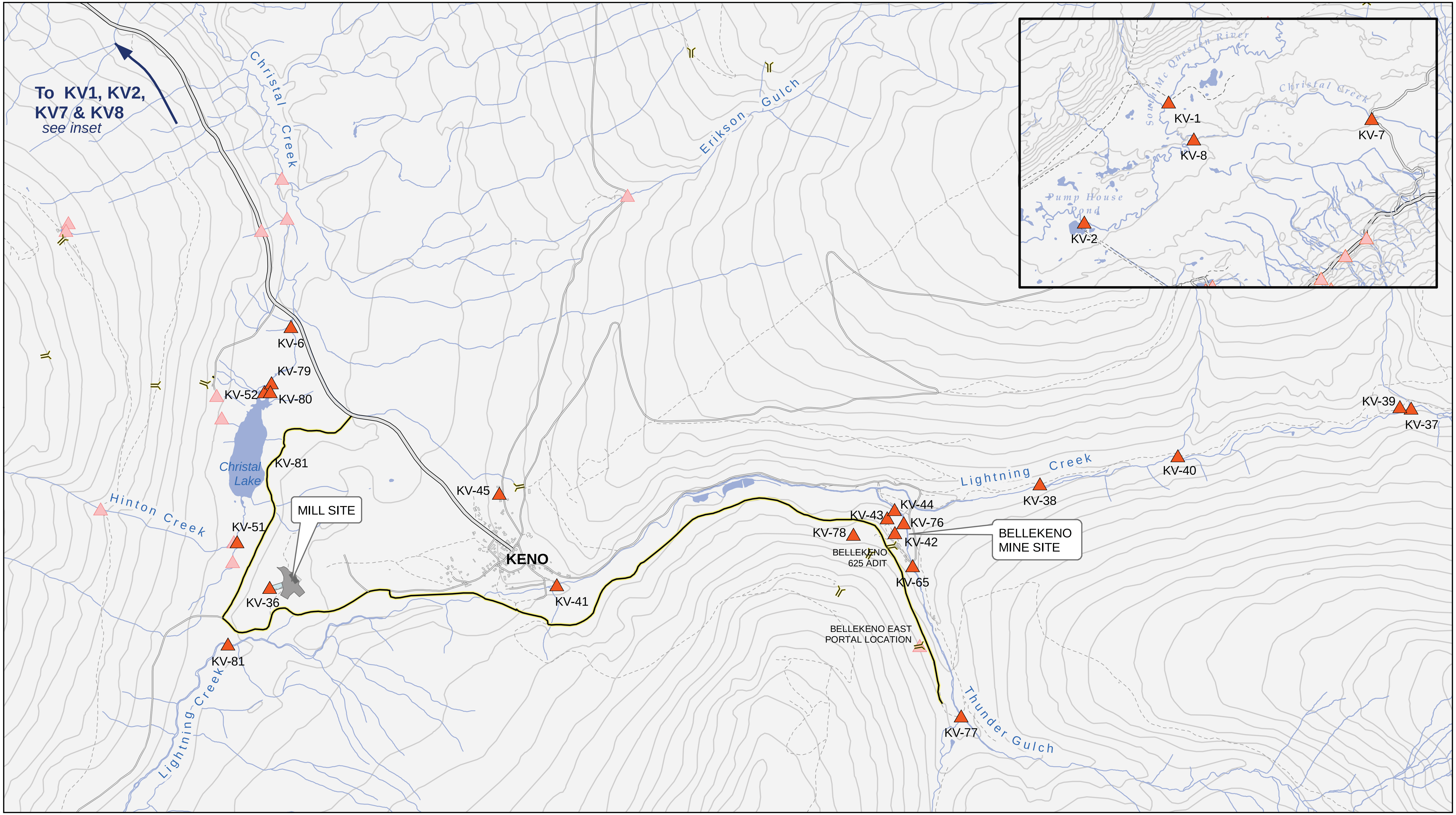

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Datum: NAD 83
Projection: UTM Zone 8N

0 125 250 500 750 1,000 metres

N

Adits	Haul Road	Contours	
▲ Proposed Bellekeno Project Water Monitoring Station*	Silver Trail Highway	WaterCourses	
▲ Other Water Monitoring Stations*	Secondary	▨ WaterBodies	
	Track,	▨ Structures	

** Reference; Table 7-2*

ALEXCO

ACCESS CONSULTING GROUP

BELLEKENO MINE PROJECT
TYPE A WATER LICENSE APPLICATION

REVISED FIGURE 7-1

BELLEKENO SURFACE WATER QUALITY MONITORING STATIONS

Drawn By: MD	AUGUST 2009	Verified by: RM

D:\Project\AllProjects\ALEX-05-01\Bellekeno\GIS\mxd\WUL_MLU_Applications\WUL_Aug_09\Fig_7_1_BKWQ_Stations.mxd

20. Submitted Dec. 24, 2009

21. Submitted Dec. 24, 2009

22. The Water Quality Assessment Report (exhibit 1.3.6.7) prepared by Minnow Environmental Inc. included 10 recommendations regarding future modifications to the environmental monitoring program. The recommendations are presented below:

a) Submitted Dec. 24, 2009

b) Monitoring at additional reference stations should be considered and the appropriateness of using KV-1 relative to the new reference station KV-72 should be evaluated;

This recommendation has been carried out.

c) Submitted Dec. 24, 2009

d) Submitted Dec. 24, 2009

e) Submitted Dec. 24, 2009

f) Submitted Dec. 24, 2009

g) Submitted Dec. 24, 2009

h) Background benchmarks should be re-developed for all substances having a guideline once an adequate reference database has been developed with consistently low MDLs and including data for a greater number of reference stations;

Appropriate additional reference stations are currently in the process of being developed. These sites will be sampled for metals and other contaminants of concern at appropriate low detection levels. As suggested in Question 15, samples for these sites will be collected on a monthly basis for a minimum two years' time at which point background benchmarks will be redeveloped based on the database of samples existing at that time.

i) Submitted Dec. 24, 2009

j) Submitted Dec. 24, 2009

Please indicate whether these recommendations have been adopted and/or if they are incorporated into the proposed environmental monitoring program for the Bellekeno East Project. If they have not been adopted or proposed please provide a rationale for not accepting them.

Please note that the work done by Minnow Environmental was for the purposes of closure and reclamation planning at Keno Hill. Many of these recommendations are either primarily or solely in the interest of environmental monitoring for the larger Keno Hill mines area.

23. *The analysis completed in the Water Quality Assessment Report (exhibit 1.3.6.7) relied upon water quality data current to either spring 2007 or summer 2007 (depending upon the station). In some cases parameter analysis was limited to use of data available only between the above dates and July 2004. Given recommendation (h) above, please advise if the currently available data still supports the completed analysis.*

    The key conclusions of the Water Quality Assessment Report, namely that cadmium, sulphate, lead, and zinc were the key contaminants of concern, concentrations were highest in tributaries immediately downstream of mine sources, and that median concentrations did not exceed water quality guidelines in the South McQuesten River, would not be altered by the incorporation of more recent data. We believe that the currently available data still supports the completed analysis.

24. *The submitted Aquatic Resources Assessment Report (exhibit 1.3.6.10) prepared by Minnow Environmental Inc. included 8 recommendations regarding future modifications to the environmental monitoring program. The recommendations are presented below:*

    a) *Expand on the habitat characterization by Sparling (2006), presented in Table 2.1, to ensure consistent information is available among areas where benthic and fish communities are typically assessed.*

       Access Consulting Group conducted additional fisheries habitat and assessment studies in 2008 and 2009 as part of the district wide closure plan.

    b) *Review monitoring station locations to ensure that each station provides unique information relative to source loads.*

       Monitoring stations have been reviewed with additional stations added to address data gaps. Minnow conducted a detailed benthic and sediment program in August 2009 to refine monitoring stations and data collection methods as part of the long term monitoring program being developed for the district wide closure plan

c) *Analyze particle size and chemistry of whole sediment samples collected in reference and mine-exposed areas to determine if metal concentrations, particularly arsenic, are high enough to potentially affected biota.*

Minnow conducted a detailed benthic and sediment program in August 2009 to refine monitoring stations and data collection methods as part of the long term monitoring program being developed for the district wide closure plan. This included collection of samples for particle size and chemistry of whole sediment.

d) *Evaluate the sample collection methods and the sampling design that have been used in past assessments of benthic community health to identify opportunities for improvement. For example, changes to the sampling design are recommended to allow for statistical comparison of conditions in mine-exposed versus reference areas and thus allow for quantification of changes over time. Specific design options should be developed and evaluated as part of the long term monitoring design.*

Minnow conducted a detailed benthic and sediment program in August 2009 to refine monitoring stations and data collection methods as part of the long term monitoring program being developed for the district wide closure plan.

e) *Once the long-term monitoring program is established, standard operating procedures (SOPs) should be developed.*

Minnow will be developing SOP as part of the long term monitoring program for the district wide closure plan.

f) *Evaluate sites that could serve as additional reference areas in future surveys to enhance evaluation of mine-exposed areas through improved understanding of reference conditions and variability.*

Minnow conducted a detailed water quality, benthic and sediment program in August 2009 to refine monitoring stations for site reference areas. The information will used to develop the long term monitoring program being developed for the district wide closure plan.

g) *Consider replacing potentially impacted KV-1 with the new reference area KV-72 by conducting a comparative assessment of the two stations when more data at KV-72 are available.*

See response to 22b, above.

h) *Collect more detailed fish health data during fisheries assessments and also measure major organ weights (e.g., gonads, livers) and fish age for any specimens that are sacrificed for tissue analysis.*

Access Consulting Group conducted additional fisheries habitat and assessment studies in 2008 and 2009 as part of the district wide closure plan. This study included the collection of fish health data and tissue samples. The results are reported in the Environmental Conditions Report (Appendix F to the Main Application Report).

Please indicate whether these recommendations have been adopted and/or if they are incorporated into the proposed environmental monitoring program for the Bellekeno East Project. If they have not been adopted or proposed please provide a rationale for not accepting them.

Please note that the work done by Minnow Environmental was for the purposes of closure and reclamation planning at Keno Hill. Many of these recommendations are either primarily or solely in the interest of environmental monitoring for the larger Keno Hill mines area.

Water Quality

25. *Please provide the predicted water quality of the following inputs that report to the mill site treatment pond:*

a) *mill water discharge;*

Table 2-13 in the Water License Application shows tailings water chemistry, and it is expected that this would be representative of conditions of mill water discharge. It is also the expected chemistry of the tailings pore water.

The mill will not discharge under normal conditions. Water used at the milling process will primarily be lost as pore water in the tailings and shipped out in concentrate. If discharge were required due to an upset in the water balance in the mill the water would be sent to the holding pond and would either be reused, or discharged after treatment.

b) *dry stack facility runoff; and*

The dry stack facility will be concurrently reclaimed to minimize the contact of precipitation or snowmelt from direct contact with the tailings. It is expected that upon compaction, 10% of the pore water, or 4.3 m^3/day at peak ore throughput, will be displaced from the tailings without dilution (at the concentrations listed in Table 2-13 of the main application), and will be report to the treatment pond.

c) *mill site facility runoff.*

The mill site facility is not expected to contribute to the metals concentration, but overall would represent dilution water. However, runoff from disturbed areas can have suspended solids, which is estimated at 50 mg/L as an annual average for the purposes of sizing water treatment purposes. Mill site facility water will be collected and report to the water treatment pond.

26. Submitted Dec. 24, 2009

27. Please provide the predicted water quality that will be released to the environment. The predicted parameters should include those which are proposed in the effluent quality standards, as well as, the contaminants of concern identified in the Environmental Conditions Report –Appendix G (exhibit 1.3.6.7).

- pH: between 6.0 and 9.5. (During dewatering the pH of the treated solution was less than 9.0. The range depends on the lime treatment process, which will tend to raise the pH, but will be maintained below 9.5 at discharge).
- TSS: less than 25 mg/L in a grab sample and less than 15 mg/L mean concentration. (Recent average was 35 mg/L during dewatering. The company will be adding a filtration step to maintain TSS below these discharge standards).
- Ammonia: less than 5 mg/L. (Recent average was 1.0 mg/L during dewatering. The company will be adding aeration and oxidation steps to optimize the ammonia removal).
- As (total): less than 0.5 mg/L. (Recent average was 0.012 mg/L during dewatering. The water is already low arsenic, and the lime treatment will ensure that this standard is maintained).
- Cd (total): less than 0.05 mg/L. (Recent average was 0.0006 mg/L during dewatering. The water is already low cadmium, and the lime treatment will ensure that this standard is maintained).

- Pb (total): less than 0.2 mg/L. (Recent average was 0.0146 mg/L during dewatering. The water is already low lead, and the lime treatment will ensure that this standard is maintained).
- Ni (total): less than 0.5 mg/L. (Recent average of treated water was 0.0275 mg/L during dewatering. The water is already low nickel, and the lime treatment will ensure that this standard is maintained).
- Radium 226: 0.37 Bq/L.
- Ag (total): 0.1 mg/L. (Recent average of treated water was 0.0006 mg/L during dewatering. The water is already low silver, and the lime treatment will ensure that this standard is maintained).
- Zn (total): 0.5 mg/L. (Recent average of treated water was 0.32 mg/L during dewatering. The lime treatment is being enhanced by filtration, which will help remove suspended zinc particulates, which will help ensure that this standard is maintained).

Please note that there are no additional contaminants of concern identified in the Environmental Conditions Report –Appendix G (exhibit 1.3.6.7) beyond these parameters.

28. *Submitted Dec. 24, 2009*

29. *Submitted Dec. 24, 2009*

30. *Please refer to section 3 of the Main Application Report. Table 3-5 on page 3-21 does not appear to be the table referenced on page 3-20. Please identify where the table referenced on page 3-20 (table 3-5) is located.*

    The table referenced on Page 3-20 of the Main Application Report (table 3-5) appears in Appendix I to the Main Application report as table 5.

31. *Please provide the referenced document "SRK 2009" described on Page 5-21 of the Main Application Report.*

    The SRK 2009 report is currently part of the Water Licence Application, contained within the Environmental Conditions Report (which appears as Appendix F to the Application) as an appendix (Appendix D to the Environmental Conditions Report).

32. *Please confirm whether Bellekeno was actively mined during the dewatered period between May 1995 and Nov 1996.*

United Keno Hill Mines Limited (UKHM) undertook advanced underground exploration during this period. Underground development consisting of the driving of trackless sized (approximately 3 m x 3 m) internal declines, ramps, exploration drifts and diamond drilling.

33. *Please provide the daily internal testing results and weekly external testing results for adit water quality during the drawdown of the Bellekeno mine pool in 2009.*

Please refer to Attachment D to these responses.

34. *Please clarify the purpose of table 6-6 on page 6-28 of the Main Application Report; as I was unable to locate any description or reference to this table in the text.*

The relevant portion of Section 6.1.5.5 of the Main Application Report should read,

> "…Thus, most of the effluent from the Mill Site will result from meteoric runoff from the mill pad and dry stack tailings facility, with a possible minor input from additional pore water loss from the dry stack tailings facility (Table 6-6)."

Hydrology

35. *The freshet runoff assessment Main Application Report -Appendix L (exhibit 1.3.12) utilizes frequency analysis of stream gauge records for northern gauged basins with areas ranging from 13.7 km^2 to 7,250 km^2 to make predictions for potential runoff amounts from the mill site and dry stack tailings facility which has an area of 0.06 km^2 and for the Lightning Creek basin above KV-41 which has an area of 59.1 km^2. While this methodology seems reasonable for Lightning Creek (given it is a stream and the catchment is of reasonable size), it seems an unusual application for the very small mill catchment area.*

Please provide comment as to whether the applied methodology is expected to produce a conservative estimate of runoff for the mill catchment and provide justification for not utilizing climatic records (precipitation inputs) and estimates of site runoff parameters to provide a runoff estimate for the mill catchment.

Yes, the applied methodology is expected to produce a conservative estimate of runoff for the mill catchment. The use of streamflow records allowed estimates of runoff volumes over a range of durations from 1 day to 365 days. Storage within the mill catchment would be required for the entire freshet runoff volume over a likely period of about 30 days. Use of climatic parameters (precipitation) depends on an assumed runoff coefficient, the value of which is highly uncertain over an extended (30 day) period. Streamflow data provides real historical runoff volumes as a function of catchment elevation and mean annual runoff. Actual freshet runoff volumes will vary each year and will be impacted by a number of variables as discussed in Clearwater Consultants Ltd. Memorandum CCL-UKHM-2 dated August 20, 2009 (Appendix L to the Main Application Report).

36. *Please refer to the site hydrology update presented in the Environmental Conditions Report – Appendix A (exhibit 1.3.6.1):*

a) *The report utilized continuous water level data available for stations KV-7, KV-9, and KV-41 up to 2007. Please clarify if continuous water level data was collected for these sites in 2008 and 2009. If so please indicate if the data validates the findings of the Site Hydrology Update.*

This data is available; however, it is considered that the additional months' worth of data will not appreciably change the results of site hydrology which has been developed to-date. The baseline for site hydrology developed as a part of the 1996 Site Characterization Report remains the baseline standard for site hydrology.

b) *The report indicated that some additional work was required to complete calculations for station KV-9. Please clarify if this work has been completed.*

This work was originally not carried out as a result of gaps in the collection of hydrological data. However, considering the findings of the 2007 Hydrological Update, the 1996 Site Characterization Report will adequately serve as a hydrological baseline from which various extrapolations about the site can be made. Moreover, data continues to be collected at this station which will fill the gaps for future analysis.

c) *The report recommended that a quality assurance and quality control program be implemented for the mine site water quantity measurements. Please clarify if such a program has been developed and/or is incorporated into this application.*

Such a program is presently in the process of being developed, and as a result it is not incorporated in this application. Once the development of the Quality Assurance and Quality Control Program is complete it will be adhered to in data collection procedures.

d) *Please provide referenced sections of the 1996 Site Characterization Report that present the original hydrology development.*

Please refer to Attachment E to these responses.

Water Balance

37. *The Bellekeno mine water balance is shown to be based on mine water inflows recorded in 2008, which is considered to be the most conservative available data. Given that the mine development will entail significant expansion of the underground workings, please explain why the mine inflows are not expected to increase over the course of the mine life. Please provide an assessment of expected maximum mine water inflows that will be expected during the operational life of the Bellekeno mine.*

Mine water inflows at Bellekeno are structurally controlled, as the water flows along the fractures which are related to vein occurrences. This highly localized flow path intersection is moved ahead with mine workings as the mining progresses along the veins; therefore, the total area available for inflow does not dramatically increase. Upon opening a new working face, the inflow rates rapidly stabilize to existing conditions. The current mine plan may open the mine up to new geo-plumbing and therefore may result in a limited increase in the surface area of collection of meteoric waters. These inflows will vary over time in accordance with meteoric conditions, which are expected to be close to the current situation and past experience over many years of mining and are not expected to increase dramatically. If any increase in inflow is observed, we expect the limited amount of new development in comparison with the current mine workings to result in a proportional sustained increase in mine inflow (a percentage increase, not a multiple of current inflow). Further, the expanded mine workings will be replaced with backfill, which is a combination of waste rock, tailings, and Portland cement. This backfilling during operations and at closure may result in plugging of some of the geo-plumbing currently exposed in existing workings and future development, which may result in a reduction of mine inflows.

38. *Please indicate if any measurement of mine water inflows within the dewatered mine has been conducted to identify inflow sources and rates for specific existing workings at the mine.*

Water inflows to the Bellekeno Mine workings all reports to the measured outflow location at the Bellekeno 625 Water Treatment Facility, for which there is significant flow data available, and is presented in the application. There is no data for specific existing headings.

39. *Please refer to page 6-3 of the Main Application Report and please provide an explanation as to why only 25% of the treated Bellekeno adit discharge is expected to be recycled for use at the Bellekeno mine.*

Treated effluent will not be used as a source of mine water. It is anticipated that all water required for drilling will be drawn from the mine pool before treatment. If required, we may augment mine pool water volume with freshwater makeup from Thunder Gulch.

40. *Page 6-4 of the Main Application Report indicates that the mill has no systematic discharge other than septic water; however, the mill water balance in table 6-5 indicates a discharge stream of 6.18 m^3/day for years 1-2 and 0.53 m^3/day for years 3-5. Please clarify the mill water discharge stream.*

During the final engineering design and optimization process recently completed, water makeup requirements have been reduced primarily through modifications in pumps which require less gland water. In the interest of completeness and currency of the application, we are submitting revised internal mill water balance information. The optimization of these design parameters has not resulted in a significant difference to the mill's environmental impact or environmental management systems. The recent optimization work does, however, result in a mill water management system that is not expected to require systematic discharge of excess mill water (see Revised Table 6-5 to the Main Application Report, below).

PROCESS DESCRIPTION	250t/day (m^3/day)	408t/day (m^3/day)
Fresh Water to Gland Seals	15.36	15.36
Fresh Water for Reagent Mixing	5.52	9.12
General Plant Use (sanitation)	0.72	0.72
Water in Fresh Ore	13.2	21.6
TOTAL WATER IN	34.8	46.8
Process Recycled Water IN	538.08	882.96
Water to Sewage	0.72	0.72
Water Leaving Plant in Filtered Concentrate	4.8	7.92
Water Leaving Plant in Filtered Tailings	34.32	56.16
Mill Discharge to Treatment (make up, if negative)	-5.04	-18
TOTAL WATER OUT	34.8	46.8
Process recycled water OUT	553.04	864.96
Mill Pad + DSTF Runoff (includes freshet)	34.3	34.3
Total Water Treated/Discharged to Christal Lake	29.26	16.3

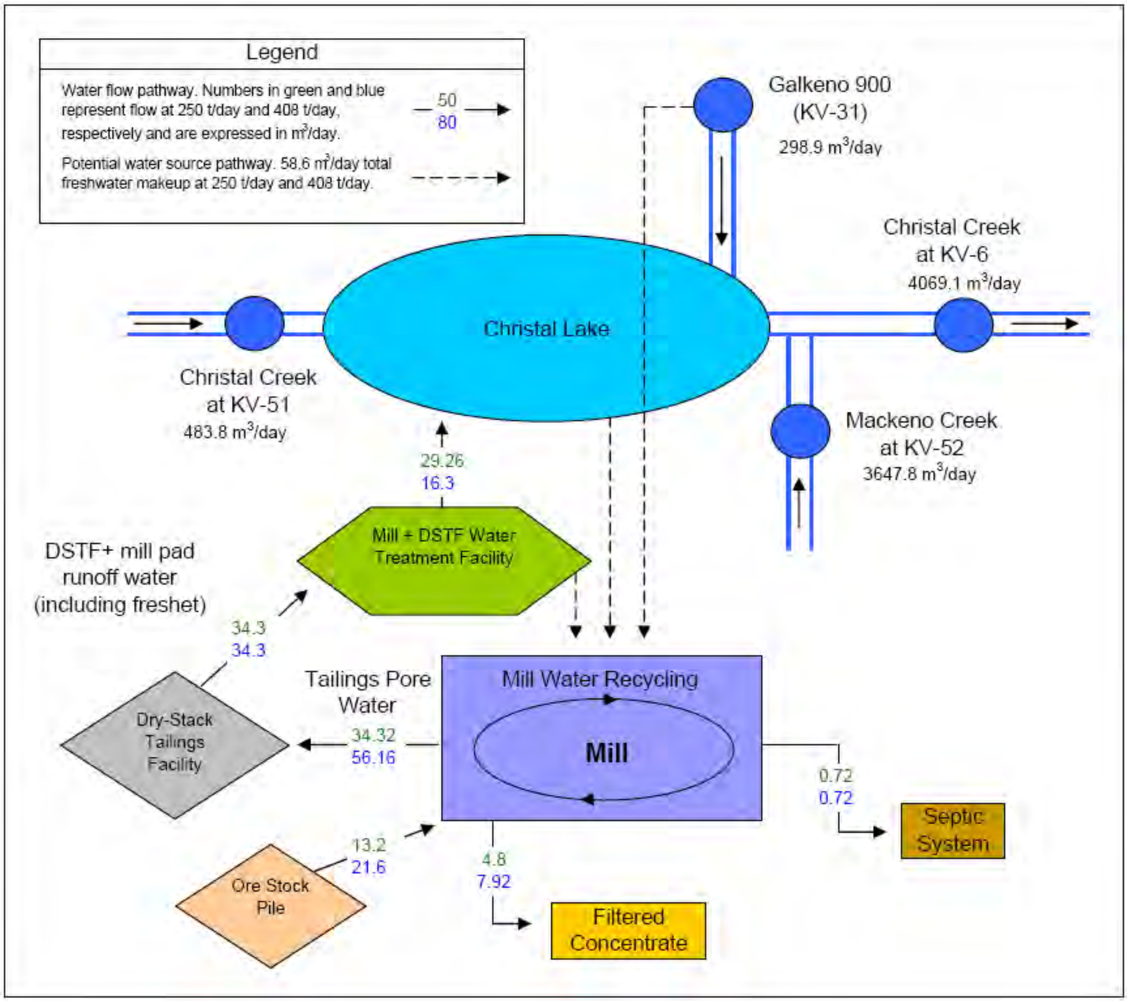
Revised Table 6-5 Mill Water Balance

41. *Table 6-5 of the Main Application Report also indicates that the estimated daily runoff from the dry stack tailings facility is 26.1 m^3/day. Please explain the basis of that estimate.*

The estimated daily runoff of 26.1 m^3/day is based on the calculated Mean Annual Runoff (MAR) at the for the Flame and Moth Mill site (215 mm, see Table 6-1 of Main Application Report) multiplied by the approximate area of the DSTF area, and divided by 365 days.

This calculation was originally made for the Mackeno Site Lower Bench with an estimated area of ~45,000 m^2. A more recent conservative estimate of this area was made for the estimation of mill site freshet runoff by the Memorandum by Clearwater Consultants (see Appendix L, volume 3). This estimated catchment area of 62,700 m^2 would result in an estimated daily runoff from the dry stack and mill pad area of 36.9 m^3/day.

The layout of the current mill site and DSTF is contained in Attachment C to these responses. This footprint enables the best estimation to date of the predicted estimated daily runoff from the mill pad and DSTF at 58,300 m^2, which gives an estimated daily runoff of 34.3 m^3/day. This number is reflected in an amended mill water balance (Revised Table 6-5 to the Main Application Report, above) and mill water use schematic (Revised Figure 6-3 to the Main Application Report, below).



Revised Figure 6-3 Mill Water Use Schematic

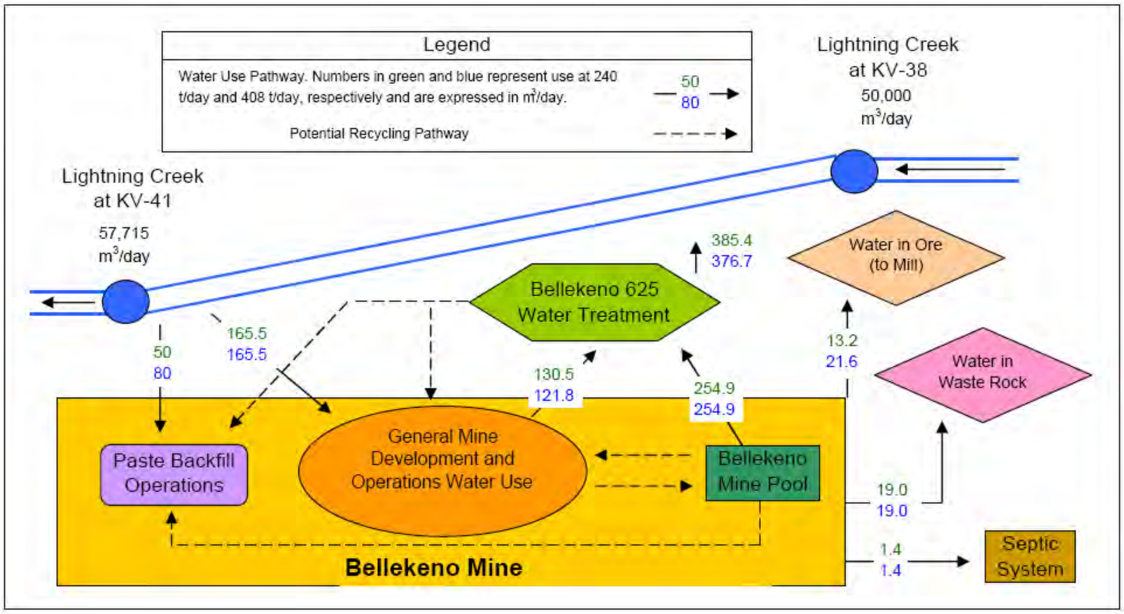
42. Please indicate the number of flow measurements utilized to develop the average flow rates listed in table 6-3 of the Main Application Report.

Input Node	Christal Creek u/s Hinton Creek	Christal Creek @ Keno Hwy	Galkeno 900 Adit	DSTF Runoff
	KV-51	**KV-6**	**KV-31**	
n=	1	18	83	*
*from the 1996 Site Characterization Report regional hydrology study				

Table 1 Number of Flow Measurements – Christal Lake Inflows and Potential Mill Freshwater Makeup Sources

43. The water use associated with waste rock removal is absent from figure 6-2 of the Main Application Report. It is, however, included in table 6-4. Please update the figure ensuring that the waste rock water use component is reflected.

The water use associated with waste rock removal is now shown on revised Figure 6-2 below.



Revised Figure 6-2 Mill Water Use Schematic

44. *Please indicate the basis for the maximum daily mill water use of 58.64m^3/day that is described on page 6-23 of Main Application Report.*

Mill water use which has been recalculated as per response Question 40 is developed based on engineering design inputs for a maximum daily ore throughput of 408t/day.

As described in revised Table 6-5 (presented in the response to question 40 above), the mill water use is determined both by water inputs/requirements (the major components being mill process water including gland water and water for reagent mixing and also sanitation and fresh water in ore) and outputs (water to septic system, water leaving plant in filtered concentrate and tailings). The net outputs, being greater than the inputs, determine the total maximum daily mill water use figure. The figure of 58.64 m^3/day was derived from an earlier iteration of the water balance.

In order to preserve flexibility for minor changes in equipment specifications for various mill components and a 25% contingency, the amount we are requesting for mill process fresh water makeup is 85.5 m^3/day (see page 6-4 of the Application for discussion).

45. *Please clarify the description of mill water discharge described on page 6-29 of the Main Application Report. It does not appear to identify the mill water discharges listed in table 6-5.*

During the final engineering design and optimization process recently completed, water makeup requirements have been reduced primarily through modifications in pumps which require less gland water. In the interest of completeness and currency of the application, we are submitting revised internal mill water balance information. The optimization of these design parameters has not resulted in a significant difference to the mill’s environmental impact or environmental management systems. For revisions to the mill water balance, please refer to Questions 40, 41 and 43.

46. *Please provide a more detailed water balance for the proposed mill pond ensuring that site freshet flows, mill water discharges, mill intakes, and treatment discharges are shown and the impact of these on the pond volume is described.*

During the final engineering design and optimization process recently completed, water makeup requirements have been reduced primarily through modifications in pumps which require less gland water. In the interest of completeness and currency of the application, we are submitting revised internal mill water balance information. The optimization of these design parameters has not resulted in a significant difference to the mill's environmental impact or environmental management systems. The recent optimization work does however result in a mill water management system that is not expected to require systematic discharge of excess mill water.

Due to the fact that the mill will not systematically discharge water, the most important consideration in designing mill pond volume was having ample capacity to store and treat spring freshet melt water. Clearwater Consultants Ltd. was commissioned to undertake a study assessing cumulative flow volumes for various return periods at the mill site, and is presented in the application as Appendix L. As a clarification to the discussion on pond sizing in the main application report page 6-24, and in light of the aforementioned modifications in mill equipment result in a net shortfall in the mill water balance (no discharge), the retention capacity for the treatment has been designed to 10 days, which results in a volume of 2,500 m^3 (based on the 200 year Best fit curve, see Figure 6-7 of the application).

47. *Please refer to the Construction Site Plan -Appendix A (exhibit 1.4.1). Please clarify that the Water Balance Process Flowsheet (drawing A00-09-012) is a correct representation of the mill water balance described elsewhere in the application or revise the drawing to be consistent with presented water balance.*

During the final engineering design and optimization process recently completed, water makeup requirements have been reduced primarily through modifications in pumps which require less gland water. In the interest of completeness and currency of the application, we are submitting revised internal mill water balance information. The optimization of these design parameters has not resulted in a significant difference to the mill's environmental impact or environmental management systems. The recent optimization work does however result in a mill water management system that is not expected to require systematic discharge of excess mill water. Therefore we can confirm that the Water Balance Flowsheet is a correct representation of the mill water balance described elsewhere in the application.

Water Use

48. *Page 2-58 of the Main Application Report refers to the process water supply system and indicates the use of treated sewage water. Please confirm if this is accurate. If so, provide the source of the treated sewage water and expected water quality of this effluent.*

The text was meant to indicate treated effluent, meaning Galkeno 900 adit discharge post-treatment.

49. *Under water licence QZ07-078, Alexco Keno Hill Mining Corp. (Alexco) is licensed to obtain up to a combined maximum of 29m^3/day for camp purposes from Flat Creek and the camp well. On page 6-3 of the Main Application Report, Alexco is requesting up to 42.75m^3/day for camp purposes. It is my understanding that 42.75m^3/day is the total quantity being requested for the camp, and is not above and 29m^3/day authorized in QZ07-078. Please confirm.*

We can confirm your correct understanding.

50. *On page 6-3, the rationale for the water use is based on a 150 person camp. On pages 6-30 & 2-71, a 200 person camp is being considered. Please confirm the size of the camp (and corresponding water use) being applied for in this licence.*

Page 6-3 referred to camp size, which will not exceed 150 persons. The other references in the document were to total employment compliment, which will reach nearly 200; however, with crew rotations, only 150 people will be in camp at a time.

51. *Under water licence QZ07-078, Alexco is licensed to obtain up to a combined maximum of 71m^3/day from Thunder Gulch and Lightning Creek. On page 6-3 of the Main Application Report, Alexco is requesting up to 165.5m^3/day for underground mine development and production. It is my understanding that 165.5m^3/day is the total quantity being requested for the mining activities, and is not above the 71m^3/day authorized in QZ07-078. Please confirm.*

    We can confirm your correct understanding.

52. *On page 2-66 of the Main Application Report, the development of groundwater wells as a backup water source for mill is discussed. Please clarify if the use of groundwater use at the mill is being identified as a potential future amendment, or if it is being requested as part of this application. If you are requesting groundwater use for this application, please provide a maximum quantity of water to be obtained measured in cubic metres per day and the number of wells proposed. If you know the location of the well, please provide a map that identifies the well location and provide coordinates.*

    This application does not request groundwater wells as a source; we can clarify that an amendment to the licence would be required, should groundwater be considered as a source.

53. *Based on table 6-5 of the Main Application Report, it is my understanding that during the peak years of operation, the mill will require approximately 1,300m^3/day to operate. If the mill were to acquire water at the requested rate of 85.5m^3/day, it would take over two weeks to acquire the quantity of water necessary to operate the mill. Please confirm if this is correct, or if you would like to request a greater amount of water for the initial mill start-up, and start-up post shutdown.*

    We confirm that this is correct; we understand that a period of days will be required to acquire the water to commission the mill at startup.

54. *Submitted Dec. 24, 2009*

Water Treatment

55. *On page 6-15 of the Main Application Report, as a contingency, it is noted that you may install a clarifier unit as a minor modification. If you are requesting that this contingency be licensed, please confirm and provide the specification for the clarifier, the treatment capacity (m^3/hr), and process chemicals. If you are not requesting this clarifier to be considered as part of this application, it is advisable that you contact Water Inspections to determine if this would constitute a "minor modification" if the licence were to be issued.*

> At the present time, it is not anticipated that a clarifier would be required for enhancing settling at the Bellekeno mine, but that filtration would be used instead to enhance TSS removal (see answer to question 58). Therefore we are not requesting this contingency be licenced.

56. *On page 5-7 of the Main Application Report -Appendix K (exhibit 1.3.11), you indicate that the ethanol-based, gravel infiltration gallery bioreactor will be employed for decommissioning of the Bellekeno 625 for 5 years; citing the success of the Galkeno 900 pilot project. Furthermore, it is suggested that this technology may also be employed immediately down slope of the drystack tailings facility. Please provide information supporting the stated success of Galkeno 900 bioreactor pilot project. Also, please provide the rationale as to why this passive treatment is only expected to be required for 5 years at Bellekeno 625.*

> Please see attached interim report of the first year of Galkeno 900 pilot test (Attachment G to these responses). Since that time, the pilot test operation has increased the flow rates through the reactor to ascertain metals removal at higher flow rates.
>
> Figure 1 shows the zinc results during the initial startup phase where water was primarily recirculated, with slow discharge, with carbon source addition (alcohol and sugars). At the end of one year the bioreactor had achieved very good zinc removal efficiency (September 10/11 sample was 6.05 mg/l zinc entering the reactor, <0.01 mg/L effluent). At that point the bioreactor began to operate in a throughflow mode, with a constant influent/effluent rate for the bioreactor of 0.5 L/s adit water. The bioreactor consistently achieved <0.02 mg/L dissolved zinc in the discharge.

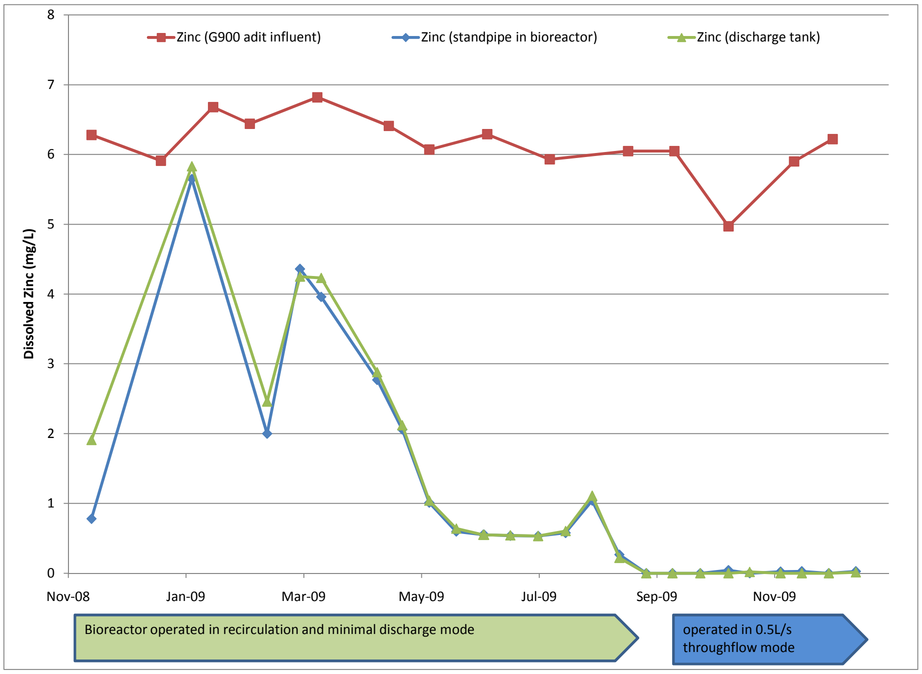


Figure 1 Operational performance of the Galkeno 900 bioreactor for zinc removal

The rate of flow through the Galkeno 900 bioreactor is substantially higher than what would be required to treat the DSTF discharge. Table 5-6 in the Water License Application shows that with 20% infiltration at the full 5 year build out of the DSTF the total annual discharge would be approximately 1900m^3 per year, or approximately 0.06 L/s. The bioreactor size required to treat the DSTF runoff would likely be somewhat smaller than what is built at Galkeno 900.

The rationale for thinking that a bioreactor as a contingency at DSTF would only require a few years of active treatment is twofold. First, the establishment of vegetation on the DSTF and the placement of cover material will be designed to minimize the infiltration. In these conditions, the net infiltration will become so low that the seepage rate from the DSTF may be so slow that no seep is collectable from the toe. Second, a bioreactor operated to maximize sulfate reduction, as the Galkeno 900 reactor is operated, will form reactive iron sulfides, which in time will accumulate in the bioreactor. Operation of the bioreactor if required as a contingency for a few years will generate this reactive iron phase during the period of active organic carbon addition. When the organic carbon addition ceases, the reactive iron phase will be the primary treatment mechanism to continue to remove metals if flow continues at a low rate into the bioreactor.

(These iron sulfides are reactive with other heavy metals, including zinc, and will remove the zinc from solution as zinc sulfide precipitates. The reactive iron sulfide [also termed acid volatile sulfide] converts to an iron oxide layer mixed with zinc sulfide minerals during this passive treatment phase until the iron sulfides are exhausted. Iron present in the native rock used as media to fill the bioreactor is the source of this iron, as well as any iron added in the water being treated.)

At Bellekeno 625, the bioreactor would be operated in a similar mode as Galkeno 900, where several years of active treatment would build up the reactive iron sulfide phase within the bioreactor. It is anticipated that in-mine pool treatment will be used as a contingency to reduce concentrations of metals in the pool, and to re-establish anoxic conditions within the mine workings that are not flooded. This will reduce the long-term leaching from the mine workings and reduce metals concentrations from the mine pool. Other mine pools treated by this technology have seen zinc reductions of over 90%. By substantially reducing loadings from the mine workings by pre-treatment in the mine pool, and by building up a reactive iron sulfide phase, active bioreactor operations may only be required for a few years.

57. *It is understood that modifications to the water treatment process at Bellekeno 625 were required due to high suspended solids loads during advanced exploration and development at the mine site in 2008/2009. Please provide the most current data and a review of the operational performance of the Bellekeno treatment plant during advanced exploration including performance both during dewatering and post dewatering.*

A review of the operational performance of the Bellekeno treatment plant during advanced exploration shows that during dewatering and during the use of some drilling materials, the existing system was not able to settle the suspended solids. The source of these suspended solids included several sources, including treatment solids generated by lime addition, clays from the drilling muds, and clays from the vein materials. Analysis of the treatment system shows insufficient settling capacity in the system, insufficient ammonia treatment capacity, but sufficient lime mixing and polymer addition capacity.

For data please refer to Table 2 to these responses on page 31. For all external results for all time periods at Bellekeno, and internal flow measurements, please refer to Attachment D (Keno Hill Water Quality Database) of the December 24, 2009, submission.

Key graphs are inserted as Figures 2 and 3 below: Zinc & Flow and TSS &Turbidity.

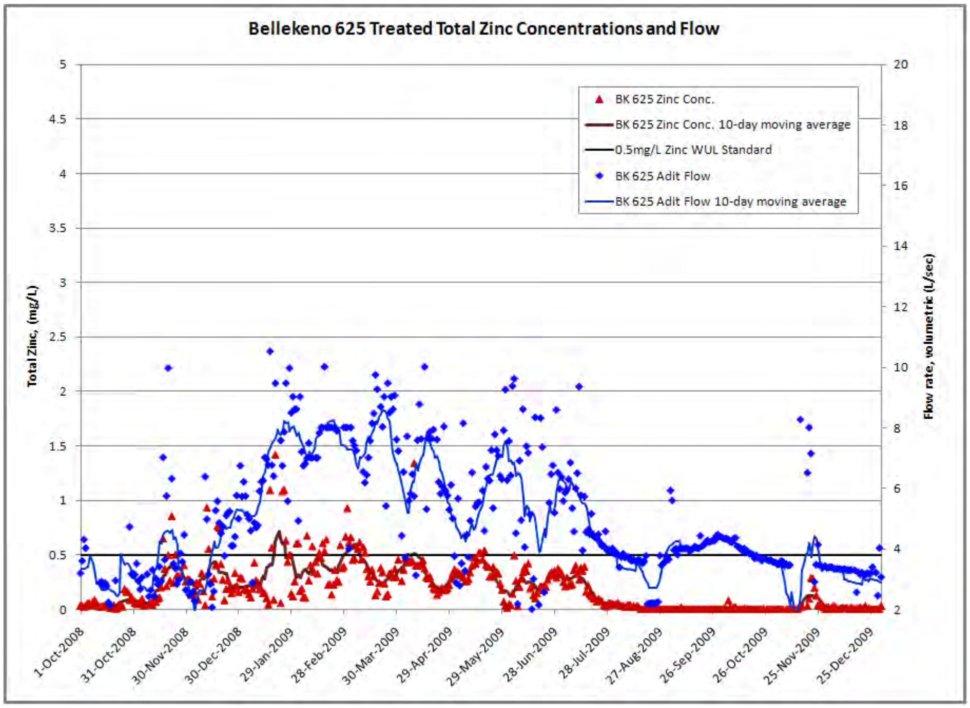


Figure 2 Internally measured zinc concentrations compared with flow at BK 625 treatment plant during dewatering and advanced exploration and development

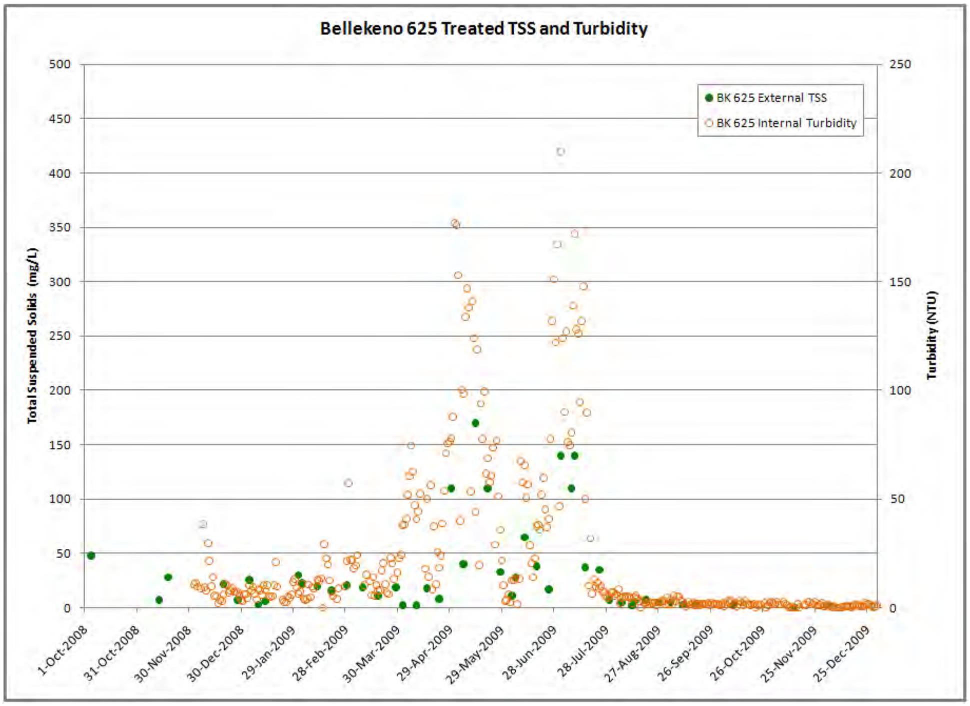


Figure 3 Internal (Alexco) turbidity measurements and external (commercial laboratory) TSS measurements during dewatering and advanced exploration and development

Table 2 Total Suspended Solids at the Bellekeno Water Treatment Facility

Oct 1 2008 - Dec 31 2009

	Bellekeno 625 Adit Discharge	Bellekeno 625 Treated Decant Discharge
	TSS	**TSS**
Sample Date	**mg/L**	**mg/L**
5-Oct-2008	2600	48
13-Nov-2008	4370	7
18-Nov-2008	-	28
20-Dec-2008	14	22
28-Dec-2008	4	7
4-Jan-2009	3	26
9-Jan-2009	2	3
13-Jan-2009	10	6
1-Feb-2009	209	30
3-Feb-2009	76	23
12-Feb-2009	22	20
20-Feb-2009	16	16
1-Mar-2009	39	21
10-Mar-2009	<5	19
19-Mar-2009	12	11
29-Mar-2009	141	19
2-Apr-2009	42	<5
10-Apr-2009	9	<5
16-Apr-2009	5	18
23-Apr-2009	45	8
30-Apr-2009	570	110
7-May-2009	41	40
7-May-2009	1	97
14-May-2009	290	170
21-May-2009	230	110
28-May-2009	32	33
4-Jun-2009	25	11
6-Jun-2009	6	28
11-Jun-2009	100	65
18-Jun-2009	83	38
25-Jun-2009	40	17
2-Jul-2009	23	140
8-Jul-2009	280	110
10-Jul-2009	240	140
16-Jul-2009	27	37
24-Jul-2009	10	35
30-Jul-2009	7	7
6-Aug-2009	9	5
12-Aug-2009	8	<4
13-Aug-2009	6	6
20-Aug-2009	7	7
27-Aug-2009	99	5
3-Sep-2009	11	5
10-Sep-2009	7	3
11-Sep-2009	5	3
18-Sep-2009	3	4
9-Oct-2009	4	3
13-Nov-2009	10	<1
2-Dec-2009	7	2

58. *Proposed mine water use at Bellekeno is shown to increase adit discharges by as much as 50% (years 1-2). Moreover, based on operations from advanced mine development, the overall suspended solids load in the increased adit discharge is expected to be higher than the pre-mine development steady state and active mining of ore could potentially alter previous steady state metal loads in the adit discharge. Please comment on the ability of the Bellekeno treatment plant to treat the expected adit discharge during operations.*

> As described previously in question 37, it is not expected that mine adit discharges will increase significantly over discharge volumes witnessed during the 2008-09 Bellekeno mine dewatering. Alexco is confident that the current water treatment system will be able to effectively handle and treat flows from the mine during operations.

59. *Mine water inflows into Bellekeno are known to have a seasonal increase during the freshet period. Please identify the expected peak inflow and resulting peak adit outflow (which includes mine development water returns) and comment on the treatment plant's capacity to treat this peak inflow amount during operations, or provide alternative strategy for managing seasonal peak water inflows. Please ensure your response accounts for any predicted changes to mine water inflows resulting from expansion of the underground workings during operations.*

> The maximum flow rate from Bellekeno 625 has been as high as 12 L/s during freshet. Alexco plans to include flexibility in the expanded treatment system to handle flows as high as 30 L/s (see Question 58). The expanded system assumes concentrations of zinc, TSS and other constituents will be similar to what has been observed during the recent closure period and during the advanced exploration and development period. As described in question 37, only minor changes to mine water inflows are expected resulting from expansion of the underground workings during operations.

60. *Please comment on the effectiveness of the Bellekeno 625 treatment plant in removing nitrogen residuals resulting from mine explosives during advanced exploration activities. Also please provide a prediction of the effectiveness of the treatment system for this issue during operations and closure treatment.*

The management of nitrogen residuals includes both source control, aeration in mine sumps, and off-gassing from the lime mixing and settling ponds. The average discharge through the advanced exploration period was approximately 0.7 mg/L ammonia nitrogen (the discharge standard limit in licence QZ07-078 is 5.00mg/L). The ammonia treatment system will be modified if necessary (under existing Type B water licences for which the process for authorizing minor modifications is in place) to effectively maintain compliance with the Water License criteria during operations and closure treatment.

61. *Page 5-7 of the Main Application Report –Appendix K (exhibit 1.3.11), indicates that following mining, the mine pool would be treated in-situ using sulphate reducing bacteria and the conventional water treatment would continue for two years. After that time a bioreactor treatment system will be utilized for five more years after which time water treatment would be discontinued.*

    Please provide evidence that this proposed closure water treatment program will result in mine water releases that will be compliant with proposed effluent water quality standards.

For a full discussion on the Galkeno 900 pilot test bioreactor, please see question 56 response.

Upon closure, the active water treatment system at BK625 would transition to include underground mine pool treatment while the mine is filling, and while the active water treatment process continues, a bioreactor would be commissioned to handle the flows realized during the 2 year post-mining period. This period would allow for proper sizing of the bioreactor system both with respect to flows and mine water chemistry.

A properly sized and operated bioreactor at Galkeno 900 has been able to maintain <0.02 mg/L dissolved zinc when operated in a through-flow mode. Other similar systems have operated for 10 years maintaining zinc compliance in the Upper Blackfoot Mining complex bioreactor and wetland system near Lincoln, Montana. The cessation of the active treatment system would only be performed after the bioreactor is operating in compliance, and the treatment system could be maintained on standby for some period as a backup for the bioreactor, if desired.

62. *Please confirm that the Bellekeno East sediment pond(s) constructed as part of QZ07-078 has/ have been fully decommissioned.*

We can confirm that these sediment ponds have been fully decommissioned.

63. *Please provide preliminary details regarding the proposed water treatment plant for the Flame and Moth Mill and the ground based discharge system for the treated effluent.*

For context, the mill process plant will have no systematic discharge (see also the response to question 25 a). The water treatment plant to be located at the Flame and Moth mill site will treat collected tailings pore water lost during compaction (3.4m^3/day at 408t/day ore throughput, see Appendix C for details) and mill site and DSTF meteoric runoff. The proposed treatment system will be similar to other existing treatment systems throughout the district and would include the following components:

- A lime and polymer mixing system to cause zinc and TSS removal, which are the primary constituents expected to be present (based on the zinc present in the tailings water, and TSS from runoff from disturbed areas);
- a 5 L/s clarifier to provide settling capacity to reduce suspended solids, sized for a 1/100-year storm event so that during such an event the pond may be emptied; and
- a land application system which will include an in ground diffuser capable of diffusing 0.5 L/s into ground downgradient of the settling pond during normal operations, and an engineered spillway to accommodate storm flows.

64. *Please clarify the expected sludge volume that will be produced during operations and closure water treatment at the Bellekeno mine and at the mill site.*

<u>Mine Sludge</u>

The sludge produced from the Bellekeno mine can be estimated at 65mg/L TSS observed during advanced development and exploration at 10L/s (very conservative assumed increased flow average from the expanded mine; Table 6-4 estimates closer to 4.3L/s, and recent flow has averaged approximately 3L/s). The lime usage rate is expected to be less than 74mg/L $Ca(OH)_2$ dry weight. The weight of zinc, iron, manganese and other metals removed during lime treatment is expected to be less than 50 mg/L throughout treatment. Together, this calculates to be 298 tonnes of dry weight sludge produced during 5 years of mine operations. The volume of sludge produced is dependent on density of sludge produced. A filter may produce 30% solids, which would calculate to approximately 993 m^3 sludge produced over 5 years. The simple lime addition settling with sludge recycle from the filter backwash might produce an initial sludge volume of closer to 3% sludge density, or closer to 10,000 m^3 sludge produced over 5 years.

Mill Sludge

The water at Flame and Moth mill is harder to estimate initial quality. The displaced tailings pore water will constitute the primary source of sludge, with negligible inputs from meteoric waters. For purposes of this response, we assume that displaced pore water to the pond is 4.3 m^3/day, and that the quality is the same as the tailings water (20.31mg/L zinc and other metals that may react with lime totaling up to 80mg/L), the lime addition rate is similar to Bellekeno 625 treatment (74mg/L $Ca(OH)_2$), and that the TSS is 50 mg/L. Together this totals 204 mg/L solids, or 1.6 tonnes solids produced over 5 years. At 3% solids (assuming no filtration) the volume of this would be 53.28 m^3 sludge produced over 5 years.

65. Submitted Dec. 24, 2009

66. Submitted Dec. 24, 2009

67. *Please clarify the status of the May 2009 (District) Sludge Management Plan submitted as Appendix N of the Main Application Report (exhibit 1.3.14). The Sludge Management Plan suggests that the Sime pit will be developed to provide significant extra storage for sludge. Please describe if this plan has been approved by other regulators.*

The Sludge Management Plan Version 3 (dated August 2009) has been revised and was submitted to the Yukon Water Board on August 12, 2009. The contents of the plan were discussed with Yukon Government Water Resources prior to the plan submission.

Deposit of Waste

68. *On page 6-30 of the Main Application Report, two options for camp wastewater treatment are discussed.*

a) *If you are requesting that the Board consider an expanded septic field, please provide a map of the area delineating the existing septic field and the proposed expanded septic field; provide the distance to the nearest water body, and the type and permeability of soils;*

Please refer to Figure 4 to these responses on page 37.

*2006 aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Flown 13,14 September 2006.

N

1:1,000
(when plotted on 11x17 inch sheet)

0 5 10 20 30 40 50 60 70 80 90 m

Existing
Proposed
Public Road
Exploration Road
Contour (m)
Surface water
(actual and potential)
Septic Flow
Existing Building
Proposed Building
CO CLEAN OUT

Exact locations of septic tanks and drainfield to be field located

ALEXCO RESOURCE CORP.

PROPOSED SEPTIC SYSTEM
INSTALLATION

SITE PLAN

Drawn by HD/MD	JANUARY 2010	Verified by EA

D:\Project\AllProjects\ALEX-05-01\Permits\Elsa_Camp_SewageDisposal\2008\Fig1_NewSeptic_Jan2010.mxd

b) *If you are requesting that the Board consider the inclusion of the rotating bio-reactor system, please provide the following information:*

A bioreactor system is no longer being considered.

69. *Submitted Dec. 24, 2009*

70. *Submitted Dec. 24, 2009*

Keno Water Well Impacts

71. *In response to concerns regarding impacts to the Keno City site water well, a conceptual hydrogeological model was presented in Main Application Report -Appendix M (exhibit 1.3.13) that suggests that well impacts due to water withdrawals from the Proposed mine site are unlikely to impact water quantity or quality at the Keno City well.*

In reviewing the conceptual model, it is noted that the model and the discussion of the likelihood of impacts associated with the mill site was based on the mill site being located at the former Mackeno site, which is both lower in elevation and further away from the Keno well than the currently proposed mill site. The Mackeno site was also very close to a surface water source which was proposed to be the major source of any groundwater utilized by the mill.

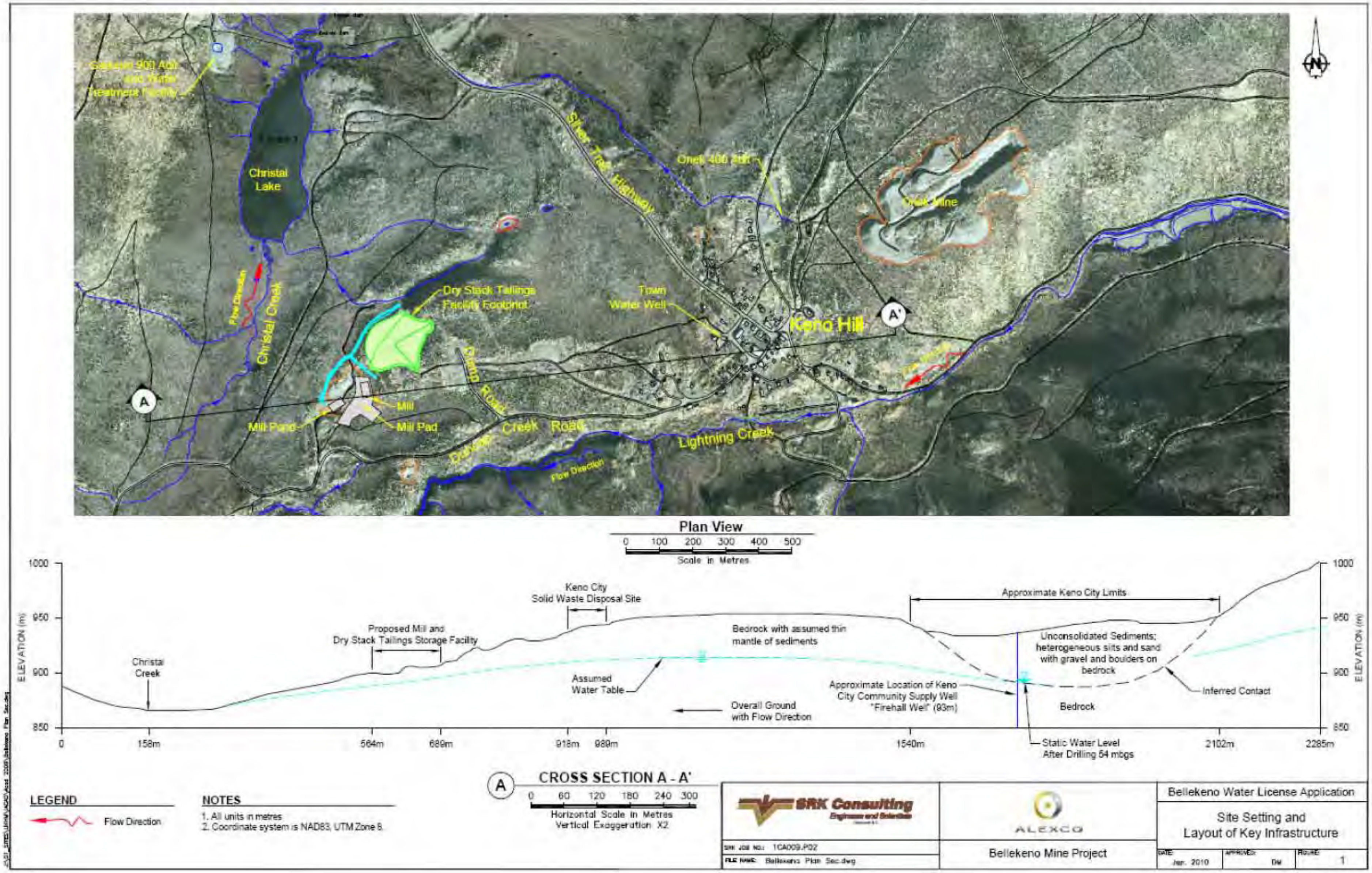
Please clarify that the conceptual impact assessment presented in Appendix M is still considered to be valid based on the proposed Flame and Moth mill site location.

There is a groundwater investigation program currently underway in accordance with Yukon Government Decision Document July 10, 2009. We can clarify that the conceptual impact assessment presented in Appendix M to the Main Application Report is still considered to be valid based on the proposed Flame and Moth mill site location, especially considering that there will not be any groundwater drawn for use at the mill.

72. *Please provide an updated figure that shows the relationship between the Flame and Moth mill site and the town well, i.e. an updated version of Figure 1 of the Main Application Report -Appendix M (exhibit 1.3.13).*

See updated Figure 1 of the Main Application Report Appendix M (exhibit 1.3.13) below:

Revised Figure 1 of Main Application Report Appendix M



73. Please clarify whether the static water level in the Keno well has been confirmed through field measurements.

This will be determined with the groundwater investigation program. At the time of this writing the static water level in the Keno well has not been confirmed through field measurements. Records indicate that the static water level was about 50 or so metres below ground surface at the time of drilling.

Mass Balance Model

74. Please refer to the Main Application Report -Appendix I (exhibit 1.3.9):

a) The mass balance model contains extensive references to former monitoring station identifiers, such as "LES-xx". Please update these references such that current monitoring station identifiers (i.e. "KV-XX") are utilized in the document in order to ensure that it is consistent with the rest of the application.

Appendix I to the Main Application Report refers several times to LES-XX stations in Table 3. A Revised Table 3 to Appendix I of the Main Application Report is below.

The reference to LES-10 (Haldane Creek at South McQuesten Road) in Appendix 1 to the Main Application Report corresponds to KV-57 in the KV numbering system.

LES-XX identifiers were used to reference LES-66 (Natural Spring on Duncan Creek Rd) in Figure 1 and Appendix 1 to the Main Application Report, which does not have a corresponding KV identifier as it is not currently included in the current Keno Hill monitoring program (sites such as this are currently being assessed under the Water Quality Assessment, Goals and Long-Term Monitoring program for inclusion in the sampling program).

Table 3 Details of Mine Site Catchments

Element	Outflow Station	Catchment Description	Catchment Area (km^2)	Catchment Median Elevation (m.a.s.l.)	MAR - Mean Annual Runoff (mm)	Jan - Mar	Apr - Jun	Jul - Sept	Oct - Dec	1000m3/yr
		Average monthly flows for minesite streams			% MAR	4.8	54.8	28.5	11.9	100
Element 1	KV-6	Christal Creek above Station KV-6	7.7	990	240	87.5	998.4	519.2	216.8	1821.9
Element 2	KV-7	Christal Creek between Stations KV-6 and KV-7	35.8	970	230	392.3	4478.9	2329.4	972.6	8173.2
Element 3	KV-55	Sandy Creek above KV-55 (above Keno Hwy)	2.3	1180	290	31.2	355.9	185.1	77.3	649.5
Element 4	KV-21	No Cash Creek above KV-21 (above Keno Hwy)	1.5	1200	300	18.7	213.1	110.8	46.3	388.8
Element 5	KV-2	South McQuesten River above KV-2 @ pumphouse	32.9	650	150	233.0	2660.3	1383.5	577.7	4854.5
KV-1	KV-1	South McQuesten River above KV-1 (upstream of confluence w/ Christal Cr)	476	940	230	5255.0	59995.0	31201.8	13028.1	109480.0
Element 6	KV-12 & KV-58	Catchment of Dam No. 3 of Valley Tailings Impoundment	4.3	760	180	37.2	424.2	220.6	92.1	774.0
Element 7	KV-47	Porcupine Creek Diversion Channel above KV-47	10.1	1110	270	130.9	1494.4	777.2	324.5	2727.0
Element 8	KV-59	Galena Creek above the mouth	10.9	970	240	122.8	1402.5	729.4	304.6	2559.3
Element 9	KV-9	Flat Creek above KV-9 before confluence w/ South McQuesten River	31.2	700	170	254.6	2906.6	1511.6	631.2	5304.0
Element 10	KV-4	South McQuesten River above KV-4 (downstream of confluence w/ Flat Cr)	29.9	670	160	229.6	2621.6	1363.4	569.3	4784.0
Element 11	KV-5	South McQuesten River above KV-5 (9km downstream of confluence w/ Flat Cr)	95	850	200	912.0	10412.0	5415.0	2261.0	19000.0
KV-57	KV-57	Haldane Creek above South McQuesten Road	88.8	830	200	852.5	9732.5	5061.6	2113.4	17760.0

b) *Please confirm that the mass balance model correctly locates the discharge path of the Galkeno 300 treated adit discharge.*

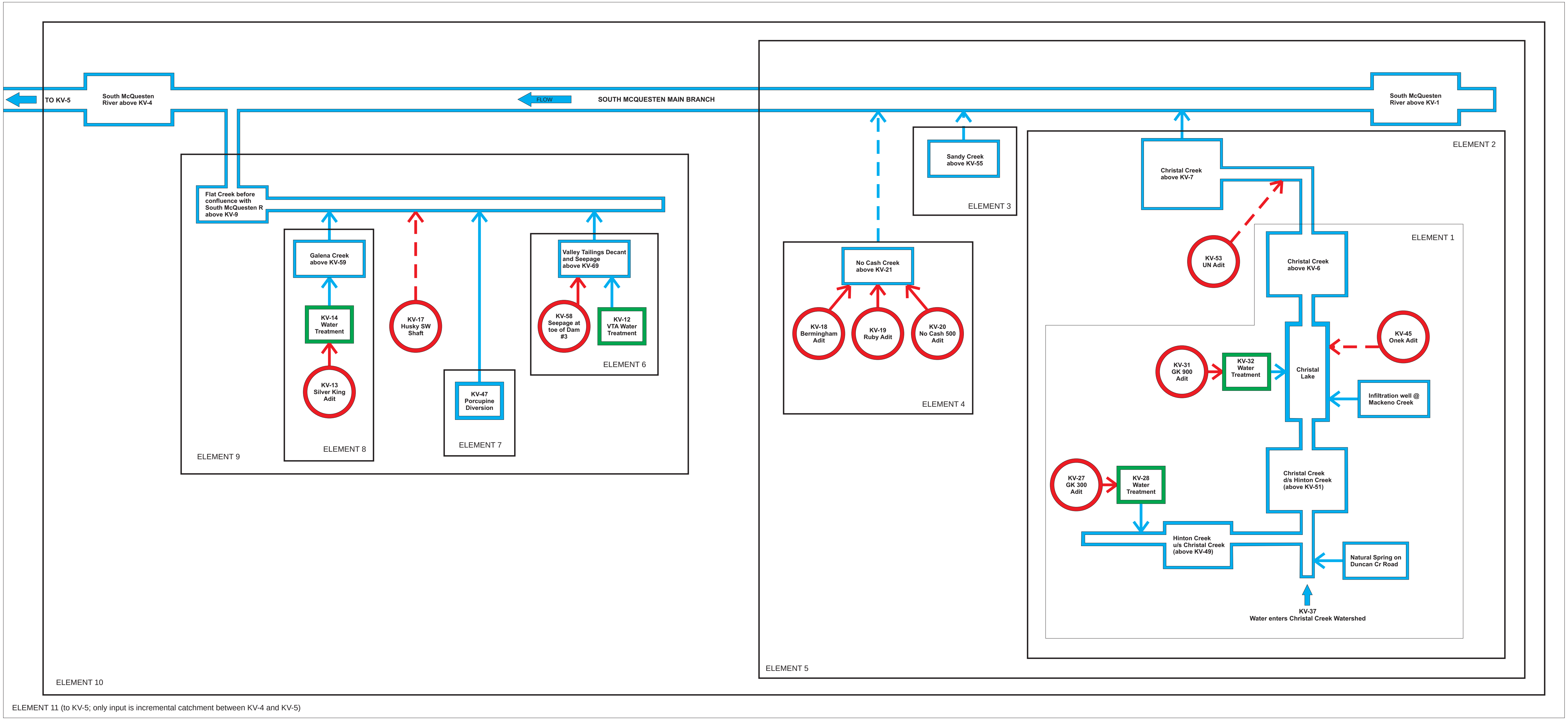
We can confirm the correct location of Galkeno 300 discharge in the mass balance model.

c) *Please provide schematic figures of the mass balance model elements.*

Please refer to Figure 5 below.

Figure 5
CHRISTALCREEK
MASS LOADING NODE INPUTS
SCHEMATIC

Dashed lines indicate discharge to ground
Solid lines indicate discharge to waterways



d) *For presented results from the mass balance, please indicate the number of flow measurements utilized in calculations of loads (when applicable).*

Please refer to Table 4 to these responses on page 46.

Table 4 Number of Discharge Measurements used in Mass Loading Model

	2008	2007	2006
South McQuesten Watershed			
KV-1	*	*	3
KV-2	*	*	*
KV-4	*	*	1
KV-5	*	*	3
KV-6	4	1	3
KV-7	4	1	6
KV-9	4	2	2
KV-12	2	5	1
KV-13	4	11	4
KV-14	8	11	7
KV-17	*	2	2
KV-18	1	2	1
KV-19	*	2	*
KV-20	*	2	*
KV-21	1	1	*
KV-27	4	10	11
KV-28	6	9	7
KV-31	3	12	4
KV-32	8	12	5
KV-45	*	2	2
KV-47	1	1	*
KV-53	*	1	*
KV-55	*	*	*
KV-58	*	*	*
KV-59	*	*	*
Lightning Creek Watershed			
KV-33	*	2	*
KV-37	2	*	*
KV-38	2	*	*
KV-39	*	*	*
KV-40	*	*	*
KV-41	5	*	2
KV-42	3	11	5
KV-43	7	6	2
KV-65			

*Sources for flows not derived from field measurements can be found in Appendix 1 to the Mass Loading Model, which appears as Appendix I to the Main Application report

Waste Rock

75. *Please identify the volume or tonnage of potentially AML waste rock from the 2008-2009 mine development work that is currently stored underground and above ground at the Bellekeno East portal.*

As described in Table 6-11 of the Application, 554.1 tonnes of potentially AML waste rock is stored underground, and 1,682.7 tonnes is above ground at the Bellekeno East Portal.

76. *Pages 2-6 and 6-31of the Main Application Report indicate that an additional 500,000 tonnes of waste rock will be removed from the mine. Please qualify the total quantity of waste rock that will be removed from the Bellekeno mine, including quantities removed in 2008 and 2009 under the advanced exploration and mine development activities (QZ07-078) and all proposed future waste rock removals associated with development, operation, and closure of the Bellekeno mine.*

- In the application for QZ07-078, 278,500 tonnes of waste rock was authorized to be removed as part of the Advanced underground exploration and development program.
- During the 2008 and 2009 seasons, a total of 48,117.5 tonnes of waste rock excavated as part of the advanced underground exploration and development program
- In this application report covering Bellekeno mine development and operations, we anticipate generation of an additional 500,000 tonnes of waste rock.
- Cumulatively, this totals 778,500 tonnes of waste rock including advanced exploration through to mine closure.

77. *Page 2-8 of the Main Application Report indicates that the conceptual design report for the Waste Rock Disposal Area is presented in Appendix C. It also indicates that a conceptual tailings and waste rock management plan report is presented in Appendix D. Appendix C contains a generic design for a lined containment facility and Appendix D presents a small number of borehole logs from geotechnical drilling. Please clarify where the conceptual design report is located. If this report has not been provided as part of the application, please do so.*

    The conceptual design report by EBA Engineering Consultants Ltd. entitled "Conceptual Tailings and Waste Rock Management Plans Bellekeno Project near Keno City, Yukon" which includes the geotechnical assessment and design considerations for the Non-AML Waste Rock Disposal Area is provided as Attachment F. The decision not to submit the report in its entirety in the original submission was due to the potential for confusion over the inclusion of an obsolete tailings management, DSTF and mill site design. For greater clarity, it is emphasized that sections 1 and 2 of this report, pertaining to the obsolete DSTF conceptual design, are not intended to be considered in this application.

    It should also be noted that Alexco is currently authorized under MLU LQ00240 and QML0009 to use waste rock for road construction and general site construction purposes and will be utilizing non-AML waste rock in this capacity over the first year of mine life. Thus, it is anticipated that construction of the Non-AML WRDA will not commence until at least mid 2011. Final preliminary designs for the Non-AML WRDA will be submitted to the Yukon Water Board prior to construction.

78. *On page 6-30 of the Main Application Report, reference is made to the temporary potentially AML waste rock storage facilities at Bellekeno 625. Based on my understanding of the project, the temporary potentially AML waste rock storage facilities are to be constructed near the Bellekeno East decline on top of the final bench of the WRDA.*

    Please confirm the location(s) of the temporary potentially AML waste rock storage facility. If the storage area is indeed on top of the final bench of the WRDA, how will potential AML waste rock be stored in advance of construction of these facilities? When will the facilities be constructed in the mine life cycle?

The temporary potentially-AML WRSF has been constructed with approval from Yukon Government, Energy, Mines & Resources (EM&R) just to the south of the Bellekeno East Portal. The technical memo regarding the geotechnical stability and design of this facility can be found as Appendix J of the Construction Site Plan, which was given as a companion to the Application.

It is anticipated that the temporary Potentially-AML WRSF, and underground storage and backfill, will meet the needs of mine development and operations for at least the first two to three years of mine life. Thus, if permanent potentially-AML WRSF(s) are eventually required, they can be constructed in another potentially suitable location as approved by the Quartz Mining Licence.

79. *It is understood that the Onek waste rock storage area for potentially AML waste rock was constructed in 2009 but not loaded as part of the mine development authorized by QZ07-078. Furthermore, the Onek facility has since been decommissioned. Please confirm that the former Onek facility is no longer part of the waste rock storage plans for the Bellekeno mine.*

We confirm that the earthworks for the Onek potentially-AML was completed in 2009, but the liner was not placed, and no P-AML waste rock was deposited in the facility. Alexco does not currently have plans to utilize the Onek WRDA as part of Bellekeno Mine development and operations. However, the company has not fully decommissioned or re-graded the site in the event that we may require its use in the future. Consideration is also being given to the final district-wide closure plan which will dictate measures to be taken for the historic Onek waste rock dumps.

80. *Page 6-67 of the Main Application Report indicated that the chip samples were still being analyzed. Please advise when the results of the mine wall testing will be available.*

All samples and results for the mine wall testing for the 2009 have been completed. We anticipate presenting results to the Board in the 2009 annual report (due February 2010).

Mill Site and Dry Stack Tailings Facility

81. *Please provide a Preliminary Design Report to replace the Conceptual Design Report presented in the Main Application Report -Appendix G (exhibit 1.3.7).*

    Please refer to Attachment C to these responses.

82. *Submitted Dec. 24, 2009*

83. *Submitted Dec. 24, 2009*

84. *Please confirm the reference for the preliminary design of the dry stack tailings facility shown on page 6-25 of the Main Application Report is correct.*

    The reference on page 6-25 of the Main Application Report is incorrect and should read, "*Additional details on preliminary design of the DSTF and water collection systems can be found in Appendix G, Volume 3*."

Bellekeno Mine Backfilling

85. *Pages 6-68 and 6-72 of the Main Application Report indicate that the portion of tailings to be placed underground will "most likely" be placed as a paste backfill. Please confirm if underground tailings will or will not be stored as a paste product underground.*

    Underground tailings will not be stored as a pumped paste product. Tailings will be stored underground, placed manually with equipment as a mixture with cement with or without rock. See also the response to question 89.

86. *Please confirm that all pyrite concentrate produced will be stored in Bellekeno stopes and underground cavities located below the expected mine pool level following mining.*

    It is confirmed that all pyrite concentrate will be stored in Bellekeno stopes and underground cavities located below the expected mine pool level following mining.

87. *Please indicate when the predicted static level for the mine will be determined and describe the plan for pyrite tailings placement prior to that determination.*

    Pyritic tailings will be placed below the 625 level, and primarily below the 800 level prior to achieving the static water level, which will be at least the 625 level (i.e. the tailings will be placed below water level at all times).

88. *Please identify if any of the historical workings of the Bellekeno mine will be backfilled as part of the proposed mining operation.*

    The 800 level will be backfilled.

89. *Please clarify the proportion of new mine workings and stopes that will be filled with tailings and/or waste rock materials.*

    Approximately 90% of the stopes will be filled with a mixture of pyrite tails, P-AML, waste rock and tails with an average of 2-3% cement.

90. *Please indicate the volume of stopes and development workings that will be excavated above the 625 level (i.e. above the historical flooding level of the Bellekeno mine).*

    The volume of stopes and development workings that will be excavated above the 625 level is approximately 20,000 m^3 (as noted in the development plan).

Decision Document

91. *The project scope on the YESAA decision document states the project timeline to be 10 years. The application provided to the Water Board, however, has proposed a 15 year timeline. Please be advised that the Water Board cannot issue a licence that conflicts or is contrary to the YESAA decision document.*

    We understand that the license term will be 10 years.

92. *Clause 11 of the decision document describes the requirement for baseline data to be collected from a site at Christal Creek. In looking at the YESAA Evaluation Report, it appears as though a new monitoring station along Christal Creek is required. Please advise if this new monitoring station has been identified, and if baseline characterization of this new monitoring station has begun.*

    A new monitoring station in Christal Creek was established in 2008 (KV-52: Christal Creek upstream Hinton Creek confluence) and is monitored on a quarterly basis.

93. *Submitted Dec. 24, 2009*

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT A

(Q-6)

January 19, 2010

minnow
environmental inc.
2 Lamb Street
Georgetown, Ontario
L7G 3M9

January 6, 2010

Mr. Dan Cornett
Access Consulting Group
#3 Calcite Business Centre
151 Industrial Road
Whitehorse, Yukon
Y1A 2V3

Reference: Reliance on Technical Reports, United Keno Hill Project, Yukon Elsa Reclamation and Development Company Ltd.

Dear Mr. Cornett;

Minnow Environmental Inc. acknowledges that the reports entitled “Water Quality Assessment Report for United Keno Hill Mines, July 2008” and “Aquatic Resource Assessment Report for United Keno Hill Mines, March 2009”, may be relied upon[1] by the Yukon Water Board, and the federal and territorial regulatory agencies responsible for review of such reports.

Yours truly,

Minnow Environmental Inc.

Cynthia Russel

Cynthia Russel, B.Sc.
President.

---

[1] While all Minnow reports are prepared following QA/QC protocols to prevent errors, we can not confirm that there are no errors or misrepresentations in data and information used from other sources in these reports. We commit that the reports referred to herein were prepared to the best of our ability and represent our understanding of conditions at the time the reports were prepared.

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE
APPLICATION QZ09-092 –
Response to Review for Adequacy and Supplemental Information

ATTACHMENT B
(Q-9)

January 19, 2010

CREATING AND DELIVERING BETTER SOLUTIONS
www.eba.ca

January 5, 2010 EBA File: W14101178.003

Mr. Robert L. McIntyre, R.E.T.
Vice President, Corporate Affairs and Communications
Suite 1150, 200 Granville St.,
Vancouver, BC V6C 1S4

Attention: Mr. Robert McIntyre

Subject: Reliance on Technical Reports
Mill and Mine Development, Bellekeno Mine, Yukon

Dear Mr. McIntyre

EBA Engineering Consultants Ltd. (EBA) acknowledges that the Issued for Use reports dated between August 2008 and the present prepared for Alexco Resource Corp with regard to the Mill and Mine Development, Bellekeno Mine Project and in support of their "Water Use License" application submitted to the Yukon Water Board may be relied upon by the Yukon Water Board, and the federal and territorial regulatory agencies responsible for review of such reports.

If there is a need for clarification, the contact within EBA for the work is Mr. Christopher Dixon.

Sincerely,
EBA Engineering Consultants Ltd.

C. J. Dixon

Richard Trimble

Christopher J. Dixon, P.Eng.
Geotechnical Engineer, Yukon Region
Direct Line: 867.668.2071 x241
cdixon@eba.ca

J. Richard Trimble, M.Sc. (Eng.), P.Eng.
Principal Consultant, Office Manager
Direct Line: 867.668.2071 x222
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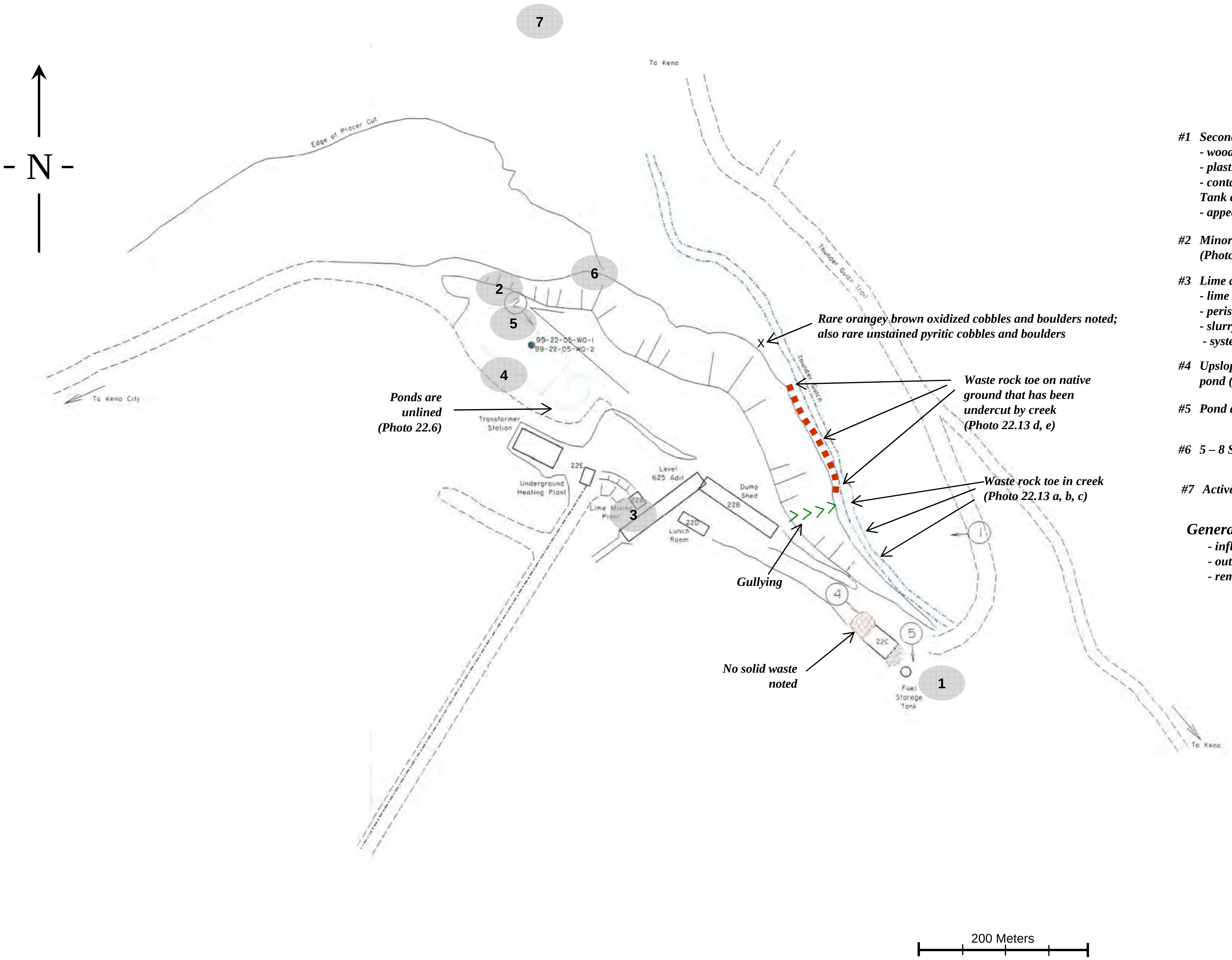
Ltr Alexco Resources .doc

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA



#1 Secondary Containment
- *wood lumber crib lined with black plastic*
- *plastic is compromised on west side, i.e. a spill would not be contained*
- *containment has ponded water and algae inside to depth of 5 cm*

Tank contains ~8” of product
- *appears to be drawn down to level of outlet pipe and valve*

#2 Minor tension cracks along edge of pond and along crest of waste rock slope (Photos 22.7 and 22.8)

#3 Lime addition system in Bellekeno 625 adit shack
- *lime slurry storage tank with single mixer*
- *peristaltic pump*
- *slurry drips into adit outflow in half-round 16” corrugated pipe*
- *system is connected to grid power (Photos 22.1, 22.2, 22.3, 22.4)*

#4 Upslope runoff drains into poorly graded ditch along south side of pond and may seep into pond (Photo 22.5a)

#5 Pond discharge via 16” corrugated pipe over edge of waste rock pile (Photos 22.9 and 22.9a)

#6 5 – 8 Seeps, no staining but some unhealthy vegetation (Photo 22.12)

#7 Active placer operation on Lightning Creek above and below confluence with Thunder Gulch

General Notes - September 20, 2005
- *inflow to ponds ~5L/s (Photo 22.11)*
- *outflow via discharge pipe ~ 0.4 L/s (Photo 22.9a)*
- *remainder lost to seepage*

Base map from “Keno Valley/Dublin Gulch Environmental Baseline Assessment”' Public Works and Government Services Canada, March 2000. See PWGSC (2000) for additional baseline information.

Revised: SRK Consulting 2006

SRK Consulting
Engineers and Scientists
VANCOUVER

ALEXCO

Bellekeno Site #22
Bellekeno 600 area

Job No: 1CA009.000
Filename: Site 1_Silver King_20070131.ppt

Baseline Environmental Report,
United Keno Hill Mines Property

Date: Jan. 2007
Approved:
Figure: 22.1

Photo 22.1 Bellekeno main adit shack

Photo 22.2_Bellekeno lime tank and pumps

Photo 22.3_Bellekeno lime addition point

Photo 22.4_Bellekeno lime addition detail

Photo 22.5a_Bellekeno ponds

Photo 22.5b_Bellekeno ponds

Photo 22.6_Bellekeno ponds

Photo 22.7_Bellekeno tension cracks on upstream crest

Photo 22.8_Bellekeno tension cracks on downstream crest

Photo 22.9a_Bellekeno discharge

Photo 22.9b_Bellekeno discharge

Photos 22.10a_Belleken ponds

Photos 22.10b_Bellekeno ponds

Photos 22.11_Bellekeno outflow from adit

Photos 22.12_Bellekeno area at toe of dump where seeps emerge

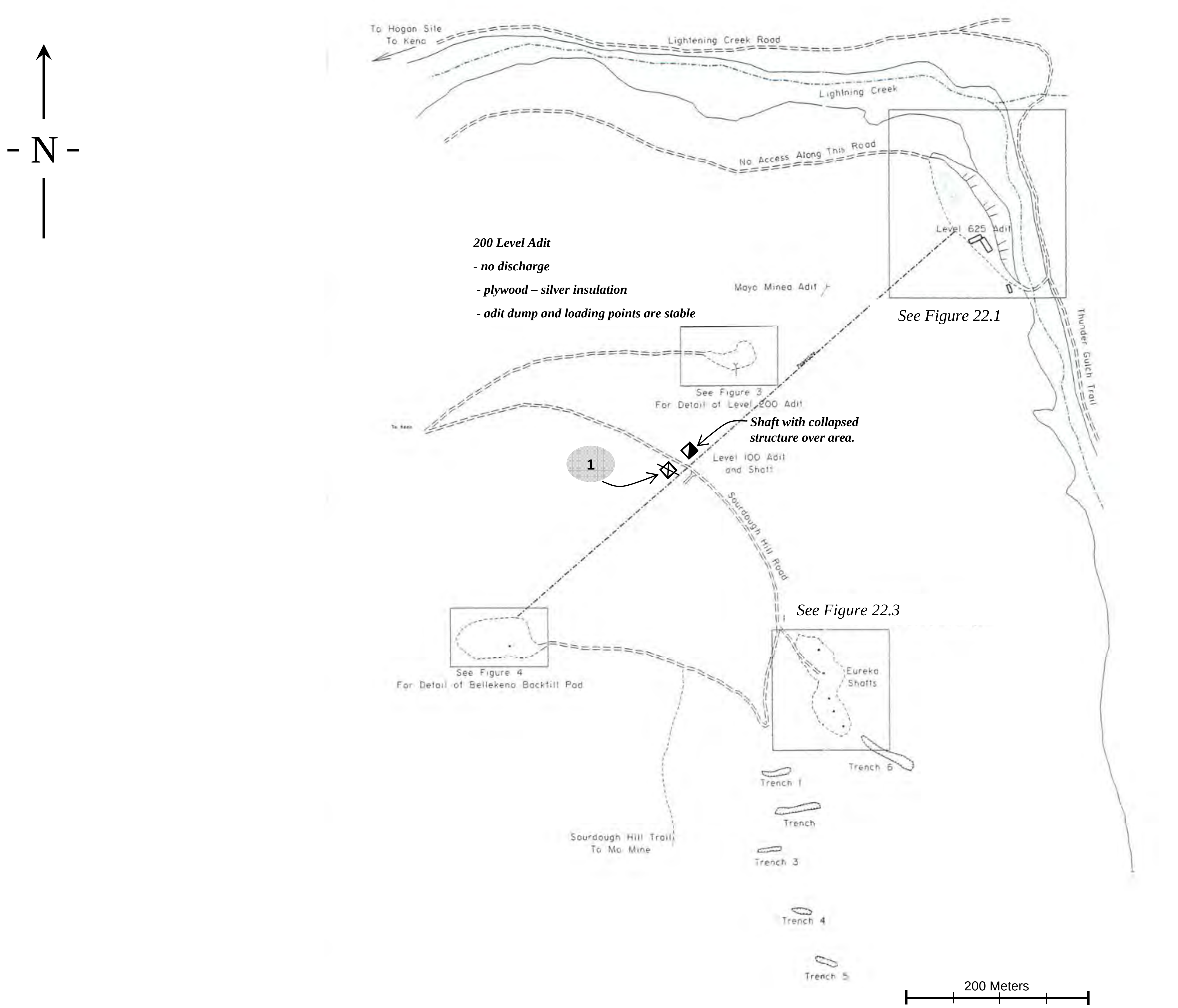
Photos 22.13a_Bellekeno dump toe in creek

Photos 22.13b_Bellekeno dump toe in creek

Photos 22.13c_Bellekeno dump toe in creek

Photos 22.13d_Bellekeno dump toe in creek

Photos 22.13e_Bellekenoe dump toe in creek



#1 Raise backfilled in 2006

200 Level Adit

- *no discharge*
- *plywood – silver insulation*
- *adit dump and loading points are stable*

See Figure 22.1

Shaft with collapsed structure over area.

See Figure 22.3

Base map from "Keno Valley/Dublin Gulch Environmental Baseline Assessment"' Public Works and Government Services Canada, March 2000.
See PWGSC (2000) for additional baseline information.

Revised: SRK Consulting 2006

SRK Consulting
Engineers and Scientists
VANCOUVER

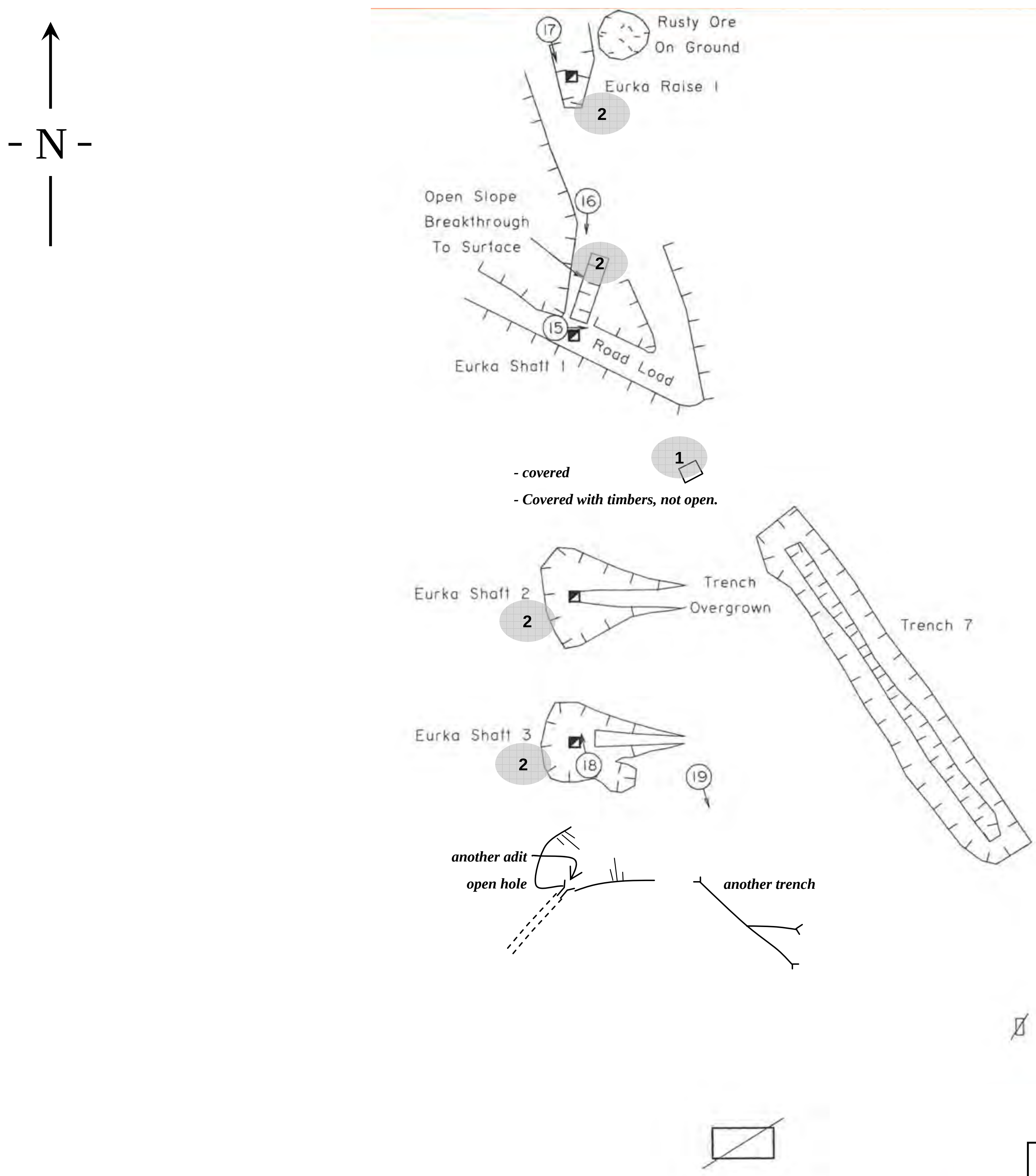
ALEXCO

Bellekeno Site #22
Site overview

Job No: 1CA009.000	**Baseline Environmental Report,**	Date: Jan. 2007	Approved:
Filename: Site 1_Silver King_20070131.ppt	**United Keno Hill Mines Property**		Figure: **22.2**

Photo 22.14_200 Level Adit

Photo 22.15_Shaft at 100 Level with collapsed structure



#1 *- Unmapped vertical raise identified in 2005.*
- 6 – 8 ft of the raise is exposed. Lower down is closed as the sides may have collapsed.
- May have been backfilled in 2006.

#2 - Eureka Raise 1, Eureka Shaft 1 and adjacent collapsed stope, Eureka Shaft 2, Eureka Shaft 3 all backfilled in 2006

200 Meters

Base map from "Keno Valley/Dublin Gulch Environmental Baseline Assessment"' Public Works and Government Services Canada, March 2000.
See PWGSC (2000) for additional baseline information.

Revised: SRK Consulting 2006

SRK Consulting
Engineers and Scientists
VANCOUVER

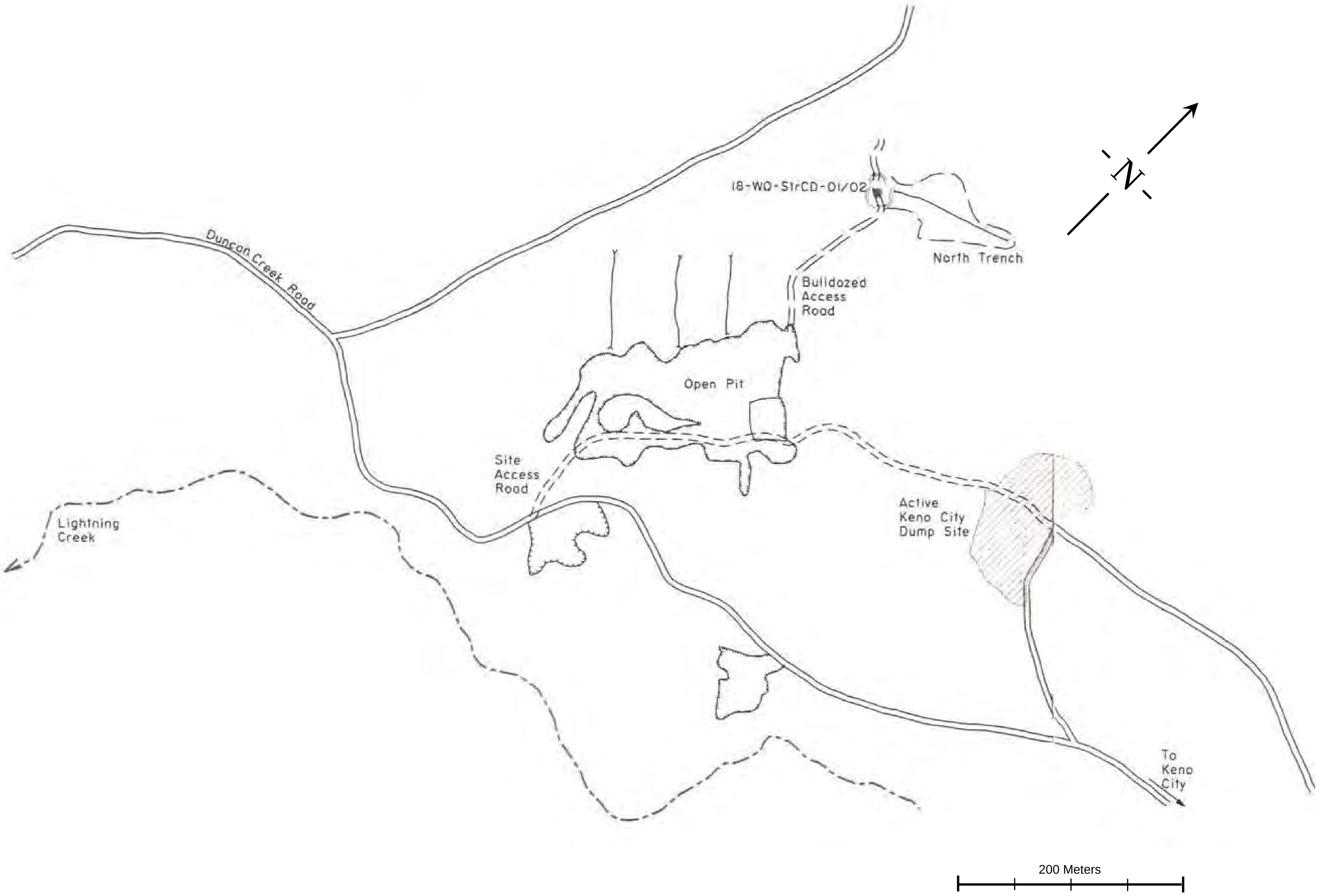
ALEXCO

Bellekeno Site #22
Eureka area

Job No: 1CA009.000
Filename: Site 1_Silver King_20070131.ppt

Baseline Environmental Report,
United Keno Hill Mines Property

Date: Jan. 2007
Approved:
Figure: **22.3**



Base map from "Keno Valley/Dublin Gulch Environmental Baseline Assessment"' Public Works and Government Services Canada, March 2000.
See PWGSC (2000) for additional baseline information.

Revised: SRK Consulting and Access Consulting Group, 2007

SRK Consulting
Engineers and Scientists
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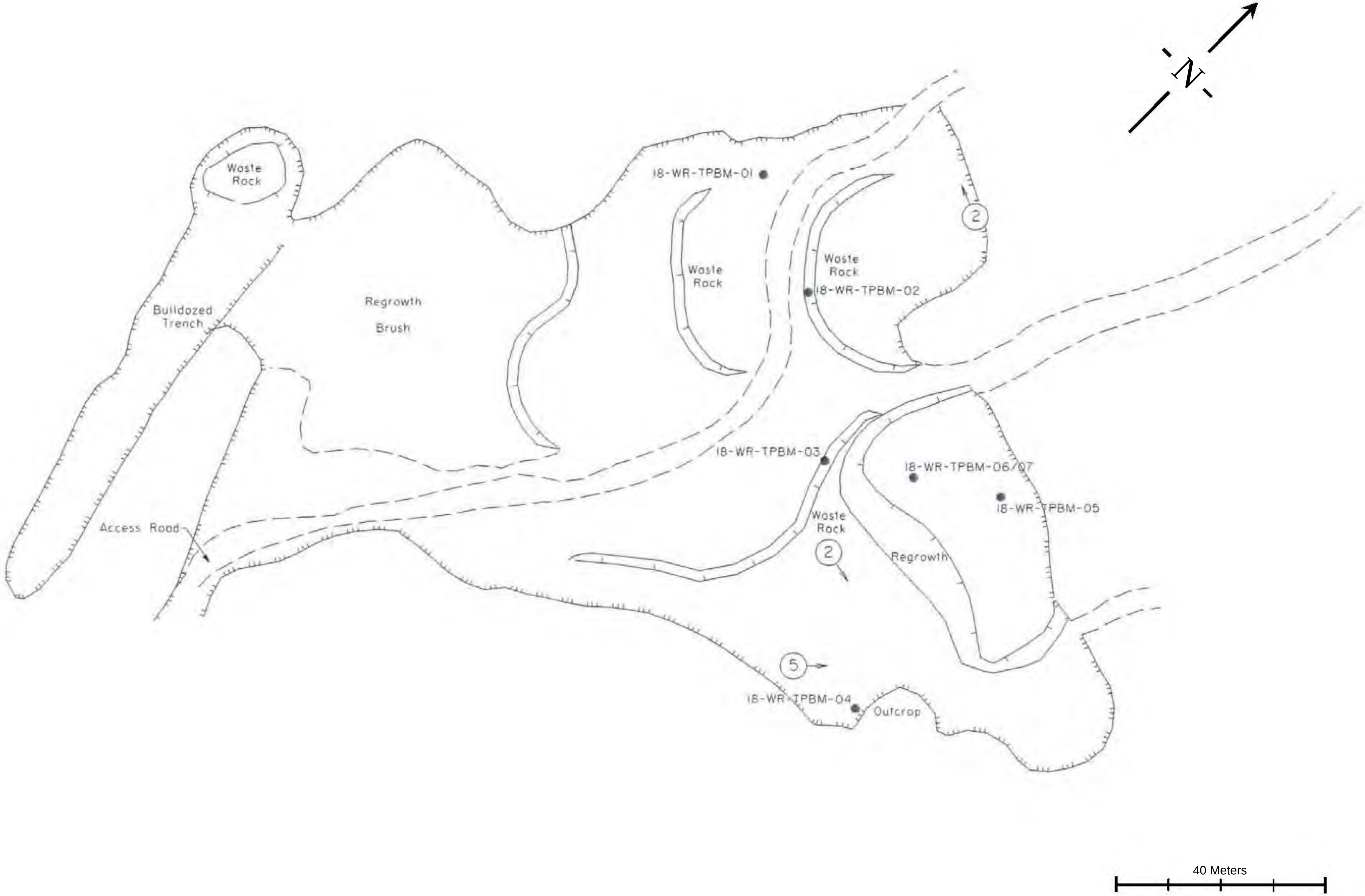
ALEXCO

Flame & Moth Site #18

Job No: ALEX-06-ESP-05
Filename: Site18_FlameMoth_20070131.ppt

Baseline Environmental Report,
United Keno Hill Mines Property

Date: Jan. 2007
Approved:
Figure: **18.1**



Base map from "Keno Valley/Dublin Gulch Environmental Baseline Assessment"' Public Works and Government Services Canada, March 2000.
See PWGSC (2000) for additional baseline information.

Revised: SRK Consulting and Access Consulting Group, 2007

SRK Consulting
Engineers and Scientists
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Job No: ALEX-06-ESP-05
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Baseline Environmental Report,
United Keno Hill Mines Property

Date: Jan. 2007
Approved:
Figure: **18.2**

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE
APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT C
(Q-12, Q-81, Q-41)

January 19, 2010

Alexco Resource Corp.

ISSUED FOR USE

PRELIMINARY ENGINEERING DESIGN AND MANAGEMENT PLAN
DRY-STACKED TAILINGS FACILITY
BELLEKENO MINE MILL SITE, YUKON

W14101178.003

January 2010

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1.0 INTRODUCTION

Alexco Resource Corp. (Alexco) is constructing a silver, lead, zinc concentrating mill in the Keno Hill Silver District, Yukon. Alexco retained EBA Engineering Consultants Ltd (EBA) to provide preliminary engineering level design for tailings management at the Bellekeno Mine Mill Site.

This work was authorized by Purchase Order #3339, and the scope of service is outlined in a letter dated August 17, 2009.

2.0 BACKGROUND

Alexco began prepatory earthworks and foundation work for their concentrating mill at the Bellekeno Mine Mill site in the summer of 2009. The Bellekeno Mine Mill Site is located at an area formerly known as the Flame and Moth site and the location is shown in Figure 1. Alexco plans to store filtered tailings by constructing a dry-stacked tailings facility (DSTF) immediately north of the mill location.

EBA conducted both a preliminary geotechnical investigation, consisting of excavating thirty-one testpits, and a detailed geotechnical investigation, consisting of drilling eleven boreholes with a mini-sonic drill rig.

3.0 BELLEKENO DRY-STACKED TAILINGS FACILITY DESIGN ASSUMPTIONS

EBA used the following assumptions provided by Alexco in the design of the DSTF at the Bellekeno Mill Site:

- Tailings discharge rate of 7.75 dmt/h (dry-metric tonnes per hour) for Years 1 and 2 and 13.95 dmt/h for Years 3 and 4.
- Tailings specific gravity of 3.95.
- 60% of tailings will be stored on surface.
- The remaining 40% of tailings will be stored underground.
- Water collection pond is sized for 2,500 m^3.
- An evapo-transpirative cover consisting of 0.5 m of vegetated soil will be used for closure of the DSTF.

EBA made the following assumptions:

- Bleedwater from the tailings pile will be 10% of the porewater in the DSTF.
- The design seismic event was selected to be 1:500 year return period (0.138 g for the selected site), as recommended in "Mined Rock and Overburden Piles Investigation and Design Manual" (Piteau 1991).

4.0 GEOTECHNICAL INVESTIGATIONS

The preliminary geotechnical investigation was summarized in a letter "Geotechnical Evaluation – Proposed Mill (Option 3) and DSTF" dated August 7, 2009. Testpit logs are included for reference in Appendix A.

The detailed geotechnical investigation was conducted between August 28 and September 2, 2009. Mr. Christopher Dixon, P.Eng., and Mr. James Buyck conducted the investigation. Eleven boreholes were drilled using a mini-sonic drill rig provided by Boart Longyear. Approximate UTM (NAD83) coordinates, noted on the testhole logs, were determined using a hand-held GPS unit. Elevations shown on the logs were determined using the approximate coordinates and 1 m contour information generated from air photos and local topographic survey contours provided by Alexco.

4.1 SURFACE CONDITIONS

The site in the vicinity of the DSTF slopes generally west at approximately 15% to 20%. There is disturbance in the area from previous surface earthwork and historic mining. A trail runs roughly north with a ditch that follows it to convey runoff around the former Flame and Moth Mine. Vegetation in the area consists of mosses and small spruce trees. A ridge crosses the site in a north-south direction. The ridge slopes approximately 5% to 10% towards the south.

4.2 SUBSURFACE CONDITIONS

Nine boreholes were drilled near the DSTF. Information gathered in these boreholes indicates two general soil profiles in the area:

- glaciofluvial GRAVEL underlain by bedrock and
- SILT and SAND till underlain by gravel and bedrock.

The testhole locations and general subsurface conditions are shown in Figure 2.

The gravel was encountered along the ridge that crosses the site. The gravel in the area of the DSTF was found in both frozen and unfrozen states. It is typically sandy with trace silt, compact, medium grained, well graded, and brown, and it is underlain by a thin layer of silt and sand till and then bedrock. Bedrock encountered in testholes is a competent quartzite. Subsurface conditions for the gravel area are summarized in Table 1.

TABLE 1: GENERAL SUBSURFACE CONDITIONS FOR GRAVEL AREA

Soil Unit	Min Thickness (m)	Max Thickness (m)	Average Thickness (m)
GRAVEL	1.3	3.7	2.5
SILT and SAND Till	0.2	1.3	1.0
BEDROCK (quartzite)	@2.1 mbgs*	@5.0 mbgs*	@3.4 mbgs*

*metres below ground surface.

All silt and sand till encountered in the area of the DSTF was frozen. The silt and sand till typically contains trace gravel and trace clay, is low to non-plastic, olive grey, is underlain by gravel seams within the till and then by quartzite bedrock. Two boreholes on the west side of the ridge, BH15 and BH17, were drilled through the silt and sand layer. The gravel seams were encountered below 16 m depth in BH15, and bedrock was encountered at 14.2 m depth in BH17. One borehole, BH23, was drilled through the till deposit on the east side of the ridge and gravel seams were encountered at 7.6 m depth.

Two boreholes, BH24 and BH25, were drilled near a proposed water collection pond. The general soil conditions in this area are gravel fill over glaciofluvial gravel over silt and sand till over glaciofluvial gravel. The glaciofluvial gravel and silt and sand till are similar to the soils described above and are all unfrozen.

4.3 GROUNDWATER

No groundwater was encountered within the proposed footprint of the DSTF. However; shallow groundwater was encountered in BH17 at 1.2 m depth, and a standpipe piezometer was installed at that location. A standpipe piezometer was also installed near the proposed water collection pond in BH24. For piezometer installation details, please see the borehole logs in Appendix A.

4.4 PERMAFROST

Permafrost was encountered throughout the proposed DSTF. The permafrost encountered ranged from non-visible, non-excess ice to massive ice lenses. Ice volumes estimated as a percentage of the total soil volume vary between less than 5% and nearly 100%. The type and amount of ice inclusions within the permafrost generally follows the soil stratigraphy.

The permafrost beneath the ridge area can generally be described as containing ice-coated particles, and the amount of ice is estimated at less than 10% of the total soil volume.

The permafrost to the west of the ridge area contains a combination of horizontally stratified ice lenses, massive ice, and non-visible excess ice. The ice lenses are typically about 5 mm thick. The massive ice was encountered in BH15, BH16, BH17, and BH18. It is segmented by layers of ice and silt, and each segment ranges in thickness from 0.6 m to 5 m. The assumed bottom of the massive ice strata was determined in BH15, BH16, and BH17, and the average thickness of massive ice in these three boreholes is 3.8 m.

The permafrost to the east of the ridge area contains a combination of horizontally stratified ice lenses, randomly oriented ice inclusions, and non-visible excess ice. One borehole, BH23, was drilled into the permafrost in this area. The top 3.5 m of the permafrost here is considered to be ice-rich, containing 10% to 35% randomly orientated ice crystals and non-visible excess ice by volume. Below this, the permafrost is considered to be ice-poor (moisture contents in the soil are below the 100% saturation moisture content).

Ground temperature instrumentation was installed in four locations: BH15, BH17, BH18, and BH23. Data collected from these instruments shows that the permafrost to the west and east of the ridge is very warm, approximately between -0.2ºC and -0.4ºC. The thermal gradient in BH23 is calculated as +3ºC/100 m. Based on this data, permafrost is not expected to extend beyond 20 m depth in this area. Ground temperature information is shown on the borehole logs in Appendix B.

4.5 BEDROCK

Bedrock was encountered in five of the nine boreholes drilled near the DSTF. The bedrock was classified as a competent quartzite. The drilling method (sonic drilling) only provides broken chips and small pieces of the bedrock when the bedrock is in a competent state. These pieces are only useful for the classification of the rock type; no other information can be provided on the bedrock at this time.

5.0 LABORATORY TESTING

EBA conducted laboratory tests on recovered samples from the drill program. The following tests were conducted and are explained in more detail below:

- Moisture Content
- Particle Size Distribution
- Atterberg Limits
- Bulk Density
- Porewater Salinity
- Thaw Consolidation
- Direct Shear

5.1 MOISTURE CONTENT

Moisture content determination was conducted on almost all samples returned to EBA's Whitehorse laboratory. Results of the test are reported on the borehole logs. The moisture content reported is defined as mass of water divided by mass of dry solids.

5.2 PARTICLE SIZE DISTRIBUTION

Particle size distribution determination was conducted by both sieve and sieve hydrometer methods on selected samples returned to EBA's Whitehorse laboratory. Results of the testing immediately follow the borehole log from which each sample was collected.

5.3 ATTERBERG LIMIT DETERMINATION

Atterberg limit determination was conducted on selected fine-grained samples returned to EBA's Whitehorse laboratory. Atterberg Limit testing involves determining the liquid limit (LL) and the plastic limit (PL) of a soil and then calculating the plasticity index (PI) which is used to aid in classification of the soil type. Results of the testing are presented on the borehole logs and included here in Table 2.

TABLE 2: RESULTS OF ATTERBERG LIMITS TESTING

Testhole	Sample	Depth (m)	LL (%)	PL (%)	PI	Moisture Content (%)	Soil Description
BH15	SA08	6.3 – 6.4	18.7	15.7	3.1	70.2	ML
BH16	SA05	2.7 – 3.0	17.6	14.9	2.7	37.6	SM
BH18	SA06	5.1 – 5.4	16.1	15.1	1.0	27.1	ML
BH19	SA02	1.0 – 1.2	18.8	17.7	1.1	47.4	SM
BH22	SA03	1.3 – 1.5	17.8	16.5	1.2	71.5	ML
BH23	SA11	6.4 – 6.5	19.5	14.7	4.8	17.1	ML
BH24	SA03	5.4 – 5.6	20.2	15.6	4.6	10.5	ML
BH25	SA07	8.7 – 8.9	17.4	14.4	3.0	9.7	ML

5.4 FROZEN BULK DENSITY

Frozen bulk density of selected frozen samples of the silt, both ice-rich and ice-poor, was determined in EBA's Whitehorse laboratory. Samples of various moisture contents were selected to establish a relationship between bulk density and moisture content. The relationship between frozen bulk density and moisture content is linear. For moisture contents less than 100%, the relationship is:

$$\gamma_b = 2160.9 - 1060.4\omega \qquad [1]$$

Where: γ_b is frozen bulk density (kg/m^3)
ω is moisture content in %/100 (i.e, ω of 27% is used as 0.27)

The results of all the tests are also presented in Table 3.

TABLE 3: FROZEN BULK DENSITY RESULTS

Testhole	Sample	Depth (m)	Bulk Density (kg/m³)	Moisture Content (%)
BH18	SA06	5.1 – 5.4	1879	27
BH16	SA05	2.7 – 3.0	1754	37
BH16	SA07	4.1 – 4.4	1649	48
BH15	SA08	6.3 – 6.4	1438	71
BH22	SA03	1.3 – 1.5	1389	72
BH16	SA10	6.3 – 6.5	1353	74
BH18	SA09	7.3 – 7.5	1106	279
BH15	SA07	4.7 – 5.3	938	1202
BH17	SA03	4.2 – 4.5	905	3318

5.5 POREWATER SALINITY

Porewater salinity of selected samples was determined in EBA's Whitehorse laboratory. The results are shown in Table 4. Soils with porewater salinity of 3 ppt or less are considered to be non-saline.

TABLE 4: POREWATER SALINITY RESULTS

Testhole	Sample	Depth (m)	Porewater Salinity (ppt)
BH15	SA08	6.3 – 6.4	1.0
BH17	SA07	4.2 – 4.5	2.5
BH19	SA02	1.0 – 1.2	3.0
BH18	SA06	5.1 – 5.4	1.5
BH22	SA03	1.3 – 1.5	1.0
BH23	SA11	6.4 – 6.5	3.0

5.6 THAW CONSOLIDATION

Thaw consolidation tests were conducted on two samples from BH23: SA02 and SA03. These samples are both representative of ice-rich silt. Thaw consolidation tests were conducted by obtaining an undisturbed frozen core sample of the ice-rich silt. The frozen samples were then trimmed to 75 mm diameter and placed in a one-dimensional oedometer and loaded to 150 kPa to simulate the force generated from the mass of the tailings in the DSTF. The samples were allowed to thaw, and the change in sample height was recorded. This data allows the calculation of C_v, which is used in consolidation calculations. The change in sample height (i.e., strain) was also recorded. This can be used to approximate the volume of change due to melting ice and soil consolidation in the foundation soils of the proposed DSTF. The average thaw-strain of the ice-rich silt was 60%. Test results are shown in Appendix B.

5.7 DIRECT SHEAR

Direct shear testing was conducted on both the thawed consolidated silt and sand till and the tailings. The tailings samples were obtained from the Elsa Tailings facility. The particle size distribution of the Elsa Tailings is nearly identical to the particle size distribution determined for the proposed Bellekeno Tailings. Particle size distribution results are shown in Appendix B. The resulting strengths are summarized in Table 5 and included in Appendix B. EBA has applied experience and engineering judgement to the test results and chosen to use a cohesion of 0 kPa and a ϕ of 30° for both materials, even though test results show higher strengths.

TABLE 5: SOIL STRENGTH PROPERTIES

Soil Type	Peak Strength		Residual Strength	
	Cohesion (kPa)	Friction (ϕ)	Cohesion (kPa)	Friction (ϕ)
Thawed Silt and Sand Till	1.0	39.0	0.5	38.5
Tailings	20.2	35.2	7.5	34.7

6.0 DRY-STACKED TAILINGS FACILITY DESIGN

The design of the DSTF at the Bellekeno Mine Mill Site involves the construction of drainage works and the placement and compaction of the filtered tailings.

6.1 TAILINGS PLACEMENT

The tailings will be placed and compacted in the DSTF. Before tailings are placed, all trees will be cut by hand and removed with minimal disturbance to the ground surface, and a minimum 0.5 m gravel drainage blanket will be placed. In the ridge area, some gravel (up to 3 m) will be excavated leaving at least 0.5 m of gravel above the silt and sand till and bedrock. In the area east of the ridge, a minimum 0.5 m thick gravel drainage blanket will be placed over the existing peat. The tailings will be placed directly on this drainage blanket.

The anticipated rate of tailing generation is 187 dmt (dry metric tonnes)/day for the first two years and 408 dmt/day for the next year and nine months. This information was provided to EBA by Alexco. Other tailings assumptions are summarized in Section 3.0. The anticipated in-place tailings volumes are summarized in Table 6. These results are shown graphically in Figures 3 through 6. Three sections through the final geometry of the DSTF are shown in Figure 7.

TABLE 6: ANTICIPATED YEARLY TAILINGS VOLUMES

Months of Operation	Tailings Produced (dmt)	Tailings Produced (m³)	Tailings Stored Underground (m³)	Tailings Stored on Surface (m³)	Cumulative Tailings Stored on Surface (m³)
0–12	67,890	39,940	15,970	23,970	23,970
12–24	67,890	39,940	15,970	23,970	47,940
24–36	122,200	71,890	28,750	43,140	91,080
36–45	91,070	53,570	21,430	32,140	123,220

The tailings are deposited off a conveyor stacker outside the mill building. The tailings will exit the mill at a temperature between 10 and 20ºC. Since new warm tailings will continuously pile over the cooling tailings, there is no concern for the tailings freezing in place as long as tailings are constantly being deposited in one location from the mill.

The current plan is to haul tailings from the mill discharge location to the DSTF at least once per day. If tailings cannot be moved from the mill discharge location to the DSTF (e.g., site whiteout conditions), they will be temporarily piled at the discharge location. In such an event, the tailings will be subject to freezing temperatures, and the outer edge of the tailings pile may freeze.

One-dimensional freezing calculations, as described in Andersland and Ladanyi (2004), estimate that in 7 days of -40ºC weather, the crust will freeze between 100 mm and 300 mm. Experience from the Minto Mine shows that the tailings placed in a conical pile will develop a frozen edge with a thickness of less than to 100 mm in 4 to 6 hours. Experience at the EKATI Diamond Mine shows similar results, but EKATI's coarse processed kimberlite has a coarser gradation and higher moisture content.

If an emergency or breakdown occurs and the tailings are left out for 7 days without being transported to the DSTF, we can expect a 300 mm thick edge of frozen tailings to have formed around all piles. The tailings beneath the frozen edge will be thawed and still compactable. The thawed tailings should be hauled to the DSTF and placed in accordance with the standard tailings placement method. The frozen edge of tailings should be hauled to a location within the DSTF (at least 30 m from any edge) and placed in a loose state. The frozen tailings should not be covered until they have thawed and are properly compacted. All tailings placed in the DSTF should be properly compacted.

Experience at Minto Mine has shown that dumping tailings from a truck, pushing them into place with a bulldozer, and then compacting them with a vibratory drum packer will result in proper compaction of tailings in cold weather. A procedure similar to this has also been successfully used for placing and compacting granular materials for the construction of frozen core dams in Northern Canada (three at EKATI, one at Polaris, and one at Jericho).

The frozen core dam procedure involves heating the soil with 10% moisture to a temperature of 10ºC to 20ºC. The warm, saturated soil is then loaded into haul trucks and hauled to site spread into 300 mm lifts by a bulldozer and compacted with a vibratory compactor in temperatures as low as -50ºC. This procedure is very similar to what is being proposed for tailings disposal.

Soils will freeze faster while being spread and compacted than they will if left in a pile. Therefore, once the tailings are hauled to the DSTF, they must be immediately spread and compacted when freezing temperatures are present. Alexco will conduct regular quality control testing to ensure that the tailings are being compacted to at least 95% of maximum dry density as per ASTM D698.

The filtered tailings will have an average moisture content of approximately 17%. EBA determined the maximum dry density and optimum moisture content of the tailings as defined by ASTM D698 to be 1690 kg/m^3 at 16.5%. This means that on average the tailings will be placed slightly over the optimum moisture content.

6.2 RUNOFF DIVERSION STRUCTURES

The drainage works for the facility consist of two outer diversion berms, a blanket drain, a toe runoff collection ditch, a conveyance channel, and a water collection pond. The outer diversion berms will be constructed from gravel and are intended to promote runoff flow away from the DSTF and mill pad. The blanket drain will be constructed from gravel or waste rock and be approximately 0.5 m thick. The blanket drain will allow any water that seeps through the tailings or that is generated from thawing permafrost to drain from the facility. A toe runoff collection ditch will collect runoff water from the DSTF and intercept water seeping through the drainage blanket, diverting it to the water collection pond via the conveyance channel. The conveyance channel will be lined and constructed completely from gravel fill (no excavation below ground); it is intended to route water collected in the ditch from the facility to the water collection pond. The water collection pond will be a lined excavation into the native soils. The water collection pond is currently sized for 2,500 m^3. This size was provided by Alexco and is the volume expected to be generated for a 10-day freshet with a 1:200 year return period (Clearwater, 2009). The drainage works are shown in Figures 6 and 8.

6.3 TAILINGS SEEPAGE

To fully understand the forces governing seepage from the DSTF, there must be a general understanding of a soil phase diagram, saturation, void ratio, moisture content, and moisture density relationships. Soils are composed of three phases: solids (minerals), liquids (water), and gases (air). Soil voids are defined as the volume occupied by water and air. Saturation is defined as the ratio of volume of water to the volume of voids (i.e., 100% saturation means there is no air in the soil). The void ratio is defined as the ratio of the volume of voids to the volume of solids. Moisture content is defined as the mass of water divided by the mass of solids.

Maximum dry density, as used here, refers to the maximum dry density as determined by ASTM D698. ASTM D698 is a test that uses a constant force to determine the maximum dry density of a soil at that standard force. As the moisture content of a soil increases towards the optimum moisture content, the dry density that a soil can be compacted to (using the same standard applied force) also increases. The dry density of a soil (using the same standard applied force) will reach a maximum at its optimum moisture content. Increasing a soils moisture content past its optimum moisture content and continuing to apply the same standard force will cause the dry density of the soil to decrease. This is because most of the voids in the soil are filled with water, which is an incompressible fluid. Typically, the optimum moisture content of a fine-grained soil corresponds to a saturation of 80% (Coduto 1999).

When soil is compacted, the total volume of the soil is decreased by decreasing the volume of air in the soil, which decreases the volume of voids. If the volume of voids is decreased but the volume of water is constant, then by definition, the saturation increases. Experience shows that water may seep from soil during compaction when it is over its optimum moisture content (especially when a vibratory compactor is used).

The expected gradation and optimum moisture content of the tailings at Bellekeno Mine Mill Site will be similar to those in the Elsa tailings facility. The optimum moisture content for the Elsa tailings is approximately 16.5%. Since the tailings at Bellekeno Mine Mill Site are expected to be only slightly higher than the optimum moisture content, the seepage from compaction is considered to be negligible. For the purposes of this calculation, however, EBA has conservatively estimated the seepage at 10% of the total porewater, and the total volume of seepage water will depend on the volume of tailings placed. It is not expected that water will seep from the DSTF during the winter months because porewater that might seep out will freeze and be covered by tailings before it has a chance to thaw. In perpetuity, this ice is expected to melt and the tailings in the DSTF are expected to be unfrozen. The tailings are not expected to be over 100% saturation so this water should stay in voids of the tailings over the long term. This ice formation has been accounted for in the short-term stability analysis of the DSTF. The associated minor surface settlement has been accounted for in the long-term stability analysis and closure planning of the DSTF.

The mill is expected to produce 67,890 dmt of tailings a year for Years 1 and 2, 122,202 dmt of tailings in Year 3, and 91,066 dmt of tailings in Year 4 all at a moisture content of 17%. Only 60% of the total tailings will be placed in the DSTF, and the other 40% will be backfilled underground, so the total mass of tailings placed in the DSTF per year is 40,734 dmt for Years 1 and 2, 73,321 dmt for Year 3, and 54,639 dmt for Year 4.

The total volume of water entering the tailings facility per year is 6,925 m^3 in Years 1 and 2, 12,464 m^3 in Year 3, and 9,289 m^3 in Year 4. If 10% of that water seeps from the facility year round, then the total volume of water seeping from the DSTF is 693 m^3 per year or 1.9 m^3/day in Years 1 and 2, 1,246 m^3 per year or 3.4 m^3/day in Year 3, and 929 m^3 per year or 3.4 m^3/day in Year 4. However, this flow will only be shown as active in May, June, July, August, September, and October to better reflect expected operating conditions. Using an average rate of seepage of 1.9 m^3/day for Years 1 and 2, and 3.4 m^3/day for Years 3 and 4 over 6 months, it is expected that the seepage from the DSTF will be 347 m^3 per year in Years 1 and 2 and 623 m^3 per year in Years 3 and 4.

7.0 THAW CONSOLIDATION

Construction of the DSTF will involve placing and compacting relatively warm tailings on relatively cold ground. This will change the thermal equilibrium that exists on the site and eventually thaw the existing permafrost in the area.

EBA conducted thaw-consolidation testing on samples of undisturbed ice-rich permafrost recovered from BH23.

Results of the two thaw-consolidation tests are shown in Figures 9 and 10. An average C_v value of 0.0014 cm^2/s was determined using standard consolidation theory. The C_v value is low and accounts for volume changes due to melting ice within the soil profile. An assumption in thaw-consolidation theory is that drainage is not impeded from the top of the consolidating layer. EBA has assumed that a 0.5 m thick gravel drainage blanket sufficiently meets this assumption.

To determine excess porewater pressures generated through thawing permafrost, a depth of thaw must first be determined. EBA chose an upper bound to this problem by conducting a one-dimensional thaw calculation presented by Andersland and Ladanyi (2004). Assuming that the ice-rich till has a frozen moisture content of 90% and dry density of 635 kg/m^3 and is at a temperature of -0.4ºC, and that the tailings remain at 20ºC for four months, the frozen silt will thaw 1.2 m. Using a C_v of 0.0014 cm^2/s and a rate of thaw of 1.2 m, in four months, the anticipated excess porewater pressure generated is R_u=0.35. This value was used in slope stability calculations, where appropriate.

It was also determined during laboratory testing that the thaw-strain of the ice-rich silt is approximately 60% (Figures 9 and 10). The stratum of ice-rich silt is approximately 3.5 m thick, which will correspond to an anticipated distortion of 2.1 m in perpetuity.

The long-term thaw consolidation of ice-poor silt was determined assuming:

- the strata of ice-poor silt over gravel or bedrock is 7 m thick,
- $C_c = I_p/74 = 0.05$ (Coduto 1999),
- $e_o = 0.5$, typical value for silty sand (Coduto 1999).

Based on information above, the long-term thaw-consolidation of the ice-poor silt would be approximately 0.4 m. Therefore, it is expected that in perpetuity the movement of the crest of the pile will be approximately 2.5 m. There will also be slumping of the south slope of the pile since the ice-poor silt continues in this direction, but there should be minimal settlement in the west slope of the pile since it is founded on gravel over bedrock and any till layer in this area is considered to be thin and ice-poor. This movement has been accounted for in the long-term stability of the pile; however, it may be beneficial to place more cover material in this area during closure. This should be reviewed when a detailed closure plan is developed.

8.0 STABILITY OF THE DSTF

The stability of the DSTF was determined using Geostudio 2007 – Slope/W module, which is a computer program that uses limit equilibrium theory to compute the factor of safety (FS) of slopes. The DSTF slopes were analyzed in several different conditions, including during construction (Years 1 through 4) and after closure activities in both static and pseudo-static scenarios. A minimum FS is suggested for each condition by the BC Mine Waste Rock Pile Research Committee (Piteau 1991).

The suggested FS are given for two cases: Case A and Case B. Case A is typically used when less rigorous analyses are conducted or when where material properties and actual failure mechanisms are not well understood. Case B is typically used when more rigorous analyses are conducted or when material properties and failure mechanisms are well understood. EBA has chosen to compare the calculated FS against Case A except when the long-term strength of ice-rich frozen silt is used in the analysis. The method used to determine the long-term strength of ice-rich silt is overly conservative, and thus these scenarios should be compared against Case B.

The stability of the DSTF was analyzed along three sections in three scenarios:

- Permafrost fully frozen
- Permafrost thawed to 1.2 m depth
- Permafrost fully thawed

The parameters used for and the results of each analysis are summarized in the subsequent sections.

8.1 SOIL STRENGTH PARAMETERS

Seven material types were used in the slope stability model:

- Bedrock
- Frozen ice-rich silt
- Frozen ice-poor silt
- Thawed silt
- Tailings
- Gravel
- Loose Gravel

The material parameters are summarized in Table 7.

TABLE 7: MATERIAL PROPERTIES

Material Type	Unit Weight (kN/m³)	Frictional Strength		Non-Frictional Strength
		Cohesion (kPa)	Friction (ϕ')	c_u (kPa)
Bedrock	Bedrock is considered impenetrable in this model			
Frozen Ice-Rich Silt (90% ω)	11.8	0	30°	50
Frozen Ice-Poor Silt (20% ω)	19.1	0	30°	N/A
Thawed Silt	19.1	0	30°	N/A
Tailings	19.4	0	30°	N/A
Gravel	24.0	0	35°	N/A
Loose Gravel	21.1	0	30°	N/A

All soils are expected to behave as frictional materials for any short-term loading conditions; these are modelled in the drained state. Short-term loading is considered to be during the construction of the pile or during any pseudo-static analysis. All soils, except for the frozen ice-rich silt, are also expected to behave as frictional materials during long-term loading conditions.

As noted in Johnston (1981), a conservative approach to determining the bearing capacity of frozen soil is to assume that the internal angle of friction (ϕ) of the soil is equal to 0, thus relying solely on the cohesive properties of the frozen soil. Johnston (1981) also describes a formula to determine the lower limit for the 50 year shear strength (in kPa) of frozen soils and it is:

$$C_u = 35 + 28T \qquad [2]$$

Where: T is in °C below freezing (with a positive sign).

The properties of each soil type are discussed in more detail below.

8.1.1 Bedrock

The bedrock in the area is a competent quartzite. The strength of the bedrock is assumed to be much higher than that of the soil around it. Any slope failures will therefore happen through the soil and not the bedrock. For modelling purposes, the bedrock was assumed to be impenetrable.

8.1.2 Frozen Ice-Rich Silt

Assuming that the temperature of the frozen ice-rich silt is -0.4°C, the 50 year shear strength would be 46 kPa and the soil would be modelled as undrained. However, EBA believes this value to be extremely low for the soil and based on experience and engineering judgement has decided to use 50 kPa. The bulk density of the ice-rich silt was determined assuming a moisture content of 90%. In short-term loading, it is expected that the ice-rich silt will behave as a frictional material with properties similar to those determined for the thawed state.

8.1.3 Frozen Ice-Poor Silt

EBA assumed that the frozen ice-poor silt will behave similarly to thawed silt in both short-term and long-term loading conditions. The bulk density of the ice-poor silt was determined using a moisture content of 20%.

8.1.4 Thawed Silt

EBA assumed that the thawed silt would behave as a frictional material in both short-term and long-term loading conditions. The strength was determined using direct shear test results. The bulk density was assumed to be the same as ice-poor silt since there should be little volume change due to the thawing of ice-poor silt.

8.1.5 Tailings

Tailings should behave as a frictional material in both short-term and long-term loading conditions. The strength of the tailings was determined using direct shear test results. The bulk density was determined by first determining the maximum dry density of the tailings (1690 kg/m^3) and then adding the mass of water (assuming moisture content of 17%). This is a conservative estimate since the tailings should be compacted to only 95% of the maximum dry-density.

8.1.6 Gravels

Gravel should behave as a frictional material in both short-term and long-term loading conditions. The friction angle of the gravel was conservatively assumed as 35º based on EBA's experience with gravels in the Keno City area. This was reduced to 30º for gravel placed in a loose state. The bulk density was based on a maximum dry density of 2,385 kg/m^3. It is assumed that the gravel would be placed at 95% density and 8% moisture for the drain area and 87% density and 4% moisture for the cover material.

8.2 PERMAFROST FULLY FROZEN

This scenario is intended to model the condition where the tailings have been placed but the underlying soils have not yet thawed. The factor of safety against long-term slope instability was determined using the long-term strength of ice-rich silt. This is a conservative assumption and should be considered a lower bound for thawing of the ice-rich silt. A summary of the factors of safety for several conditions within this scenario are provided in Table 8. Slope stability plots are found in Appendix C.

TABLE 8: DSTF SLOPE STABILITY FACTOR OF SAFETY – FULLY FROZEN CASE

Stability Condition	Factor of Safety Suggested Minimum (Piteau 1991)		Calculated for DSTF		
	Case A	Case B	Section A	Section B	Section C
Stability of Surface					
Short-Term (during construction – static)	**1.0**	*1.0*	1.7	2.0	2.0
Long-Term (after closure – static)	*1.2*	**1.1**	1.5	1.9	2.1
Deep-Seated Stability					
Short-Term (during construction – static)	**1.3–1.5**	*1.1-1.3*	2.1	2.2	3.1
Short-Term (during construction – pseudo-static)	**1.1–1.3**	*1.0*	1.5	1.5	1.4
Long-Term (after closure – static)	*1.5*	**1.3**	1.4	1.6	1.6
Long-Term (after closure – pseudo-static)	**1.1–1.3**	*1.0*	1.4	1.3	1.4

Note: **Bold** values are recommended minimum for each condition.
Italic values are provided for information only.

8.3 PERMAFROST THAWED TO 1.2 METRE DEPTH

This scenario is intended to model the condition where the tailings are placed and the underlying soils have thawed 1.2 m in four months. This rate of thaw is relatively quick. It was determined assuming that the tailings would remain at +20°C for four consecutive months. The porewater pressures developed due to this rate of thaw is R_u=0.35. This should be considered an upper bound for thawing of the ice-rich silt. Any thaw beyond this initial 1.2 m will likely occur at a much slower rate. The slower rate of thaw will allow porewater to dissipate prior to developing excess porewater pressures. A summary of the factors of safety for several conditions within this scenario are provided in Table 9. Slope stability plots are found in Appendix D.

TABLE 9: DSTF SLOPE STABILITY FACTOR OF SAFETY – 1.2 m THAWED CASE

Stability Condition	Factor of Safety Suggested Minimum (Piteau 1991)		Calculated for DSTF		
	Case A	Case B	Section A	Section B	Section C
Stability of Surface					
Short-Term (during construction – static)	**1.0**	*1.0*	1.7	2.0	1.8
Long-Term (after closure – static)	*1.2*	**1.1**	1.5	1.9	1.8
Deep-Seated Stability					
Short-Term (during construction – static)	**1.3–1.5**	*1.1-1.3*	2.0	2.1	1.8
Short-Term (during construction – pseudo-static)	**1.1–1.3**	*1.0*	1.3	1.4	1.2
Long-Term (after closure – static)	*1.5*	**1.3**	1.4	1.7	1.9
Long-Term (after closure – pseudo-static)	**1.1–1.3**	*1.0*	1.3	1.3	1.2

Note: **Bold** values are recommended minimum for each condition
Italic values are provided for information only.

8.4 PERMAFROST FULLY THAWED

This scenario is intended to model the anticipated long-term condition where the tailings are placed and the underlying soils have fully thawed and consolidated. Due to the rate of thaw and the lack of excess ice below the ice-rich silt layer, no excess porewater pressure is anticipated. This should be considered a reasonable approximation of the DSTF's long-term state. A summary of the factors of safety for several conditions within this scenario are provided in Table 10. Slope stability plots are found in Appendix E.

TABLE 10: DSTF SLOPE STABILITY FACTOR OF SAFETY – FULLY THAWED CASE

Stability Condition	Factor of Safety Suggested Minimum (Piteau 1991)		Calculated for DSTF		
	Case A	Case B	Section A	Section B	Section C
Stability of Surface					
Short-Term (during construction – static)	**1.0**	*1.0*	N/A[1]		
Long-Term (after closure – static)	*1.2*	**1.1**	1.5	1.9	2.0
Deep-Seated Stability					
Short-Term (during construction – static)	**1.3–1.5**	*1.1-1.3*	N/A[1]		
Short-Term (during construction – pseudo-static)	**1.1–1.3**	*1.0*	N/A[1]		
Long-Term (after closure – static)	*1.5*	**1.3**	2.2	2.3	2.3
Long-Term (after closure – pseudo-static)	**1.1–1.3**	*1.0*	1.5	1.5	1.5

Note: **Bold** values are recommended minimum for each condition
Italic values are provided for information only.
[1] Foundation will not be fully thawed during construction of the pile.

9.0 DSTF RISKS AND MITIGATIONS

The risks associated with the DSTF and suggested mitigations are summarized in Table 11.

TABLE 11: DRY-STACKED TAILINGS FACILITY RISK AND MITIGATION SUMMARY TABLE

Risk	Design Constraint	Mitigation	Discussion
Deep-seated slope failure	Minimum FS = 1.3 (static); 1.3 (pseudo-static 1:500 year event)	Facility is designed to the applicable guidelines.	Probability of exceedance of the design seismic event is 10% in 50 years.
Long-term surface slope failure	Minimum FS = 1.4 (static)	Facility is designed to the applicable guidelines	Surface failures can be repaired without major effort.
Short-term surface slope failure	Minimum FS = 1.7 (static)	Facility is designed to the applicable guidelines	Surface failures can be repaired with available on-site equipment.
Pile erosion	Minimize surface runoff	Diversion berm included upgradient pile is sloped to allow runoff to flow off the pile.	Diversion berm is intended to direct runoff around the pile. Closure plan includes capping with a coarser material to prevent erosion.
Insufficient drainage	Melting ice in permafrost needs to drain.	Drainage blanket provided beneath entire footprint of DSTF.	Drainage blanket will also aid in draining any water percolating through the pile.
Liquefaction	Compact tailings	Tailings are specified to be compacted with a steel drum vibratory compactor.	Foundation soils should be coarse enough not to liquefy.
Snow and ice buried during pile construction	Operational issue	Operational procedures will be developed to minimize this.	Buried snow and ice could affect the stability and capacity of the facility.
Frost heave	Limit excess porewater in frost-susceptible materials	Free draining foundation soils limits excess porewater available to generate frost heave.	Frost heaving deforms the structure and affects the stability of the facility.
Leaking from capping material upon closure	Monitor pile upon closure	Monitoring stations located downgradient from the facility will detect leaks and then repairs can be made. Water will be collected and treated if necessary.	Capping material can be repaired by mechanical means if a leak is detected

10.0 DSTF CLOSURE PLAN

Since the DSTF will be constructed as a sidehill fill, progressive reclamation is feasible and will be conducted. Once tailings placement for a portion of the DSTF is complete, an evapo-transpirative cover (0.5 m of loosely placed gravel soil) will be placed over the surface of the compacted tailings to temporarily store runoff and allow it evaporate or to be used by plants. The water collection pond and diversion berms and ditches will be left in place. The water collection pond will be able to act as bio-reactors if necessary, and the berms will continue to divert runoff water away from the DSTF area. The entire affected footprint will be re-vegetated with plants that promote soil evapo-transpiration, similar to those used at Brewery Creek Mine. This procedure has been successfully used at the Brewery Creek Mine, which was reclaimed by Alexco, and is also feasible here since the annual pan evaporation exceeds the annual precipitation (Tremblay et al. 2001).

The DSTF will require an annual geotechnical inspection for at least five years after closure. This requirement should be reviewed after five years. EBA also recommends that piezometers, ground temperature instrumentation, and slope indicator instrumentation be installed for long-term monitoring of the DSTF. These instruments can be installed as progressive closure activities during construction of the DSTF. The recommended approximate locations of these instruments are shown in Figures 11 and 12.

11.0 LIMITATIONS

This report and its contents are intended for the sole use of Alexco Resource Corp. and their agents. EBA does not accept any responsibility for the accuracy of any of the data, the analysis, or the recommendations contained or referenced in the report when the report is used or relied upon by any Party other than Alexco Resource Corp., or for any Project other than the proposed development at the subject site. Any such unauthorized use of this report is at the sole risk of the user. Use of this report is subject to the terms and conditions stated in EBA's Services Agreement. EBA's General Conditions are provided in Appendix F of this report.

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned.

Sincerely,
EBA Engineering Consultants Ltd.

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Jan 14/2010

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Association of Professional
Engineers of Yukon

REFERENCES

Andersland and Ladanyi, 2004. *Frozen Ground Engineering.* American Society of Civil Engineers and John Wiley & Sons, Inc. Hoboken, New Jersey, USA.

Coduto, Donald P., 1999. *Geotechnical Engineering Principals and Practices.* Prentice Hall, Upper Saddle River, New Jersery, USA.

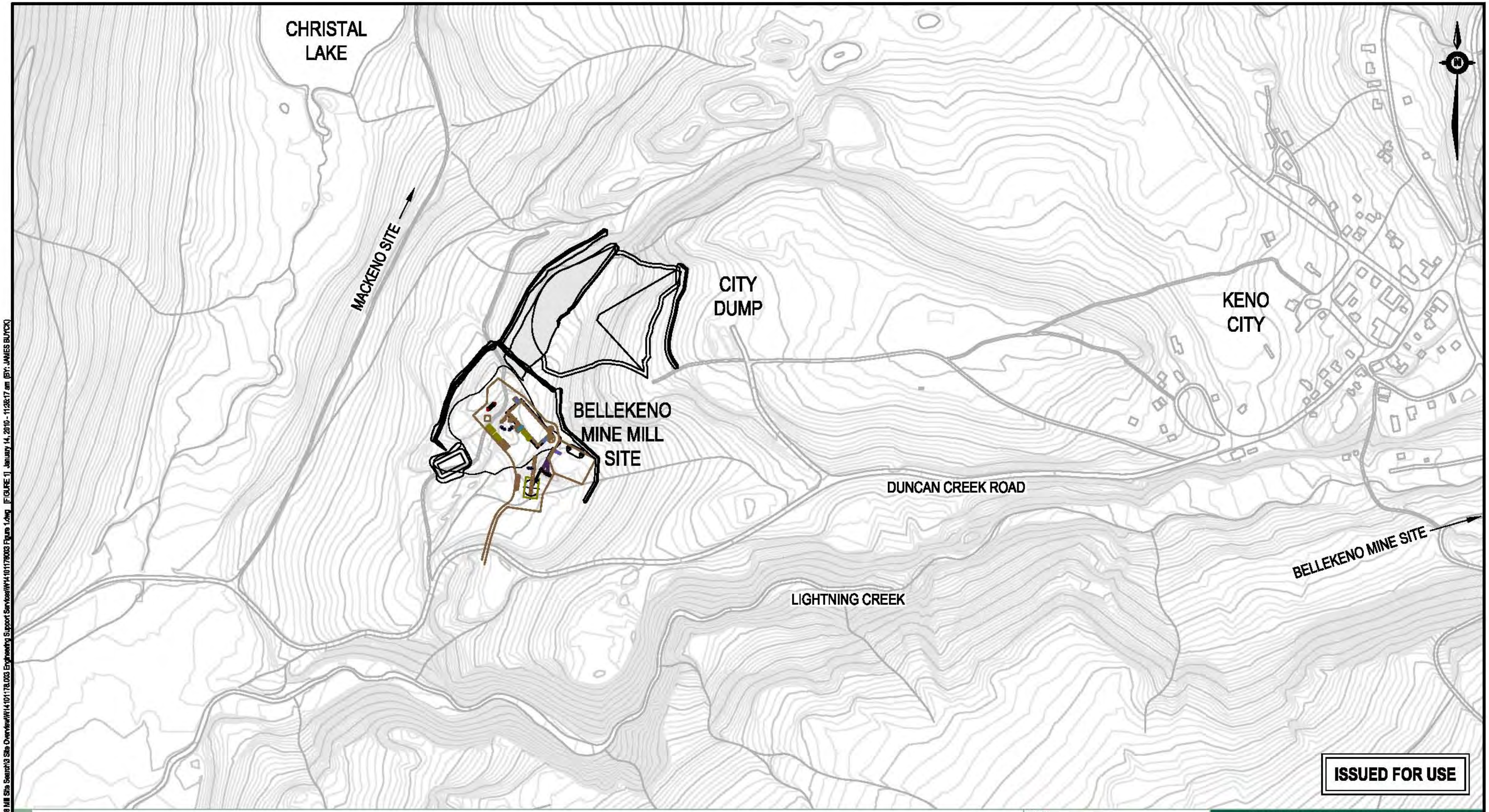
Clearwater Consultants Ltd., 2009. "Memorandum CCL-UKMH-2 FINAL". Submitted to Access Consulting Group on August 20, 2009.

Johnston G. H., 1981. *Permafrost Engineering Design and Construction.* Hunter Rose Company Ltd, Toronto, Ontario, Canada.

Piteau Associates Engineering Ltd. 1991. "Investigation and Design of Mine Dumps – Interim Guidelines." Prepared for British Columbia Mine Waste Rock Pile Research Committee, May 1991.

Tremblay, Gilles and Hogan, Charlene, 2001. "MEND Manual Volume 4 – Prevention and Control". Mine Environment Neutral Drainage (MEND) Program.

FIGURES



ISSUED FOR USE

NOTES:

BASE PLAN PROVIDED BY ALEXCO RESOURCE CANADA CORP.

0 250
Scale: 1: 5 000 (metres)

CLIENT

ALEXCO

EBA Engineering Consultants Ltd.

DRY-STACK TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

GENERAL LOCATION PLAN

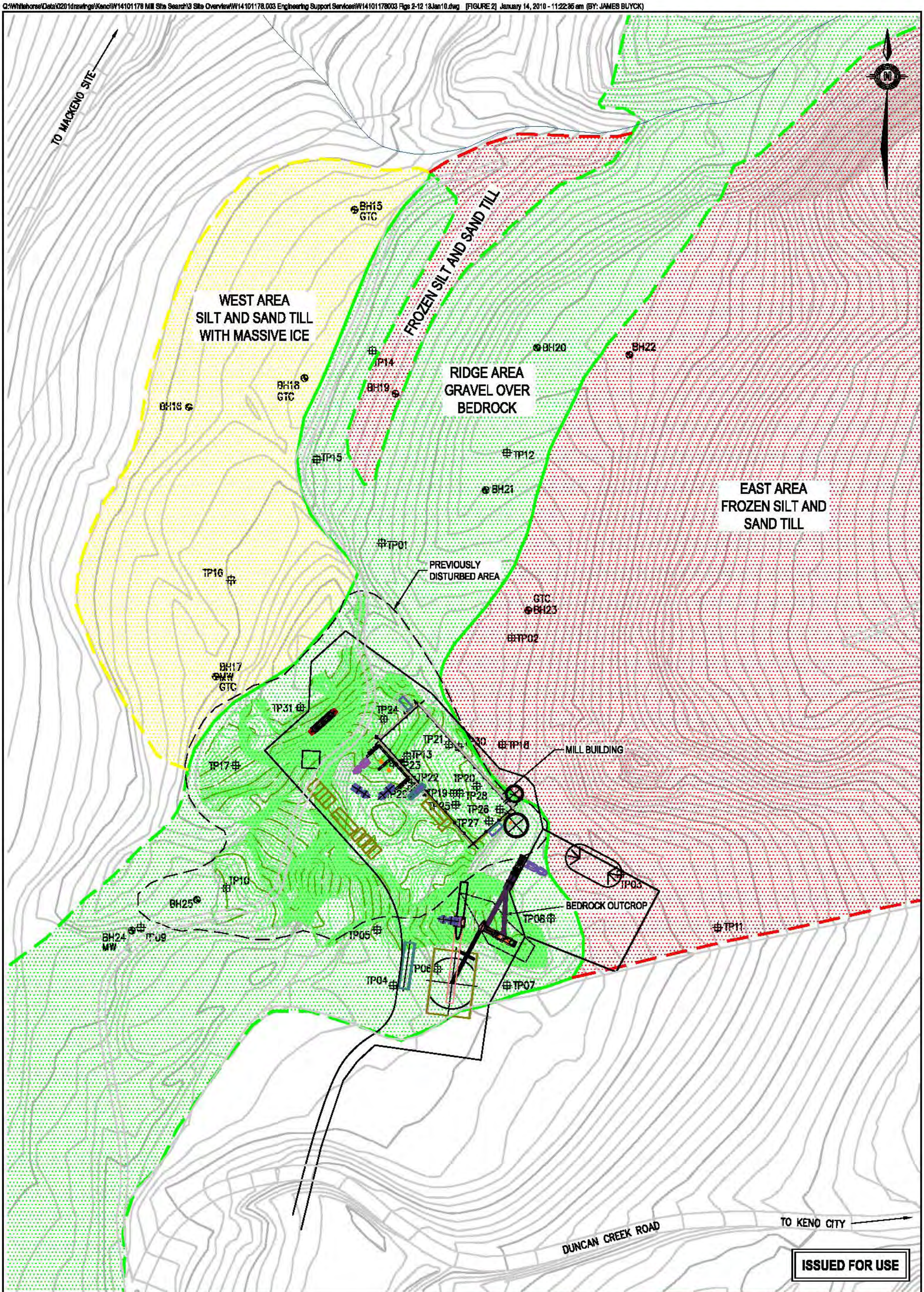
PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1

OFFICE	DATE
EBA-WHSE	January 13, 2010

Figure 1

G:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.003 Engineering Support Services\W14101178003 Figure 1.dwg [FIGURE 1] January 14, 2010 - 11:28:17 am (BY: JAMES BUYCK)

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.003 Engineering Support Services\W14101178003 Figs 2-12 13Jan10.dwg [FIGURE 2] January 14, 2010 - 11:22:35 am (BY: JAMES BUYCK)



ISSUED FOR USE

LEGEND

⊕	TESTPIT LOCATIONS
●	BOREHOLE LOCATIONS
GTC	GROUND TEMPERATURE CABLE
MW	MONITORING WELL

NOTES

1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

0 50

Scale: 1: 1 500 (metres)

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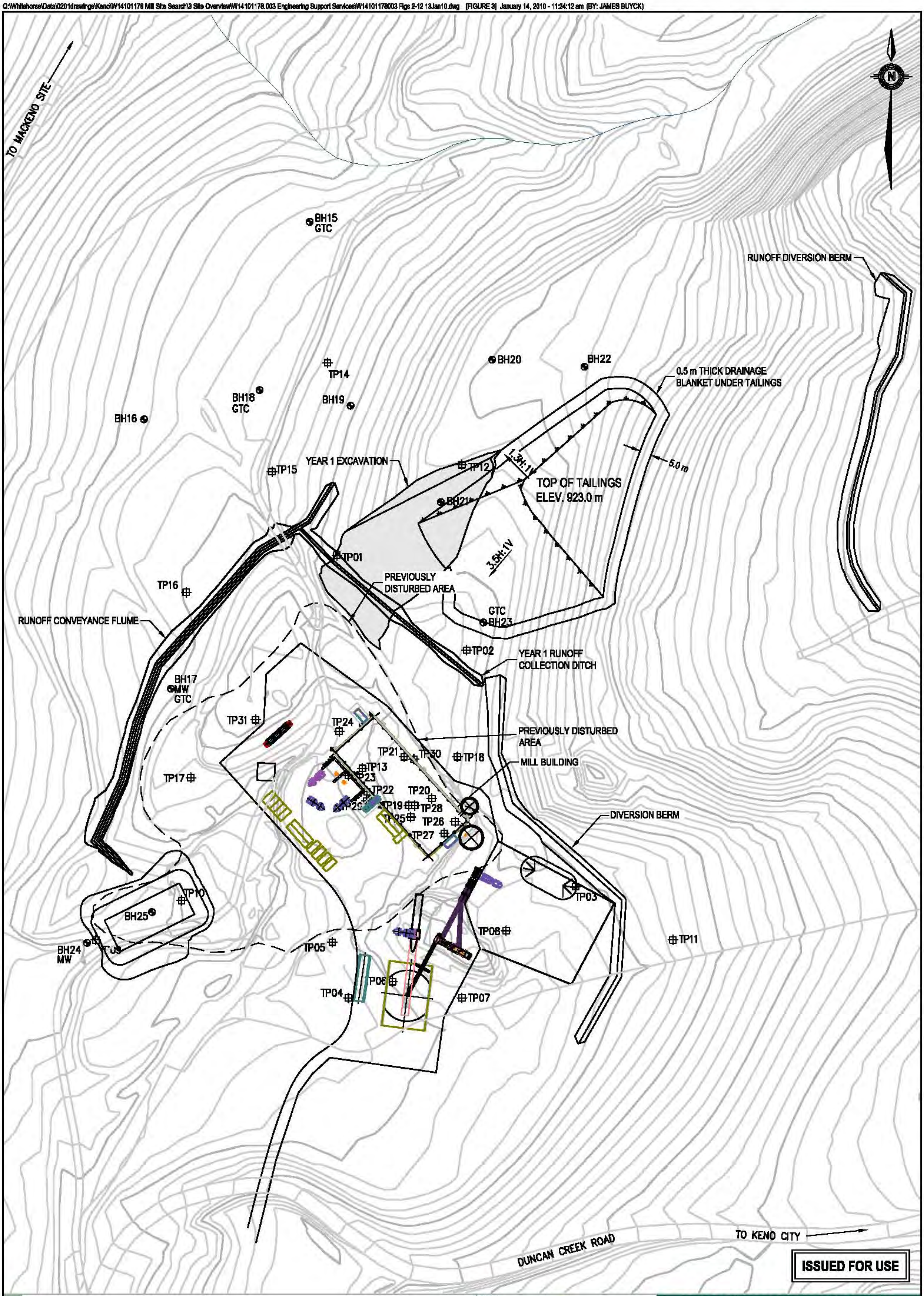
DRY-STACKED TAILINGS FACILITY DESIGN BELLEKENO MINE MILL SITE, YUKON

BOREHOLE LOCATION PLAN AND SUBSURFACE CONDITION SUMMARY

PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1
OFFICE	DATE		
EBA-WHSE	January 13, 2010		

Figure 2



ISSUED FOR USE

LEGEND

⊞ TESTPIT LOCATIONS

● BOREHOLE LOCATIONS

NOTES

1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

0 50
Scale: 1: 1 500 (metres)

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DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

GENERAL SITE LAYOUT
YEAR 1 TAILINGS PLACEMENT

PROJECT NO.	DWN	CKD	REV
W14101176.003	KJT	CJD	1

OFFICE	DATE
EBA-WHSE	January 13, 2010

Figure 3

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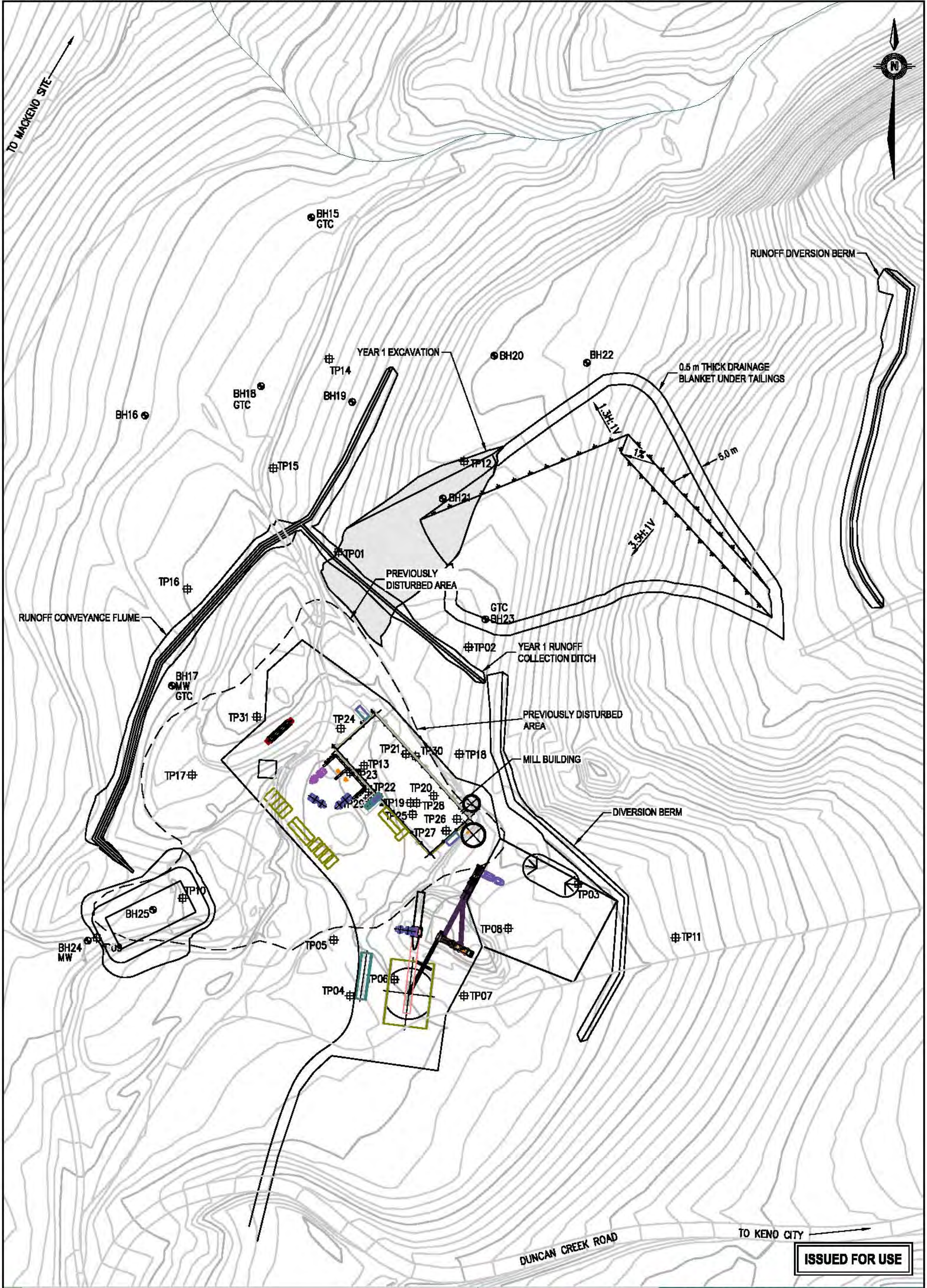

ISSUED FOR USE

LEGEND

⊕ TESTPIT LOCATIONS

● BOREHOLE LOCATIONS

0 50

Scale: 1: 1 500 (metres)

NOTES

1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

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DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

GENERAL SITE LAYOUT
YEAR 2 TAILINGS PLACEMENT

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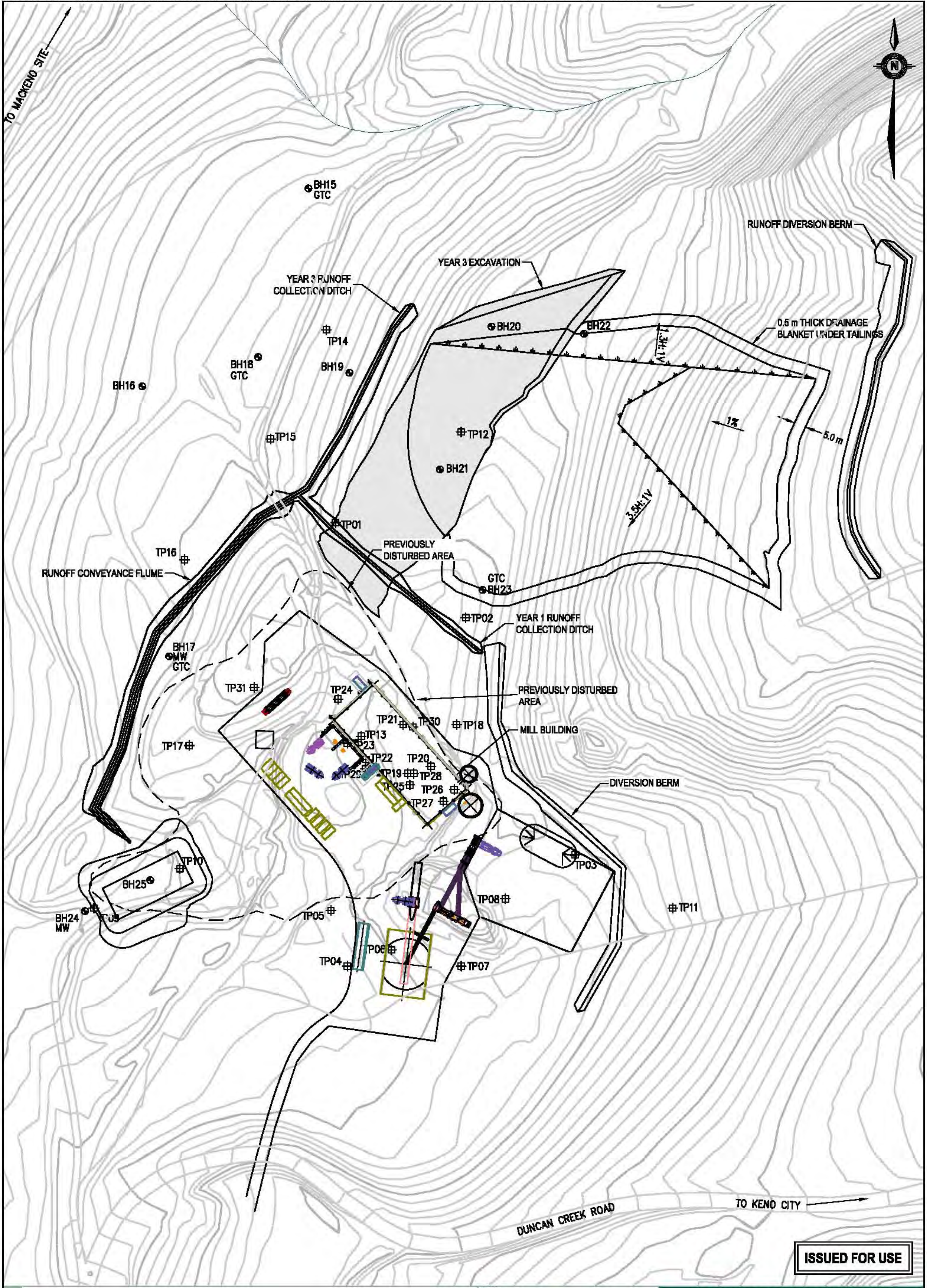
PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1
OFFICE	DATE		
EBA-WHSE	January 13, 2010		

Figure 4



ISSUED FOR USE

LEGEND

⊕ TESTPIT LOCATIONS

● BOREHOLE LOCATIONS

NOTES

1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

0 50

Scale: 1: 1 500 (metres)

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DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

GENERAL SITE LAYOUT
YEAR 3 TAILINGS PLACEMENT

PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1

OFFICE	DATE
EBA-WHSE	January 13, 2010

Figure 5

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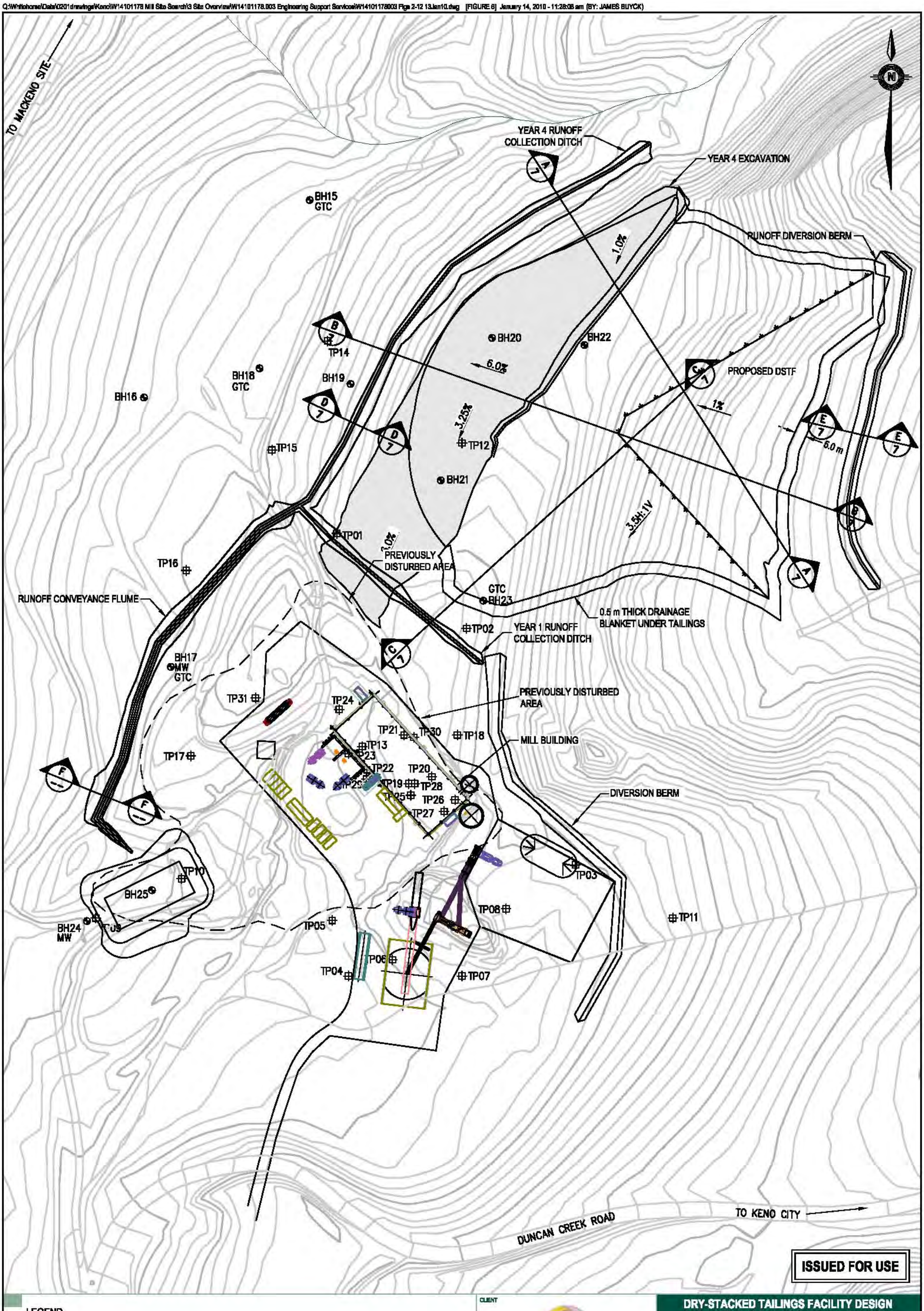

ISSUED FOR USE

LEGEND

⊕ TESTPIT LOCATIONS

● BOREHOLE LOCATIONS

NOTES

1. NTS MAP ZONE 6 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

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Scale: 1: 1 500 (metres)

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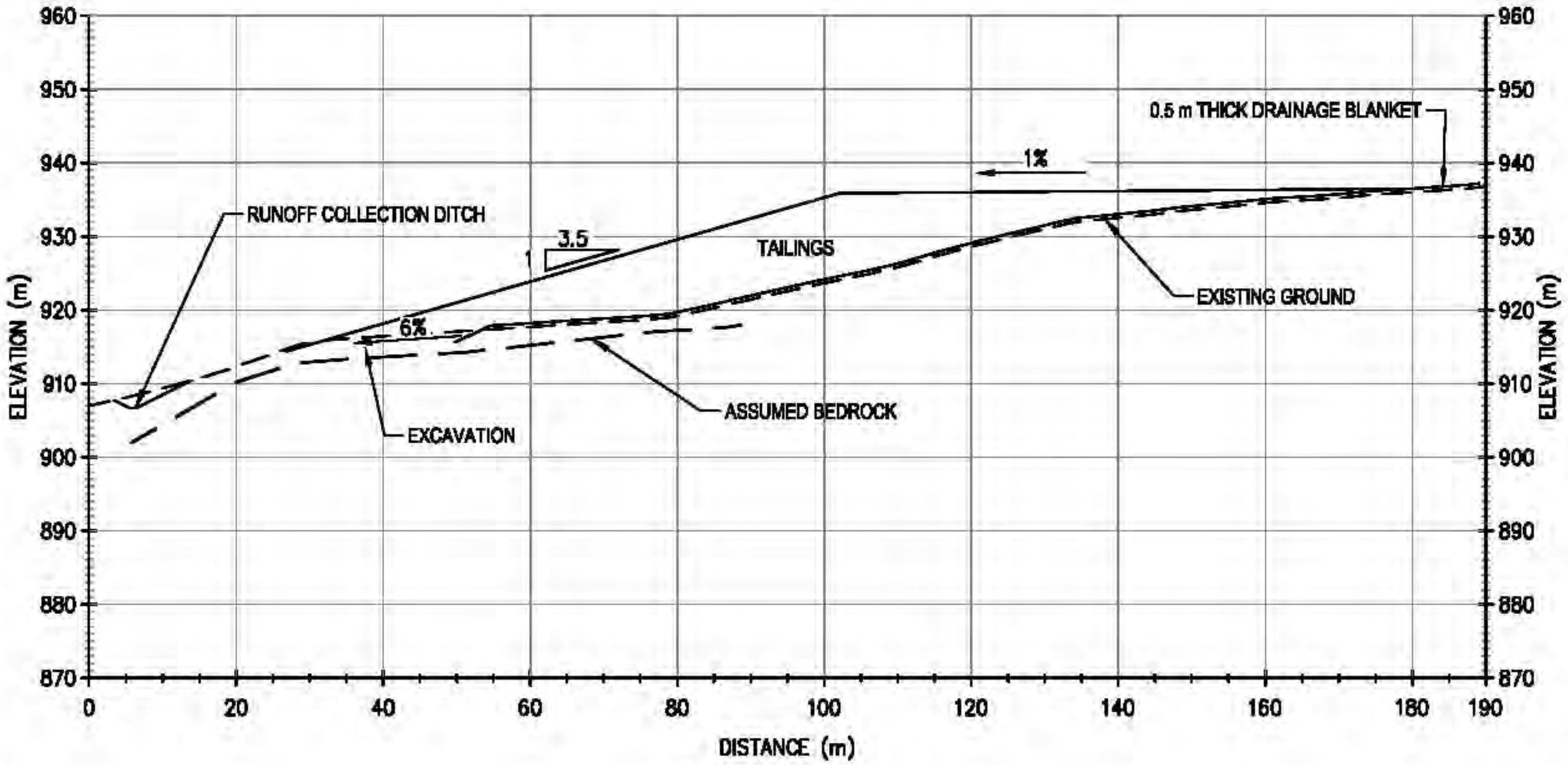
DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

GENERAL SITE LAYOUT
YEAR 4 TAILINGS PLACEMENT

PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1

OFFICE	DATE
EBA-WHSE	January 13, 2010

Figure 6



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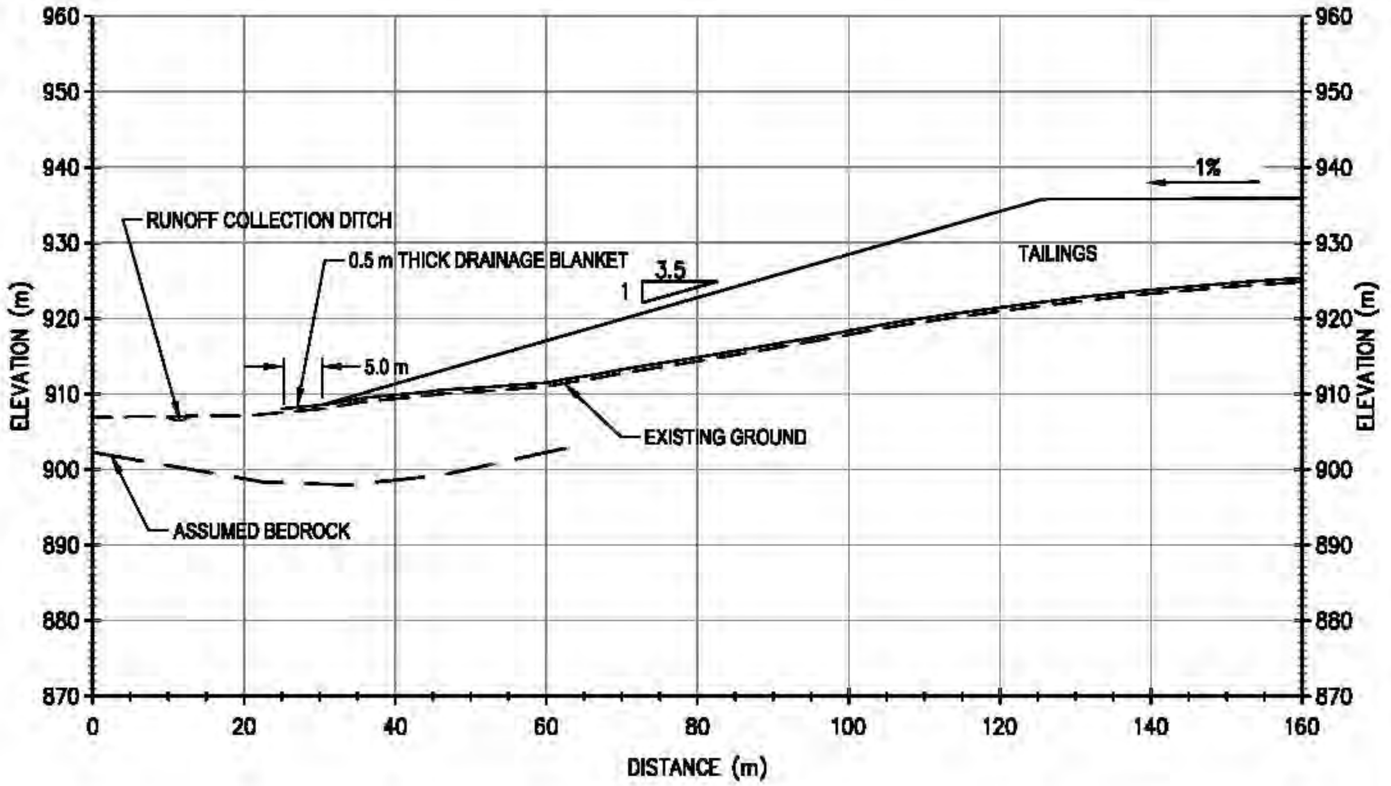

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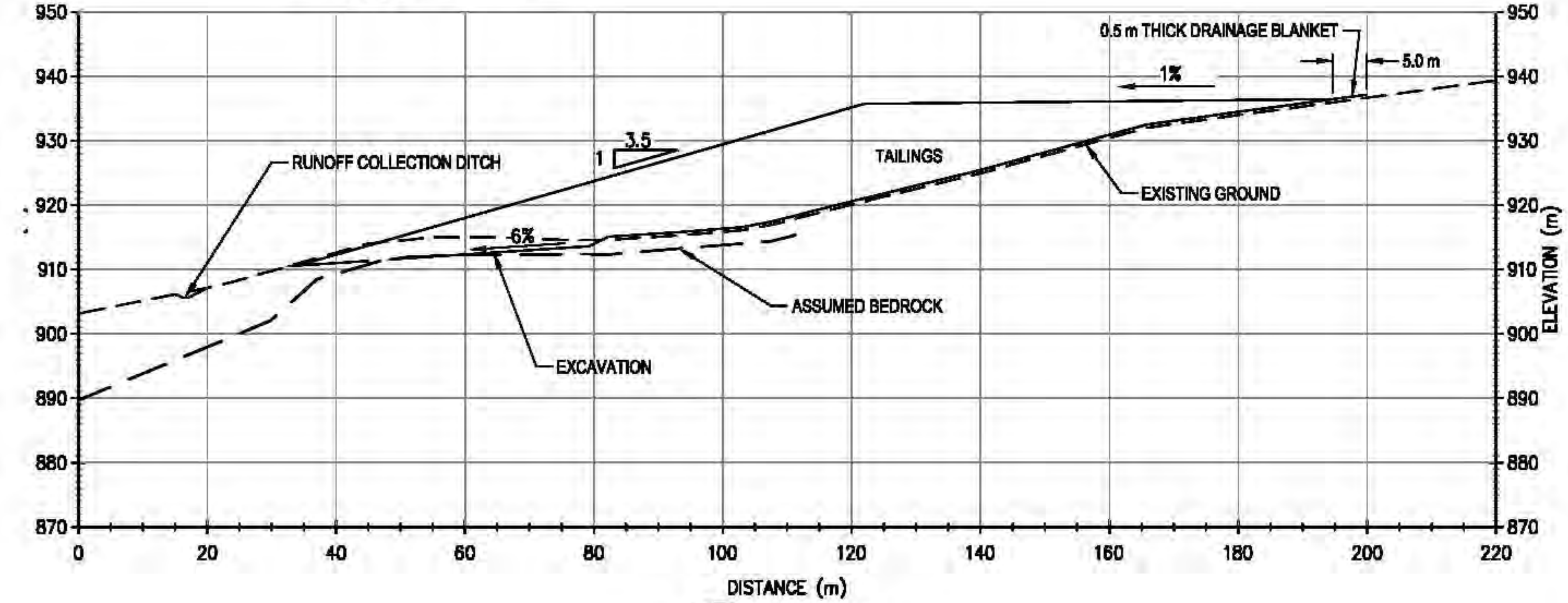

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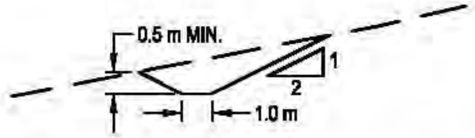

D / 6 RUNOFF COLLECTION DITCH SECTION
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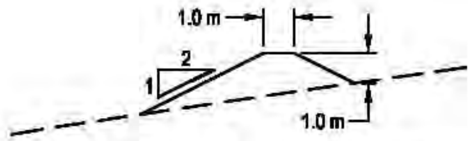

E / 6 DIVERSION BERM SECTION
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0 — 50
Scale: 1: 1000 (metres)

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DRY-STACK TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

SECTIONS AT YEAR 4 PLACEMENT

PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1
OFFICE	DATE		
WHSE	January 13, 2010		

Figure 7

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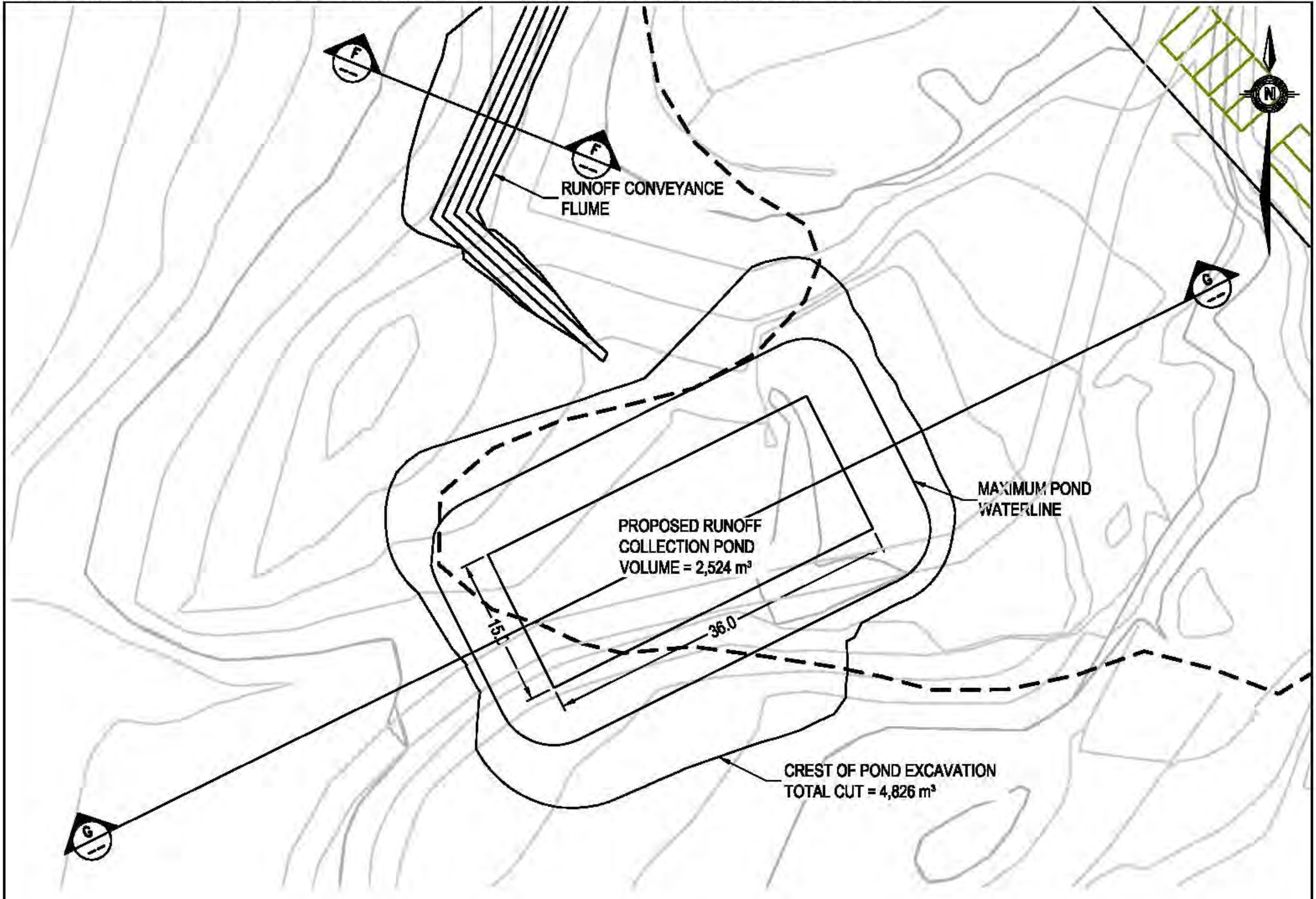

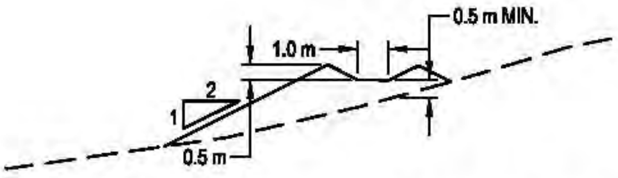

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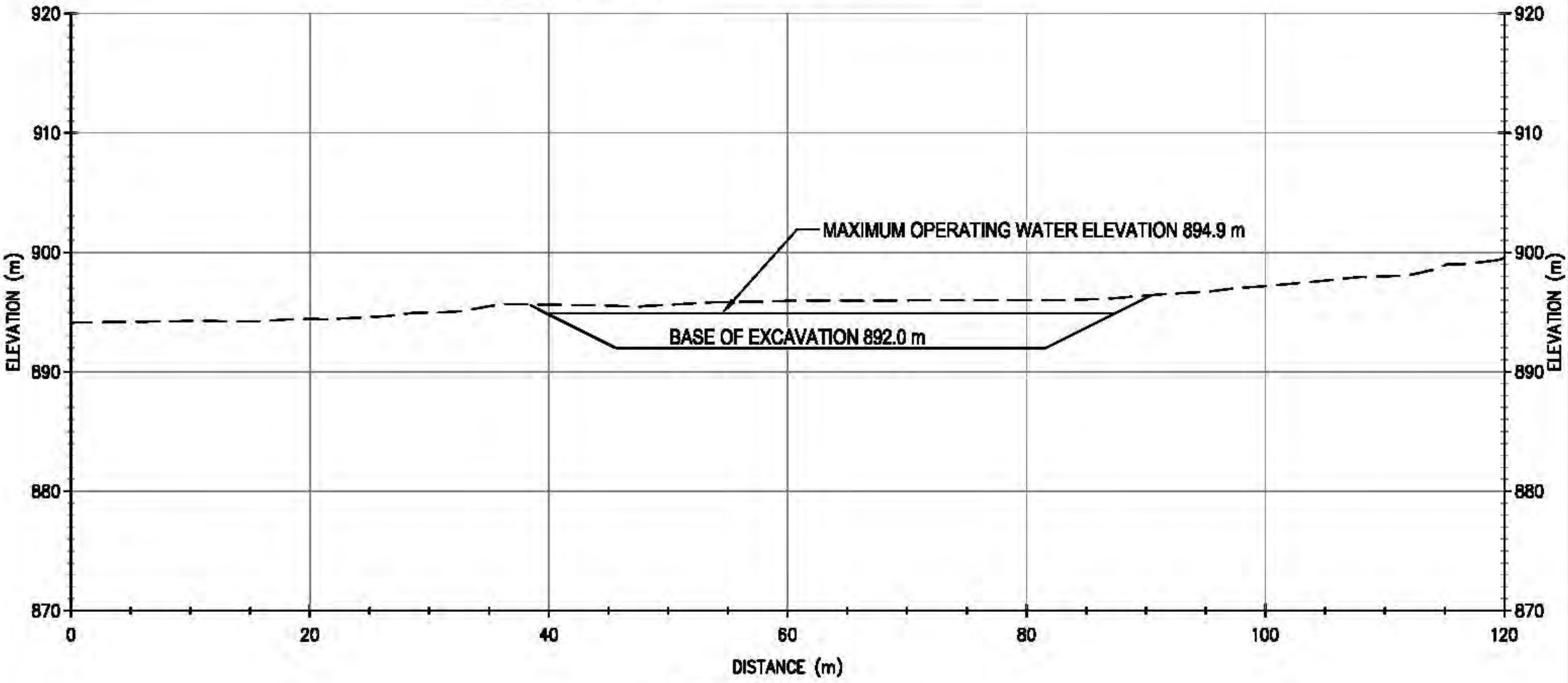

G POND SECTION
SCALE 1:500

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NOTES
1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

0 25
Scale: 1: 500 (metres)

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DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

WATER COLLECTION POND
PLAN AND PROFILE

PROJECT NO.	DWN	CKD	REV	
W14101178.003	KJT	CJD	1	**Figure 8**
OFFICE	DATE			
EBA-WHSE	January 13, 2010			

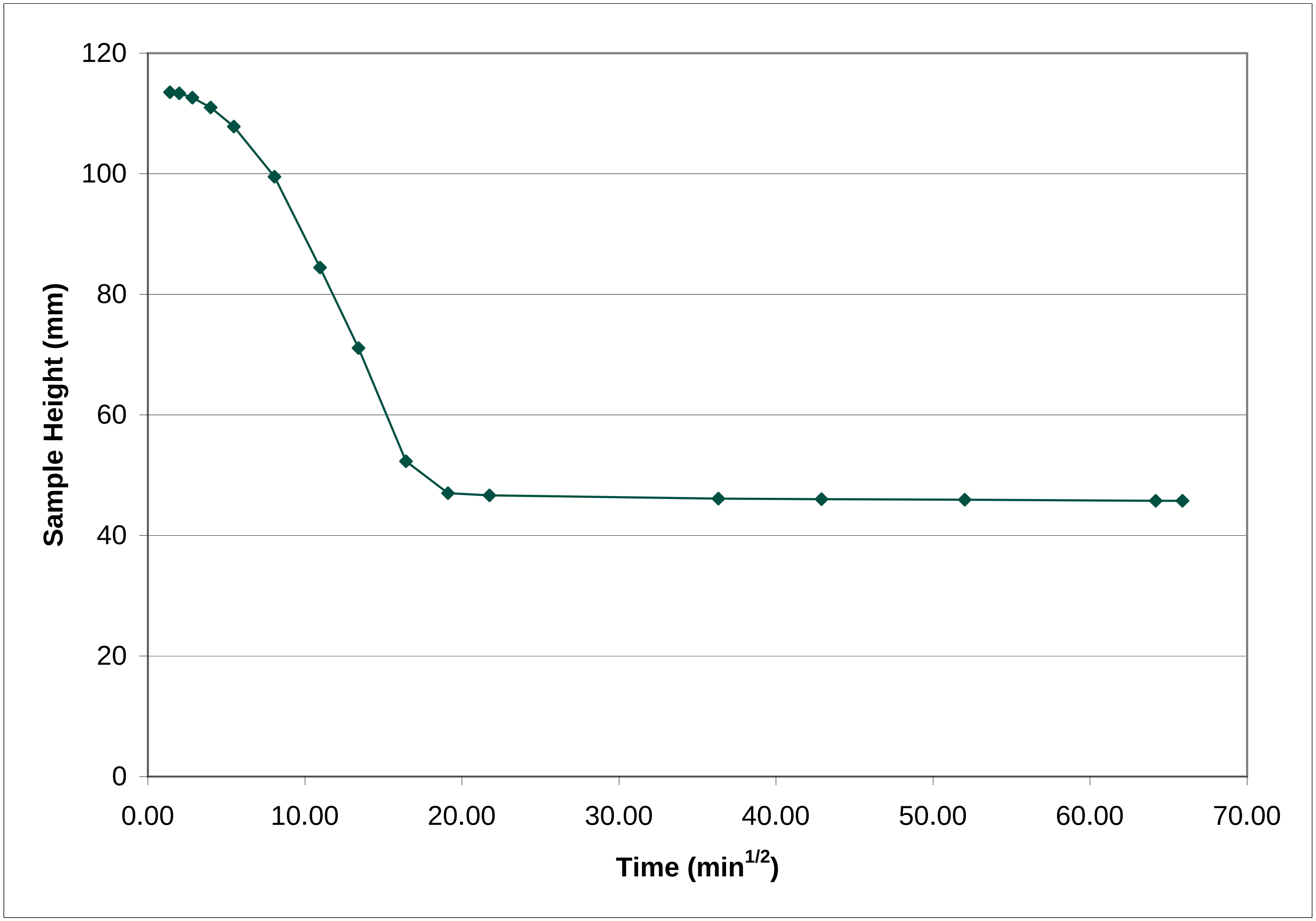


FIGURE 9
Borehole 23 - SA02 Thaw Consolidation Results

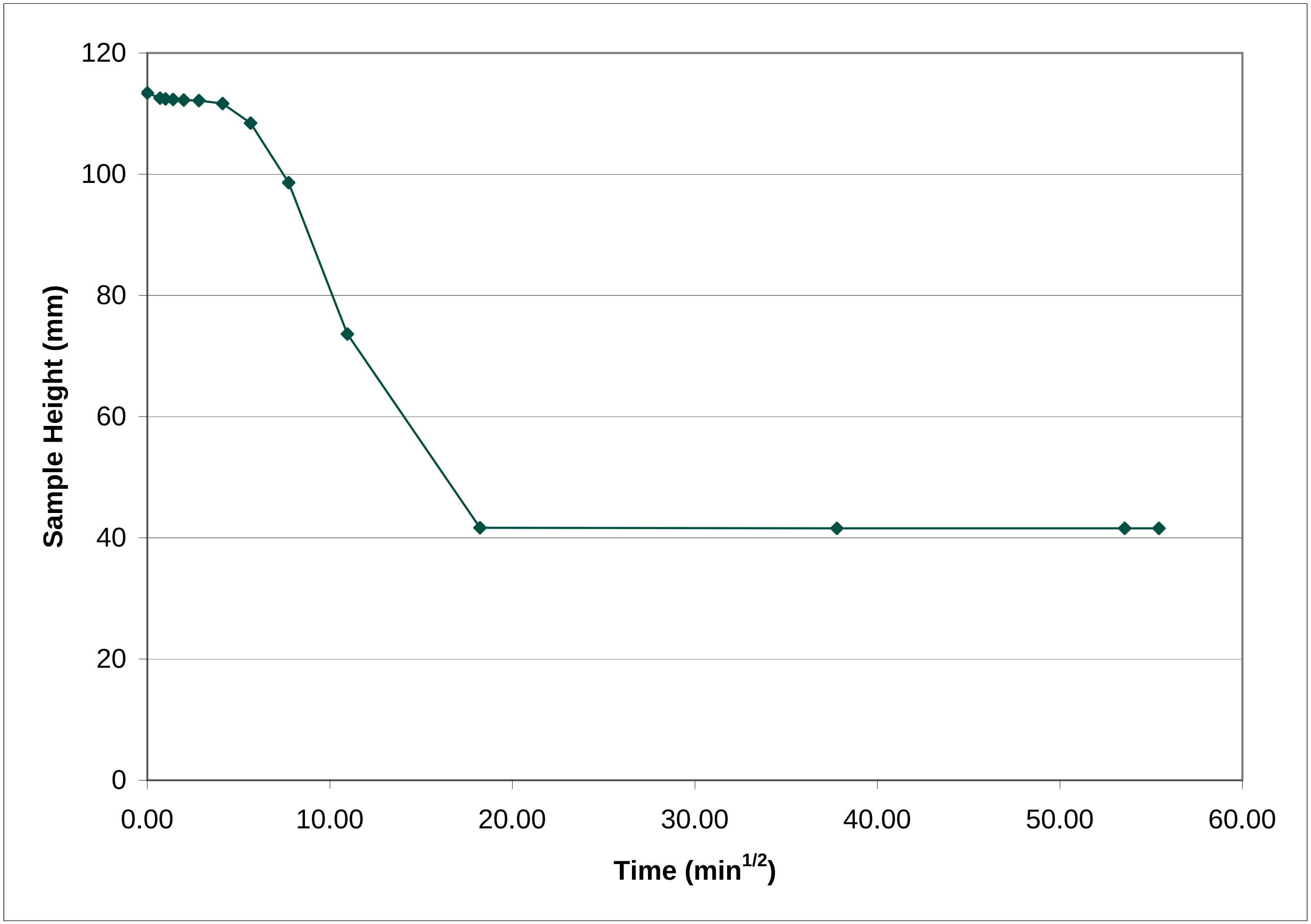
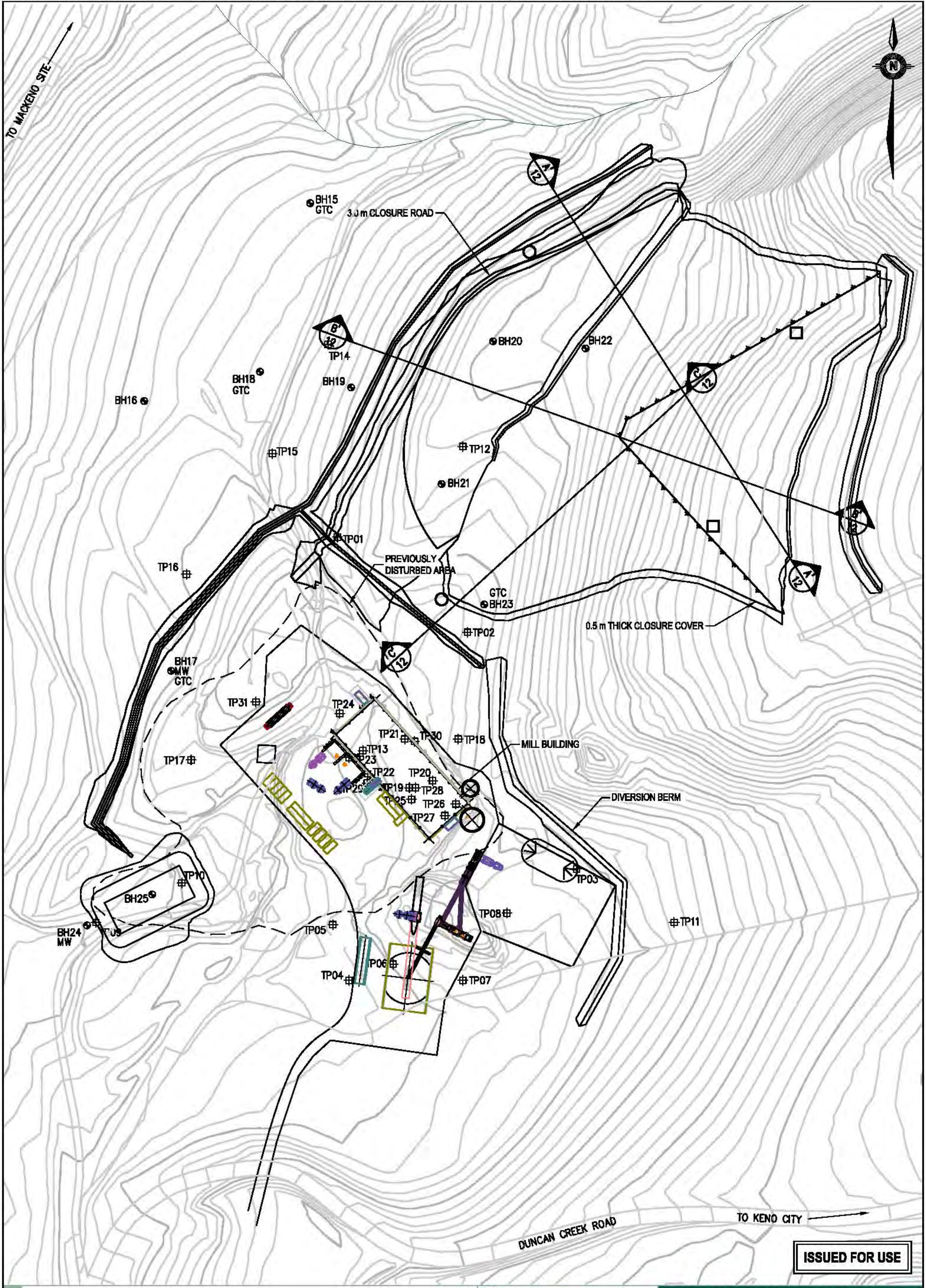


FIGURE 10
Borehole 23 - SA03 Thaw Consolidation Results

Q:\Whitehorse\Data\0201drawings\Keno\W14101176 Mill Site Search\3 Site Overview\W14101176.003 Engineering Support Services\W14101176003 Figs 2-12 13Jan10.dwg [FIGURE 11] January 14, 2010 - 11:32:36 am (BY: JAMES BUYCK)



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LEGEND

⊞ TESTPIT LOCATIONS

● BOREHOLE LOCATIONS

○ PROPOSED SLOPE INDICATOR INSTALLATION

□ PROPOSED GROUND TEMPERATURE CABLE AND SLOPE INDICATOR INSTALLATION

NOTES

1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

0 50

Scale: 1: 1 500 (metres)

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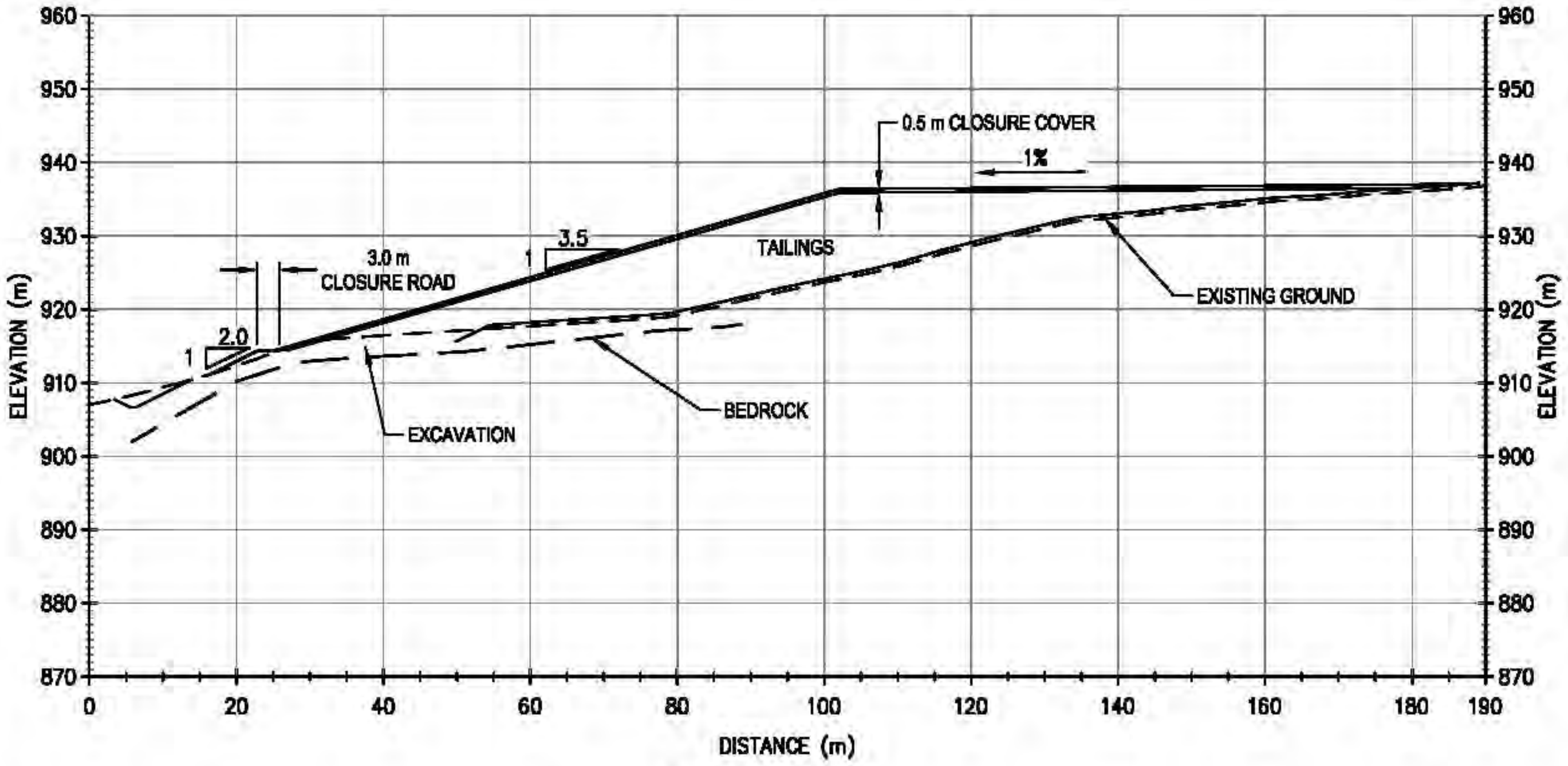
DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

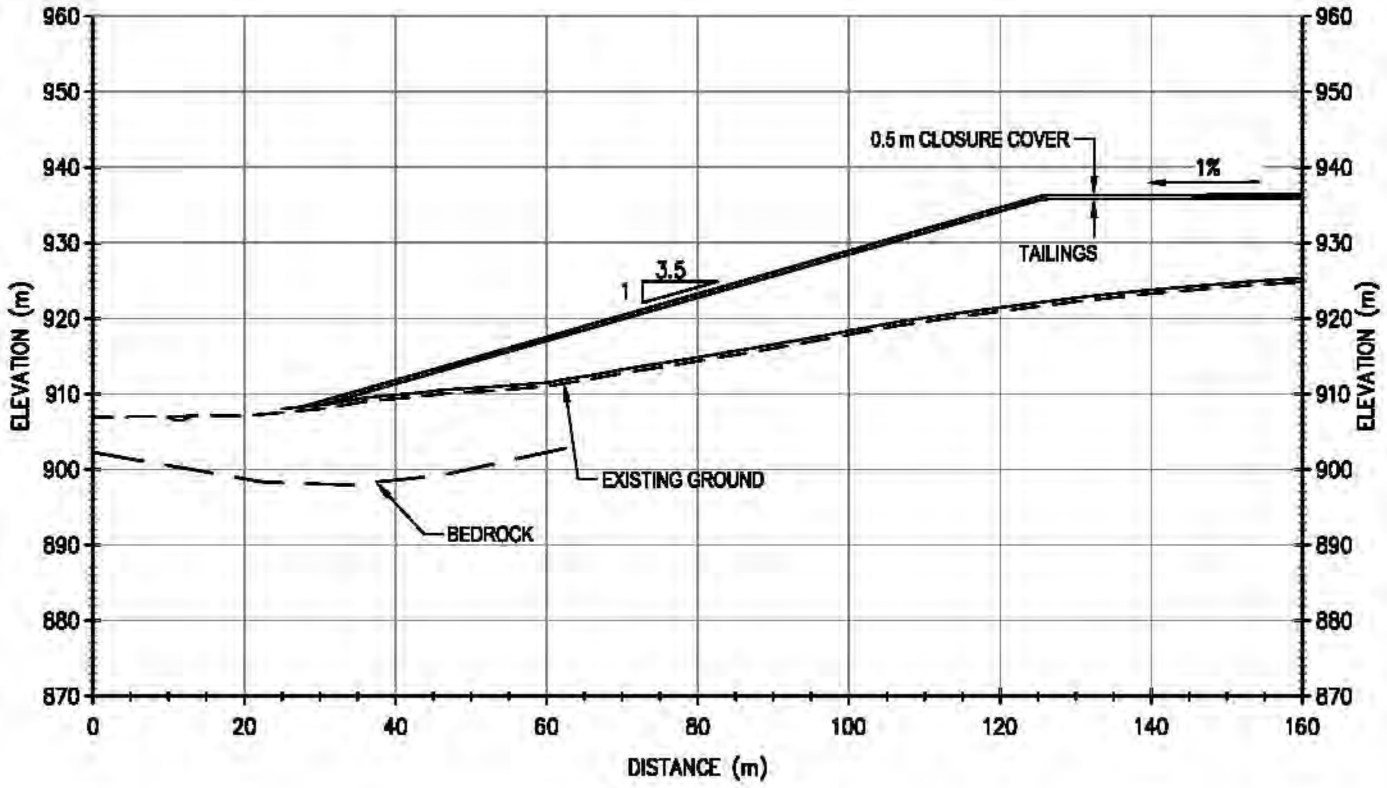
CLOSURE PLAN

PROJECT NO.	DWN	CKD	REV
W14101176.003	KJT	CJD	1
OFFICE	DATE		
EBA-WHSE	January 13, 2010		

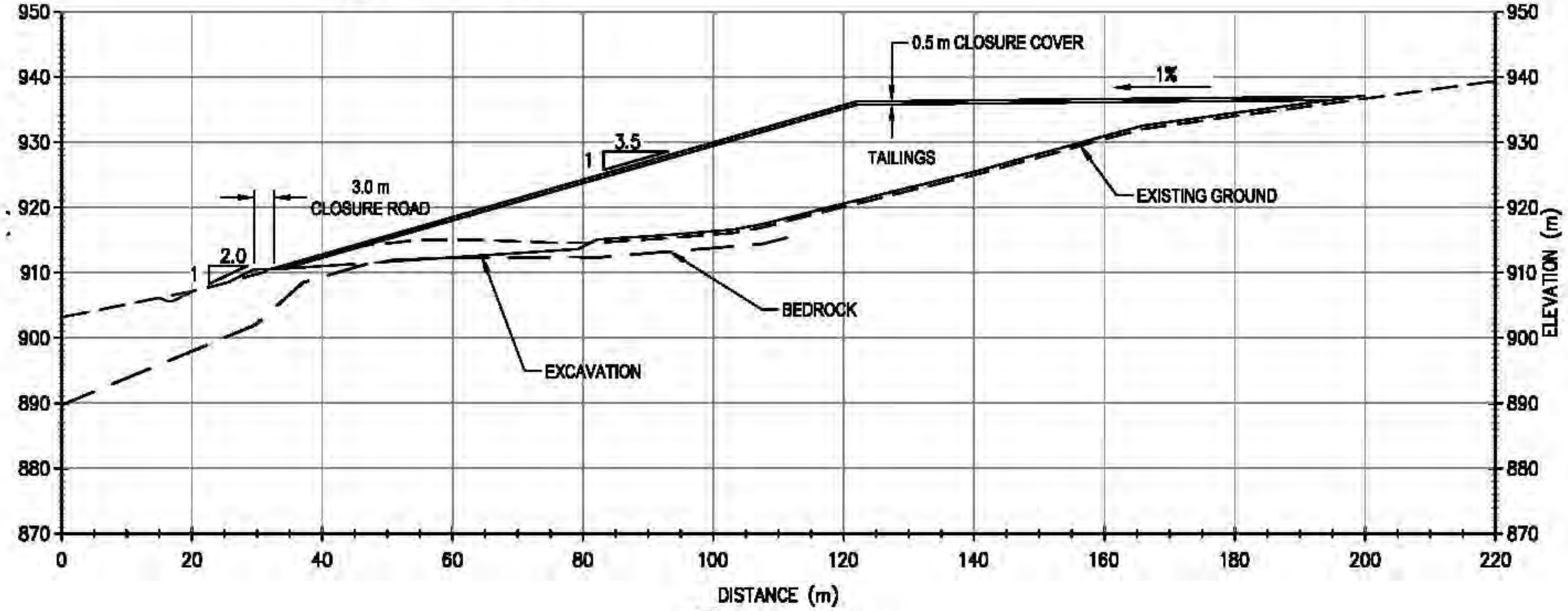
Figure 11



A' / 11 SECTION A
SCALE 1:1,000



C' / 11 SECTION C
SCALE 1:1,000



B' / 11 SECTION B
SCALE 1:1,000

ISSUED FOR USE

0 50
Scale: 1: 1000 (metres)

CLIENT
ALEXCO

EBA Engineering Consultants Ltd.

DRY-STACK TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

CLOSURE SECTIONS

PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	1

OFFICE	DATE
WHSE	January 13, 2010

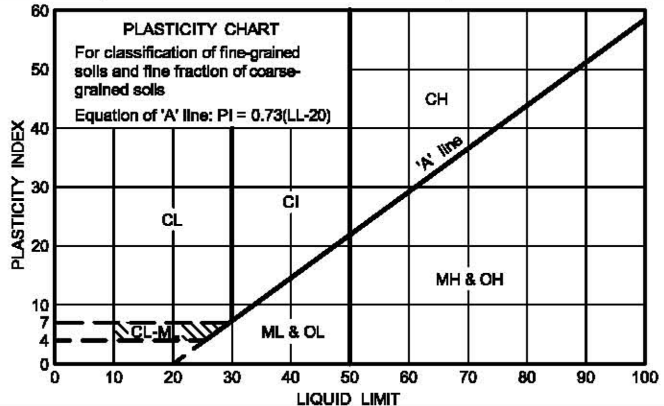
Figure 12

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.003 Engineering Support Services\W14101178003 Figs 2-12 13Jan10.dwg [FIGURE 12] January 14, 2010 - 11:33:32 am (BY: JAMES BUYCK)

APPENDIX A

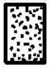
APPENDIX A TESTHOLE LOGS

MODIFIED UNIFIED SOIL CLASSIFICATION

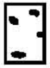
MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA		
COARSE - GRAINED SOILS More than 50% retained on No. 200 sieve*	GRAVELS 50% or more of coarse fraction retained on No. 4 sieve	CLEAN GRAVELS	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines Less than 5% pass No. 200 sieve GW, GP, SW, SP More than 12% pass No. 200 sieve GM, GC, SM, SC 5% to 12% pass No. 200 sieve Borderline classification requiring use of dual symbols	$C_u = D_{60} / D_{10}$ Greater than 4 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			GP	Poorly-graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterberg limits plot above 'A' line and plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes No. 4 sieve	CLEAN SANDS	SW	Well-graded sands and gravelly sands, little or no fines		$C_u = D_{60} / D_{10}$ Greater than 6 $C_c = \frac{(D_{30})^2}{D_{10} \times D_{60}}$ Between 1 and 3	
			SP	Poorly-graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures		Atterberg limits plot below 'A' line or plasticity index less than 4	Atterberg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterberg limits plot above 'A' line and plasticity index greater than 7	
FINE - GRAINED SOILS 50% or more passes No. 200 sieve*	SILTS AND CLAYS Liquid Limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands			
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	SILTS AND CLAYS Liquid Limit greater than50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clay of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils	* Based on the material passing the 3 in. (75 mm) sieve † ASTM Designation D 2487, for identification procedure see D 2488		

GROUND ICE DESCRIPTION

ICE NOT VISIBLE

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
N	Nf	Poorly-bonded or friable	
	Nbn	No excess ice, well- bonded	
	Nbe	Excess ice, well- bonded	

VISIBLE ICE LESS THAN 50% BY VOLUME

GROUP SYMBOLS	SYMBOLS	SUBGROUP DESCRIPTION	
V	Vx	Individual ice crystals or inclusions	
	Vc	Ice coatings on particles	
	Vr	Random or irregularly oriented ice formations	
	Vs	Stratified or distinctly oriented ice formations	

NOTES:

1. Dual symbols are used to indicate borderline or mixed ice classifications.
2. Visual estimates of ice contents indicated on borehole logs ± 5%
3. This system of ground ice description has been modified from NRC Technical Memo 79, Guide to the Field Description of Permafrost for Engineering Purposes.

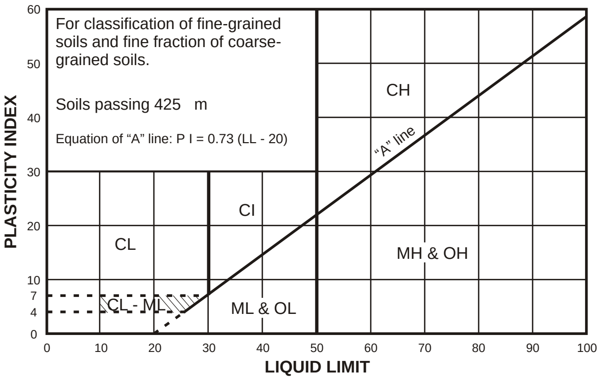
VISIBLE ICE GREATER THAN 50% BY VOLUME

ICE	ICE + Soil Type	Ice with soil inclusions	
	ICE	Ice without soil inclusions (greater than 25 mm (1 in.) thick	

LEGEND:

Soil ☐ Ice ■

MODIFIED UNIFIED SOIL CLASSIFICATION †

MAJOR DIVISIONS			GROUP SYMBOLS	TYPICAL NAMES	CLASSIFICATION CRITERIA		
COARSE-GRAINED SOILS More than 50% retained on No. 200 sieve*	**GRAVELS** 50% or more of coarse fraction retained on No. 4 sieve	**CLEAN GRAVELS**	GW	Well-graded gravels and gravel-sand mixtures, little or no fines	Classification on basis of percentage of fines Less than 5% Pass No. 200 sieve GW, GP, SW, SP More than 12% Pass No. 200 sieve GM, GC, SM, SC 5% to 12% Pass No. 200 sieve Bordering Classification requiring use of dual symbols	$C_U = D_{60}/D_{10}$ $C_U = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	Greater than 4 Between 1 and 3
			GP	Poorly graded gravels and gravel-sand mixtures, little or no fines		Not meeting both criteria for GW	
		GRAVELS WITH FINES	GM	Silty gravels, gravel-sand-silt mixtures		Atterburg limits plot below "A" line or plasticity index less than 4	Atterburg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			GC	Clayey gravels, gravel-sand-clay mixtures		Atterburg limits plot above "A" line or plasticity index greater than 7	
	SANDS More than 50% of coarse fraction passes No. 4 sieve	**CLEAN SANDS**	SW	Well-graded sands and gravelly sands,little or no fines		$C_U = D_{60}/D_{10}$ $C_U = \frac{(D_{30})^2}{D_{10} \times D_{60}}$	Greater than 6 Between 1 and 3
			SP	Poorly graded sands and gravelly sands, little or no fines		Not meeting both criteria for SW	
		SANDS WITH FINES	SM	Silty sands, sand-silt mixtures		Atterburg limits plot below "A" line or plasticity index less than 4	Atterburg limits plotting in hatched area are borderline classifications requiring use of dual symbols
			SC	Clayey sands, sand-clay mixtures		Atterburg limits plot above "A" line or plasticity index greater than 7	
FINE-GRAINED SOILS 50% or more passes No. 200 sieve*	**SILTS AND CLAYS** Liquid limit 50% or less		ML	Inorganic silts, very fine sands, rock flour, silty or clayey fine sands	PLASTICITY CHART  		
			CL	Inorganic clays of low to medium plasticity, gravelly clays, sandy clays, silty clays, lean clays			
			OL	Organic silts and organic silty clays of low plasticity			
	SILTS AND CLAYS Liquid limit greater than 50%		MH	Inorganic silts, micaceous or diatomaceous fine sands or silts, elastic silts			
			CH	Inorganic clays of high plasticity, fat clays			
			OH	Organic clays of medium to high plasticity			
HIGHLY ORGANIC SOILS			PT	Peat, muck and other highly organic soils	*Based on the material passing the 3 in. (75 mm) sieve †ASTM Designation D 2487, for identification procedure see D2488		

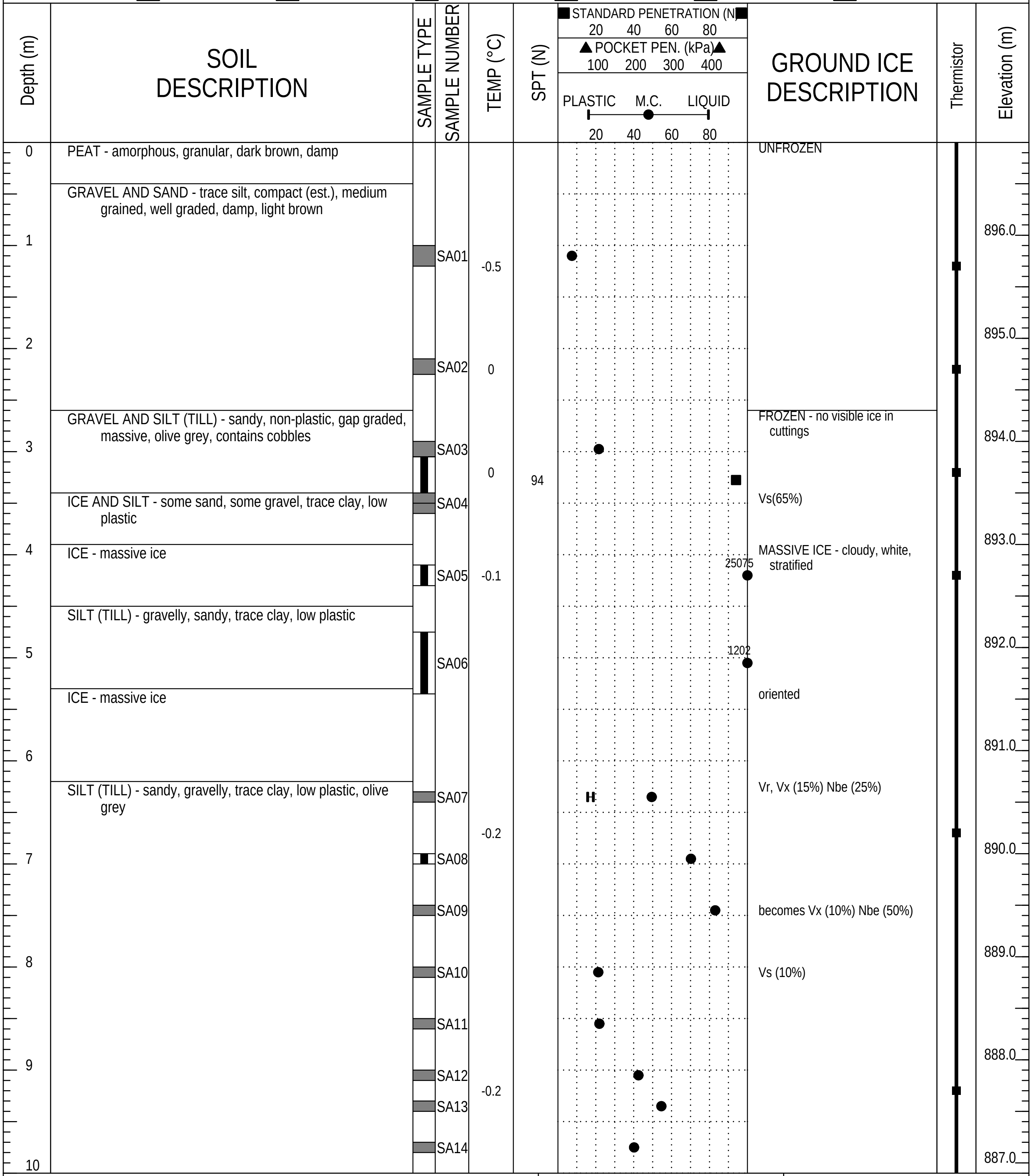
SOIL COMPONENTS				
FRACTION	SIEVE SIZE		DEFINING RANGES OF PERCENTAGE BY WEIGHT OF MINOR COMPONENTS	
	PASSING	RETAINED	PERCENTAGE	DESCRIPTOR
GRAVEL				
coarse	75 mm	19 mm	>35 %	"and"
fine	19 mm	4.75 mm	21 to 35 %	"y-adjective"
SAND			10 to 20 %	"some"
coarse	4.75 mm	2.00 mm	>0 to 10 %	"trace"
medium	2.00 mm	425 m		
fine	425 m	75 m		
SILT (non plastic) or CLAY (plastic)	75 m		as above but by behavior	

OVERSIZE MATERIAL	
Rounded or subrounded	
COBBLES	75 mm to 200 mm
BOULDERS	> 200 mm
Not rounded	
ROCK FRAGMENTS	>75 mm
ROCKS	> 0.76 cubic metre in volume

2046 - Revised July 07.cdr

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Lower Diversion Stucture	DRILL: Mini-Sonic	W14101178.003-BH15
Keno City, YT		ELEVATION: 896.9m

SAMPLE TYPE	▨ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND



PEAT - amorphous, granular, dark brown, damp

GRAVEL AND SAND - trace silt, compact (est.), medium grained, well graded, damp, light brown

GRAVEL AND SILT (TILL) - sandy, non-plastic, gap graded, massive, olive grey, contains cobbles

ICE AND SILT - some sand, some gravel, trace clay, low plastic

ICE - massive ice

SILT (TILL) - gravelly, sandy, trace clay, low plastic

ICE - massive ice

SILT (TILL) - sandy, gravelly, trace clay, low plastic, olive grey

UNFROZEN

FROZEN - no visible ice in cuttings

Vs(65%)

MASSIVE ICE - cloudy, white, stratified

oriented

Vr, Vx (15%) Nbe (25%)

becomes Vx (10%) Nbe (50%)

Vs (10%)

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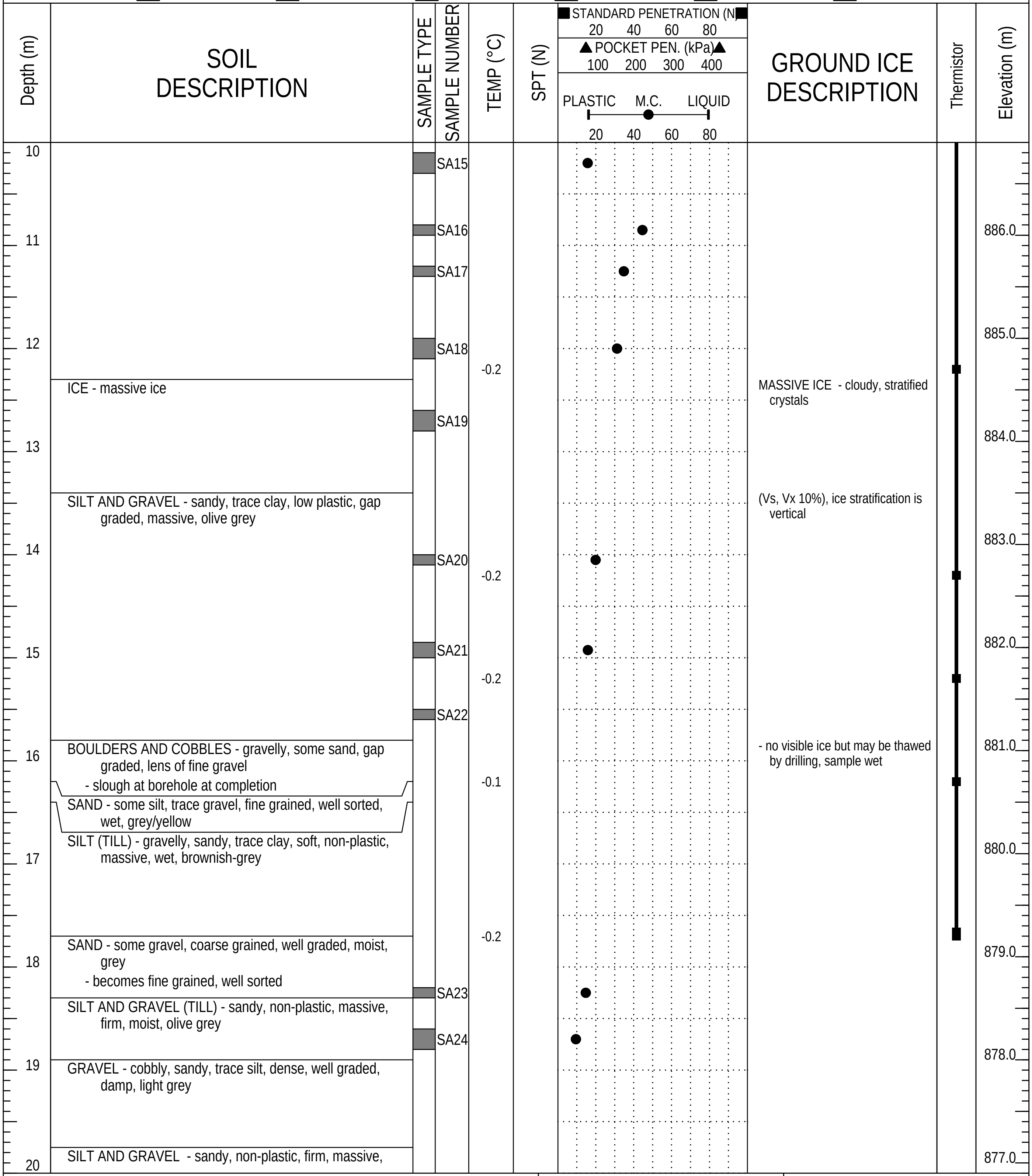
REVIEWED BY:	COMPLETE: 8/30/2009
DRAWING NO:	Page 1 of 3

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Lower Diversion Stucture	DRILL: Mini-Sonic	W14101178.003-BH15
Keno City, YT		ELEVATION: 896.9m

SAMPLE TYPE ▇ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▇ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND



ICE - massive ice

SILT AND GRAVEL - sandy, trace clay, low plastic, gap graded, massive, olive grey

BOULDERS AND COBBLES - gravelly, some sand, gap graded, lens of fine gravel

- slough at borehole at completion

SAND - some silt, trace gravel, fine grained, well sorted, wet, grey/yellow

SILT (TILL) - gravelly, sandy, trace clay, soft, non-plastic, massive, wet, brownish-grey

SAND - some gravel, coarse grained, well graded, moist, grey

- becomes fine grained, well sorted

SILT AND GRAVEL (TILL) - sandy, non-plastic, massive, firm, moist, olive grey

GRAVEL - cobbly, sandy, trace silt, dense, well graded, damp, light grey

SILT AND GRAVEL - sandy, non-plastic, firm, massive,

MASSIVE ICE - cloudy, stratified crystals

(Vs, Vx 10%), ice stratification is vertical

- no visible ice but may be thawed by drilling, sample wet

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 21.3m
	REVIEWED BY:	COMPLETE: 8/30/2009
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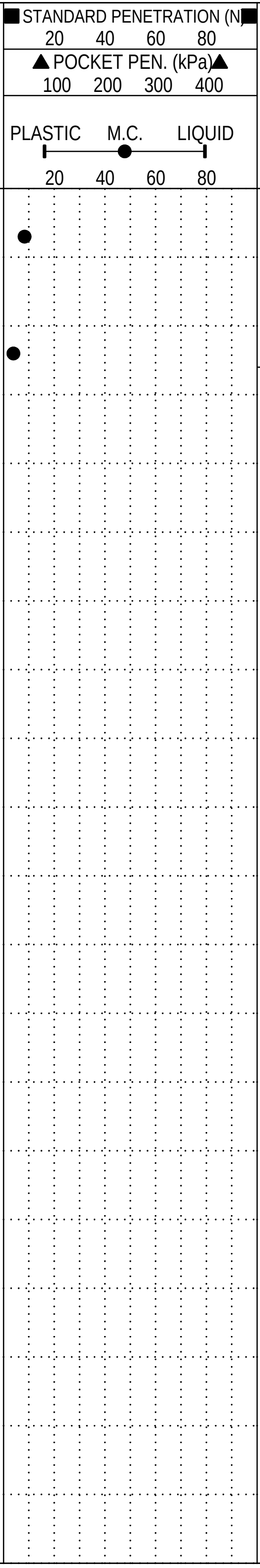
Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Lower Diversion Stucture	DRILL: Mini-Sonic	W14101178.003-BH15
Keno City, YT		ELEVATION: 896.9m

SAMPLE TYPE ▨ DISTURBED ◸ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	SPT (N)	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Thermistor	Elevation (m)
20	damp, olive grey								
		▨	SA25			●			
21	GRAVEL - sandy, cobbles, trace silt, dense, well graded, dry to damp, light brown, subrounded to subangular	▨	SA26			●			876.0
	END OF BOREHOLE 21.3 m								
22									875.0
23									874.0
24									873.0
25									872.0
26									871.0
27									870.0
28									869.0
29									868.0
30									867.0



EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 21.3m
	REVIEWED BY:	COMPLETE: 8/30/2009
	DRAWING NO:	Page 3 of 3

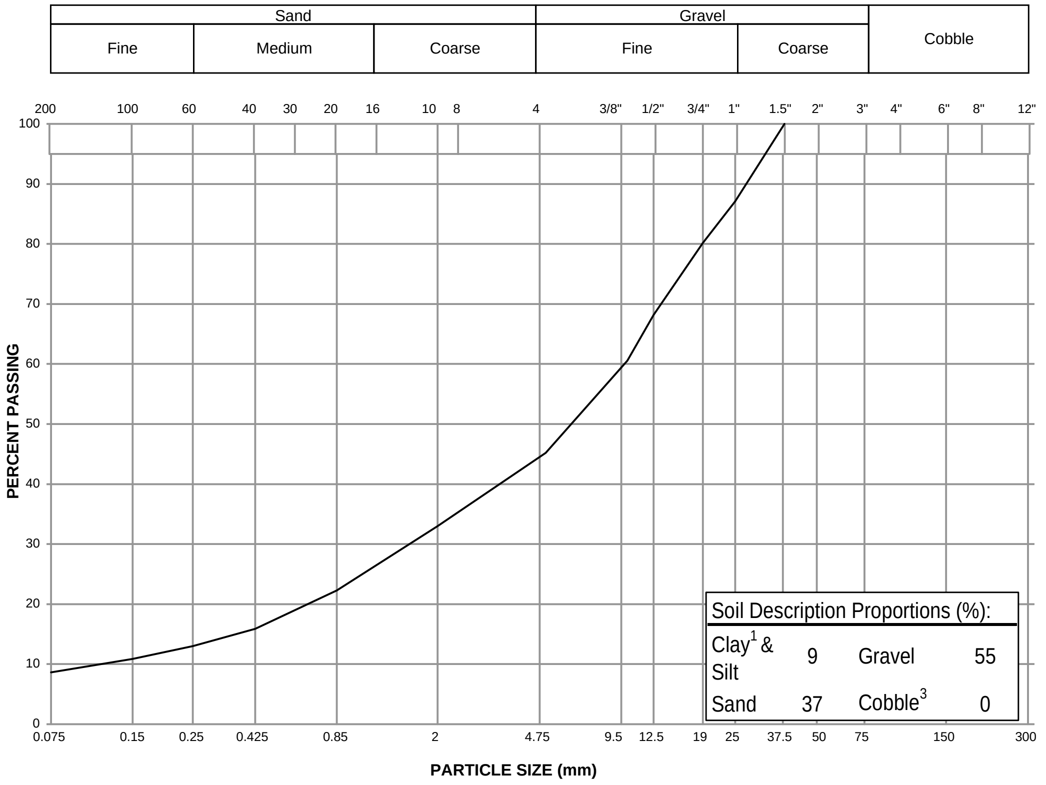
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:				Date Tested:	20-Oct-2009	By:	SMS
Sample No.:	SA01			Soil Description[2]:	GRAVEL AND SAND - trace silt		
Sample Loc.:	BH15						
Sample Depth:	1.0 - 1.2 m			USC Classification:		Cu:	81.0
Sampling Method:						Cc:	2.4
Date sampled:	Sep-09	By:	Client	Moisture Content:	7.4		

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	
50	
38	100
25	87
19	80
12.5	68
10	61
5	45
2	33
0.85	22
0.425	16
0.25	13
0.15	11
0.075	9



Soil Description Proportions (%):

Clay[1] & Silt	9	Gravel	55
Sand	37	Cobble[3]	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By:

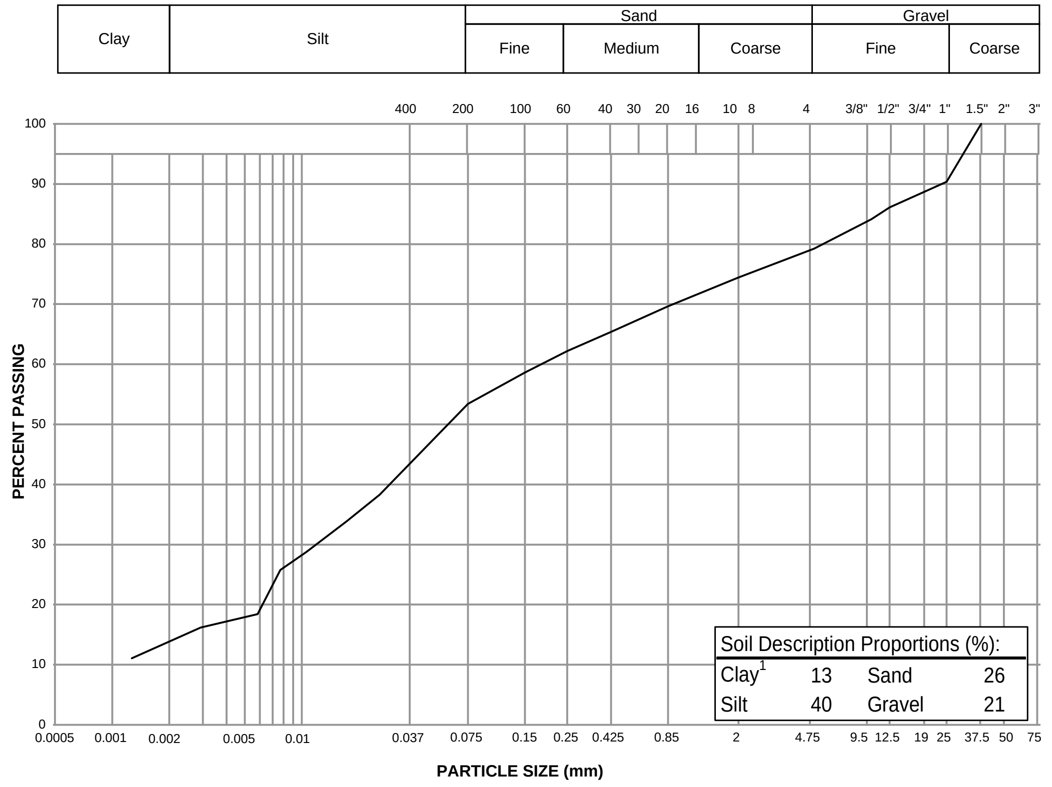
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:				Date Tested:	22-Oct-2009	By:	SMS
Sample No.:	SA08			Soil Description[2]:	SILT - sandy, gravelly, trace clay		
Sample Loc.:	BH15						
Sample Depth:	6.3 - 6.4 m			USC Classification:		Cu:	
Sampling Method:						Cc:	
Date sampled:	Sep-09	By:	Client	Moisture Content:	70.2		

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	90
19	
12.5	86
10	84
5	79
2	74
0.85	70
0.425	65
0.25	62
0.15	59
0.075	53
0.0256	38.3
0.0172	33.9
0.0105	28.7
0.0077	25.8
0.0058	18.4
0.0029	16.2
0.0013	11.1



Soil Description Proportions (%):

Clay[1]	13	Sand	26
Silt	40	Gravel	21

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ______

Remarks: ______

Reviewed By:

PARTICLE SIZE ANALYSIS TEST REPORT

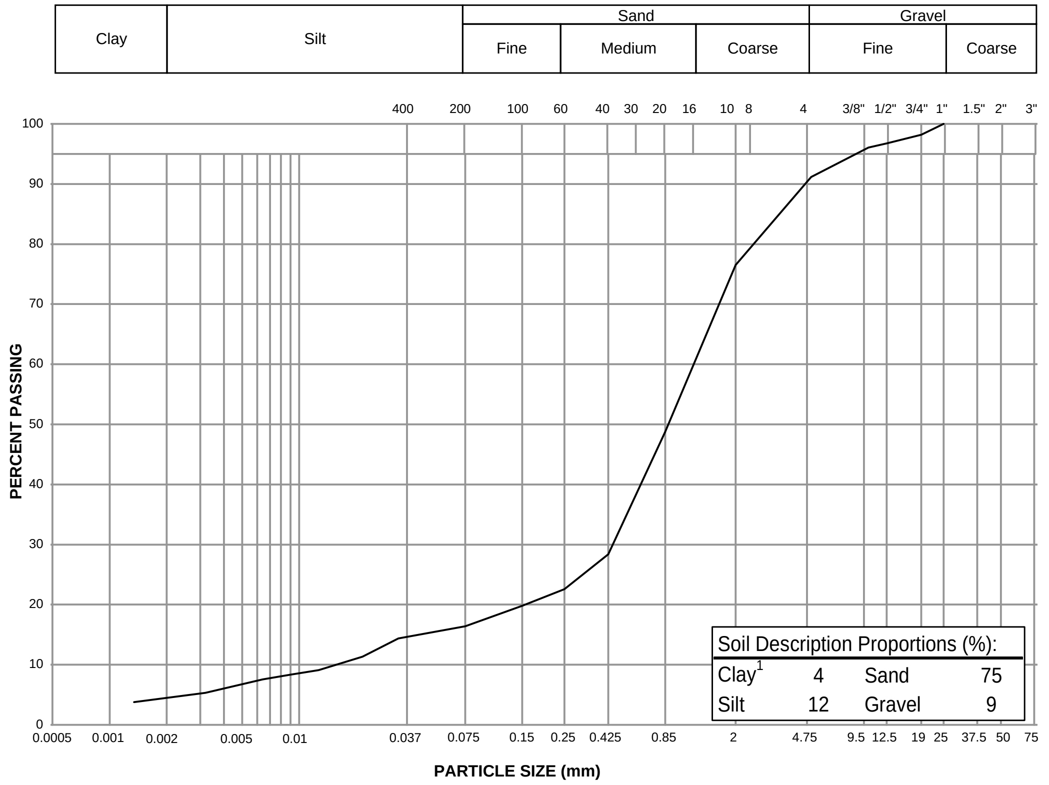
ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:
Sample No.: SA23
Sample Loc.: BH15
Sample Depth: 18.2 - 18.3 M
Sampling Method:
Date sampled: Sep-09 By: Client

Date Tested: 22-Oct-2009 By: SMS
Soil Description^2: SAND - some silt, trace gravel, trace clay
USC Classification:
Cu: 81.2
Cc: 9.9
Moisture Content: 1.3

Particle Size (mm)	Percent Passing
75	
50	
38	
25	100
19	98
12.5	97
10	96
5	91
2	77
0.85	49
0.425	28
0.25	23
0.15	20
0.075	16
0.0333	14.4
0.0215	11.4
0.0127	9.1
0.0090	8.3
0.0064	7.6
0.0032	5.3
0.0013	3.8



Soil Description Proportions (%):			
Clay^1	4	Sand	75
Silt	12	Gravel	9

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: __________

Remarks: __________

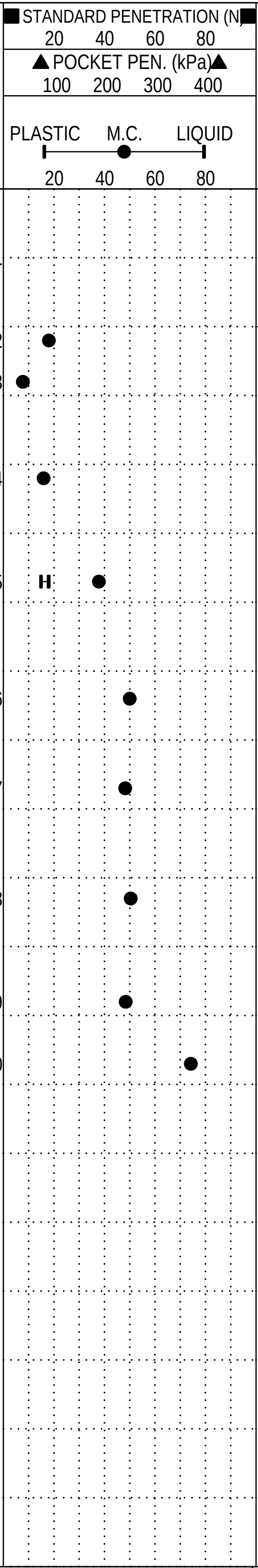
Reviewed By:

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Lower Diversion Stucture	DRILL: Mini-Sonic	W14101178.003-BH16
Keno City, YT		ELEVATION: 895.8m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	MOSS COVER - peat, black			UNFROZEN	
	GRAVEL AND SAND - some silt, well graded, subrounded gravel, medium to coarse sand, compact, moist, brown				
		▨	SA01		
					895.0
1					
	- colour changes to mottled grey around 1.0 m	▨	SA02	FROZEN - visible ice inclusions <5%, poorly bonded, partial thaw during drilling	
		▨	SA03		
	SAND (TILL) - some gravel, some silt, trace clay, medium to coarse sand, well graded, subrounded gravel, grey				
					894.0
2					
		▨	SA04		
				Vs, Vr (30%)	893.0
		▮	SA05		
3					
		▮	SA06		892.0
4					
		▮	SA07		
					891.0
5					
		▮	SA08		
					890.0
		▨	SA09		
6					
		▮	SA10		
	ICE - massive ice			MASSIVE ICE	
					889.0
7					
					888.0
8					
					887.0
9					
					886.0
10					



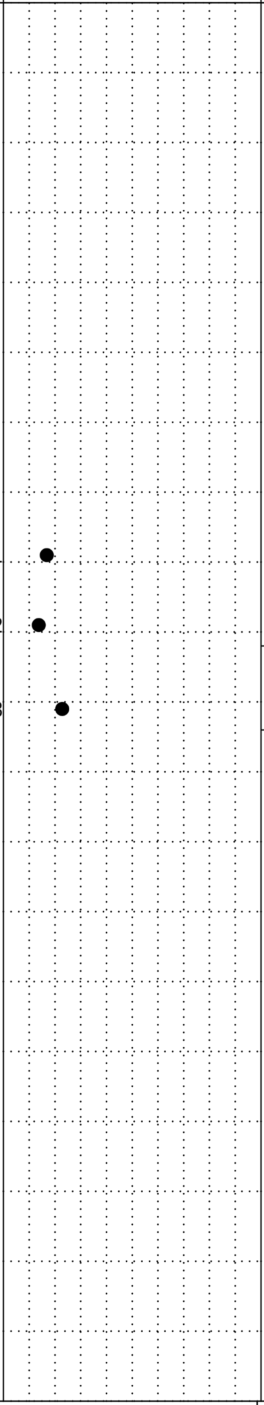
EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 15.2m
	REVIEWED BY:	COMPLETE: 9/7/2009
	DRAWING NO:	Page 1 of 2

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Lower Diversion Stucture	DRILL: Mini-Sonic	W14101178.003-BH16
Keno City, YT		ELEVATION: 895.8m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ◧ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
10						
11						885.0
	SAND (TILL) - some gravel, some silt, trace clay, medium to coarse sand, well graded, sub rounded gravel, grey				- visible ice inclusions <5%, well bonded	884.0
12						883.0
13						882.0
14		▨	SA11	●		
		▨	SA12	●	UNFROZEN	881.0
15		▨	SA13	●		
	END OF BOREHOLE 15.2 m					880.0
16						879.0
17						878.0
18						877.0
19						876.0
20						



EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 15.2m
	REVIEWED BY:	COMPLETE: 9/7/2009
	DRAWING NO:	Page 2 of 2

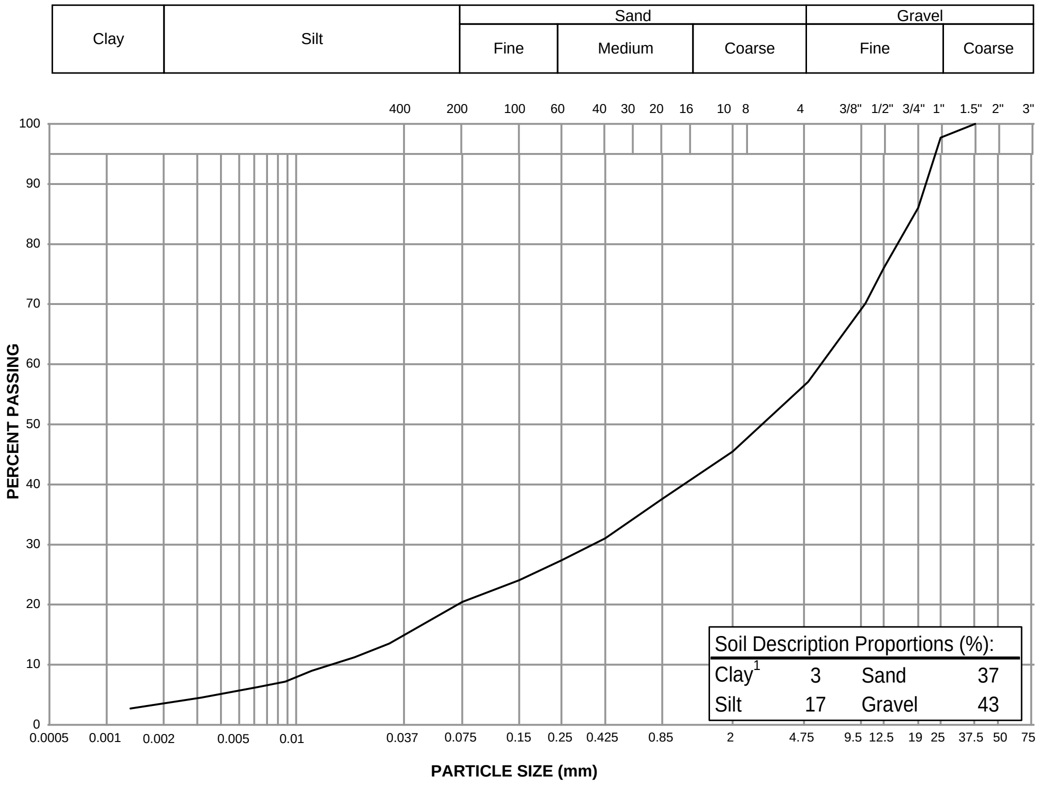
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:			Date Tested:	22-Oct-2009	By: SMS
Sample No.:	SA02		Soil Description²:	GRAVEL AND SAND - some silt, trace clay	
Sample Loc.:	BH16				
Sample Depth:	0.2 - 0.4 m		USC Classification:		Cu: 389.9
Sampling Method:					Cc: 1.5
Date sampled:	Sep-09	By: Client	Moisture Content:	10.0	

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	98
19	86
12.5	76
10	70
5	57
2	45
0.85	38
0.425	31
0.25	27
0.15	24
0.075	20
0.0310	13.5
0.0203	11.3
0.0121	9.0
0.0088	7.2
0.0063	6.3
0.0031	4.5
0.0013	2.7



Soil Description Proportions (%):			
Clay¹	3	Sand	37
Silt	17	Gravel	43

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ______

Remarks: ______

Reviewed By:

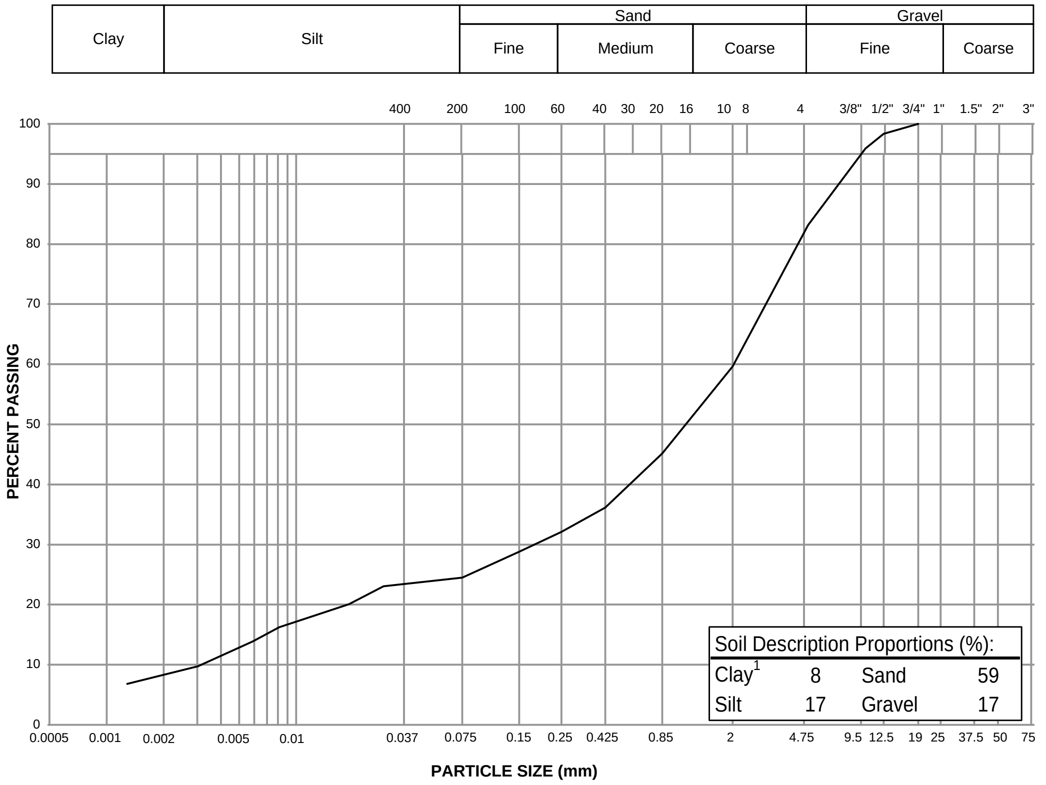
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:				Date Tested:	22-Oct-2009	By:	SMS
Sample No.:	SA05			Soil Description[2]:	SAND - some gravel, some silt, trace clay		
Sample Loc.:	BH16						
Sample Depth:	2.7 - 3.0 m			USC Classification:		Cu:	638.2
Sampling Method:						Cc:	5.3
Date sampled:	Sep-09	By:	Client	Moisture Content:	37.6		

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	100
12.5	98
10	96
5	83
2	60
0.85	45
0.425	36
0.25	32
0.15	29
0.075	25
0.0289	23.0
0.0190	20.1
0.0113	17.7
0.0081	16.2
0.0059	13.9
0.0030	9.7
0.0013	6.8



Soil Description Proportions (%):

Clay[1]	8	Sand	59
Silt	17	Gravel	17

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

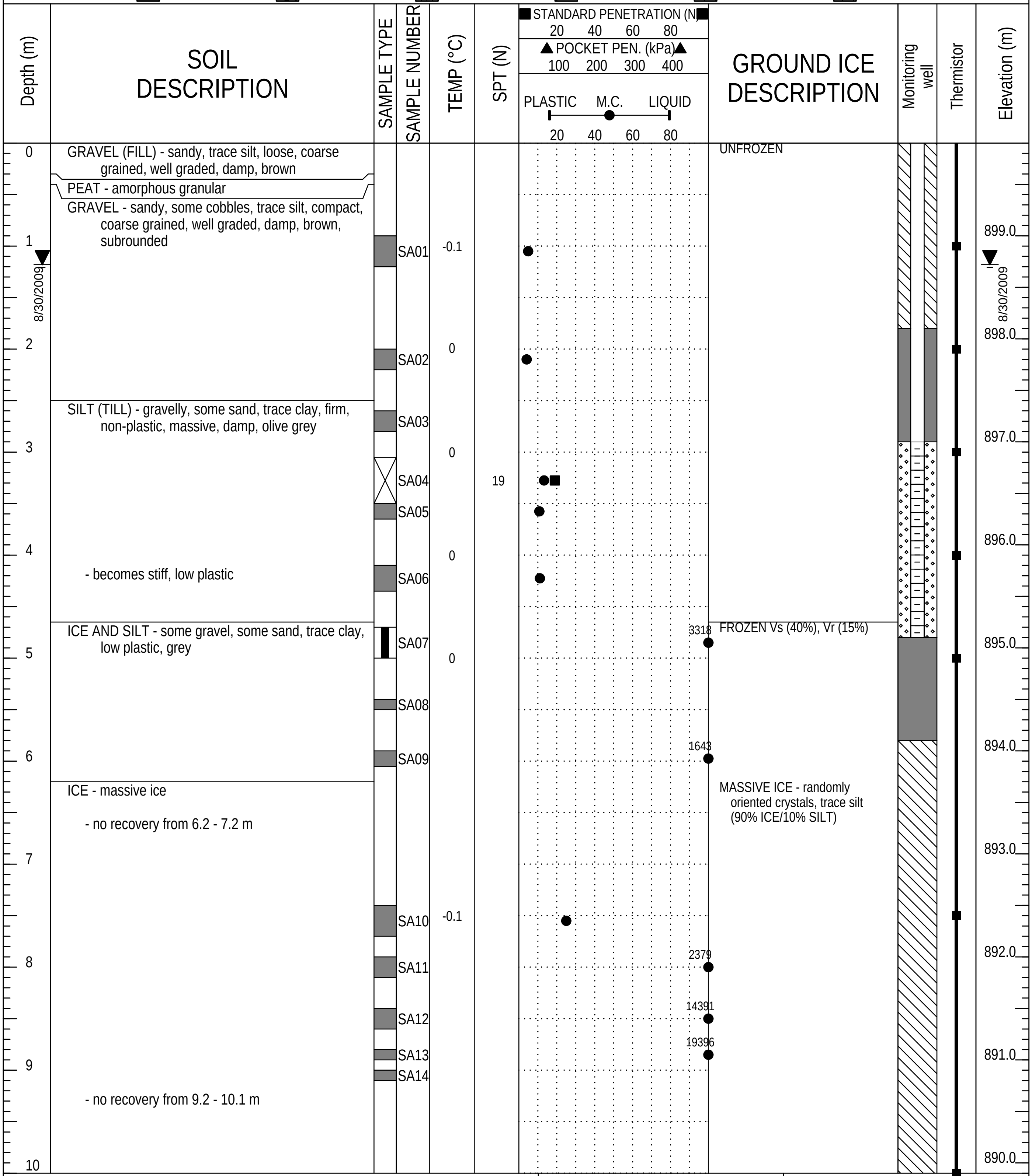
Specification: ____________________

Remarks: ____________________

Reviewed By:

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH17
Keno City, YT		ELEVATION: 899.9m

SAMPLE TYPE	▨ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND



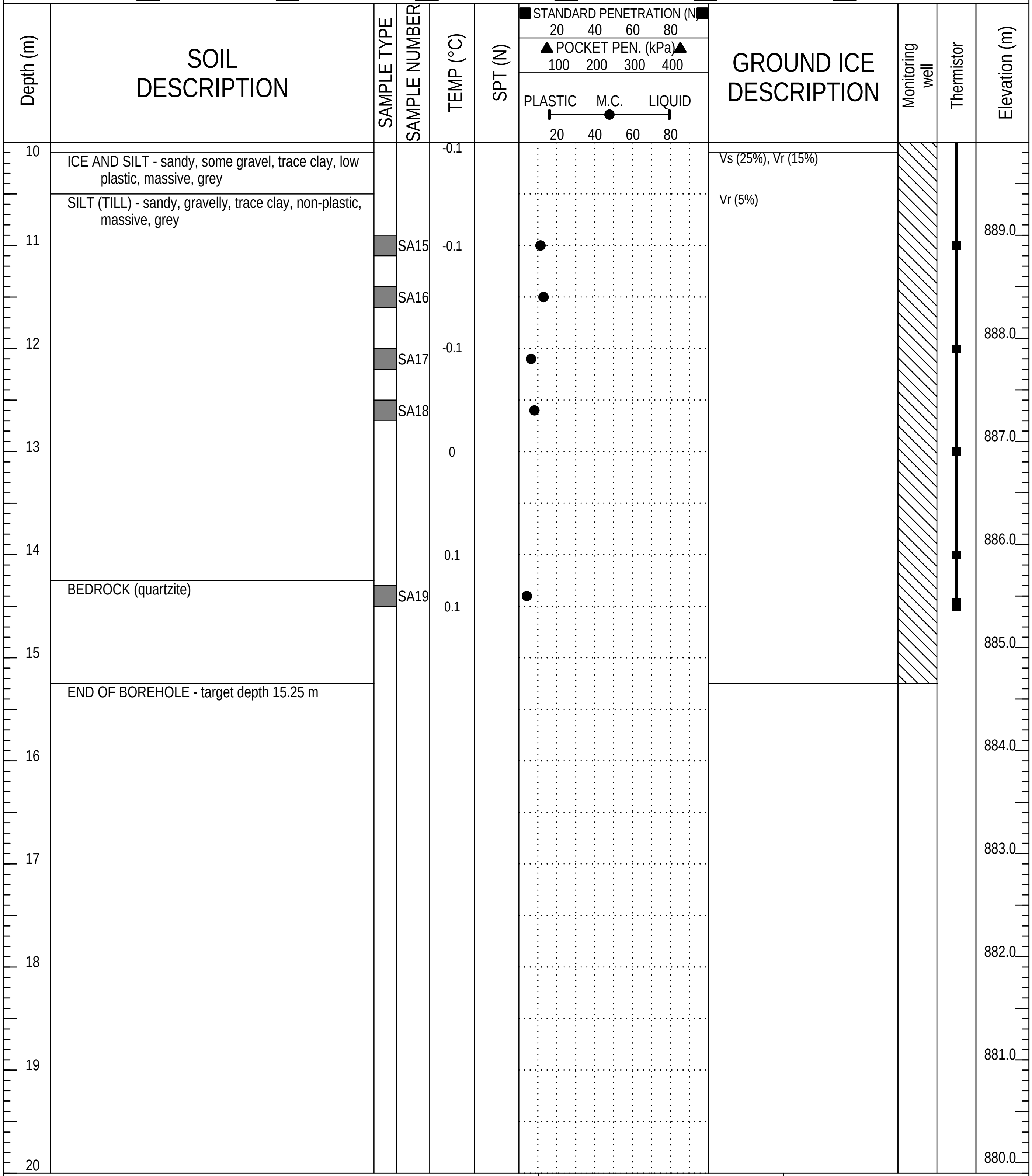
Depth (m)	SOIL DESCRIPTION	SAMPLE NUMBER	TEMP (°C)	SPT (N)	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL (FILL) - sandy, trace silt, loose, coarse grained, well graded, damp, brown				UNFROZEN	
	PEAT - amorphous granular					
	GRAVEL - sandy, some cobbles, trace silt, compact, coarse grained, well graded, damp, brown, subrounded					899.0
1		SA01	-0.1			
8/30/2009						8/30/2009
						898.0
2		SA02	0			
	SILT (TILL) - gravelly, some sand, trace clay, firm, non-plastic, massive, damp, olive grey	SA03				897.0
3			0			
		SA04		19		
		SA05				896.0
4			0			
	- becomes stiff, low plastic	SA06				
	ICE AND SILT - some gravel, some sand, trace clay, low plastic, grey	SA07			FROZEN Vs (40%), Vr (15%)	895.0
5			0			
		SA08				894.0
6		SA09				
	ICE - massive ice				MASSIVE ICE - randomly oriented crystals, trace silt (90% ICE/10% SILT)	
	- no recovery from 6.2 - 7.2 m					893.0
7						
		SA10	-0.1			892.0
8		SA11				
		SA12				891.0
		SA13				
9		SA14				
	- no recovery from 9.2 - 10.1 m					
10						890.0

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 15.25m
	REVIEWED BY:	COMPLETE: 8/30/2009
	DRAWING NO:	Page 1 of 2

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH17
Keno City, YT		ELEVATION: 899.9m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND



Depth (m)	Soil Description	Sample Number	Temp (°C)	Ground Ice Description
10	ICE AND SILT - sandy, some gravel, trace clay, low plastic, massive, grey		-0.1	Vs (25%), Vr (15%)
	SILT (TILL) - sandy, gravelly, trace clay, non-plastic, massive, grey			Vr (5%)
11		SA15	-0.1	
		SA16		
12		SA17	-0.1	
		SA18		
13			0	
14			0.1	
	BEDROCK (quartzite)	SA19	0.1	
15	END OF BOREHOLE - target depth 15.25 m			

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 15.25m
	REVIEWED BY:	COMPLETE: 8/30/2009
	DRAWING NO:	Page 2 of 2

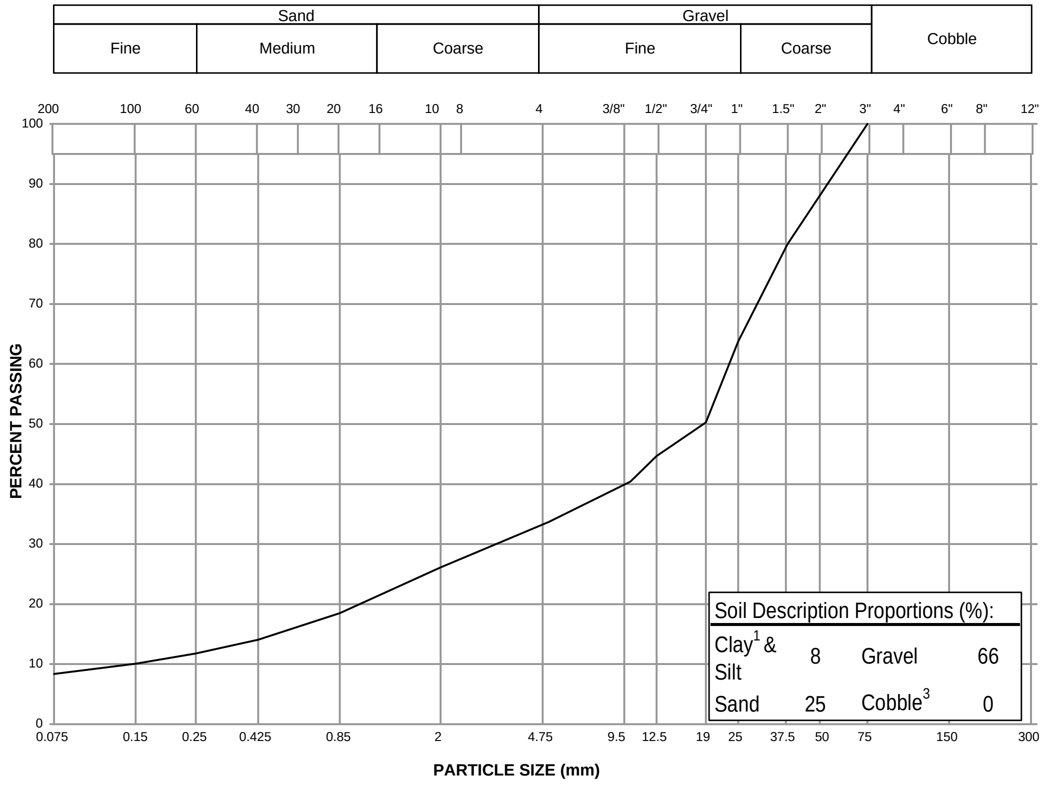
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project: Flame & Moth DSTF Drilling
Project No.: W14101178.003
Site: Keno City, YT
Client: Alexco Resource Corp
Client Rep.:

Material Type:
Sample No.: SA01
Sample Loc.: BH17
Sample Depth: 0.9 - 1.2 m
Sampling Method:
Date sampled: Sep-09 By: Client
Date Tested: 22-Oct-2009 By: SMS
Soil Description[2]: GRAVEL - sandy, trace silt
USC Classification:
Cu: 158.7
Cc: 3.6
Moisture Content: 4.6

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	80
25	64
19	50
12.5	45
10	40
5	34
2	26
0.85	18
0.425	14
0.25	12
0.15	10
0.075	8



Soil Description Proportions (%):

Clay[1] & Silt	8	Gravel	66
Sand	25	Cobble[3]	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification:

Remarks:

Reviewed By:

EBA Engineering
Consultants Ltd.

PARTICLE SIZE ANALYSIS TEST REPORT

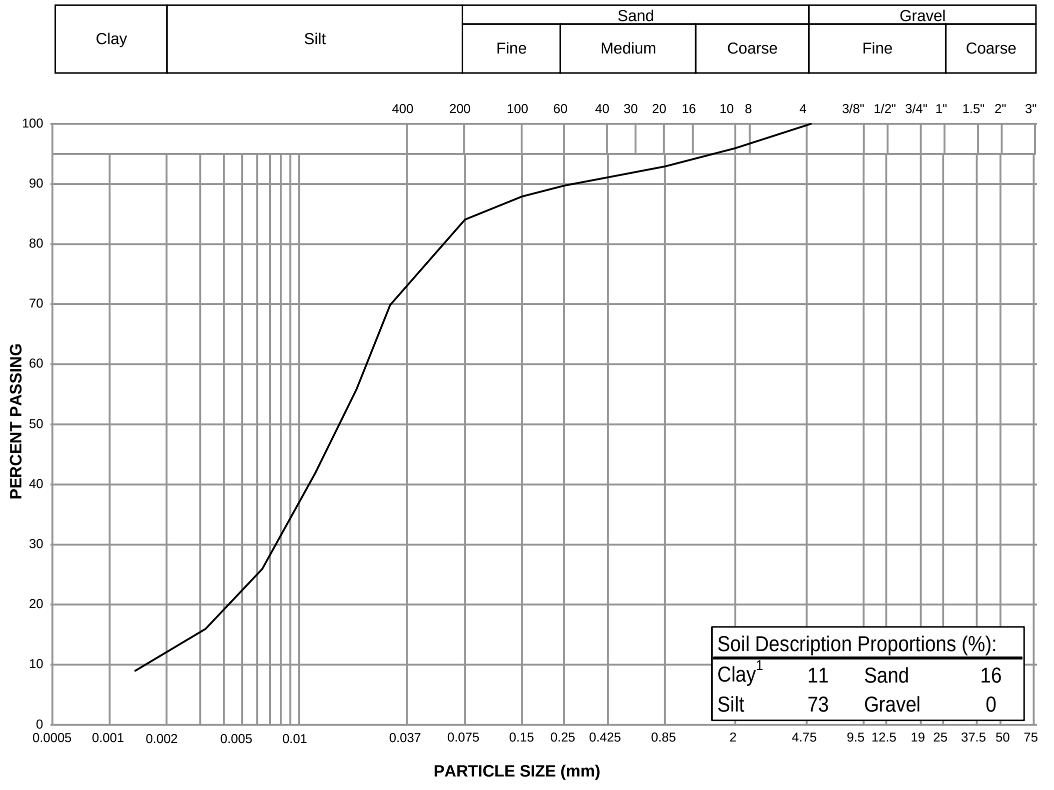
ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:
Sample No.: SA08
Sample Loc.: BH17
Sample Depth: 5.4 - 5.5
Sampling Method:
Date sampled: Sep-09 By: Client

Date Tested: 2-Nov-2009 By: SMS
Soil Description[2]: SILT - some sand, some clay
USC Classification:
Cu: 14.1
Cc: 1.5
Moisture Content:

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	
10	
5	100
2	96
0.85	93
0.425	91
0.25	90
0.15	88
0.075	84
0.0302	69.8
0.0201	55.9
0.0122	41.9
0.0088	33.9
0.0064	25.9
0.0032	16.0
0.0014	9.0



Soil Description Proportions (%):

Clay[1]	11	Sand	16
Silt	73	Gravel	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ______________________

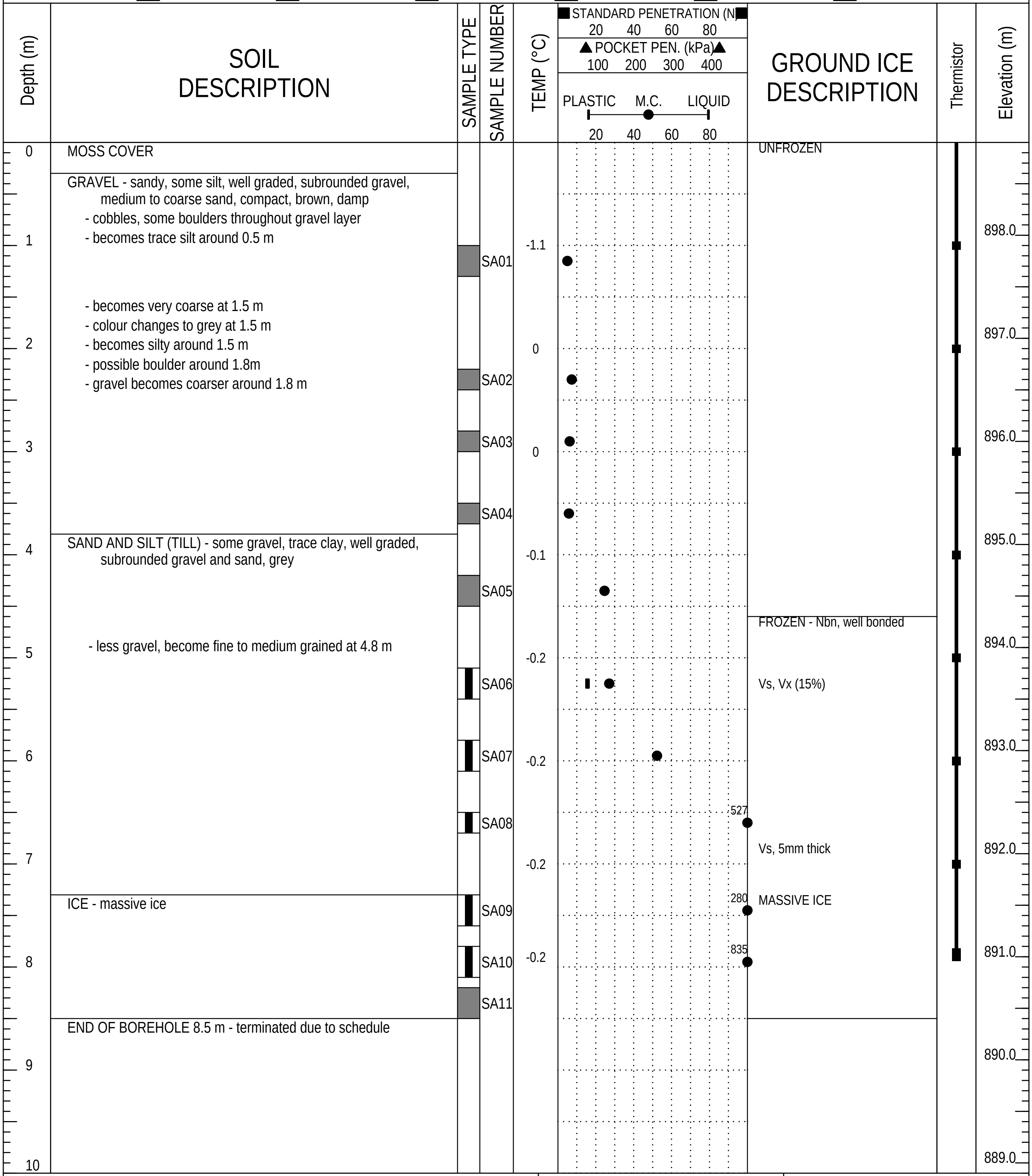
Remarks: ______________________

Reviewed By:

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Lower Diversion Stucture	DRILL: Mini-Sonic	W14101178.003-BH18
Keno City, YT		ELEVATION: 898.9m

SAMPLE TYPE ▨ DISTURBED ▨ NO RECOVERY ☒ SPT ▤ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▨ DRILL CUTTINGS ▨ SAND



MOSS COVER

GRAVEL - sandy, some silt, well graded, subrounded gravel, medium to coarse sand, compact, brown, damp
- cobbles, some boulders throughout gravel layer
- becomes trace silt around 0.5 m
- becomes very coarse at 1.5 m
- colour changes to grey at 1.5 m
- becomes silty around 1.5 m
- possible boulder around 1.8m
- gravel becomes coarser around 1.8 m

SAND AND SILT (TILL) - some gravel, trace clay, well graded, subrounded gravel and sand, grey
- less gravel, become fine to medium grained at 4.8 m

ICE - massive ice

END OF BOREHOLE 8.5 m - terminated due to schedule

UNFROZEN

FROZEN - Nbn, well bonded

Vs, Vx (15%)

Vs, 5mm thick

MASSIVE ICE

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 8.5m
	REVIEWED BY:	COMPLETE: 9/2/2009
	DRAWING NO:	Page 1 of 1

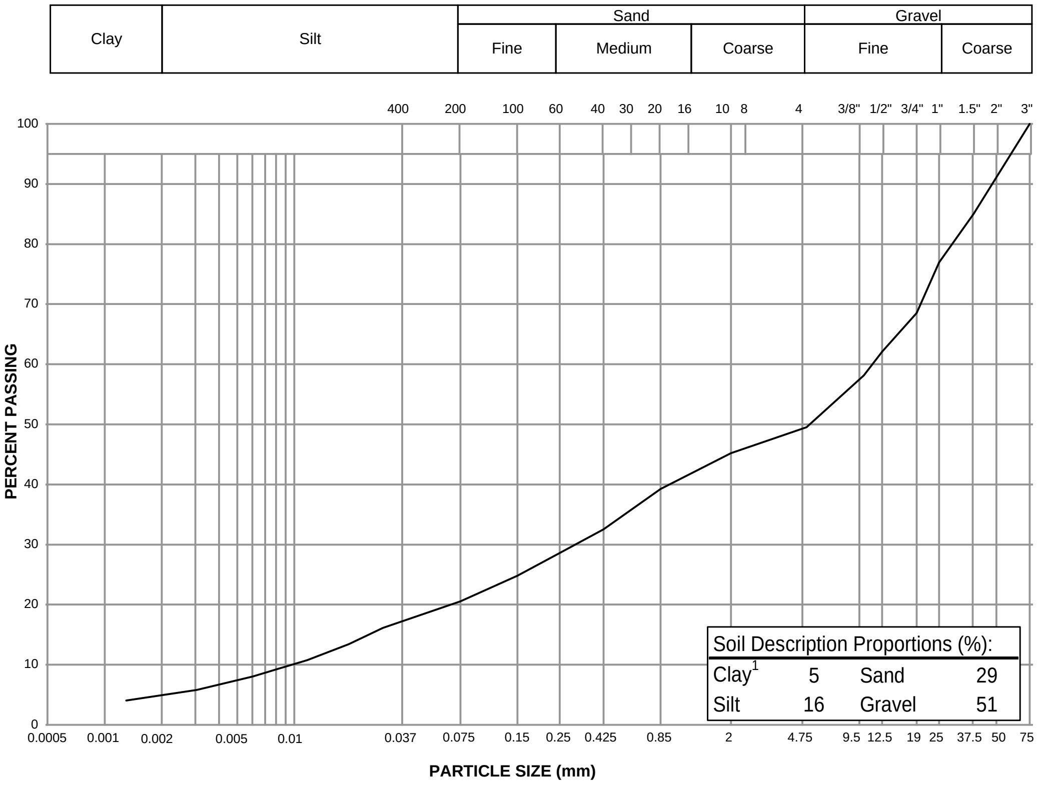
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:				Date Tested:	22-Oct-2009	By:	SMS
Sample No.:	SA02			Soil Description[2]:	GRAVEL - sandy, some silt, trace clay		
Sample Loc.:	BH18						
Sample Depth:	2.2 - 2.4 m			USC Classification:		Cu:	1133.5
Sampling Method:						Cc:	0.9
Date sampled:	Sep-09	By:	Client	Moisture Content:	0.0		

Particle Size (mm)	Percent Passing
75	100
50	
38	85
25	77
19	69
12.5	62
10	58
5	50
2	45
0.85	39
0.425	33
0.25	29
0.15	25
0.075	21
0.0292	16.1
0.0194	13.4
0.0117	10.7
0.0084	9.4
0.0060	8.1
0.0031	5.8
0.0013	4.0



Soil Description Proportions (%):			
Clay[1]	5	Sand	29
Silt	16	Gravel	51

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification:

Remarks:

Reviewed By:

EBA Engineering
Consultants Ltd.

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

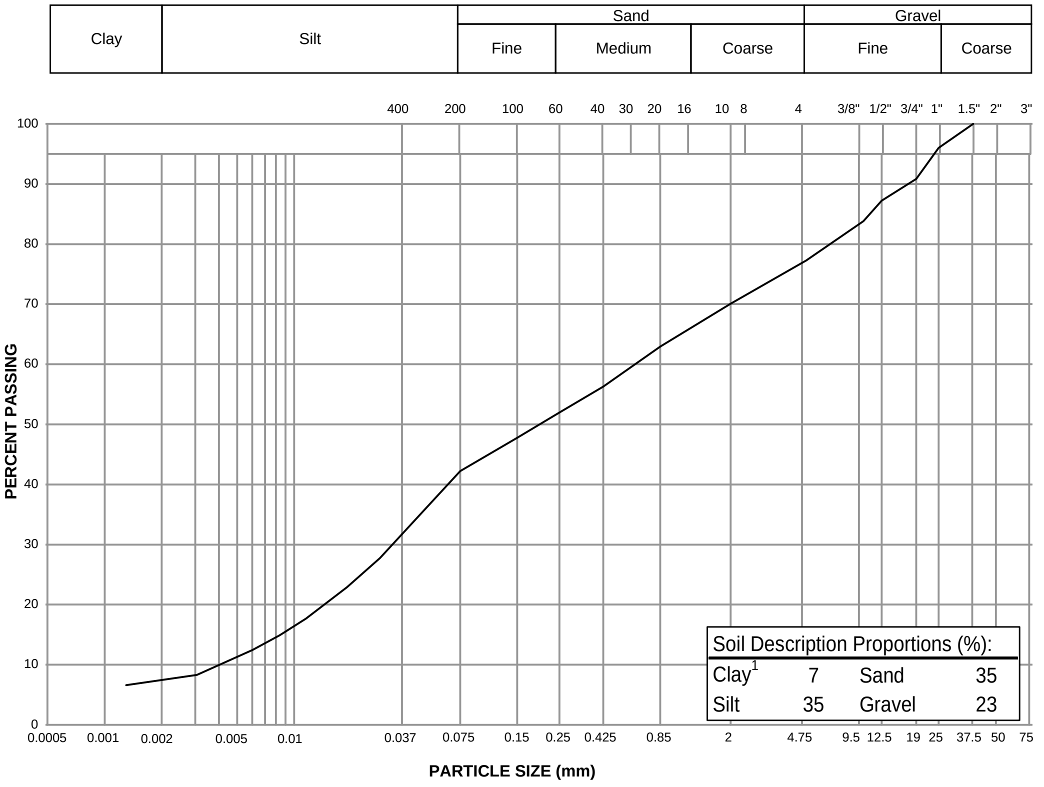
Project: Flame & Moth DSTF Drilling
Project No.: W14101178.003
Site: Keno City, YT

Client: Alexco Resource Corp
Client Rep.:

Material Type:
Sample No.: SA06
Sample Loc.: BH18
Sample Depth: 5.1 - 5.4
Sampling Method:
Date sampled: Sep-09 By: Client

Date Tested: 22-Oct-2009 By: SMS
Soil Description[2]: SAND AND SILT - some gravel, trace clay
USC Classification:
Cu: 155.7
Cc: 0.4
Moisture Content: 27.1

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	96
19	91
12.5	87
10	84
5	77
2	70
0.85	63
0.425	56
0.25	52
0.15	48
0.075	42
0.0282	27.7
0.0189	22.9
0.0115	17.7
0.0084	14.9
0.0060	12.5
0.0031	8.3
0.0013	6.6



Soil Description Proportions (%):

Clay[1]	7	Sand	35
Silt	35	Gravel	23

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ____________________

Remarks: ____________________

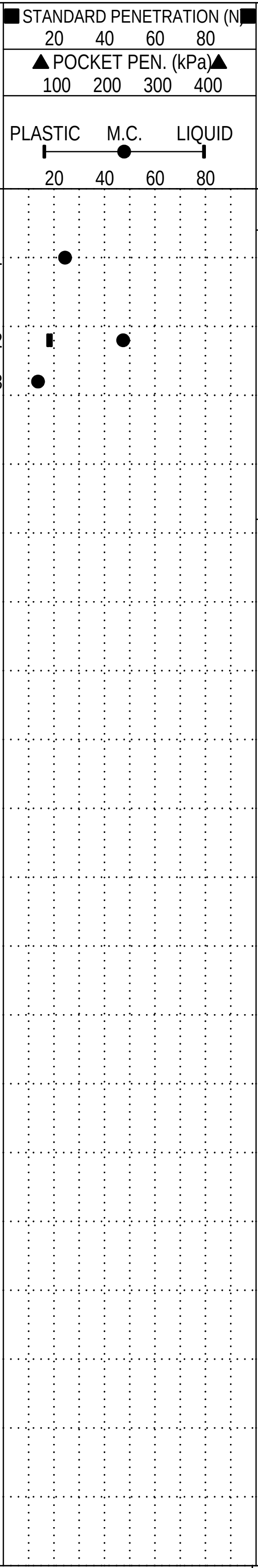
Reviewed By:

EBA Engineering
Consultants Ltd.

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH19
Keno City, YT		

SAMPLE TYPE	▨ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	◨ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁖ GROUT	▧ DRILL CUTTINGS	⁙ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Depth (ft)
0	MOSS COVER - peat, black			UNFROZEN	0
	SILT (TILL) - sandy, some gravel, trace clay, non-plastic, massive grey			FROZEN Vr (10%)	
		▨	SA01		
1					
		▨	SA02	Vr (40%)	
		▨	SA03		5
2					
	END OF BOREHOLE 2.4 m (REFUSAL)				
3					10
4					
					15
5					
6					20
7					
					25
8					
9					30
10					33



EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 2.4m
	REVIEWED BY:	COMPLETE: 9/2/2009
	DRAWING NO:	Page 1 of 1

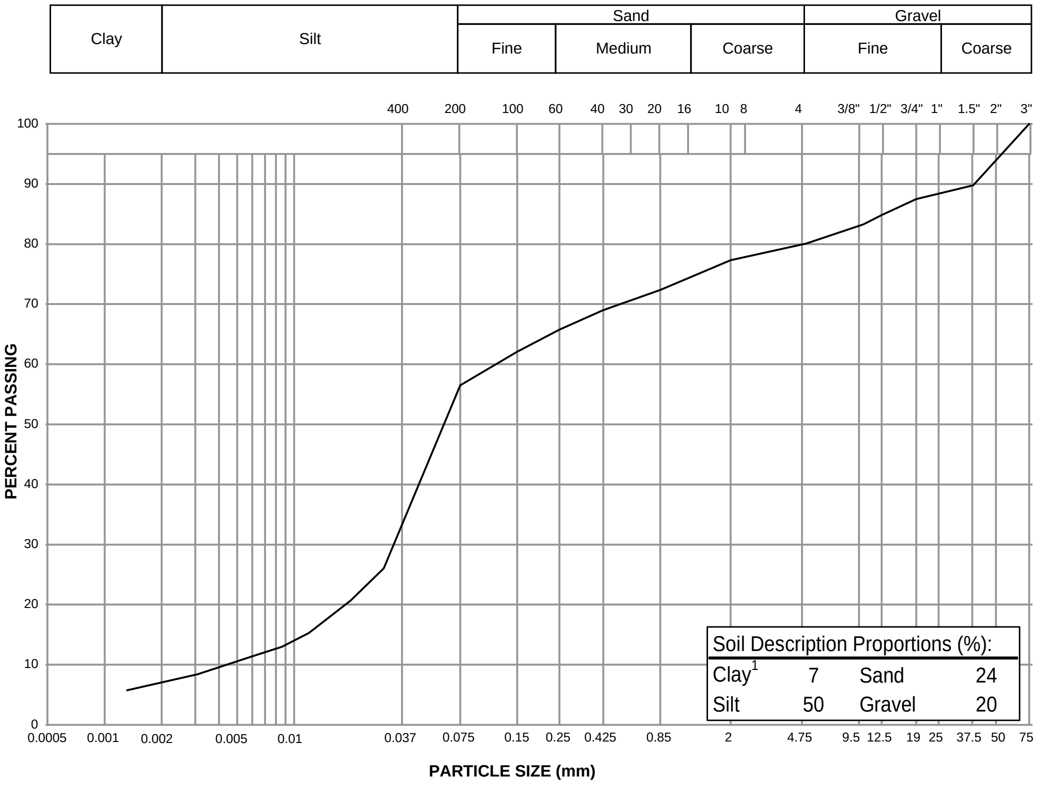
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:				Date Tested:	22-Oct-2009	By:	SMS
Sample No.:	SA02			Soil Description^2:	SILT - sandy, some gravel, trace clay		
Sample Loc.:	BH19						
Sample Depth:	1.0 - 1.2			USC Classification:		Cu:	26.2
Sampling Method:						Cc:	2.2
Date sampled:	Sep-09	By:	Client	Moisture Content:	47.4		

Particle Size (mm)	Percent Passing
75	100
50	
38	90
25	
19	87
12.5	85
10	83
5	80
2	77
0.85	72
0.425	69
0.25	66
0.15	62
0.075	57
0.0297	26.0
0.0198	20.7
0.0119	15.3
0.0086	13.0
0.0061	11.5
0.0031	8.4
0.0013	5.7



Soil Description Proportions (%):

Clay^1	7	Sand	24
Silt	50	Gravel	20

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ______________________________

Remarks: ______________________________

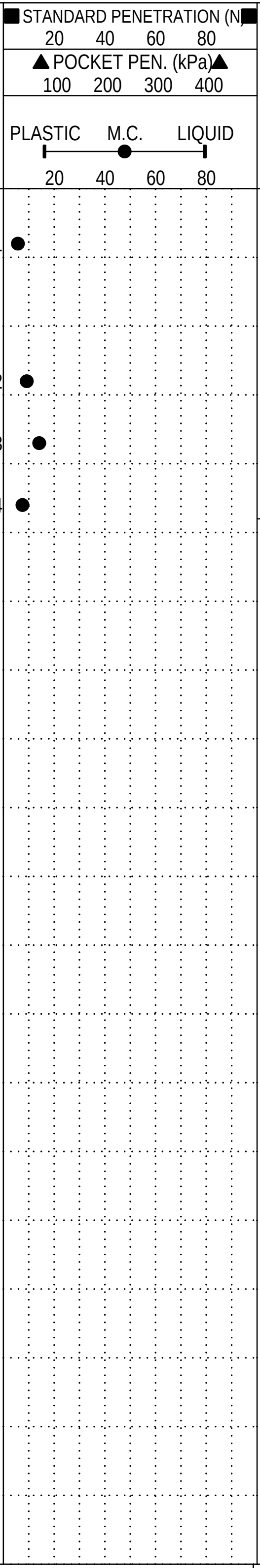
Reviewed By:

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH20
Keno City, YT		

SAMPLE TYPE ▨ DISTURBED ◸ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Depth (ft)
0	GRAVEL - sandy, trace silt, well graded, sand and gravel angular to subangular, compact, damp, brown			UNFROZEN	0
		▨	SA01		
1	- gravel content increases from 0.5 to 1.2 m - becomes moist around 0.8 m - shale particles below 1.2 m to 1.7 m				
		▨	SA02		5
2	SILT (TILL) - sandy, some gravel, trace clay, well graded sand, fine to medium grained, subrounded gravel, stiff, moist, grey	▨	SA03		
		▨	SA04		
	END OF BOREHOLE 2.4 m - hard drilling at 2.4 m, possible boulder or bedrock				
3					10
4					15
5					
6					20
7					25
8					
9					30
10					33



EBA Engineering Consultants Ltd.

LOGGED BY: CJD	COMPLETION DEPTH: 2.4m
REVIEWED BY:	COMPLETE: 9/1/2009
DRAWING NO:	Page 1 of 1

PARTICLE SIZE ANALYSIS TEST REPORT

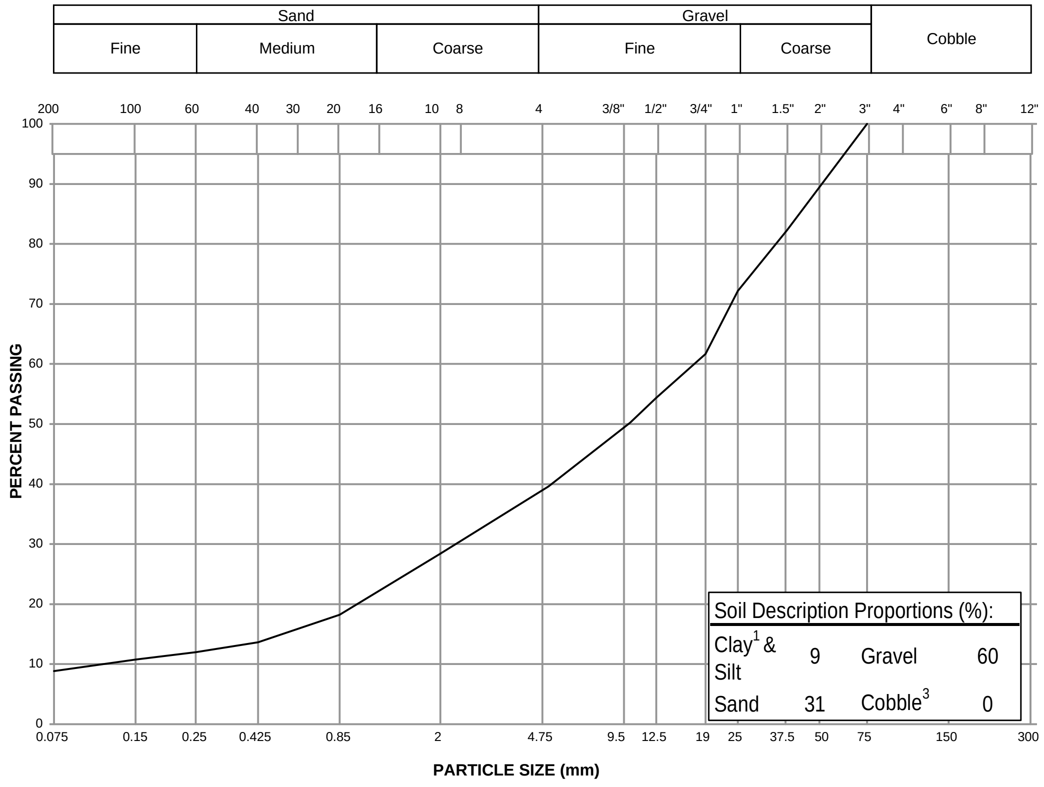
ASTM D422 & C136

Project: Flame & Moth DSTF Drilling
Project No.: W14101178.003
Site: Keno City, YT
Client: Alexco Resource Corp
Client Rep.:

Material Type:
Sample No.: SA01
Sample Loc.: BH20
Sample Depth: 0.3 - 0.5 m
Sampling Method:
Date sampled: Sep-09 By: Client

Date Tested: 22-Oct-2009 By: SMS
Soil Description^{2}: GRAVEL - sandy, trace silt
USC Classification:
Cu: 145.6
Cc: 2.8
Moisture Content: 5.7

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	82
25	72
19	62
12.5	54
10	50
5	40
2	28
0.85	18
0.425	14
0.25	12
0.15	11
0.075	9



Soil Description Proportions (%):

Clay[1] & Silt	9	Gravel	60
Sand	31	Cobble[3]	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual
[2] The description is visually based & subject to EBA description protocols
[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: ______________________________

Remarks: ______________________________

Reviewed By:

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH21
Keno City, YT		

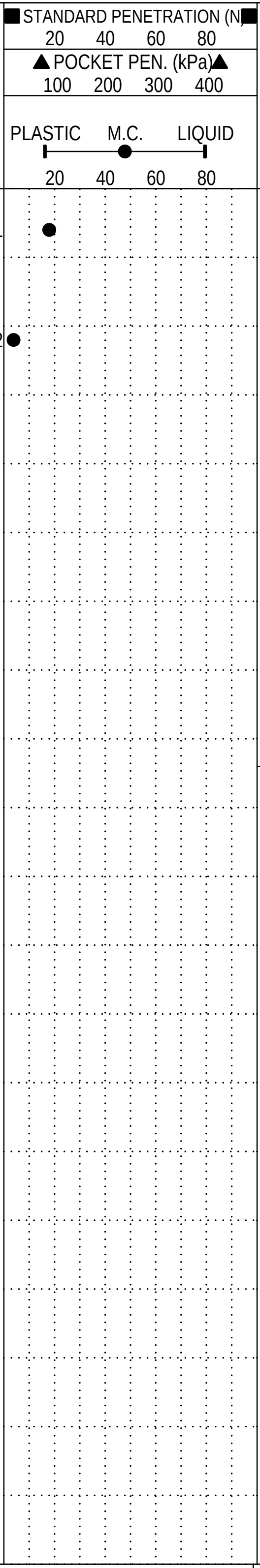
SAMPLE TYPE ▩ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Depth (ft)
0	SILT - sandy, some gravel, trace clay, stiff, fine grained, gap graded, damp, light brown, organic inclusions, subrounded to subangular	▩	SA01	UNFROZEN	0
1	GRAVEL - sandy, trace silt, coarse grained, well graded, damp, brown, subrounded to subangular - cobbles and boulders from 2.0 to 3.0 m	▩	SA02		5
3	SAND AND GRAVEL (TILL) - silty, compact, damp, brown NOTE: Very slow drilling, bit replaced, still very slow. 1.5 hrs to retrieve bit, skid steer, also back on site				10
4.2	END OF BOREHOLE 4.2 m - very slow drilling				15

Depth (m): 0, 1, 2, 3, 4, 5, 6, 7, 8, 9, 10

Depth (ft): 0, 5, 10, 15, 20, 25, 30, 33



LOGGED BY: CJD	COMPLETION DEPTH: 4.2m
REVIEWED BY:	COMPLETE: 9/1/2009
DRAWING NO:	Page 1 of 1

EBA Engineering Consultants Ltd.

YELLOWKNIFE W14101178.003.GPJ EBA.GDT 09/12/24

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

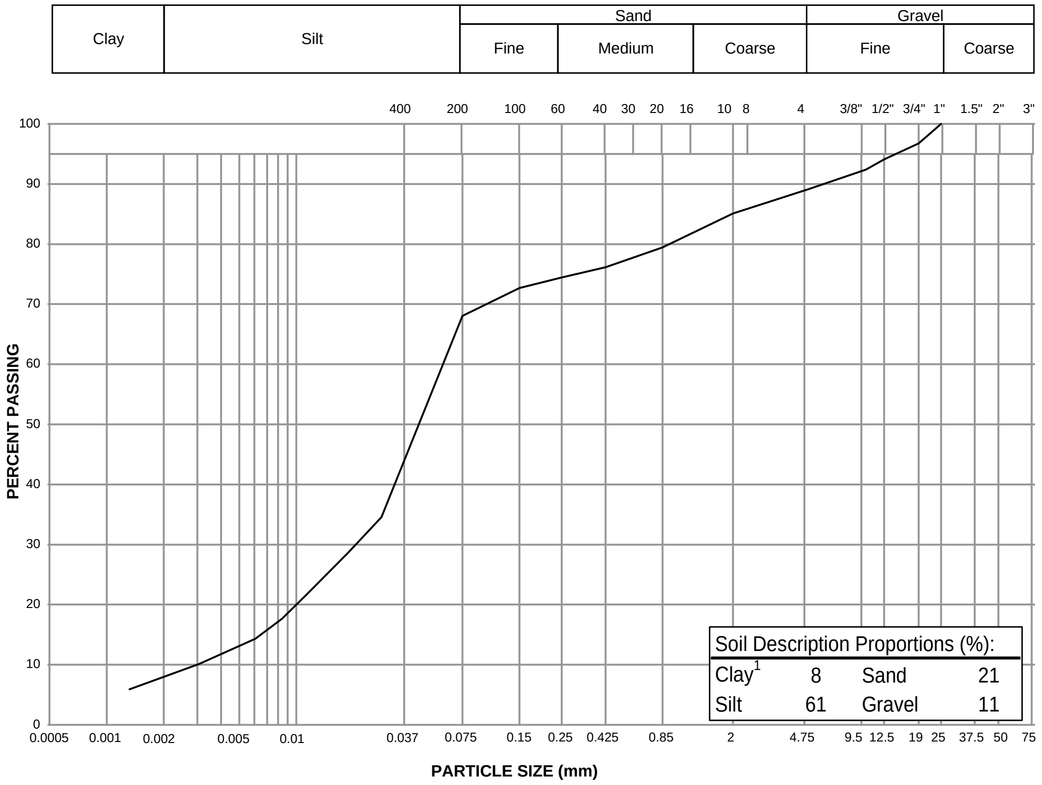
Material Type:				Date Tested:	22-Oct-2009
Sample No.:	SA01			Soil Description²:	SILT - sandy, some gravel, trace clay
Sample Loc.:	BH21				
Sample Depth:	0.2 - 0.4 m			USC Classification:	
Sampling Method:					
Date sampled:	Sep-09	By:	Client	Moisture Content:	17.9

By: SMS

Cu: 21.1

Cc: 2.3

Particle Size (mm)	Percent Passing
75	
50	
38	
25	100
19	97
12.5	94
10	92
5	89
2	85
0.85	79
0.425	76
0.25	74
0.15	73
0.075	68
0.0281	34.5
0.0188	28.6
0.0115	21.9
0.0084	17.7
0.0061	14.3
0.0031	10.1
0.0013	5.9



Soil Description Proportions (%):

Clay¹	8	Sand	21
Silt	61	Gravel	11

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification:

Remarks:

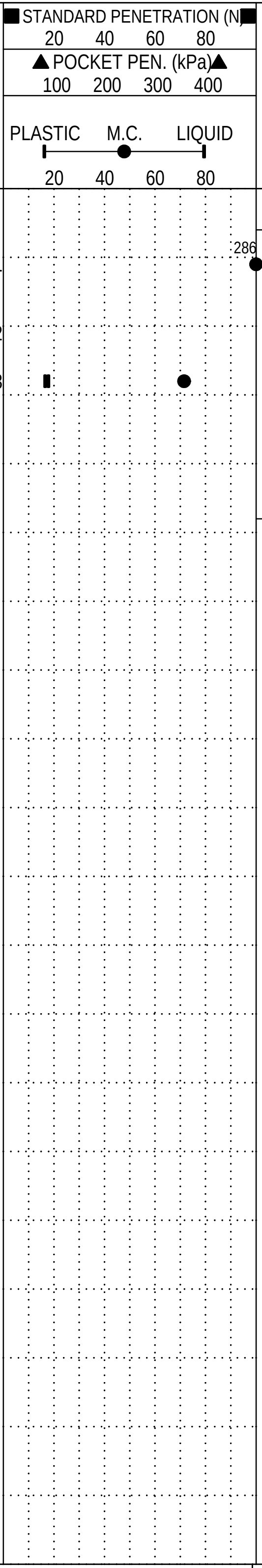
Reviewed By:

EBA Engineering
Consultants Ltd.

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH22
Keno City, YT		

SAMPLE TYPE	▨ DISTURBED	◪ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Depth (ft)
0	MOSS COVERED - peat, black			UNFROZEN	0
	SILT -sandy, trace clay, brownish black	▨	SA01	FROZEN - Nbe (25%), well bonded	
1		▮	SA02	- visible ice inclusions, < 5 %	
	SAND (TILL) - gravelly, silty, compact (est.), well graded, brown frozen	▮	SA03	- visible ice inclusions 50%, well bonded - visible ice inclusions 50%, poorly bonded	5
2	- very hard slow drilling 2.4 m				
	END OF BOREHOLE 2.4 m				
3					10
4					
5					15
6					20
7					
					25
8					
9					30
10					33



EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 2.4m
	REVIEWED BY:	COMPLETE: 9/1/2009
	DRAWING NO:	Page 1 of 1

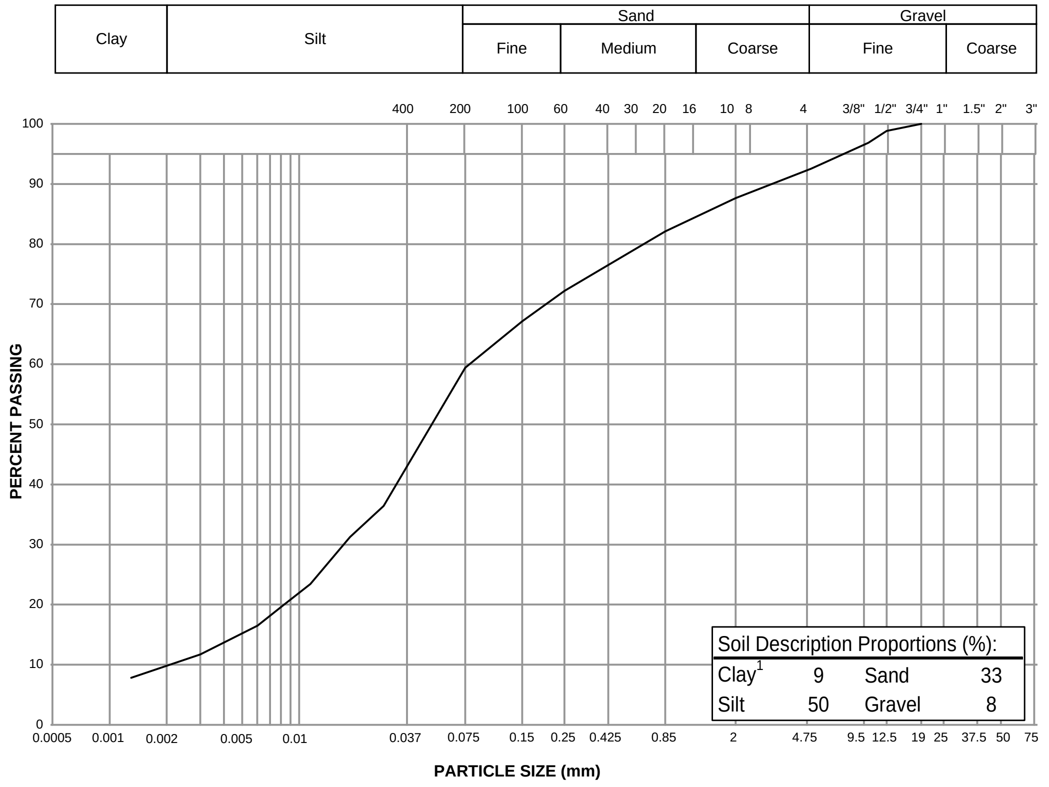
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:				Date Tested:	23-Oct-2009	By:	SMS
Sample No.:	SA03			Soil Description[2]:	SILT - sandy, trace clay, trace gravel		
Sample Loc.:	BH22						
Sample Depth:	1.3 - 1.5 m			USC Classification:		Cu:	35.7
Sampling Method:						Cc:	1.7
Date sampled:	Sep-09	By:	Client	Moisture Content:	71.5		

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	100
12.5	99
10	97
5	93
2	88
0.85	82
0.425	77
0.25	72
0.15	67
0.075	59
0.0278	36.4
0.0185	31.2
0.0114	23.4
0.0083	20.0
0.0060	16.5
0.0030	11.7
0.0013	7.8



Soil Description Proportions (%):

Clay[1]	9	Sand	33
Silt	50	Gravel	8

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

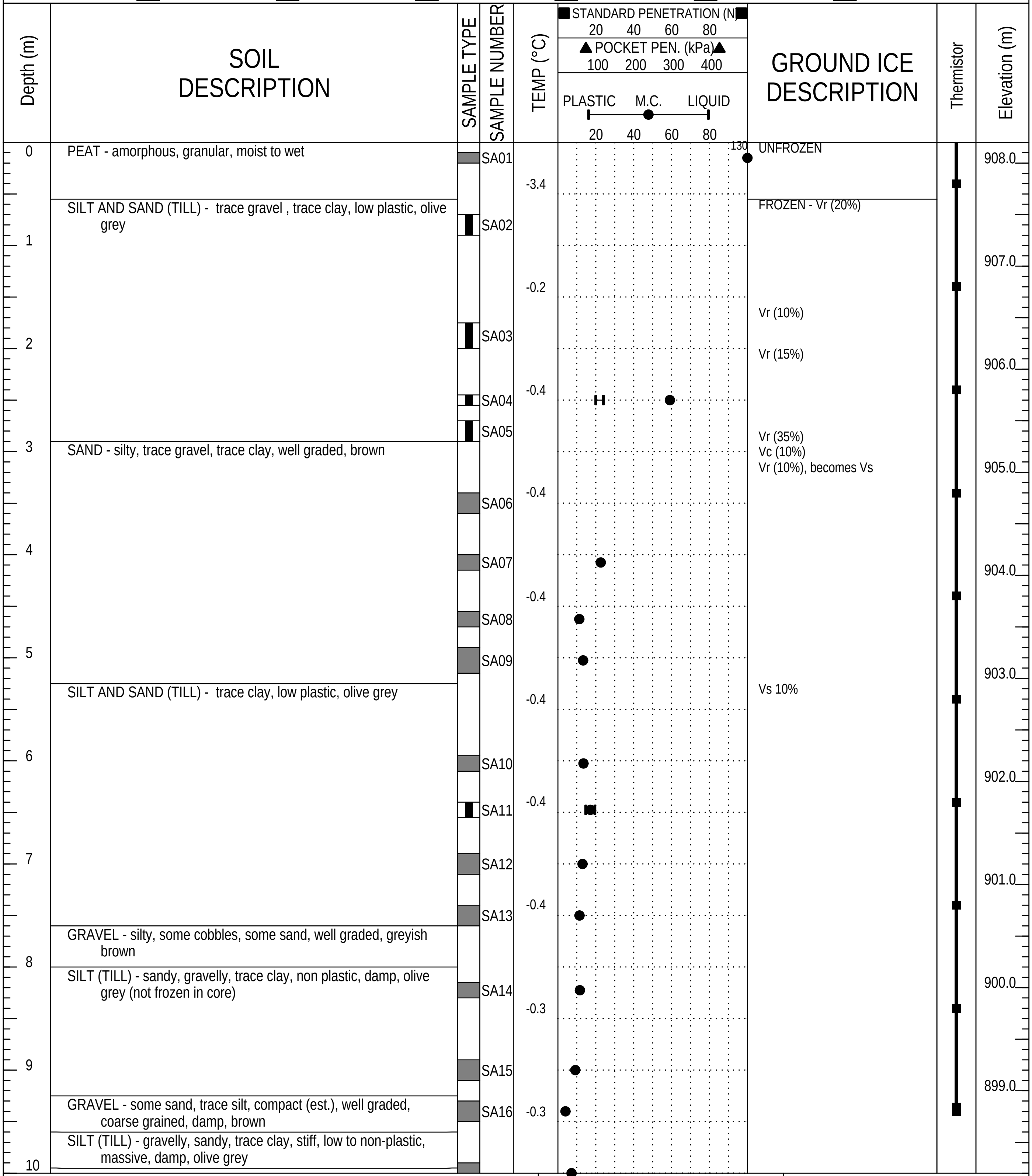
Specification: ____________________

Remarks: ____________________

Reviewed By:

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH23
Keno City, YT		ELEVATION: 908.2m

SAMPLE TYPE	▨ DISTURBED	◺ NO RECOVERY	☒ SPT	▤ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND



PEAT - amorphous, granular, moist to wet

SILT AND SAND (TILL) - trace gravel , trace clay, low plastic, olive grey

SAND - silty, trace gravel, trace clay, well graded, brown

SILT AND SAND (TILL) - trace clay, low plastic, olive grey

GRAVEL - silty, some cobbles, some sand, well graded, greyish brown

SILT (TILL) - sandy, gravelly, trace clay, non plastic, damp, olive grey (not frozen in core)

GRAVEL - some sand, trace silt, compact (est.), well graded, coarse grained, damp, brown

SILT (TILL) - gravelly, sandy, trace clay, stiff, low to non-plastic, massive, damp, olive grey

UNFROZEN

FROZEN - Vr (20%)

Vr (10%)

Vr (15%)

Vr (35%)
Vc (10%)
Vr (10%), becomes Vs

Vs 10%

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 10.15m
	REVIEWED BY:	COMPLETE: 8/29/2009
	DRAWING NO:	Page 1 of 2

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Dry Stack Tailings Facility	DRILL: Mini-Sonic	W14101178.003-BH23
Keno City, YT		ELEVATION: 908.2m

SAMPLE TYPE ■ DISTURBED ▨ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▨ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Thermistor	Elevation (m)
10	GRAVEL - silty, sandy, some cobbles, dense (est.), well graded, coarse grained, damp, brownish grey	■	SA17					898.0
	END OF BOREHOLE - refusal in cobbly soil							
11								897.0
12								896.0
13								895.0
14								894.0
15								893.0
16								892.0
17								891.0
18								890.0
19								889.0
20								

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 10.15m
	REVIEWED BY:	COMPLETE: 8/29/2009
	DRAWING NO:	Page 2 of 2

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:

Sample No.: SA07

Sample Loc.: BH23

Sample Depth: 4.0 - 4.15 m

Sampling Method:

Date sampled: Sep-09 By: Client

Date Tested: 23-Oct-2009 By: SMS

Soil Description[2]: SAND - silty, trace clay, trace gravel

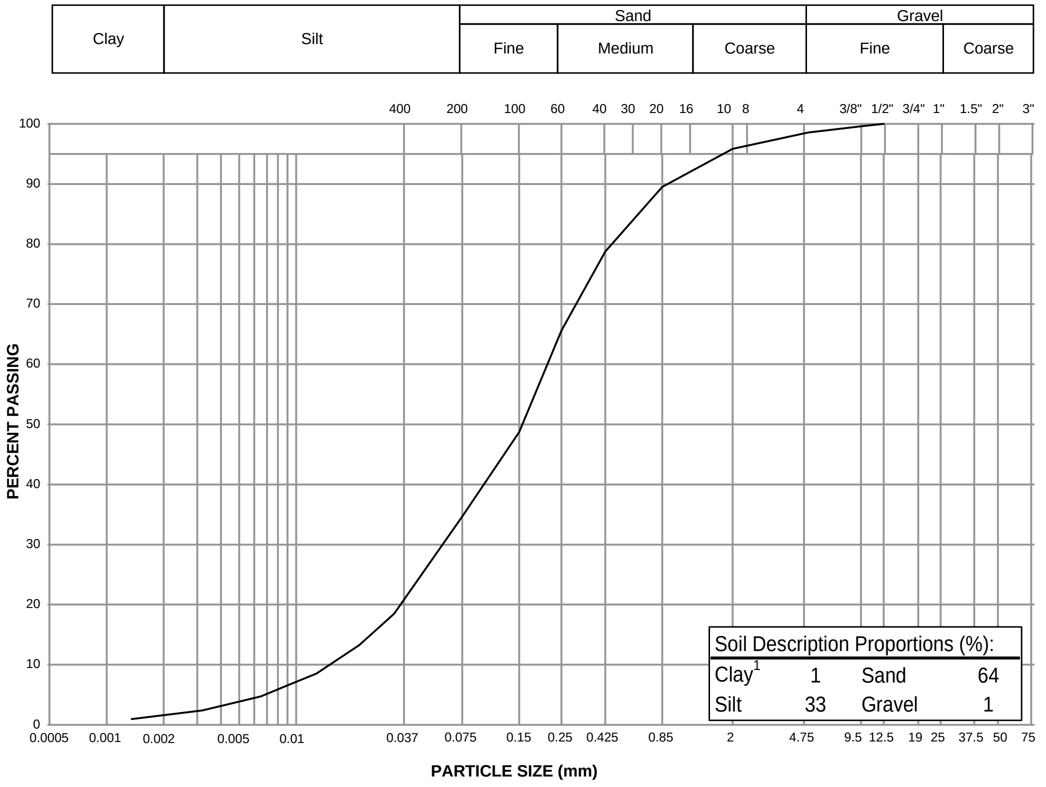
USC Classification:

Cu: 14.1

Cc: 1.2

Moisture Content: 22.6

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	
12.5	100
10	100
5	99
2	96
0.85	90
0.425	79
0.25	66
0.15	49
0.075	35
0.0328	18.5
0.0215	13.3
0.0127	8.5
0.0091	6.6
0.0065	4.7
0.0032	2.4
0.0014	0.9



Soil Description Proportions (%):

Clay[1]	1	Sand	64
Silt	33	Gravel	1

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification:

Remarks:

Reviewed By:

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

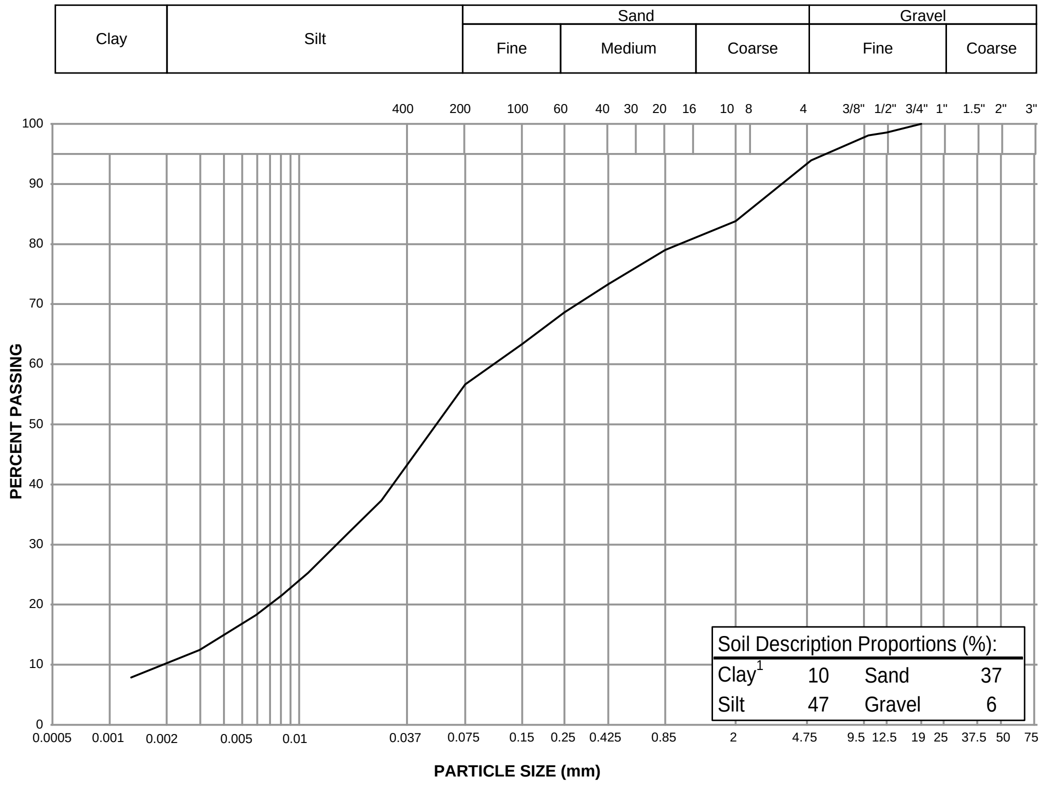
Project: Flame & Moth DSTF Drilling
Project No.: W14101178.003
Site: Keno City, YT

Client: Alexco Resource Corp
Client Rep.:

Material Type:
Sample No.: SA11
Sample Loc.: BH23
Sample Depth: 6.4 - 6.55
Sampling Method:
Date sampled: Sep-09 By: Client

Date Tested: 23-Oct-2009 By: SMS
Soil Description[2]: SILT AND SAND - trace clay, trace gravel
USC Classification:
Cu: 54.1
Cc: 1.1
Moisture Content: 17.1

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
19	100
12.5	99
10	98
5	94
2	84
0.85	79
0.425	73
0.25	69
0.15	63
0.075	57
0.0270	37.3
0.0181	31.9
0.0111	25.3
0.0081	21.6
0.0059	18.3
0.0030	12.4
0.0013	7.9



Soil Description Proportions (%):

Clay[1]	10	Sand	37
Silt	47	Gravel	6

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ______________________

Remarks: ______________________

Reviewed By:

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:

Sample No.: SA16

Sample Loc.: BH23

Sample Depth: 9.3 - 9.5 m

Sampling Method:

Date sampled: Sep-09 By: Client

Date Tested: 23-Oct-2009 By: SMS

Soil Description[2]: GRAVEL - some sand, trace silt

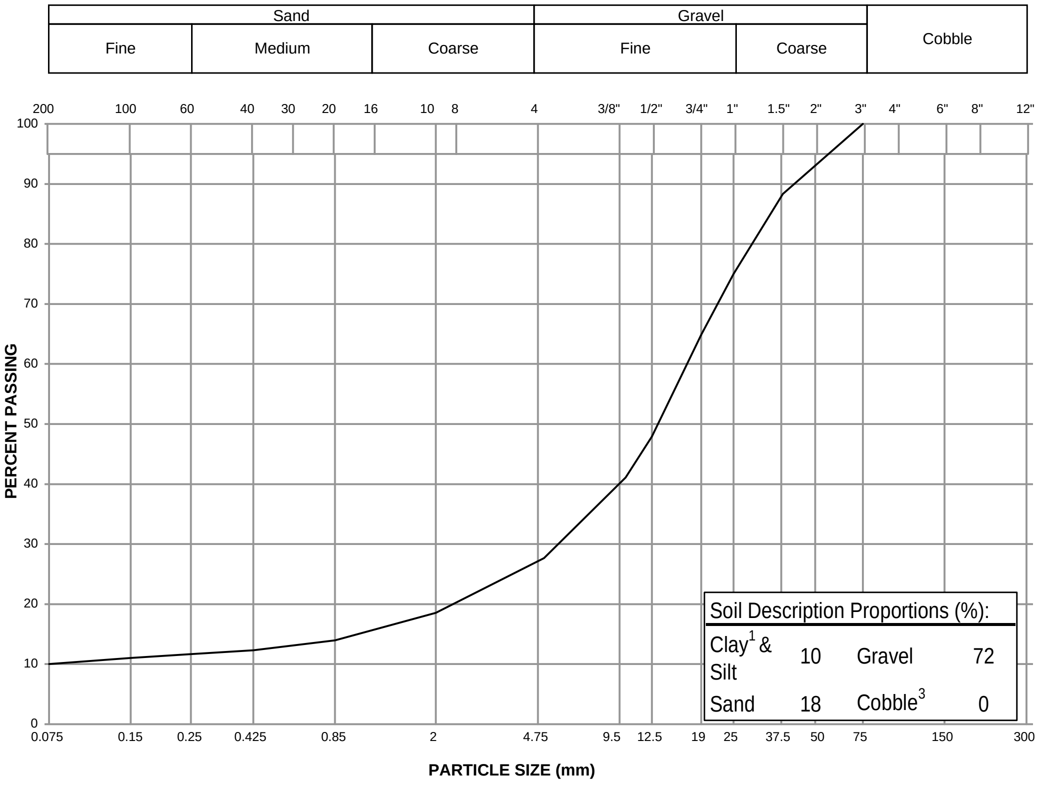
USC Classification:

Cu: 229.0

Cc: 26.9

Moisture Content: 4.0

Particle Size (mm)	Percent Passing
300	
200	
150	
100	
75	100
50	
38	88
25	75
19	65
12.5	48
10	41
5	28
2	19
0.85	14
0.425	12
0.25	12
0.15	11
0.075	10



Soil Description Proportions (%):

Clay[1] & Silt	10	Gravel	72
Sand	18	Cobble[3]	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

[3] If cobbles are present, sampling procedure may not meet ASTM C702 & D75

Specification: ____________________

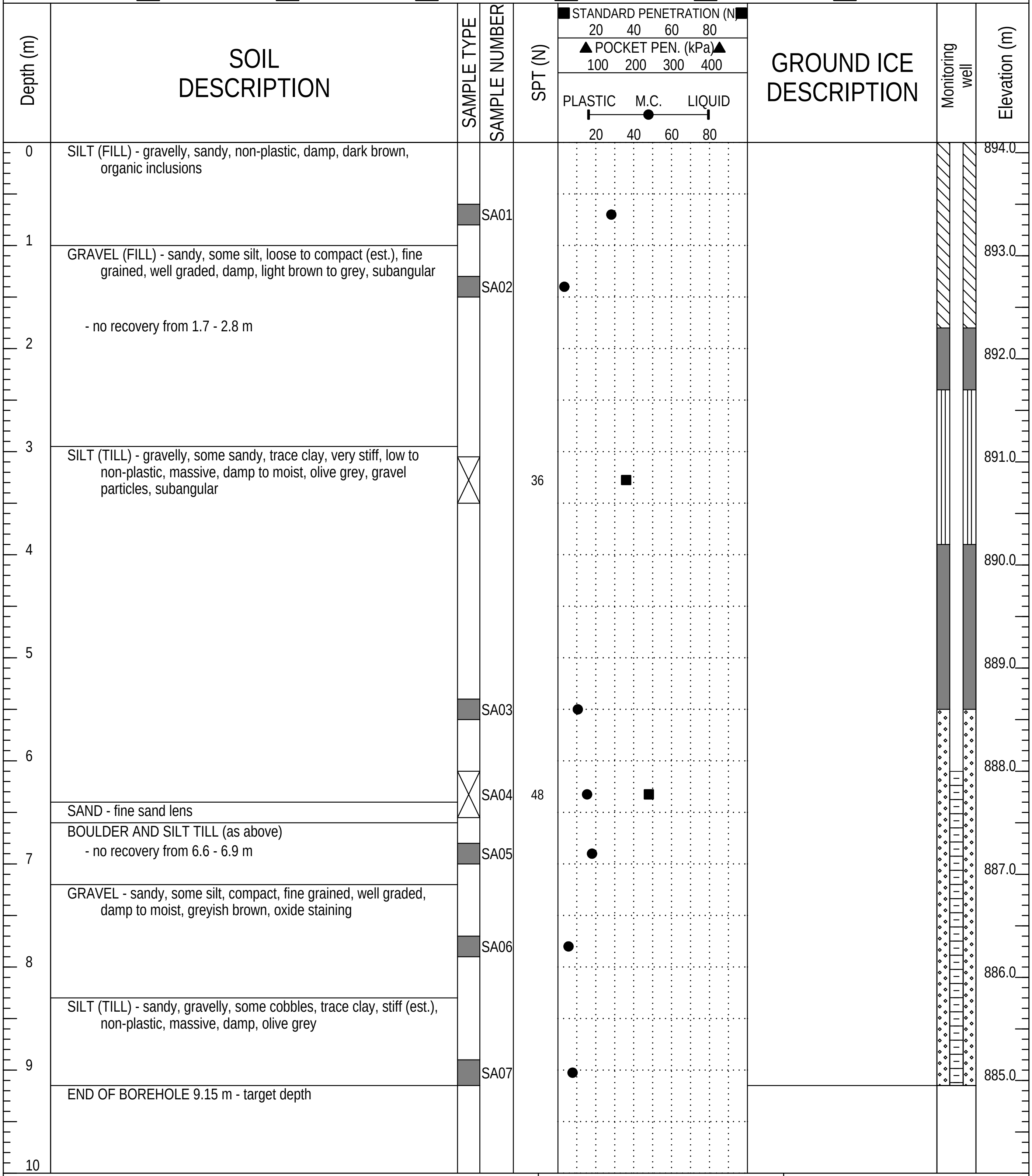
Remarks: ____________________

Reviewed By: C.J. Dixon

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Water Retention Pond	DRILL: Mini-Sonic	W14101178.003-BH24
Keno City, YT		ELEVATION: 894.1m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ◧ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND



SILT (FILL) - gravelly, sandy, non-plastic, damp, dark brown, organic inclusions

GRAVEL (FILL) - sandy, some silt, loose to compact (est.), fine grained, well graded, damp, light brown to grey, subangular

- no recovery from 1.7 - 2.8 m

SILT (TILL) - gravelly, some sandy, trace clay, very stiff, low to non-plastic, massive, damp to moist, olive grey, gravel particles, subangular

SAND - fine sand lens

BOULDER AND SILT TILL (as above)

- no recovery from 6.6 - 6.9 m

GRAVEL - sandy, some silt, compact, fine grained, well graded, damp to moist, greyish brown, oxide staining

SILT (TILL) - sandy, gravelly, some cobbles, trace clay, stiff (est.), non-plastic, massive, damp, olive grey

END OF BOREHOLE 9.15 m - target depth

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 9.15m
	REVIEWED BY:	COMPLETE: 8/29/2009
	DRAWING NO:	Page 1 of 1

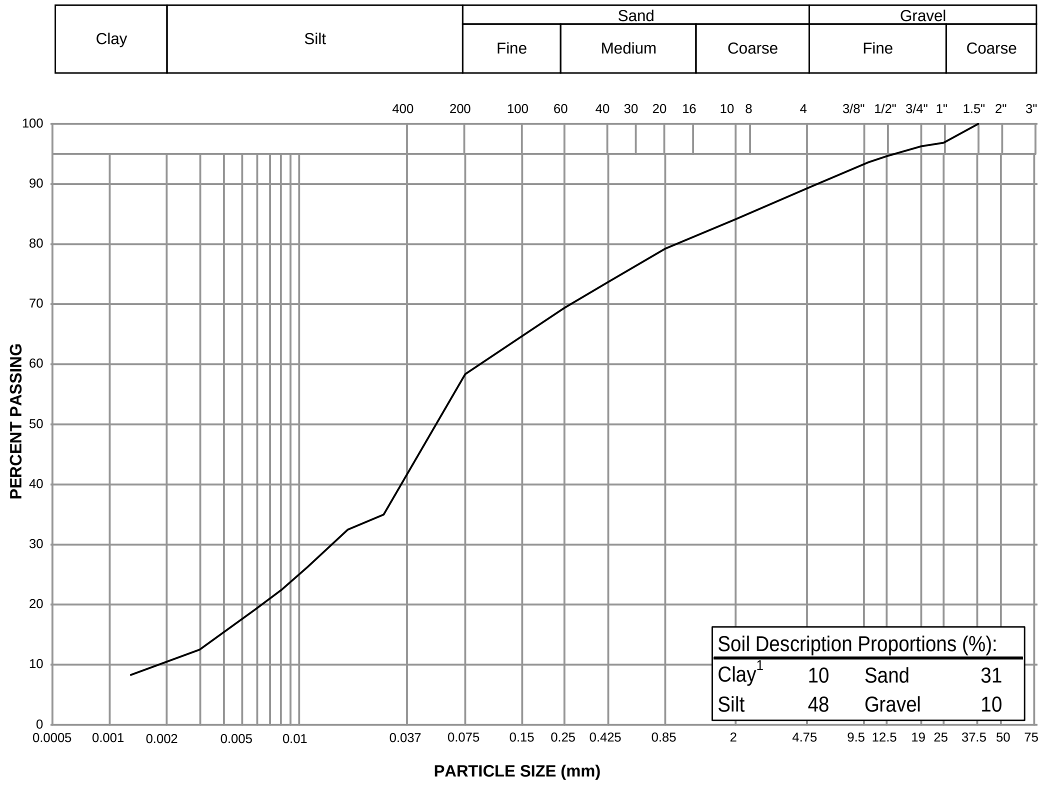
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:		Date Tested:	23-Oct-2009	By:	SMS
Sample No.:	SA03	Soil Description[2]:	SILT - sandy, trace clay, trace gravel		
Sample Loc.:	BH24				
Sample Depth:	5.4 - 5.6 m	USC Classification:		Cu:	47.9
Sampling Method:				Cc:	1.3
Date sampled:	Sep-09 By: Client	Moisture Content:	10.5		

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	97
19	96
12.5	95
10	94
5	90
2	84
0.85	79
0.425	74
0.25	69
0.15	65
0.075	58
0.0278	35.0
0.0180	32.5
0.0111	26.2
0.0081	22.5
0.0059	19.2
0.0030	12.5
0.0013	8.3



Soil Description Proportions (%):

Clay[1]	10	Sand	31
Silt	48	Gravel	10

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ____________________

Remarks: ____________________

Reviewed By:

EBA Engineering
Consultants Ltd.

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Water Retention Pond	DRILL: Mini-Sonic	W14101178.003-BH25
Keno City, YT		ELEVATION: 894.9m

SAMPLE TYPE ▨ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)

GRAVEL (FILL) - silty, some sand, loose, gap graded, damp, brown/green, organic inclusions

GRAVEL (glaciofluvial) - sandy, some silt, compact, medium grained, well graded, damp, brown, subrounded to subangular

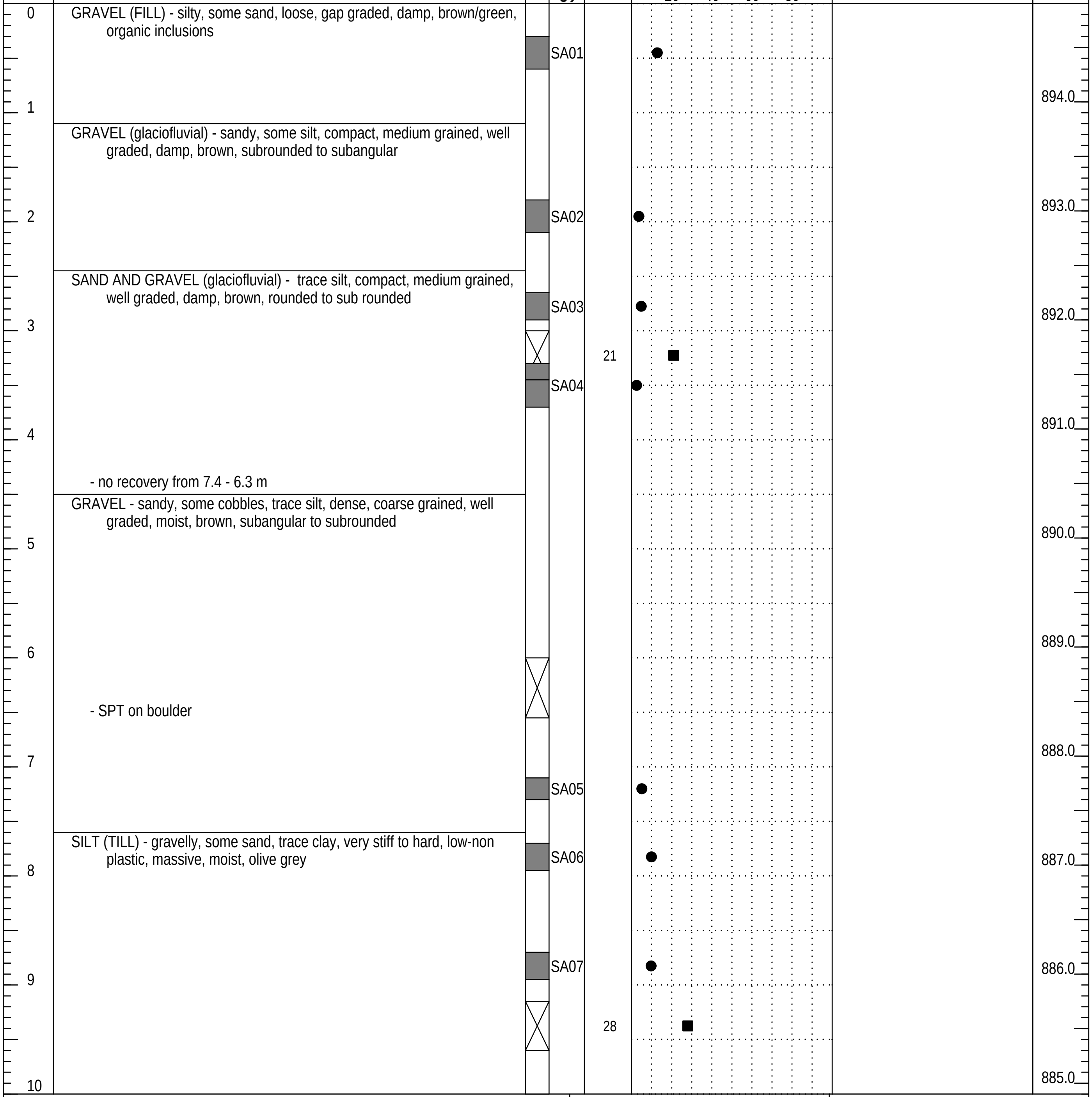
SAND AND GRAVEL (glaciofluvial) - trace silt, compact, medium grained, well graded, damp, brown, rounded to sub rounded

- no recovery from 7.4 - 6.3 m

GRAVEL - sandy, some cobbles, trace silt, dense, coarse grained, well graded, moist, brown, subangular to subrounded

- SPT on boulder

SILT (TILL) - gravelly, some sand, trace clay, very stiff to hard, low-non plastic, massive, moist, olive grey



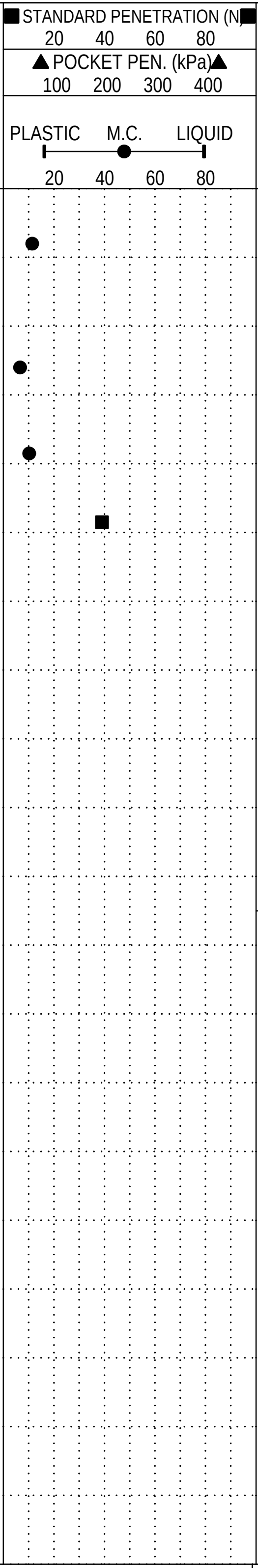
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 15.25m
	REVIEWED BY:	COMPLETE: 8/28/2009
	DRAWING NO:	Page 1 of 2

Flame & Moth DSTF Drilling	CLIENT: Alexco Resources	PROJECT NO. - BOREHOLE NO.
Water Retention Pond	DRILL: Mini-Sonic	W14101178.003-BH25
Keno City, YT		ELEVATION: 894.9m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ◨ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	SPT (N)	GROUND ICE DESCRIPTION	Elevation (m)
10		▨	SA08			
	SILT (TILL) - gravelly, some sand, trace clay, stiff to hard, massive, damp grey					
11	GRAVEL - cobbly, sandy, trace silt, compact, coarse grained, gap graded, damp, rust to grey, oxidation					884.0
		▨	SA09			
12		▨	SA10			883.0
	- no recovery from 12.5 - 15.0 m	☒		39		
13						882.0
14						881.0
15	- boulder of possible bedrock					880.0
	END OF BOREHOLE 15.25 m - target depth					
16						879.0
17						878.0
18						877.0
19						876.0
20						875.0



EBA Engineering Consultants Ltd.

LOGGED BY: CJD	COMPLETION DEPTH: 15.25m
REVIEWED BY:	COMPLETE: 8/28/2009
DRAWING NO:	Page 2 of 2

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

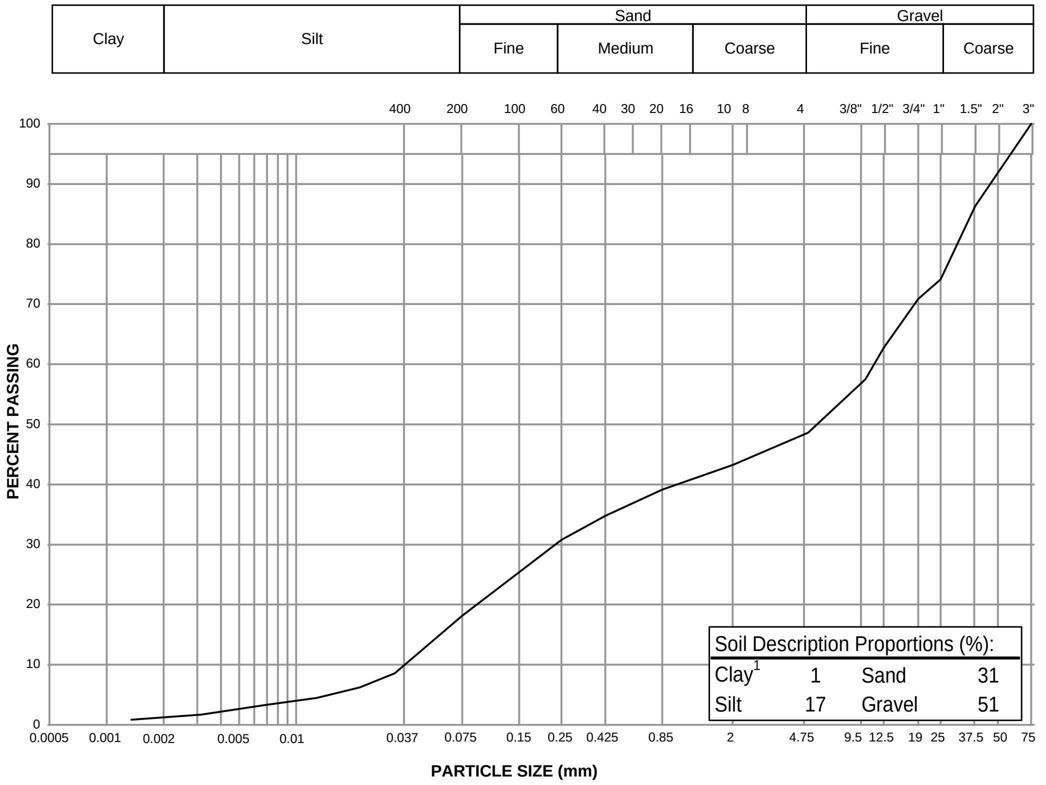
Project: Flame & Moth DSTF Drilling
Project No.: W14101178.003
Site: Keno City, YT

Client: Alexco Resource Corp
Client Rep.:

Material Type:
Sample No.: SA02
Sample Loc.: BH25
Sample Depth: 1.8 - 2.1 m
Sampling Method:
Date sampled: Sep-09 By: Client

Date Tested: 25-Oct-2009 By: SMS
Soil Description[2]: GRAVEL - sandy, some silt, trace clay
USC Classification:
Cu: 284.4
Cc: 0.1
Moisture Content: 3.6

Particle Size (mm)	Percent Passing
75	100
50	
38	86
25	74
19	71
12.5	63
10	58
5	49
2	43
0.85	39
0.425	35
0.25	31
0.15	25
0.075	18
0.0331	8.6
0.0216	6.2
0.0128	4.5
0.0091	3.9
0.0065	3.2
0.0032	1.7
0.0014	0.9



Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: __________

Remarks: __________

Reviewed By: C.J. Dixon

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:

Sample No.: SA04

Sample Loc.: BH25

Sample Depth: 3.3 - 3.7

Sampling Method:

Date sampled: Sep-09 By: Client

Date Tested: 25-Oct-2009 By: SMS

Soil Description[2]: SAND AND GRAVEL - trace silt, trace clay

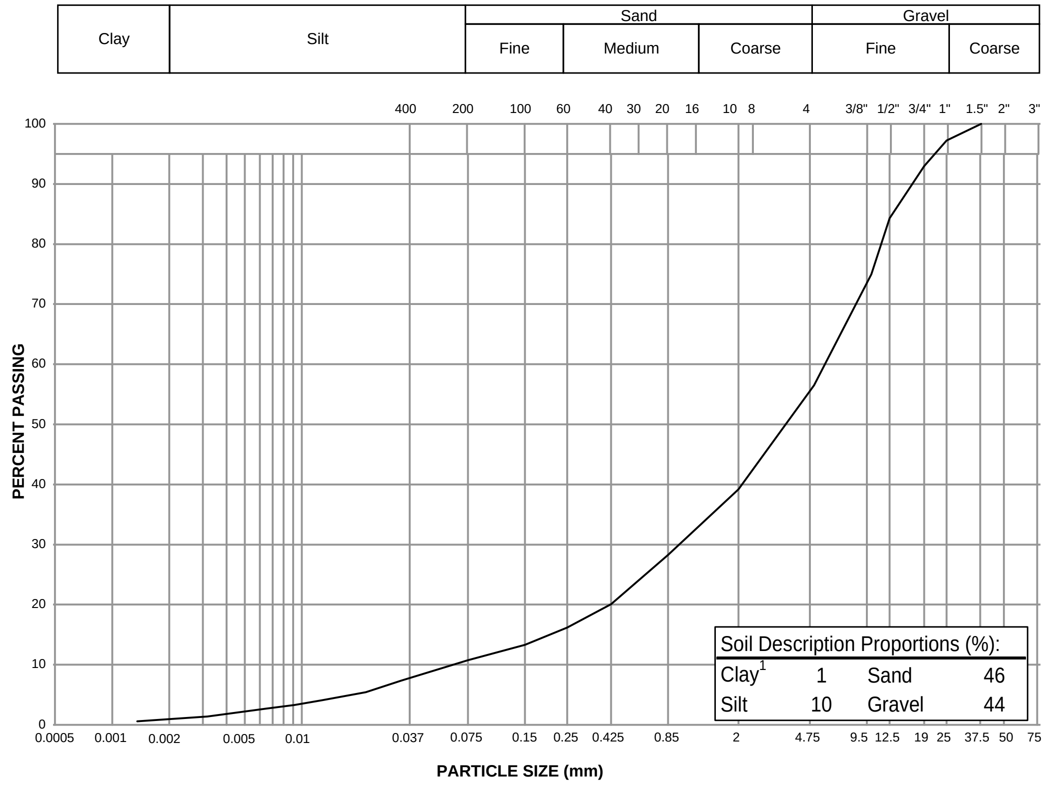
USC Classification:

Cu: 90.3

Cc: 2.7

Moisture Content: 2.5

Particle Size (mm)	Percent Passing
75	
50	
38	100
25	97
19	93
12.5	84
10	75
5	57
2	39
0.85	28
0.425	20
0.25	16
0.15	13
0.075	11
0.0333	7.4
0.0217	5.4
0.0128	4.1
0.0091	3.3
0.0065	2.7
0.0032	1.4
0.0014	0.6



Soil Description Proportions (%):			
Clay[1]	1	Sand	46
Silt	10	Gravel	44

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: __________

Remarks: __________

Reviewed By:

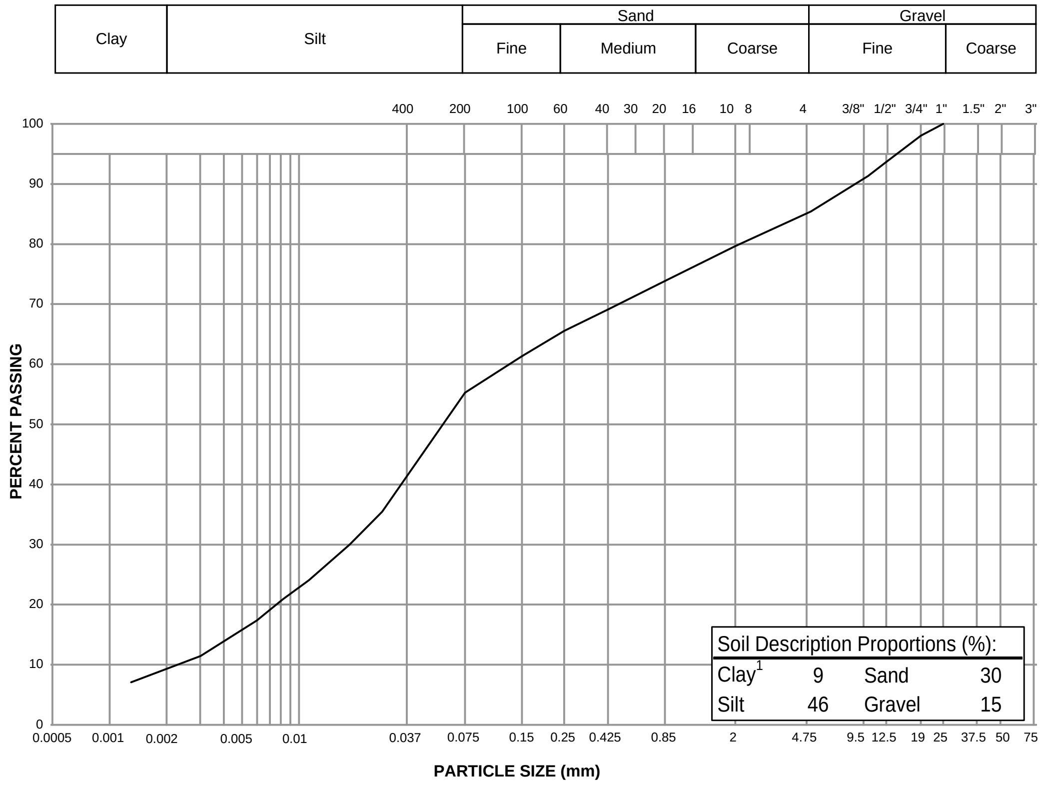
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Drilling	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Keno City, YT		

Material Type:			Date Tested:	25-Oct-2009	By: SMS
Sample No.:	SA07		Soil Description^2:	SILT - sandy, some gravel, trace clay	
Sample Loc.:	BH25				
Sample Depth:	8.7 - 8.95 m		USC Classification:	Cu:	54.4
Sampling Method:				Cc:	1.0
Date sampled:	Sep-09	By: Client	Moisture Content:	9.7	

Particle Size (mm)	Percent Passing
75	
50	
38	
25	100
19	98
12.5	94
10	91
5	85
2	80
0.85	74
0.425	69
0.25	66
0.15	61
0.075	55
0.0274	35.5
0.0184	30.0
0.0113	24.1
0.0082	20.9
0.0060	17.3
0.0030	11.4
0.0013	7.1



Soil Description Proportions (%):

Clay^1	9	Sand	30
Silt	46	Gravel	15

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: __________

Remarks: __________

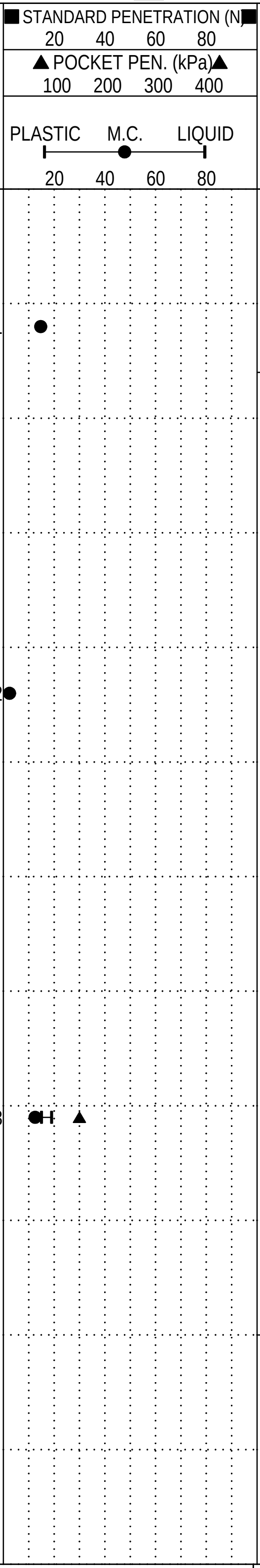
Reviewed By:

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP01
near Keno City, YT	7086907N; 483901E; Zone 8	ELEVATION: 906.4m

SAMPLE TYPE ▨ DISTURBED ▨ NO RECOVERY ☒ SPT ▤ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▨ DRILL CUTTINGS ▨ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - woody, some silt, roots, organics			Frozen Nbe	
	GRAVEL (FILL) - sandy - some silt, compact (est.), medium grained, well graded, frozen, sub-rounded, brown				906.0
		▨	SA01		
				Unfrozen	
1	GRAVEL - sandy, some cobbles, trace silt, compact (est.), coarse grained, well graded, damp, brown, sub-rounded				
					905.0
2		▨	SA02		
					904.0
	- becomes loose				
3					
					903.0
	SILT - sandy, some gravel, some clay, stiff, low plastic, massive, damp, olive grey				
4		▨	SA03		
					902.0
5	EOH - refusal, possible bedrock (quartzite)				
					901.0
6					



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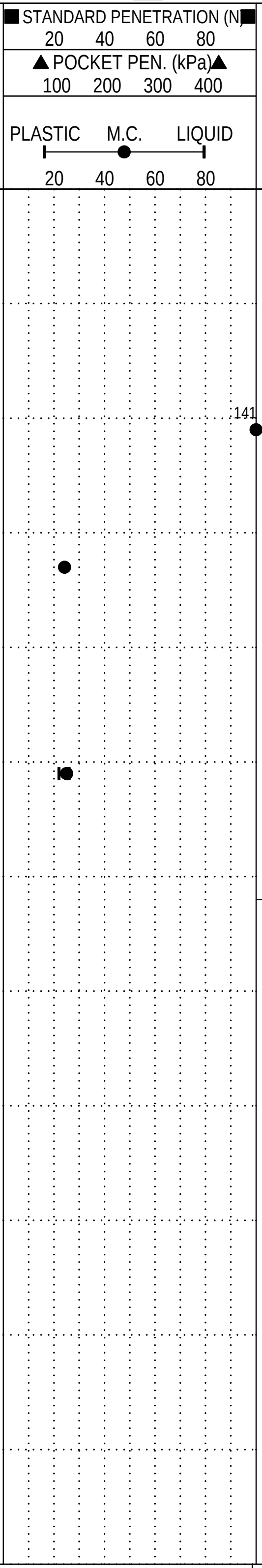
LOGGED BY: CJD	COMPLETION DEPTH: 5m
REVIEWED BY: JRT	COMPLETE: 5/6/2009
DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP02
near Keno City, YT	7086862N; 483957E; Zone 8	ELEVATION: 908.3m

SAMPLE TYPE ▩ DISTURBED ▨ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▨ DRILL CUTTINGS ⁘ SAND



Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - silty, woody, fibrous, roots, organics				Frozen	
	SAND - silty, some gravel, trace clay, loose (est.), low plastic, massive, frozen, organic inclusions				Vr, Vs (35%) ice lens up to 10cm thick	908.0
1						
		▩	SA01			
						907.0
	-becomes some clay				Vx (5%)	
		▩	SA02	-0.6		
2					Vx, Vs (10%)	
						906.0
		▩	SA03			
3						
	EOH - target depth					
						905.0
4						
						904.0
5						
						903.0
6						

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 3.1m
	REVIEWED BY: JRT	COMPLETE: 5/6/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP03
near Keno City, YT	7086760N; 484004E; Zone 8	ELEVATION: 907.4m

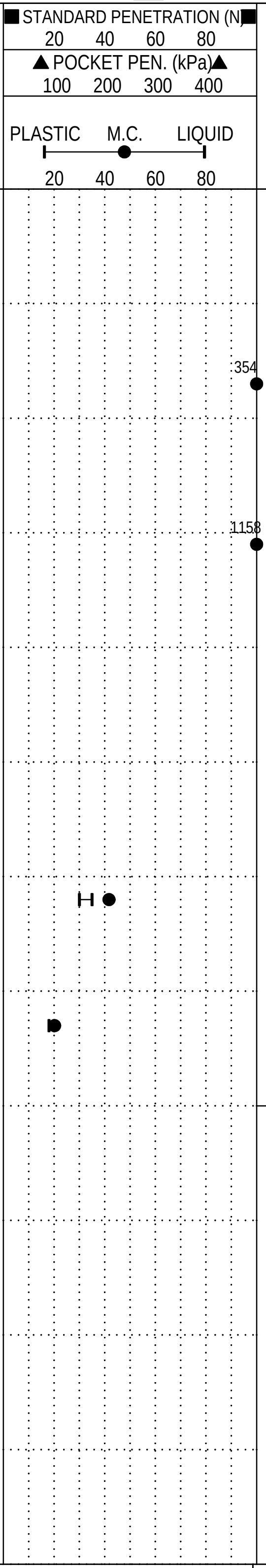
SAMPLE TYPE ▩ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ◨ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION
0	PEAT - amorphous granular, roots, organics, black and brown, frozen				Frozen
		▩	SA01		
		▩	SA02		
3	SILT - some sand, trace clay, soft (est.), low-plastic, massive, frozen, olive grey	▩	SA03	-1.7	Vs (35%) ice lens up to 10cm thick
	SAND - silty, gravelly, trace clay, firm (est.), non-plastic, massive, frozen, olive grey	▩	SA04		Vs and Vc (5%)
4	EOH - target depth				

Depth (m): 0, 1, 2, 3, 4, 5, 6

Elevation (m): 907.0, 906.0, 905.0, 904.0, 903.0, 902.0



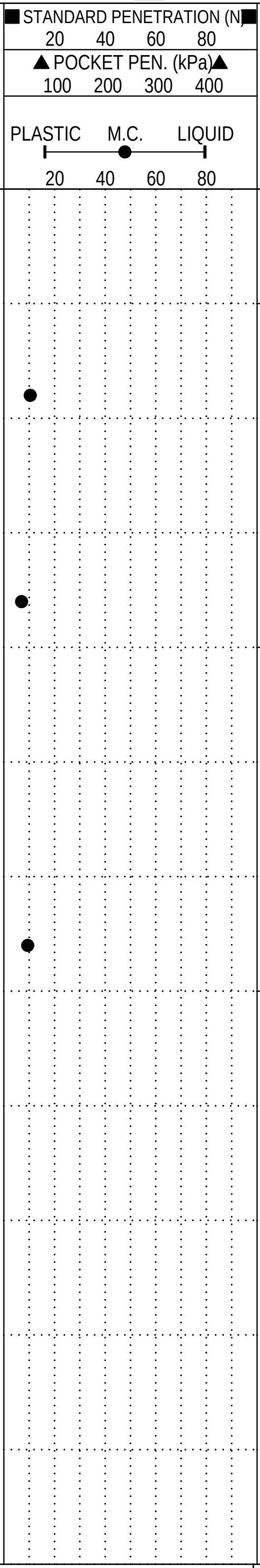
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 4m
	REVIEWED BY: JRT	COMPLETE: 5/6/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP04
near Keno City, YT	7086712N; 483906E; Zone 8	ELEVATION: 903.8m

SAMPLE TYPE ▩ DISTURBED ◸ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - roots, organic mat, woody, black				Frozen	
	SAND - silty, some gravel, compact (est.), medium grained, well graded, frozen, light brown, sub-rounded					
	GRAVEL - sandy, silty, some cobbles, compact (est.), coarse grained, well graded, moist, dark brown, pockets of silt, sub-rounded				Unfrozen	
						903.0
1		▩	SA01			
		▩	SA02			902.0
2					Frozen Nbn	
						901.0
3					Vc (10%)	
		▩	SA03	-0.3		
	EOH - refusal in frozen gravel					
						900.0
4						
						899.0
5						
						898.0
6						



EBA Engineering Consultants Ltd.

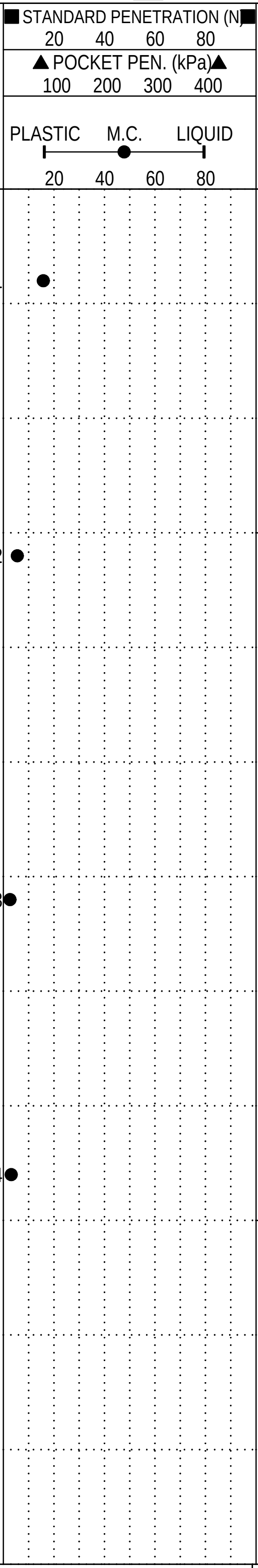
LOGGED BY: CJD	COMPLETION DEPTH: 3.5m
REVIEWED BY: JRT	COMPLETE: 5/6/2009
DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP05
near Keno City, YT	7086736N; 483899E; Zone 8	ELEVATION: 903.4m

SAMPLE TYPE ■ DISTURBED ◸ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ∴ GROUT ▧ DRILL CUTTINGS ⁙ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - roots, organics			Frozen	
	SAND AND GRAVEL - silty, trace cobbles, compact (est.), coarse grained, well graded, frozen, medium brown, sub-rounded				
		■	SA01		903.0
1					
	0.1 m thick silt lens - frozen, light brown				902.0
		■	SA02	Unfrozen	
2	SAND - some gravel, some silt, trace cobbles, loose (est.), coarse grained, well graded, damp, dark brown, sub-angular				
					901.0
	SAND AND GRAVEL - trace silt, trace cobbles, compact (est.), medium grained, well graded, damp, dark brown, sub-rounded				
3		■	SA03		
					900.0
4		■	SA04		
					899.0
	EOH - target depth				
5					
					898.0
6					



LOGGED BY: CJD	COMPLETION DEPTH: 4.5m
REVIEWED BY: JRT	COMPLETE: 5/3/2009
DRAWING NO: Figure 2	Page 1 of 1

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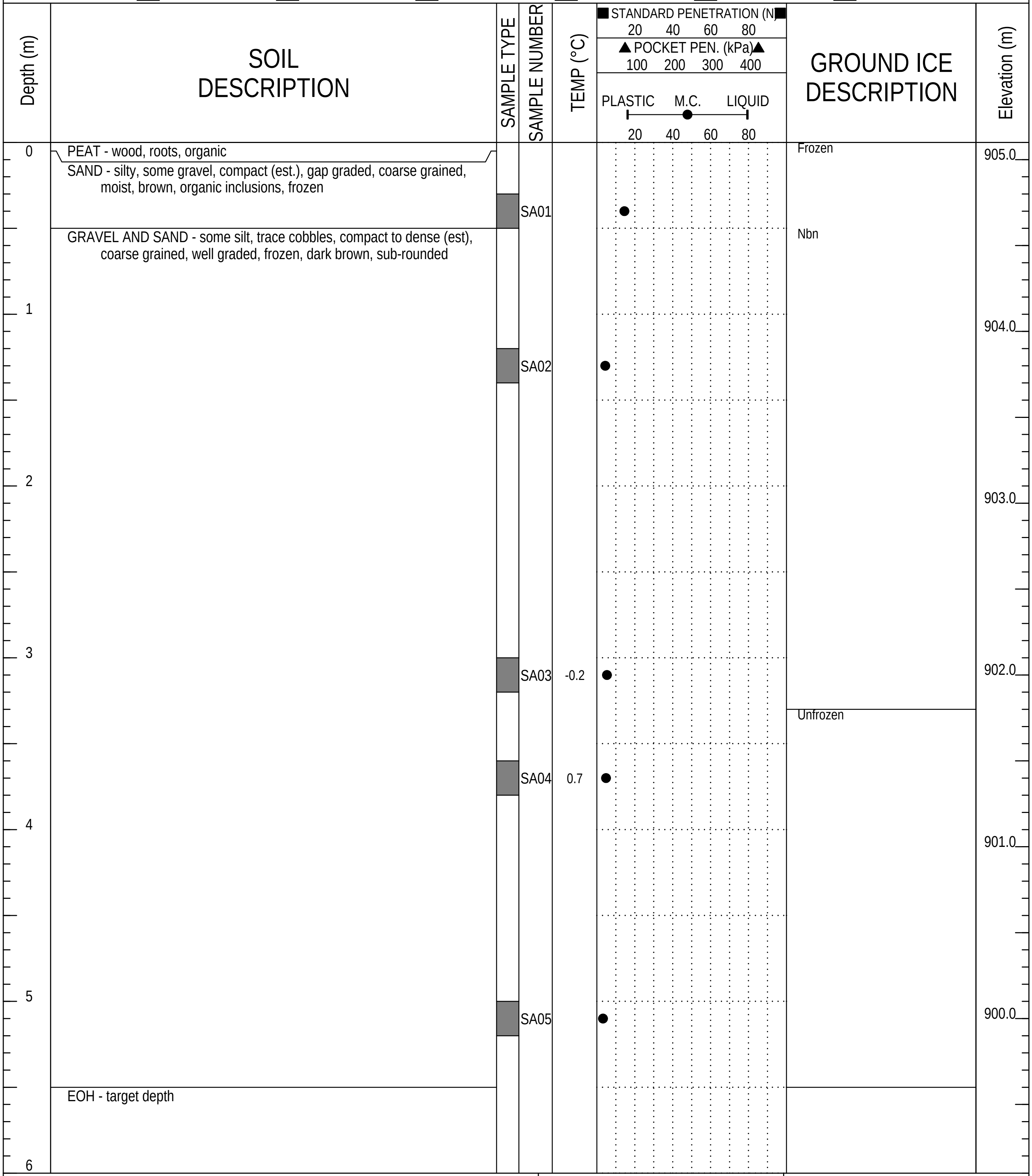
Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP06
near Keno City, YT	7086719N; 483925E; Zone 8	ELEVATION: 905.1m

SAMPLE TYPE ▨ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁙ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁙ SAND



PEAT - wood, roots, organic

SAND - silty, some gravel, compact (est.), gap graded, coarse grained, moist, brown, organic inclusions, frozen

GRAVEL AND SAND - some silt, trace cobbles, compact to dense (est), coarse grained, well graded, frozen, dark brown, sub-rounded

EOH - target depth

Frozen

Nbn

Unfrozen

EBA Engineering Consultants Ltd.	LOGGED BY: CJD
	REVIEWED BY: JRT
	DRAWING NO: Figure 2

COMPLETION DEPTH: 5.5m

COMPLETE: 5/6/2009

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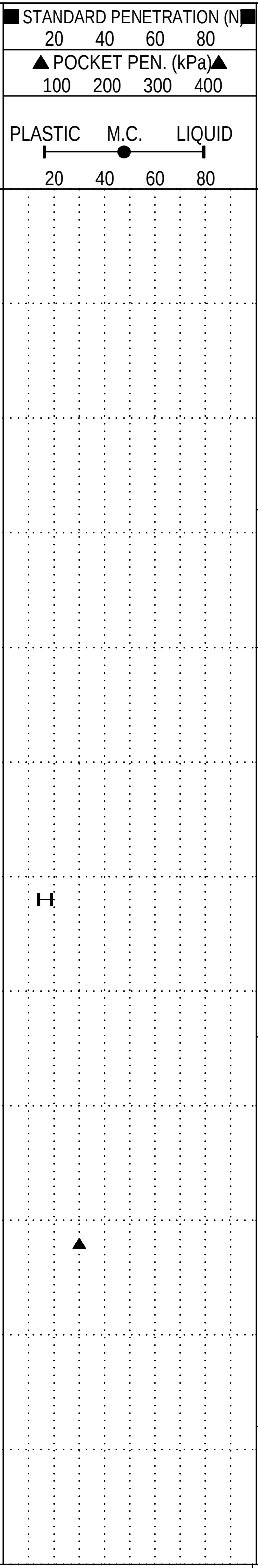
Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP07
near Keno City, YT	7086712N; 483955E; Zone 8	ELEVATION: 906.7m

SAMPLE TYPE ▨ DISTURBED ▨ NO RECOVERY ☒ SPT ▤ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▧ DRILL CUTTINGS ▨ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - some silt, woody, roots, black				Frozen	
	SILT - sandy, some gravel, medium, non-plastic, frozen, brown, organics, roots	▨	SA01			
	SAND - gravelly, trace cobbles, trace silt,, compact (est.), medium grained, well graded, damp to moist, brown, sub-rounded					
						906.0
1		▨	SA02			
					Unfrozen	
						905.0
	- seepage					
2					Frozen Nbn	
	SILT - sandy, some gravel, trace clay, stiff (est.), low plastic, massive, olive grey					
						904.0
3						
		▨	SA03	-0.1	Vx, Vc (<5%)	
					Unfrozen	903.0
4						
		▨	SA04	1.5		902.0
5						
	EOH - refusal at probable bedrock (quarzite)					
						901.0
6						



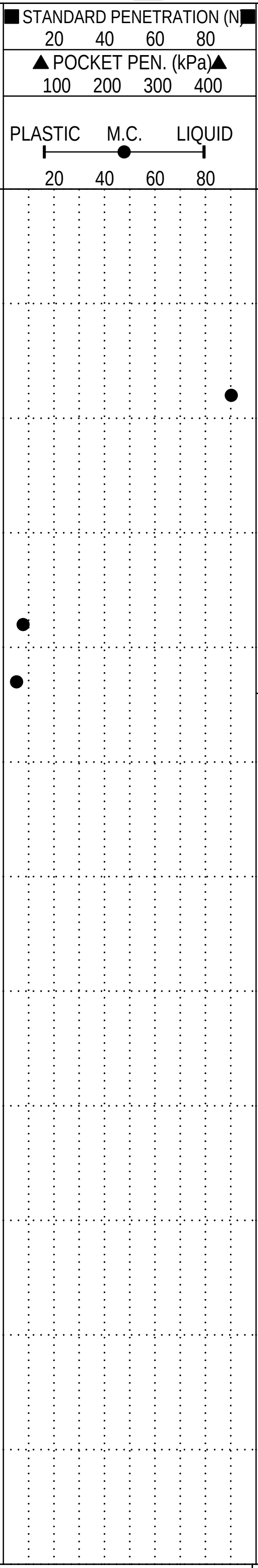
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 5.4m
	REVIEWED BY: JRT	COMPLETE: 5/6/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP08
near Keno City, YT	7086741N; 483974E; Zone 8	ELEVATION: 908.6m

SAMPLE TYPE ▨ DISTURBED ☐ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▨ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - silty, woody, organics, roots, frozen				Frozen	
	SAND - gravelly, some silt, loose (est.), well graded, coarse grained, frozen					
						908.0
1		▨	SA01	-0.5	Vc, Vr (25%)	
						907.0
	BEDROCK - laminated, moderately weathered					
2		▨	SA02		Vs (10%)	
		▨	SA03			
	EOH refusal, frozen bedrock					
						906.0
3						
						905.0
4						
						904.0
5						
						903.0
6						



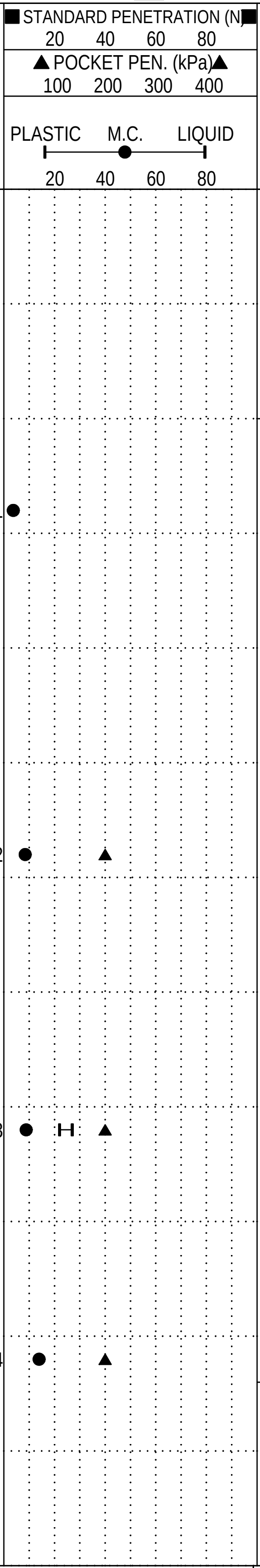
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 2.2m
	REVIEWED BY: JRT	COMPLETE: 5/6/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Detention Berm	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP09
near Keno City, YT	7086737N; 483797E; Zone 8	ELEVATION: 895.8m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - woody, organic, dark brown, frozen			Frozen	
	GRAVEL AND SAND - some cobbles, trace silt, compact to dense (est.), coarse grained, well graded, damp, medium brown, sub-rounded				895.0
1	- unfrozen			Unfrozen	
		▨	SA01		894.0
2					
	BOULDERS - cobbley, some gravel, some silt, dense (est.), coarse grained, gap graded, damp, bluish grey, sub-rounded				893.0
3	SILT (till) - gravelly, sandy, trace clay, stiff, low plastic, damp, olive grey, massive	▨	SA02		892.0
4		▨	SA03		891.0
5		▨	SA04		
	EOH - target depth				890.0
6					



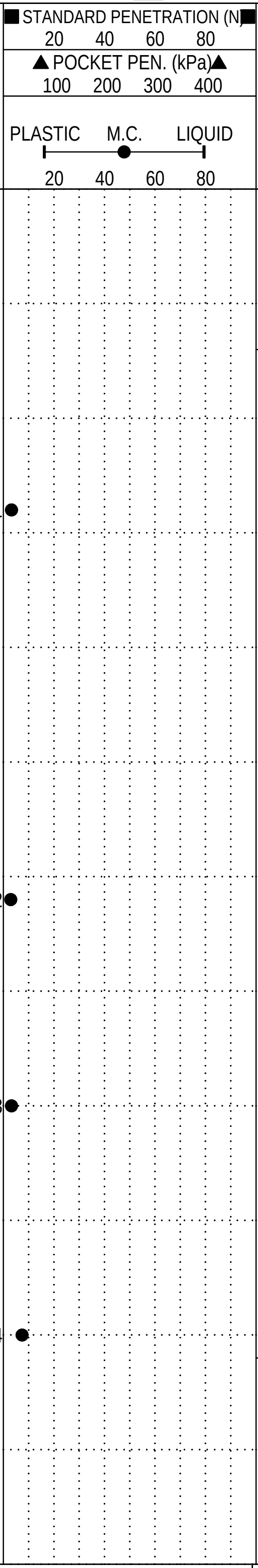
EBA Engineering Consultants Ltd.	LOGGED BY: CJD
	REVIEWED BY: JRT
	DRAWING NO: Figure 2
COMPLETION DEPTH: 5.2m	COMPLETE: 5/5/2009
Page 1 of 1	

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Runoff Collection Pond	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP10
near Keno City, YT	7086754N; 483834E; Zone 8	ELEVATION: 896m

SAMPLE TYPE ▨ DISTURBED ⧄ NO RECOVERY ⊠ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - sandy, some cobbles, trace silt, dense (est.), coarse grained, well graded, damp, medium brown, frozen			Frozen	896.0
				Unfrozen	
1					895.0
		▨	SA01		
2					894.0
3					893.0
		▨	SA02		
4		▨	SA03		892.0
▼	- water				▼
5		▨	SA04		891.0
	EOH - target depth				
6					890.0



LOGGED BY: CJD	COMPLETION DEPTH: 5.1m
REVIEWED BY: JRT	COMPLETE: 5/5/2009
DRAWING NO: Figure 2	Page 1 of 1

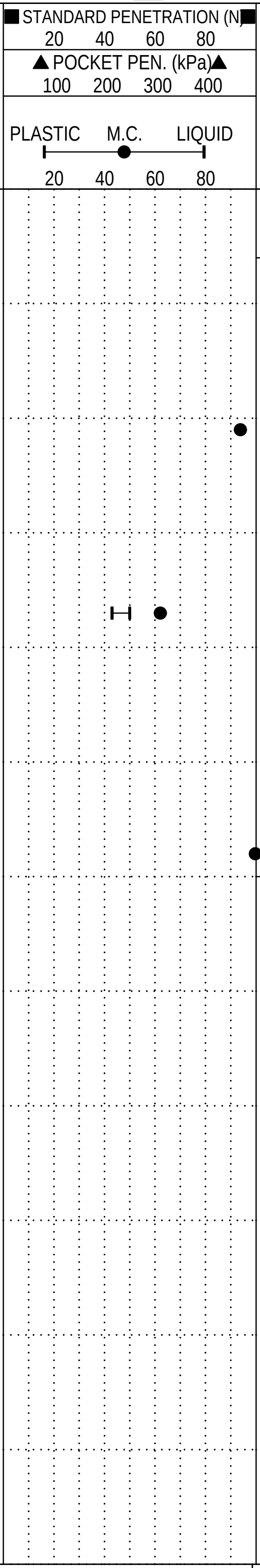
EBA Engineering Consultants Ltd.

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP11
near Keno City, YT	7086737N; 484046E; Zone 8	ELEVATION: 912.4m

SAMPLE TYPE ▩ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▨ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - silty, woody, organic, roots, silt is brown, peat is black -seepage				Unfrozen	
					Frozen	912.0
	SILT - some sand, some gravel, trace clay, soft (est), high plastic, massive, frozen, olive grey				Vs, Vc (25%)	
1		▩	SA01	-0.6		
						911.0
		▩	SA02			
2					Vs, Vc (20%)	
						910.0
		▩	SA03		Vs, Vc (30%)	
3	EOH- target depth					
						909.0
4						
						908.0
5						
						907.0
6						



LOGGED BY: CJD	COMPLETION DEPTH: 3m
REVIEWED BY: JRT	COMPLETE: 5/6/2009
DRAWING NO: Figure 2	Page 1 of 1

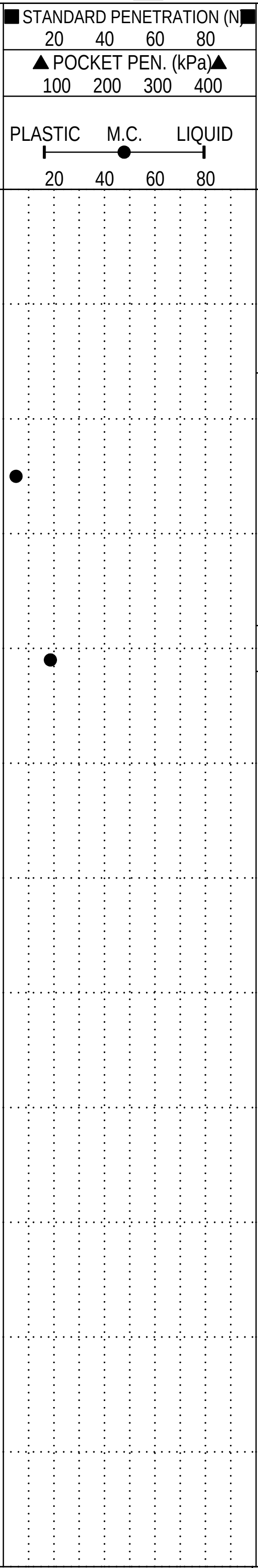
EBA Engineering Consultants Ltd.

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP12
near Keno City, YT	7086942N; 483955E; Zone 8	ELEVATION: 913.8m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - woody, roots, organics				Frozen	
	SILT - sandy, some gravel, trace clay, stiff (est.), non-plastic, frozen, light brown, organic, roots					
	GRAVEL AND SAND - some cobbles, trace silt, compact (est.), medium grained, well graded, brown					
					unfrozen	913.0
1						
		▨	SA01			
						912.0
2	SILT and BOULDERS - sandy, trace clay, trace gravel, non-plastic, bedded, frozen, brown	▨	SA02	-0.3	Frozen, Vs (<5%)	
	EOH - refusal at possible bedrock (quartzite)					
						911.0
3						
						910.0
4						
						909.0
5						
						908.0
6						



EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 2.1m
	REVIEWED BY: JRT	COMPLETE: 5/7/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP13
near Keno City, YT	7086811N; 483912E; Zone 8	ELEVATION: 905m

SAMPLE TYPE	▇ DISTURBED	◸ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▇ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - (waste rock) - cobbley, some sand, trace silt, loose to compact (est.), coarse grained, well graded, damp to moist, reddish-brown, angular				Unfrozen	905.0
		▇	SA01	●		
1	-hole sloughing					904.0
	BEDROCK (quartzite), moderately weathered, oxidized, blocky					
2						903.0
3	EOH - target depth and sloughing					902.0
4						901.0
5						900.0
6						899.0

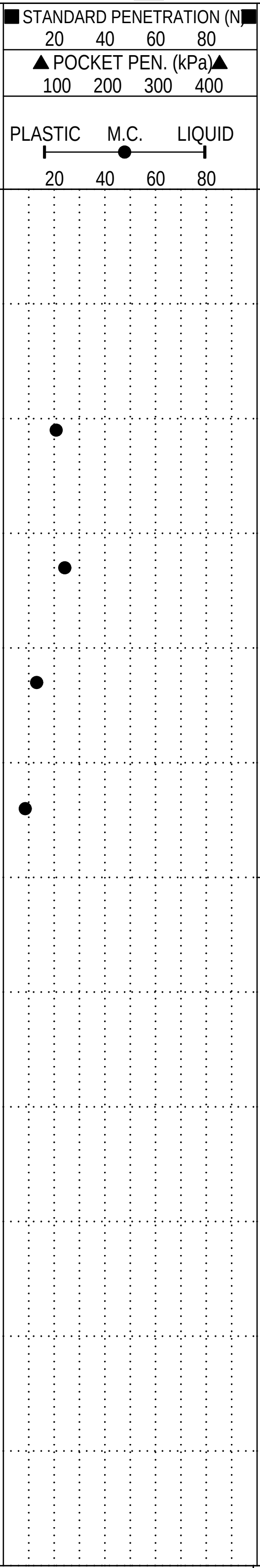
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 3m
	REVIEWED BY: JRT	COMPLETE: 5/7/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP14
near Keno City, YT	7086986N; 483897E; Zone 8	ELEVATION: 901.4m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - amorphous granular, organic, roots and rootlets				Frozen	
						901.0
1	SILT - sandy, some gravel, non-plastic, massive, frozen, olive grey	▨	SA01		Vs (10%)	
	SAND - gravelly, some cobbles, trace silt, dense (est.), well graded, coarse grained, sub-rounded, brown, frozen					900.0
		▨	SA02		Vc, Vx (10%)	
2		▨	SA03	-0.2	Vc, Vx (5%)	
						899.0
		▨	SA04		Nbn	
3	EOH - target depth					
						898.0
4						
						897.0
5						
						896.0
6						



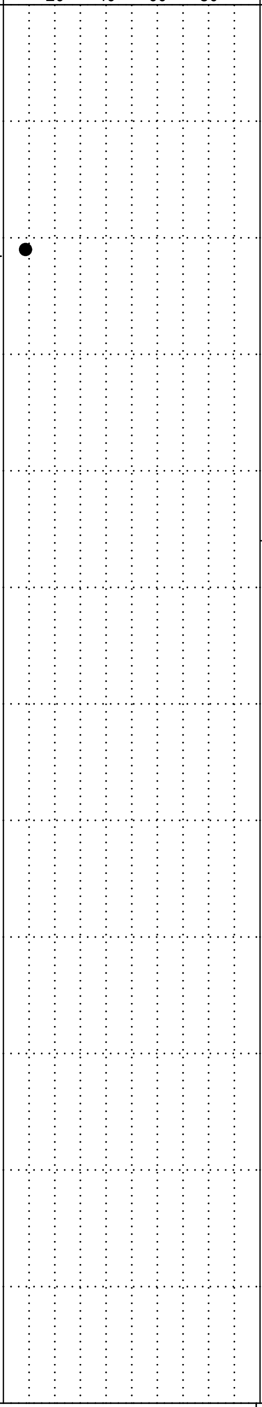
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 3m
	REVIEWED BY: JRT	COMPLETE: 5/7/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP15
near Keno City, YT	7086939N; 483873E; Zone 8	ELEVATION: 900.4m

SAMPLE TYPE ▇ DISTURBED ▨ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▐ CORE

BACKFILL TYPE ▇ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - organic, rootlets, black, frozen				Frozen	
						900.0
	GRAVEL - sandy, some cobbles, some silt, compact (est.), medium grained, well graded, frozen, brown					
1		▇	SA01	●	Nbn	
						899.0
2						
	EOH - refusal at possible bedrock (quartzite)					898.0
3						
						897.0
4						
						896.0
5						
						895.0
6						



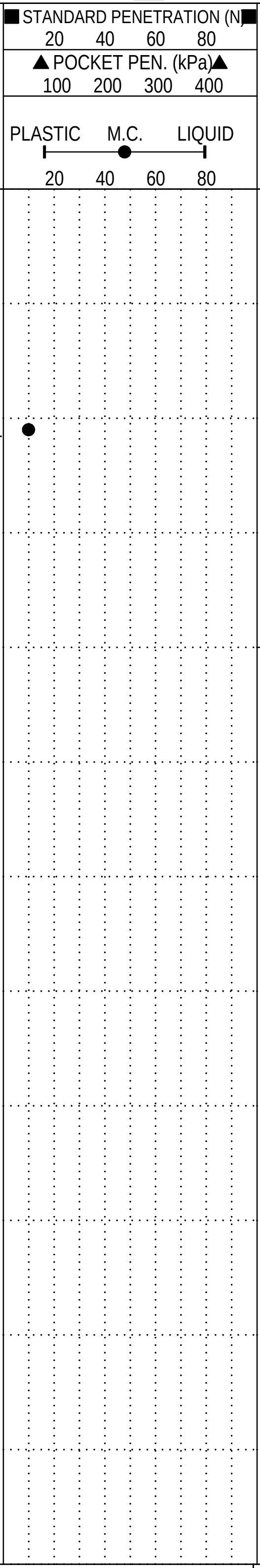
EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 2.3m
	REVIEWED BY: JRT	COMPLETE: 5/7/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP16
near Keno City, YT	7086887N; 483836E; Zone 8	ELEVATION: 900.1m

SAMPLE TYPE: ▩ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE: ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT -amorphous granular, some silt, frozen			Frozen, visible ice wedges 10 cm wide at top	900.0
	SAND - gravelly, silty, some cobbles, dense (est.), medium grained, well graded, frozen, brown			Nbn	
1		▩	SA01		899.0
	BOULDERS - some cobbles, some gravel, trace sand, trace silt, frozen			Vc (5%)	
2	EOH - refusal in frozen boulders				898.0
3					897.0
4					896.0
5					895.0
6					



EBA Engineering Consultants Ltd.

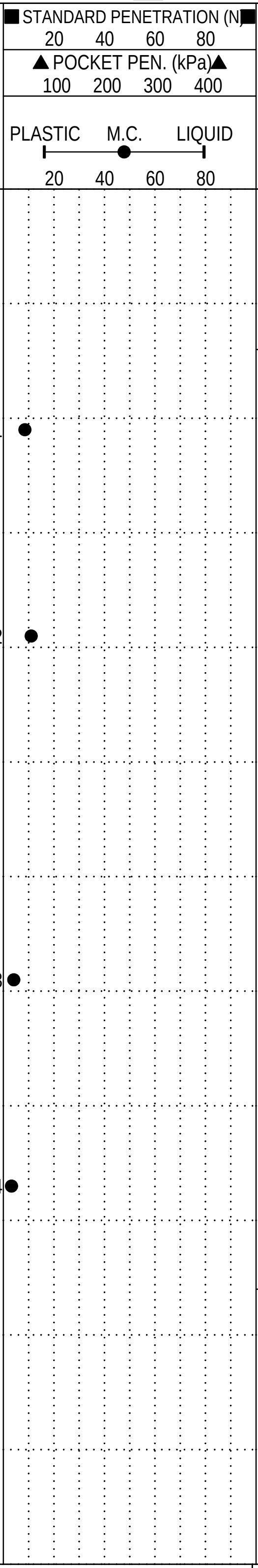
LOGGED BY: CJD	COMPLETION DEPTH: 2m
REVIEWED BY: JRT	COMPLETE: 5/7/2009
DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
DSTF	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP17
near Keno City, YT	7086807N; 483838E; Zone 8	ELEVATION: 902.5m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL AND SAND (fill) - some cobbles, some silt, coarse grained, well graded, sub-rounded, damp, brown, roots, trees, peat inclusions, frozen			Frozen	
					902.0
				Unfrozen	
	- becomes loose to compact (est.), damp				
1		▨	SA01		
					901.0
2		▨	SA02		
	PEAT - woody, roots, black				
	SILT - sandy, some gravel, firm (est.), non-plastic, massive, damp, brown				
	GRAVEL AND SAND- some cobbles, trace silt, coarse grained, compact (est.), well graded, sub-rounded, damp, brown				900.0
3					
		▨	SA03		899.0
4					
		▨	SA04		898.0
	EOH - target depth				
5					
					897.0
6					



LOGGED BY: CJD	COMPLETION DEPTH: 4.8m
REVIEWED BY: JRT	COMPLETE: 5/7/2009
DRAWING NO: Figure 2	Page 1 of 1

EBA Engineering Consultants Ltd.

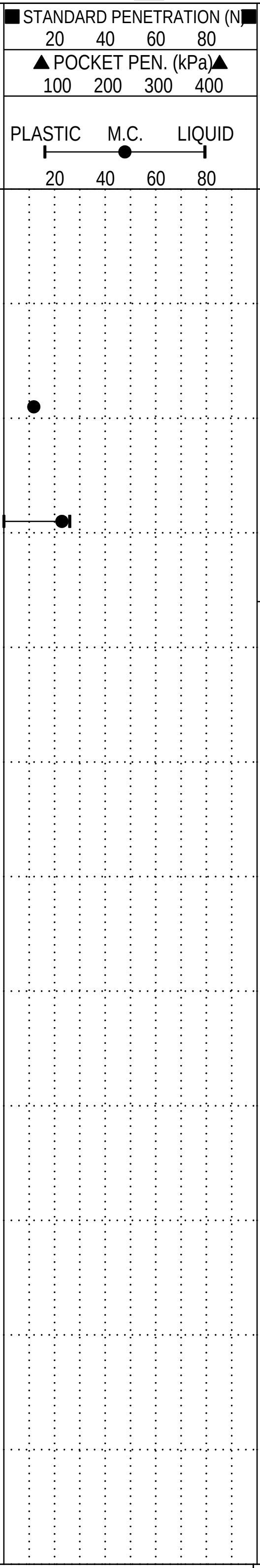
YELLOWKNIFE W14101178.002.GPJ EBA.GDT 09/08/07

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Pad	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP18
near Keno City, YT	7086816N; 483953E; Zone 8	ELEVATION: 908.7m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	TEMP (°C)	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - woody, fine fibrous, some silt, roots, rootlets, organics				Frozen	
	SILT AND SAND - some gravel, trace clay, non-plastic, massive, frozen, gravel angular, light brown					908.0
1		▨	SA01		Vx (<5%)	
		▨	SA02	-0.3	Vs, Vc (5%)	907.0
	EOH - target depth					
2						906.0
3						905.0
4						904.0
5						903.0
6						



EBA Engineering Consultants Ltd.

LOGGED BY: CJD	COMPLETION DEPTH: 1.8m
REVIEWED BY: JRT	COMPLETE: 5/7/2009
DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Case Rubber Tired Backhoe	W14101178.002-TP19
near Keno City, YT	7086795N; 483932E; Zone 8	ELEVATION: 905.4m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL (FILL/WASTE ROCK) - sandy, some silt, well graded sub-rounded gravel, coarse to medium grained sand, brown - cobbles, trace of silt below 0.3 m				905.0
1					904.0
2					903.0
	END OF TESTPIT @ 2.5 m (REFUSAL) - hard solid ground, probable bedrock				
3					902.0
4					901.0
5					900.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 2.5m
	REVIEWED BY: JRT	COMPLETE: 6/29/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Case Rubber Tired Backhoe	W14101178.002-TP20
near Keno City, YT	7086798N; 483942E; Zone 8	ELEVATION: 905.9m

SAMPLE TYPE	■ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	■ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N)■ 20 40 60 80 ▲ POCKET PEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL (FILL/WASTE ROCK) - sandy, some silt, well graded rounded to angular particles, coarse to medium grained sand, compact, dark, damp, greyish brown				
	BEDROCK - highly fractured, some weathering, friable stratified				
					905.0
1					
	END OF TESTPIT @ 1.2 m (REFUSAL)				
					904.0
2					
					903.0
3					
					902.0
4					
					901.0
5					
					900.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 1.2m
	REVIEWED BY: JRT	COMPLETE: 6/29/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Case Rubber Tired Backhoe	W14101178.002-TP21
near Keno City, YT	7086816N; 483930E; Zone 8	ELEVATION: 905.7m

SAMPLE TYPE ▩ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N)■ 20 40 60 80 ▲ POCKET PEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL (FILL/WASTE ROCK) - sandy, trace of silt, well graded angular gravel, coarse to medium grained sand, compact, mottled reddish brown and grey				
	BEDROCK - moderately weathered, highly fractured, friable to competent particles				
					905.0
	- becomes more competent with depth				
1					
					904.0
2	END OF TESTPIT @ 2.0 m (REFUSAL)				
					903.0
3					
					902.0
4					
					901.0
5					
					900.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 2m
	REVIEWED BY: JRT	COMPLETE: 6/29/2009
	DRAWING NO: Figure 2	Page 1 of 1

YELLOWKNIFE W14101178.002.GPJ EBA.GDT 09/08/07

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Case Rubber Tired Backhoe	W14101178.002-TP22
near Keno City, YT	7086801N; 483914E; Zone 8	ELEVATION: 904.8m

SAMPLE TYPE ■ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	BEDROCK - highly fractured, weathered, friable to competent particles, blocky stratigraphy				
					904.0
1	- becomes more competent with depth				
	END OF TESTPIT @ 1.2 m (REFUSAL)				
					903.0
2					
					902.0
3					
					901.0
4					
					900.0
5					
					899.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 1.2m
	REVIEWED BY: JRT	COMPLETE: 6/29/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Case Rubber Tired Backhoe	W14101178.002-TP23
near Keno City, YT	7086808N; 483906E; Zone 8	ELEVATION: 904.6m

SAMPLE TYPE ■ DISTURBED ◩ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	ORGANIC ROOT MATERIAL				
	GRAVEL (FILL) - sandy, trace of silt, well graded angular gravel, coarse to medium grained gravel, compact, damp, dark brown and grey - cobbles, some boulders below 0.3 m				904.0
1	becomes coarser with depth				903.0
2					
	END OF TESTPIT @ 2.5 m NOTE: Possible bedrock, but could not confirm due to sloughing sidewalls of testpit				902.0
3					901.0
4					900.0
5					899.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 2.5m
	REVIEWED BY: JRT	COMPLETE: 6/29/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Case Rubber Tired Backhoe	W14101178.002-TP24
near Keno City, YT	7086827N; 483902E; Zone 8	ELEVATION: 904m

SAMPLE TYPE	▨ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N)■ 20 40 60 80 ▲ POCKET PEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	ORGANIC ROOT MATERIAL				904.0
	GRAVEL (FILL/WASTE ROCK) - sandy, trace to some silt, well graded sub-rounded and angular particles, compact, damp, dark brownish and grey				
1					903.0
2					902.0
	- organic layer, rootlets, black				
	GRAVEL - sandy, some silt, well graded sub-rounded gravel, medium to coarse grained sand, damp, brownish grey				
	BEDROCK - friable, weathered - becomes more competent with depth				
	END OF TESTPIT @2.8 m (REFUSAL)				
3					901.0
4					900.0
5					899.0
6					898.0

EBA Engineering Consultants Ltd.	LOGGED BY: JSB	COMPLETION DEPTH: 2.8m
	REVIEWED BY: JRT	COMPLETE: 6/29/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP25
near Keno City, YT	7086790N; 483933E; Zone 8	ELEVATION: 904.5m

SAMPLE TYPE	▩ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▩ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - sandy, some silt, compact, damp, sub-rounded to sub-angular, well graded, brown				
					904.0
1					
					903.0
2					
	SILT (TILL) - gravelly, sandy, trace clay, firm (est.), organic inclusions, damp, olive grey				
	EOH - Target Depth				902.0
3					
					901.0
4					
					900.0
5					
					899.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 2.4m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP26
near Keno City, YT	7086788N; 483951E; Zone 8	ELEVATION: 903.4m

SAMPLE TYPE	■ DISTURBED	◿ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	■ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	PEAT - amorphous, granular, roots, organics, black				
	SILT (TILL) - gravelly, sandy, trace clay, firm, organic inclusions, damp, olive grey				903.0
1	GRAVEL - sandy, some silt, compact, sub-rounded to sub-angular, brown				
	EOH - Target Depth				902.0
2					901.0
3					900.0
4					899.0
5					898.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 1.2m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP27
near Keno City, YT	7086783N; 483947E; Zone 8	ELEVATION: 902.9m

SAMPLE TYPE ▩ DISTURBED ◸ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▩ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁙ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - sandy, some silt, compact, well graded, sub-rounded to sub-angular, damp, brown - becomes silty				
					902.0
1					
	- becomes some silt				
	EOH -Refusal, probable quartzite bedrock				
					901.0
2					
					900.0
3					
					899.0
4					
					898.0
5					
					897.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 1.8m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP28
near Keno City, YT	7086795N; 483934E; Zone 8	ELEVATION: 903.8m

SAMPLE TYPE ▨ DISTURBED ◿ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ◨ CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - sandy, some silt, compact, well graded, sub-rounded to sub-angular, damp, brown				
					903.0
1	EOH - Target Depth				
					902.0
2					
					901.0
3					
					900.0
4					
					899.0
5					
					898.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 1m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP29
near Keno City, YT	7086797N; 483912E; Zone 8	ELEVATION: 902.3m

SAMPLE TYPE ■ DISTURBED ◪ NO RECOVERY ☒ SPT ☰ A-CASING ▥ SHELBY TUBE ◨ CORE

BACKFILL TYPE ■ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N)■ 20 40 60 80 ▲ POCKET PEN. (kPa)▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - sandy, some silt, compact, well graded, sub-rounded to sub-angular, damp, brown				
					902.0
	Refusal, probable weathered quartzite bedrock				
1					
					901.0
2					
					900.0
3					
					899.0
4					
					898.0
5					
					897.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 0.5m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Mill Building	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP30
near Keno City, YT	N; E; Zone 8	ELEVATION: 903.2m

SAMPLE TYPE	▨ DISTURBED	◺ NO RECOVERY	☒ SPT	☰ A-CASING	▥ SHELBY TUBE	▮ CORE
BACKFILL TYPE	▨ BENTONITE	⁘ PEA GRAVEL	▥ SLOUGH	⁘ GROUT	▧ DRILL CUTTINGS	⁘ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - sandy, some silt, compact, well graded, sub-rounded to sub-angular, damp, brown				
					903.0
1					
	SILT (TILL) - gravelly, sandy, trace clay, firm, organic inclusions, damp, olive grey				
					902.0
	EOH - Target Depth Note: End of bedrock knob				
2					
					901.0
3					
					900.0
4					
					899.0
5					
					898.0
6					

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 1.3m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

Flame and Moth Mill & DSTF	CLIENT: Alexco	PROJECT NO. - TESTPIT NO.
Borrow Pit	EXCAVATOR: Hitachi 270 LC	W14101178.002-TP31
near Keno City, YT	7086832N; 483866E; Zone 8	ELEVATION: 903.9m

SAMPLE TYPE ▨ DISTURBED ▨ NO RECOVERY ☒ SPT ▤ A-CASING ▥ SHELBY TUBE ▮ CORE

BACKFILL TYPE ▨ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▧ DRILL CUTTINGS ▨ SAND

Depth (m)	SOIL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	■ STANDARD PENETRATION (N) ■ 20 40 60 80 ▲ POCKET PEN. (kPa) ▲ 100 200 300 400 PLASTIC M.C. LIQUID 20 40 60 80	GROUND ICE DESCRIPTION	Elevation (m)
0	GRAVEL - cobbly, sandy, some to trace silt, compact, well graded, sub-rounded to sub-angular, damp, brown					
						903.0
1		▨	1			
						902.0
2	EOH - Target Depth					
						901.0
3						
						900.0
4						
						899.0
5						
						898.0
6						

EBA Engineering Consultants Ltd.	LOGGED BY: CJD	COMPLETION DEPTH: 2m
	REVIEWED BY: JRT	COMPLETE: 7/16/2009
	DRAWING NO: Figure 2	Page 1 of 1

APPENDIX B

APPENDIX B TEST RESULTS

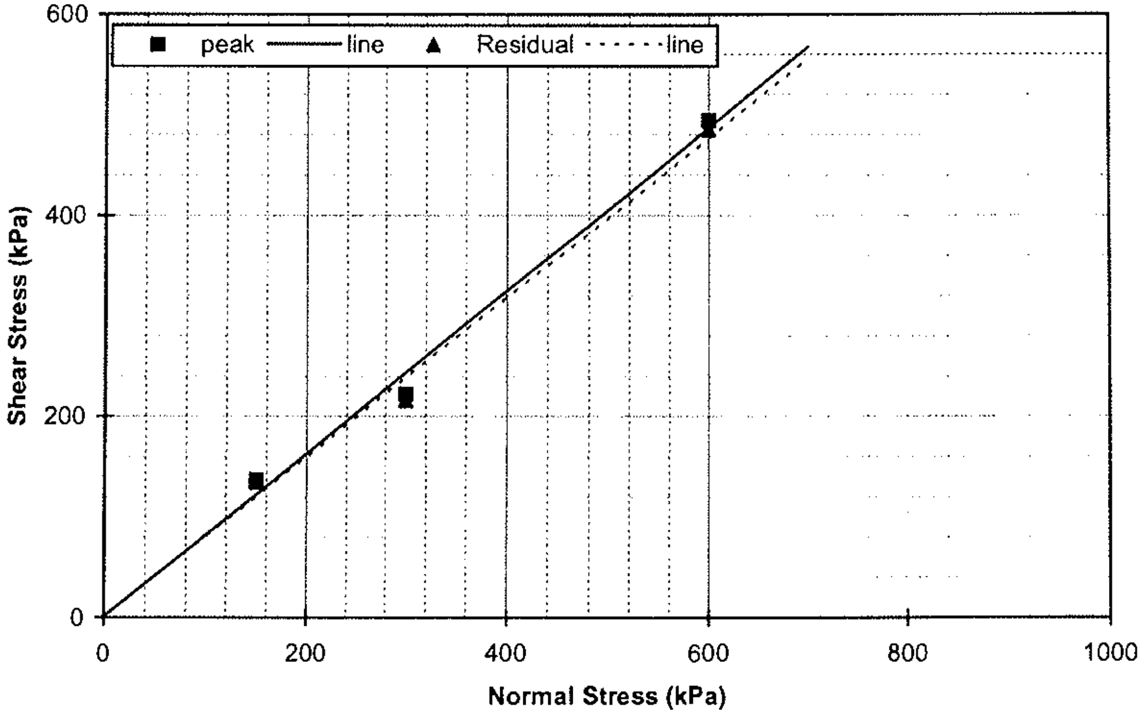
EBA Engineering Consultants Ltd.

Creating and Delivering Better Solutions

Summary of Direct Shear Test Results

Project : Flame and Moth BSTF Drilling and Design **Project No. :** W14101178.003

Test Hole : ~~BH11-~~ BH23 **Depth:** 0.7-2.9 m **Date :** 09-11-03



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength	1.0	39.0
Residual Strength	0.5	38.5

EBA Engineering Consultants Ltd.

Direct Shear Test **Flame and Moth BSTF Drilling and Design**

Project No.: W14101178.003
Date Tested: 09-10-19

Borehole No.: TH23
Depth (m): 0.7-0.9
Test Number: DS-5

Initial Sample Conditions

Moisture Content (%): 59.2
Wet Density (Mg/m^3): 1.401
Dry Density (Mg/m^3): 0.880

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.90	-0.787	123.7
0.13	-0.019	8.0	8.11	-0.802	124.4
0.30	-0.037	16.7	8.31	-0.818	124.4
0.52	-0.056	25.7	8.59	-0.835	124.2
0.75	-0.076	35.5	8.79	-0.852	124.0
0.96	-0.095	44.9	8.97	-0.867	124.6
1.19	-0.114	52.2	9.15	-0.882	125.4
1.41	-0.139	58.4	9.34	-0.897	126.4
1.64	-0.170	64.1	9.76	-0.905	128.8
1.87	-0.203	67.9	9.94	-0.910	128.8
2.09	-0.236	72.9	10.14	-0.913	128.9
2.32	-0.263	76.3	10.36	-0.914	129.5
2.53	-0.295	79.1	10.76	-0.917	131.1
2.76	-0.320	82.4	10.93	-0.918	131.5
2.98	-0.352	84.9	11.13	-0.919	131.3
3.40	-0.402	91.2	11.33	-0.919	132.0
3.60	-0.423	94.2	11.51	-0.920	132.9
3.78	-0.458	96.7	11.89	-0.921	134.4
4.01	-0.471	98.8	12.08	-0.921	134.3
4.21	-0.498	101.3	12.27	-0.922	134.4
4.61	-0.540	105.1	12.45	-0.923	134.8
4.81	-0.571	107.0	12.63	-0.924	135.1
5.02	-0.588	108.9	12.99	-0.925	136.2
5.22	-0.608	110.5	13.17	-0.924	136.5
5.62	-0.652	113.9	13.32	-0.926	136.7
5.83	-0.662	115.3	13.50	-0.927	136.6
6.03	-0.677	116.6	13.69	-0.929	136.4
6.25	-0.682	117.7	14.01	-0.931	136.2
6.66	-0.706	119.5	14.19	-0.933	135.9
6.86	-0.719	120.9	14.37	-0.936	135.6
7.05	-0.739	122.0	14.55	-0.938	135.3
7.26	-0.755	122.2			
7.69	-0.770	123.8			

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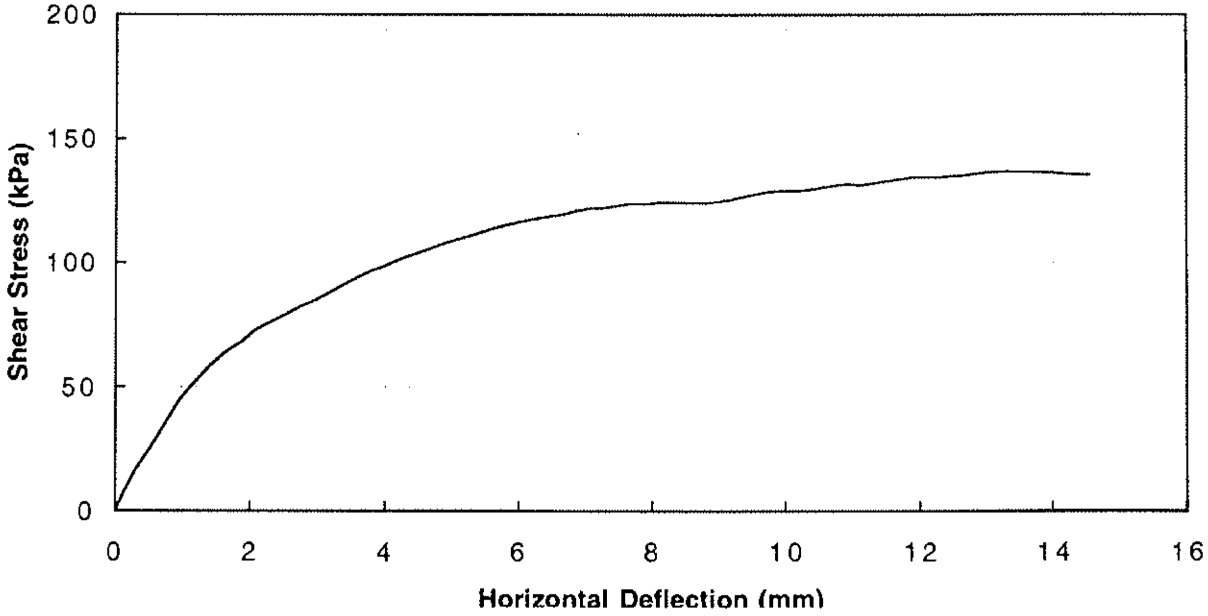
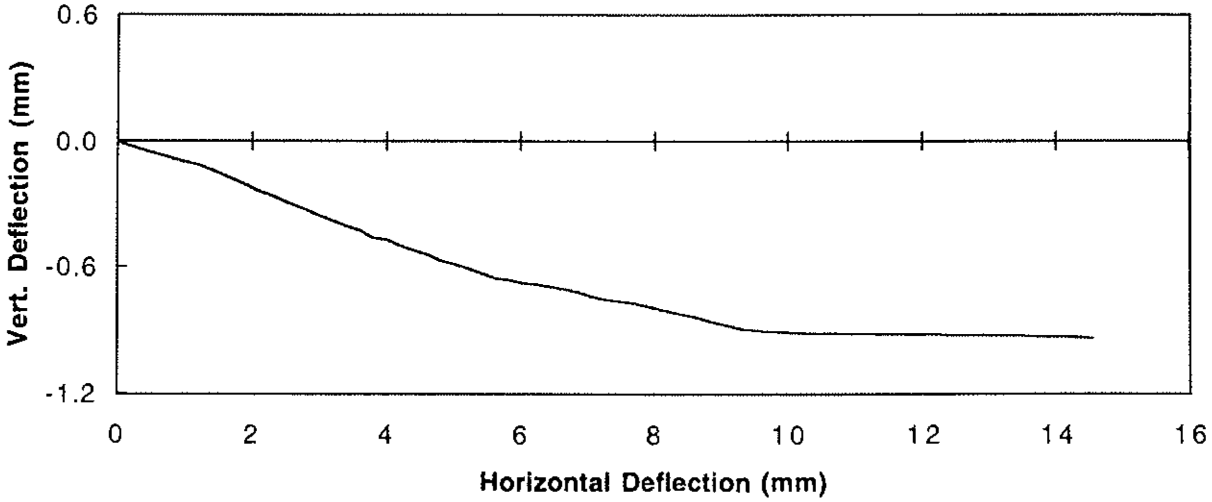
Direct Shear Test

Peak Stress = 137 kPa





Borehole Number: A23
Depth (m): 0.7-0.9
Normal Stress(kPa): 150
Displ. Rate(mm/min.):0.005
Test No.: DS-5

EBA Engineering Consultants Ltd.

Direct Shear Test **Flame and Moth BSTF Drilling and Design**

Project No.: W14101178.003
Date Tested: 09-10-19

Borehole No.: #23
Depth (m): 0.7-0.9
Test Number: DS-6

Initial Sample Conditions

Moisture Content (%): 93.3
Wet Density (Mg/m^3): 1.323
Dry Density (Mg/m^3): 0.685

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.16	-0.010	20.3
0.35	-0.030	40.1
0.54	-0.084	62.9
0.71	-0.108	77.8
0.90	-0.144	91.6
1.12	-0.167	105.1
1.34	-0.198	114.3
1.57	-0.222	124.7
1.79	-0.250	131.0
2.01	-0.276	136.9
2.22	-0.301	141.6
2.44	-0.322	146.8
2.66	-0.347	151.4
3.07	-0.387	158.8
3.28	-0.402	162.7
3.49	-0.454	165.8
3.69	-0.491	169.2
4.11	-0.529	175.8
4.31	-0.558	178.3
4.52	-0.577	180.7
4.71	-0.605	182.8
5.11	-0.643	186.8
5.31	-0.659	188.7
5.50	-0.688	190.5
5.70	-0.708	192.2
6.11	-0.744	195.8
6.30	-0.766	197.3
6.50	-0.776	198.5
6.68	-0.803	199.9
7.08	-0.868	201.8
7.27	-0.901	202.7
7.50	-0.934	203.6
7.90	-0.968	204.7
8.10	-1.002	205.1
8.32	-1.033	204.3
8.53	-1.061	204.4
8.86	-1.070	207.1
9.06	-1.089	209.3
9.25	-1.107	210.1
9.47	-1.109	211.0
9.86	-1.141	212.2
10.06	-1.149	212.4
10.27	-1.155	212.7
10.47	-1.159	213.1
10.87	-1.181	213.7
11.07	-1.190	215.3
11.27	-1.194	216.2
11.46	-1.206	218.1
11.85	-1.222	219.6
12.05	-1.229	220.6
12.23	-1.243	221.3
12.41	-1.250	221.6
12.79	-1.270	221.4
12.98	-1.278	221.2
13.17	-1.285	220.8
13.35	-1.297	219.8
13.54	-1.305	219.3
13.91	-1.325	218.4
14.09	-1.344	218.0
14.27	-1.363	217.1
14.43	-1.378	216.8
14.60	-1.393	216.6
14.81	-1.409	216.3

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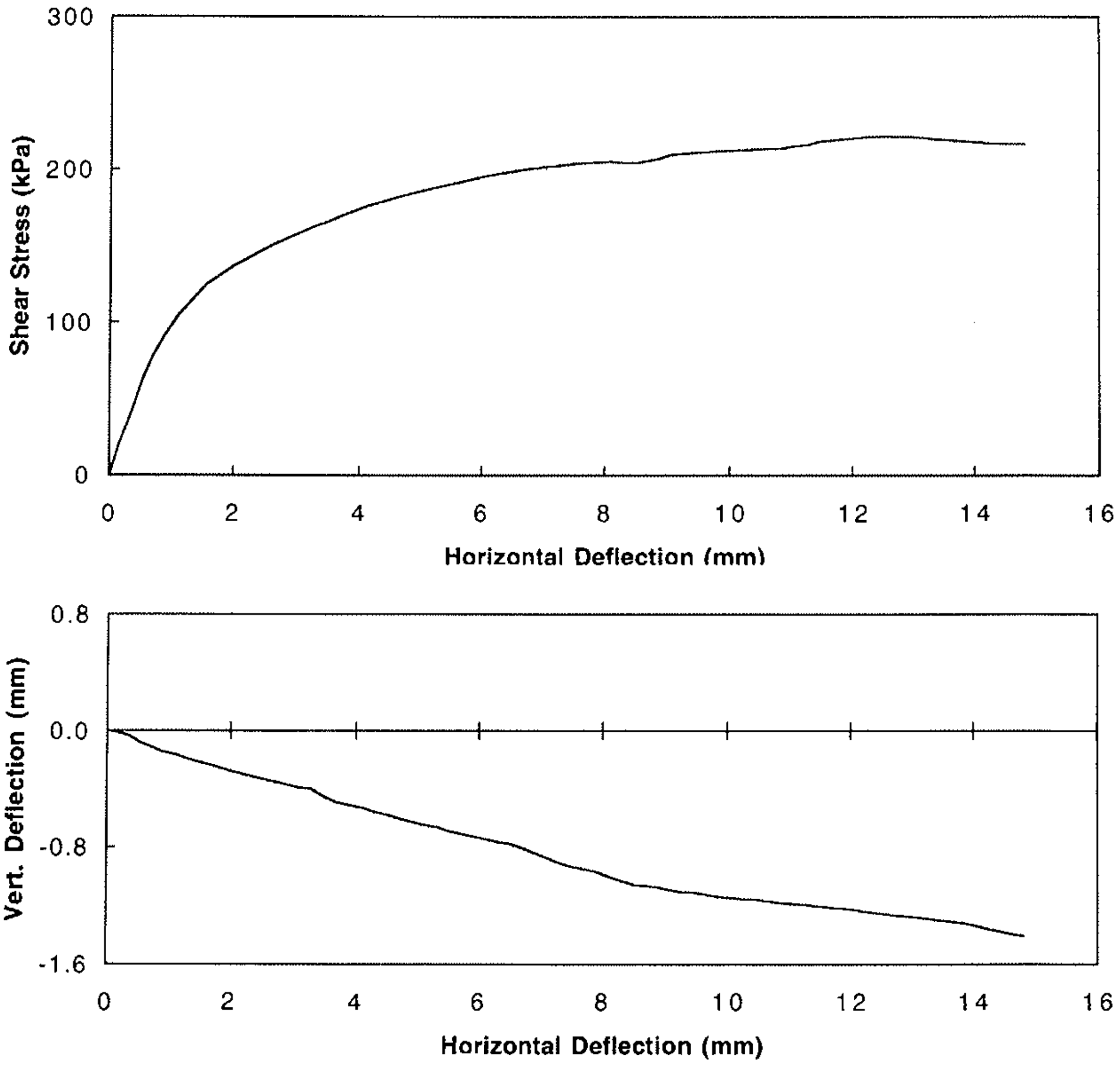
Direct Shear Test

Peak Stress = 222 kPa



Borehole Number: H23
Depth (m): 0.7-0.9
Normal Stress(kPa): 300
Displ. Rate(mm/min.): 0.005
Test No.: DS-6

EBA Engineering Consultants Ltd.

Direct Shear Test

Flame and Moth BSTF Drilling and Design

Project No.: W14101178.003
Date Tested: 09-10-22

Borehole No.: TH23
Depth (m): 2.7-2.9
Test Number: DS-7

Initial Sample Conditions

Moisture Content (%): 17.3
Wet Density (Mg/m^3): 2.084
Dry Density (Mg/m^3): 1.776

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	6.98	-0.242	463.0
0.13	-0.033	34.0	7.23	-0.241	465.5
0.27	-0.065	81.3	7.48	-0.241	466.8
0.41	-0.093	121.0	7.74	-0.241	468.9
0.57	-0.122	157.9	7.97	-0.240	472.4
0.76	-0.142	197.0	8.23	-0.240	472.9
0.88	-0.151	228.6	8.47	-0.241	477.6
1.01	-0.166	251.0	8.74	-0.242	478.1
1.14	-0.172	269.6	9.00	-0.244	475.8
1.26	-0.181	284.9	9.24	-0.247	478.3
1.37	-0.191	298.8	9.50	-0.253	479.2
1.51	-0.198	315.8	9.74	-0.257	481.2
1.64	-0.207	330.5	10.00	-0.260	484.4
1.89	-0.215	353.4	10.24	-0.262	486.2
2.15	-0.218	371.0	10.50	-0.263	487.1
2.40	-0.221	384.1	10.75	-0.264	487.8
2.67	-0.226	391.5	10.99	-0.264	489.5
2.92	-0.229	398.2	11.24	-0.266	491.0
3.18	-0.233	415.3	11.47	-0.267	491.9
3.45	-0.238	428.5	11.71	-0.269	492.7
3.70	-0.242	437.3	11.95	-0.270	493.3
3.96	-0.246	445.0	12.18	-0.272	493.8
4.21	-0.250	449.9	12.39	-0.274	493.5
4.47	-0.250	451.6	12.62	-0.275	493.1
4.73	-0.250	453.2	12.85	-0.276	492.4
4.97	-0.250	455.3	13.07	-0.277	491.3
5.23	-0.250	457.2	13.30	-0.278	490.0
5.47	-0.248	460.5	13.54	-0.279	488.5
5.74	-0.247	459.9	13.76	-0.279	487.2
6.00	-0.246	462.9	13.97	-0.279	486.1
6.24	-0.245	464.3	14.21	-0.279	485.4
6.48	-0.244	466.7			
6.73	-0.243	466.1			

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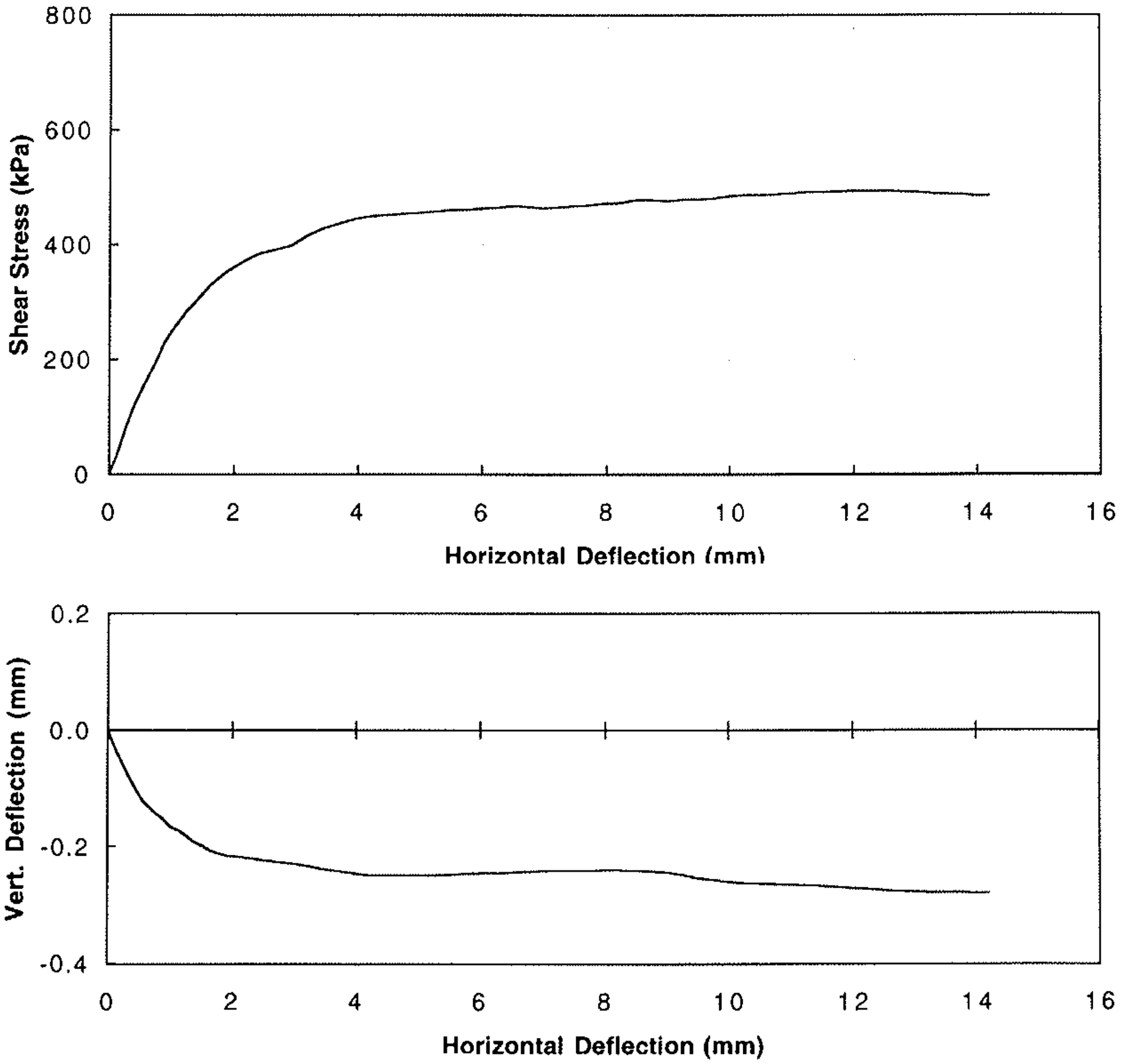
Direct Shear Test

Peak Stress = 494 kPa



Borehole Number: ~~11~~23
Depth (m): 2.7-2.9
Normal Stress(kPa): 600
Displ. Rate(mm/min.): 0.012
Test No.: DS-7

SAMPLE INFORMATION

Project: Flame & Moth BSTF Drilling and Design

Address:

Project Number: W14101178.003

Date Tested: 09.10.15 By: S.K.

Test Apparatus: Thaw Strain

Machine Number: 89128

Rate of Strain: mm% / minute

Normal Stress: 150 kPa

Cell Pressure: kPa

Back Pressure: kPa

Head Differential: kPa

Swelling Pressure: kPa

Borehole Number: #23

Depth: 0.7 – 0.9 m

Test Number: TS - 1

Sample Description:

Sample Description	Diameter (mm)	Height (mm)
1	75.48	113.36
2	75.24	113.30
3	75.46	113.54
4	75.44	113.86
Mean	75.41	113.52

$V = 507.02 \text{ cm}^3$

	Trimmings	Initial	Final
Tare Number			
Mass of Wet Soil & Tare g		556.20	330.25
Mass of Dry Soil & Tare g			
Mass of Tare g			
Mass of Dry Soil g			
Mass of Moisture g			
Moisture Content %			
Wet Density Mg/m^3		1.097	1.654
Dry Density Mg/m^3			

Sketch and Remarks:

150 kPa = 21.75 psi. × 6.92 in^2 = 150.5 lbs − hanger

= 147.2 lbs. on hanger

$$\text{Strain} = \frac{\Delta h}{\Sigma H} = \frac{68.81 \text{ mm}}{113.52 \text{ m}} \times 100 = 60.6\ \%$$

Angle of Shear:

eba

2097

EBA Engineering Consultants Ltd.

eba

CONSOLIDATION TEST

Project:

Address:

Project Number: W14101178.003

Date Tested: 09.10.15 By: S.K.

Borehole No.: H 23

Depth: 0.7 - 0.9 m

Test No.: TS-1

Sheet No.: 1

Machine No.:

Load To ___ kPa				Load To ___ kPa			
Date	Time	Elapsed Time-Min.	Dial Rdg. ~~(.0002 cm)~~ mm	Date	Time	Elapsed Time-Min.	Dial Rdg. (.0002 cm)
Init rdg. w/hanger			45.48				
Rdg. after 20 lbs added			45.16	seating			
	Load to	150 kPa					
10.15	0830	0	45.16				
	0832	2	44.14				
	0834	4	43.99				
	0838	8	43.25				
	0846	16	41.63				
	0900	30	38.45				
	0935	65	30.13				
	1030	120	15.07				
	1130	180	1.70/40.21	-43.46			
	1300		21.44				
	1435		16.13				
	1623		15.76				
16	0730		15.25				
	1610		15.14				
17	0735		15.04				
19	0710		14.88				
19	1050		14.86	68.81			

SAMPLE INFORMATION

Project: Flame & Moth BSTF Drilling and Design

Address:

Project Number: W14101178.003

Date Tested: 09.10.19 By: S.K.

Test Apparatus: Thaw Strain

Machine Number: 89128

Rate of Strain: mm% / minute

Normal Stress: 150 kPa

Cell Pressure: kPa

Back Pressure: kPa

Head Differential: kPa

Swelling Pressure: kPa

Borehole Number: #23

Depth: 2.7 - 2.9 m (3.2 - 3.4 marked on bag)

Test Number: TS-2

Sample Description:

Sample Description	Diameter	Height
1	75.14	114.42
2	75.22	113.30
3	75.16	112.52
4	75.08	113.46
Mean	75.15	113.43

$V = 503.13\ cm^3$

	Trimmings	Initial	Final
Tare Number			
Mass of Wet Soil & Tare g		607.85	396.57
Mass of Dry Soil & Tare g			
Mass of Tare g			
Mass of Dry Soil g			
Mass of Moisture g			
Moisture Content %			
Wet Density Mg/m^3		1.208	2.152
Dry Density Mg/m^3			

Sketch and Remarks:

$$\text{Strain} = \frac{\Delta h}{\Sigma H} = \frac{71.88\ mm}{113.43\ mm} \times 100 = \underline{63.4}\ \%$$

Angle of Shear:

EBA Engineering Consultants Ltd.

CONSOLIDATION TEST

Project:
Address:
Project Number: W1410178.003
Date Tested: 09.10.20 By: S.K.

Borehole No.: H23
Depth: 2.7 - 2.9 m
Test No.: TS-2
Sheet No.: 1
Machine No.:

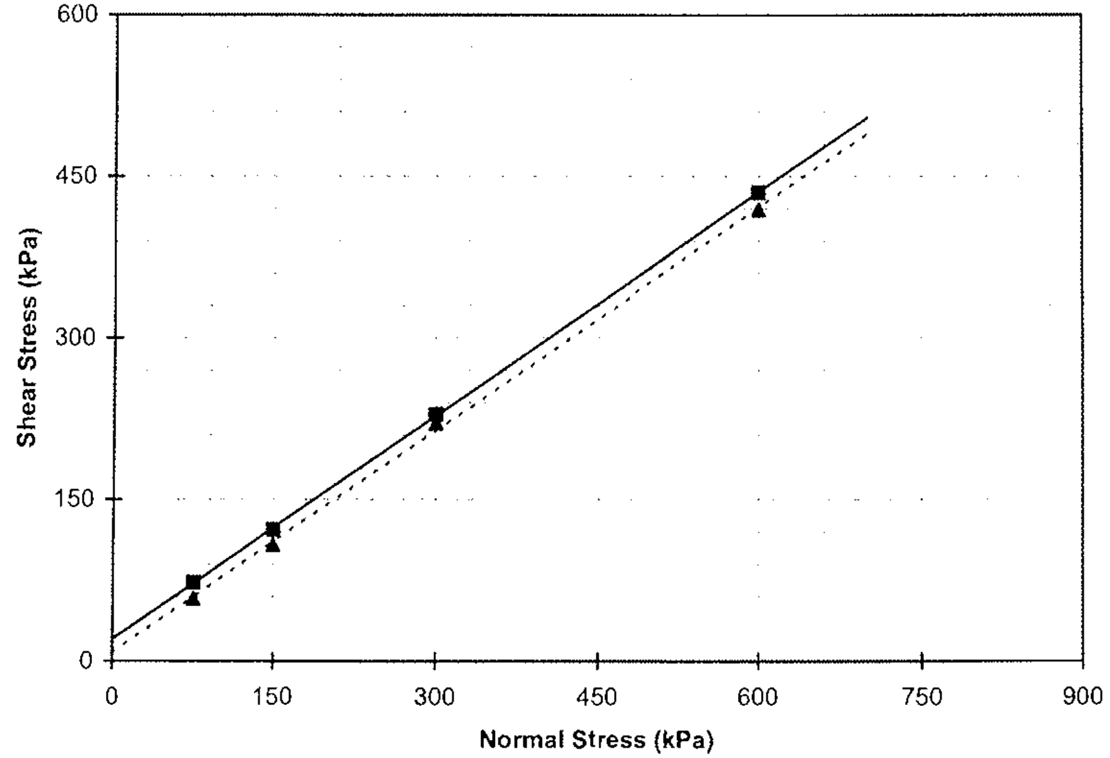
Load To ______ kPa				Load To ______ kPa			
Date	Time	Elapsed Time-Min.	Dial Rdg. ~~(.0002 cm)~~ (mm)	Date	Time	Elapsed Time-Min.	Dial Rdg. (.0002 cm)
Init rdg. w/ hanger			47.30				
Rdg. after 20 lbs. added			47.21	— seating			
	Load to 150 kPa						
10.20	0738	0	47.21				
		.5	46.33				
		1	46.22				
		2	46.11				
		4	46.04				
		8	45.95				
	0755	17	45.43				
	0810	32	42.19				
	0838	60	32.40				
	0938	120	7.40/47.90	— 39.81			
	1310		15.92				
21	0725		15.85				
22	0725		15.83				
	1050		15.83	— 71.88			

Summary of Direct Shear Test Results

ASTM D 3080-04

Project : Flame and Moth BSTF Drilling and Design **Project No. :** W14101178.003

Sample No.: Tailings 001 **Date :** 09-10-16



Inferred Shear Strength Parameters :-

	Cohesion Intercept (kPa)	Inferred Angle of Shearing Resistance (Degrees)
Peak Strength	20.2	35.2
Residual Strength	7.5	34.7

EBA Engineering Consultants Ltd.

Direct Shear Test

Flame and Moth BSTF Drilling and Design

Project No.: W14101178.003
Date Tested: 09-10-09

Sample No.: Tailings 001
Test Number: DS-1

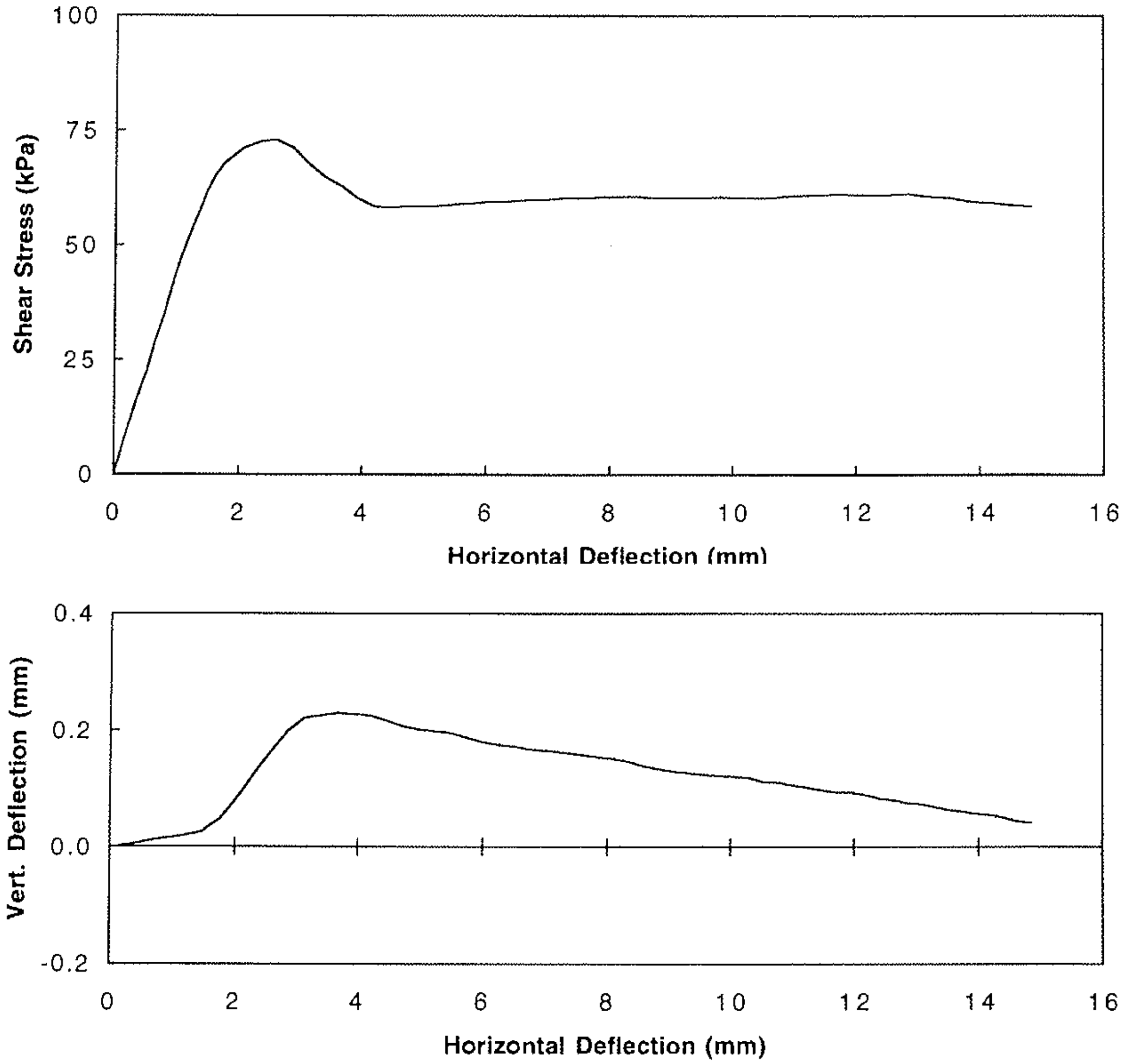
Initial Sample Conditions

Moisture Content (%): 16.3
Wet Density (Mg/m^3): 1.959
Dry Density (Mg/m^3): 1.683

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.18	0.003	8.5
0.38	0.005	17.0
0.52	0.008	22.2
0.64	0.011	28.4
0.79	0.014	34.7
0.93	0.016	41.3
1.07	0.018	47.8
1.22	0.021	53.2
1.36	0.023	57.8
1.48	0.027	61.9
1.61	0.038	65.3
1.75	0.047	67.8
2.06	0.087	71.1
2.33	0.129	72.5
2.60	0.166	72.8
2.87	0.200	71.2
3.14	0.221	67.6
3.41	0.226	64.8
3.67	0.229	62.7
3.92	0.227	60.3
4.19	0.226	58.4
4.45	0.217	58.1
4.71	0.208	58.4
4.98	0.202	58.4
5.24	0.199	58.5
5.50	0.195	58.9
6.01	0.180	59.3
6.27	0.175	59.4
6.53	0.172	59.7
6.77	0.167	59.8
7.04	0.165	60.0
7.30	0.162	60.3
7.57	0.159	60.2
7.82	0.154	60.4
8.07	0.151	60.5
8.33	0.147	60.6
8.56	0.139	60.4
8.80	0.135	60.3
9.06	0.130	60.3
9.31	0.127	60.3
9.55	0.124	60.3
9.82	0.122	60.4
10.30	0.119	60.2
10.53	0.111	60.2
10.78	0.110	60.4
11.01	0.106	60.7
11.26	0.102	60.9
11.50	0.097	61.0
11.74	0.094	61.1
11.98	0.093	60.9
12.22	0.089	60.9
12.43	0.083	60.8
12.66	0.080	61.0
12.87	0.075	61.2
13.10	0.073	60.8
13.31	0.068	60.5
13.53	0.063	60.4
13.76	0.060	59.8
13.98	0.057	59.4
14.20	0.055	59.3
14.42	0.050	58.8
14.62	0.045	58.6
14.85	0.041	58.4

Direct Shear Test

Peak Stress = 73 kPa



Sample Number:	Tailings 001
Normal Stress(kPa):	75
Displ. Rate(mm/min.):	0.012
Test No.:	DS-1

SAMPLE INFORMATION

Project: Flame & Moth BSTF Drilling & Design
Address:

Project Number: WK401178.003
Date Tested: 09.10.09 By: S.K.
Test Apparatus: Direct Shear
Machine Number: 1
Rate of Strain: .012 mm[illegible] / minute
Normal Stress: 75 kPa
Cell Pressure: kPa
Back Pressure: kPa
Head Differential: kPa
Swelling Pressure: kPa

Borehole Number: Tailings 001
Depth:
Test Number: DS-1
Sample Description:

Sample Description	Diameter (mm)	Height (mm)
1		
2		
3		
4		
Mean	63.50	19.06

γmax = 1.770 Mg/m³ @ 16.8 % Opt. m.c.   V = 60.36 cm³

	Trimmings	Initial	Final
Tare Number			
Mass of Wet Soil & Tare g		194.16	(125.24) 129.07
Mass of Dry Soil & Tare g			(101.61) 105.98
Mass of Tare g		75.94	6.68
Mass of Dry Soil g			
Mass of Moisture g			
Moisture Content %		16.35	23.25
Wet Density Mg/m³		1.959	
Dry Density Mg/m³		1.683	

95.1 % SPD

8.96
6.65
2.31

Sketch and Remarks:

75 kPa = 10.9 psi. × 4.91 in² = 53.4 lbs. − hanger
= 38.4 lbs. on hanger

Angle of Shear:

eba

EBA Engineering Consultants Ltd.

Direct Shear Test **Flame and Moth BSTF Drilling and Design**

Project No.: W14101178.003
Date Tested: 09-10-09

Sample No.: Tailings 001
Test Number: DS-2

Initial Sample Conditions

Moisture Content (%): 16.8
Wet Density (Mg/m^3): 1.959
Dry Density (Mg/m^3): 1.678

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.11	-0.003	26.0
0.23	-0.005	41.4
0.35	-0.010	50.8
0.51	-0.012	60.0
0.62	-0.014	68.1
0.75	-0.015	75.7
0.88	-0.016	83.3
1.15	-0.012	94.9
1.41	0.002	103.1
1.65	0.010	108.2
1.92	0.029	111.1
2.19	0.059	111.6
2.45	0.073	110.4
2.74	0.097	108.1
3.00	0.103	106.1
3.27	0.103	105.2
3.52	0.098	105.1
3.79	0.092	105.0
4.04	0.085	103.7
4.29	0.077	101.7
4.55	0.058	100.7
4.80	0.039	101.0
5.05	0.027	101.7
5.29	0.007	102.6
5.54	-0.005	105.6
5.78	-0.018	109.7
6.03	-0.033	113.6
6.28	-0.039	117.2
6.53	-0.053	119.7
6.78	-0.060	121.2
7.03	-0.064	121.5
7.30	-0.064	121.4
7.55	-0.071	121.2
7.80	-0.080	120.6
8.06	-0.086	119.1
8.32	-0.093	117.9
8.57	-0.103	115.6
8.82	-0.111	113.4
9.08	-0.109	111.5
9.34	-0.118	110.7
9.59	-0.122	110.6
9.85	-0.126	110.8
10.10	-0.133	110.5
10.34	-0.146	110.4
10.58	-0.158	109.9
10.82	-0.165	110.1
11.07	-0.172	109.9
11.31	-0.180	110.1
11.54	-0.190	109.9
11.79	-0.196	109.8
12.03	-0.200	109.6
12.26	-0.207	109.6
12.49	-0.217	109.7
12.71	-0.224	109.4
12.94	-0.234	109.4
13.18	-0.239	109.2
13.41	-0.246	109.0
13.63	-0.252	108.9
13.86	-0.259	108.7
14.08	-0.268	108.7
14.31	-0.276	108.4
14.52	-0.283	108.3
14.72	-0.290	108.2

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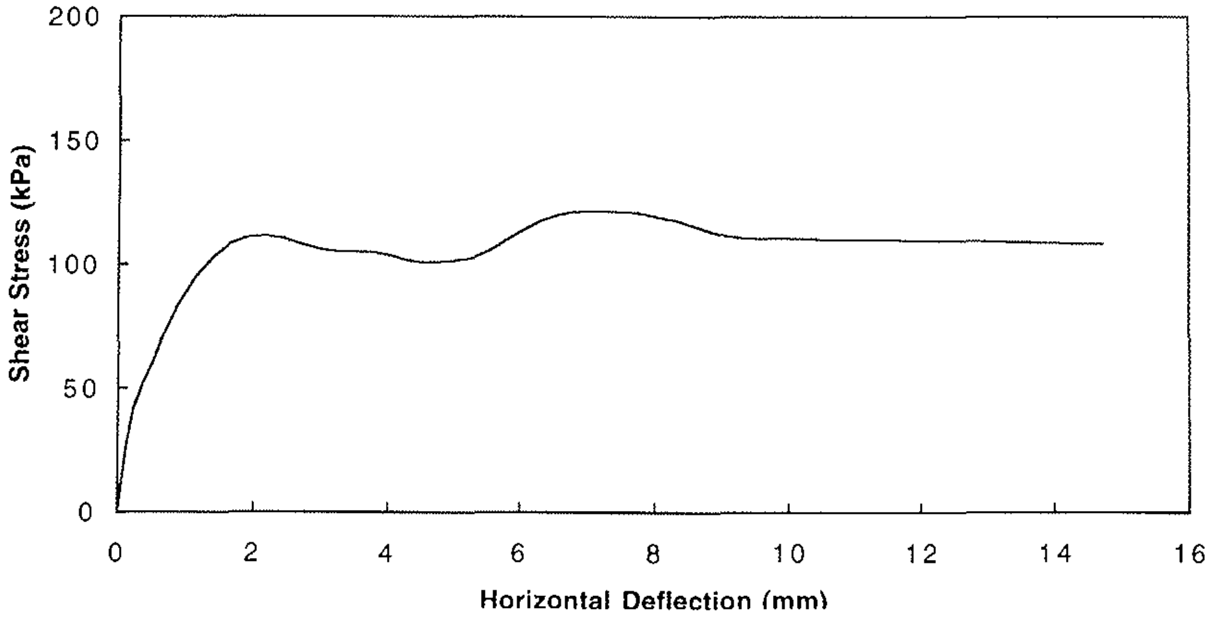
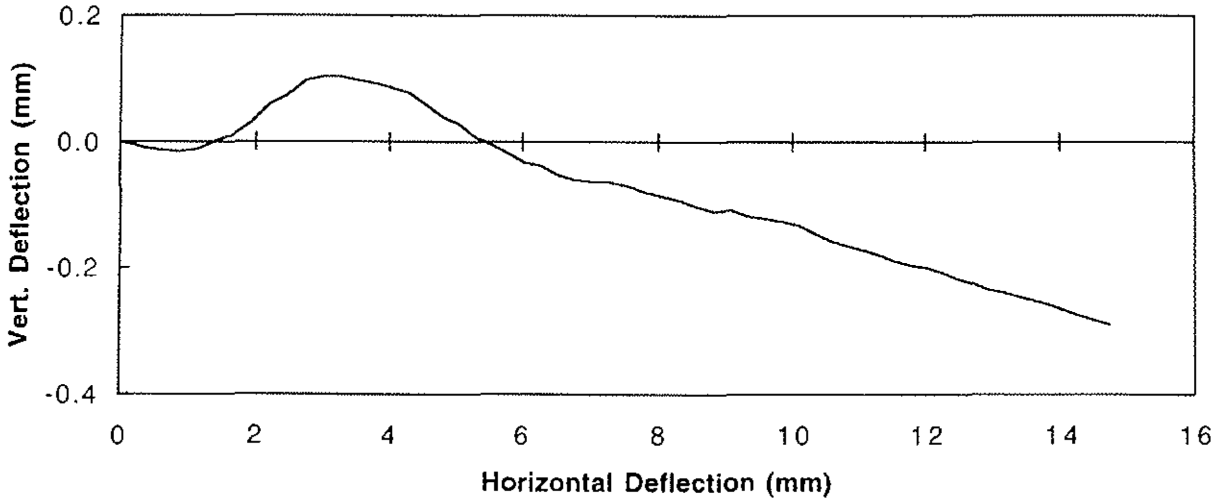
Direct Shear Test

Peak Stress = 122 kPa





Sample Number:	Tailings 001
Normal Stress(kPa):	150
Displ. Rate(mm/min.):	0.012
Test No.:	DS-2

SAMPLE INFORMATION

Project: Flame & Moth BSTF Drilling & Design

Address:

Project Number: W1410 1178.003

Date Tested: 09.10.09 By: S.K.

Test Apparatus: Direct Shear

Machine Number: 2

Rate of Strain: .012 mm(s) / minute

Normal Stress: 150 kPa

Cell Pressure: kPa

Back Pressure: kPa

Head Differential: kPa

Swelling Pressure: kPa

Borehole Number: Tailings 001

Depth:

Test Number: DS-2

Sample Description:

Sample Description	Diameter (mm)	Height (mm)
1		
2		
3		
4		
Mean	63.50	19.06

$\rho_{max.} = 1.770$ Mg/m³ @ 16.8 % opt. m.c.

V = 60.36 cm³

	Trimmings	Initial	Final
Tare Number			
Mass of Wet Soil & Tare g		194.18	(125.90) 129.77
Mass of Dry Soil & Tare g			(101.27) 105.69
Mass of Tare g		75.94	6.70
Mass of Dry Soil g			
Mass of Moisture g			
Moisture Content %		16.76	24.33
Wet Density Mg/m³		1.959	
Dry Density Mg/m³		1.678	

94.8 % SPD

$$\begin{array}{r} 8.86 \\ 6.58 \\ \hline 2.28 \end{array}$$

Sketch and Remarks:

150 kPa = 21.75 psi x 4.91 in² = 106.8 lbs.

= 2.6 lbs. on Lv. hanger

Angle of Shear:

eba

EBA Engineering Consultants Ltd.

Direct Shear Test

Flame and Moth BSTF Drilling and Design

Project No.: W14101178.003
Date Tested: 09-10-09
Sample No.: Tailings 001
Test Number: DS-3

Initial Sample Conditions

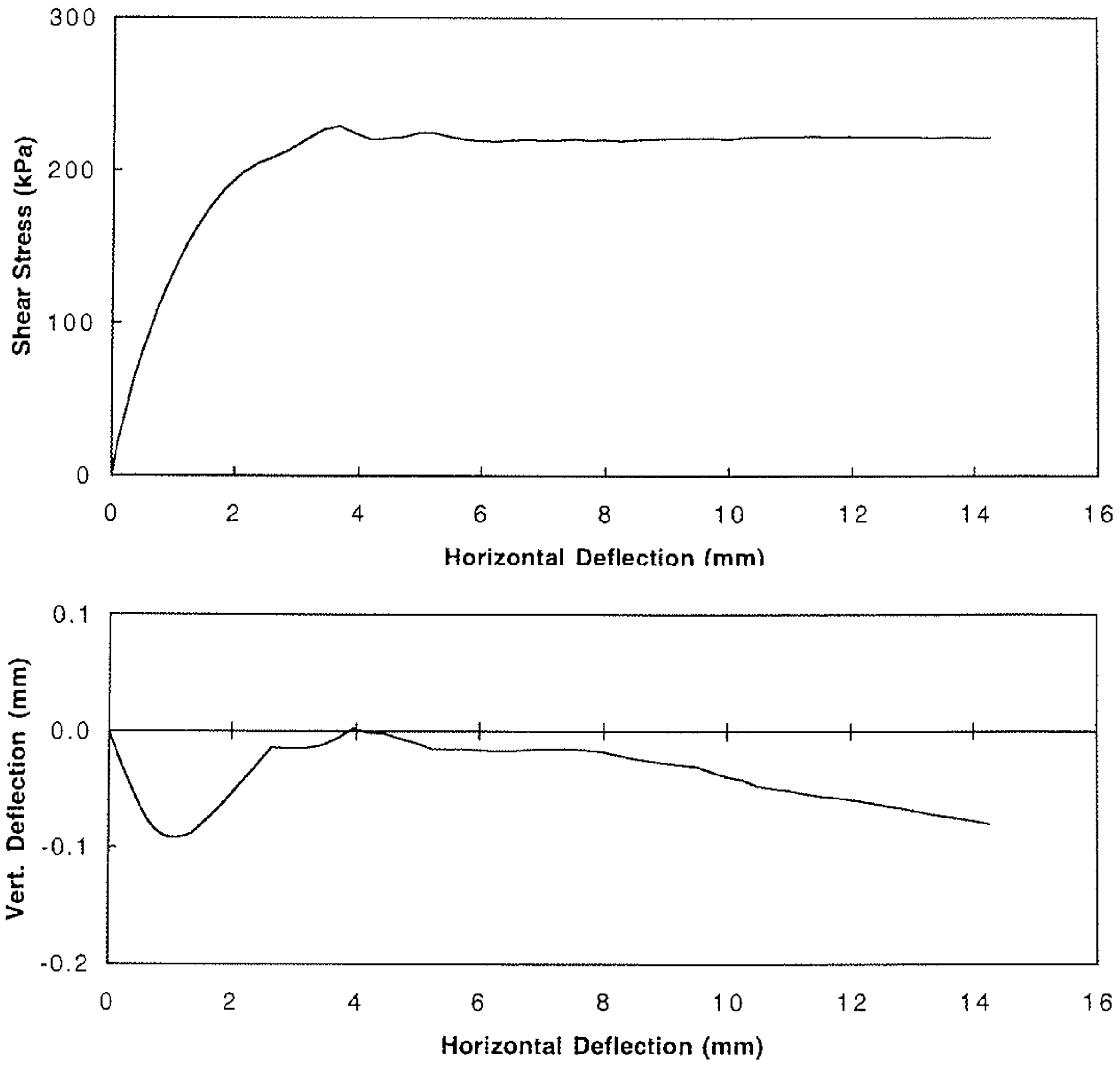
Moisture Content (%): 16.4
Wet Density (Mg/m^3): 1.959
Dry Density (Mg/m^3): 1.682

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0
0.11	-0.015	23.4
0.22	-0.031	42.1
0.34	-0.046	61.3
0.49	-0.063	80.3
0.63	-0.076	95.1
0.74	-0.084	109.3
0.87	-0.089	121.7
0.99	-0.091	133.0
1.11	-0.091	142.8
1.23	-0.090	152.2
1.35	-0.088	160.5
1.59	-0.076	175.4
1.84	-0.063	188.0
2.11	-0.047	197.8
2.38	-0.031	204.8
2.64	-0.014	208.8
2.90	-0.015	213.8
3.16	-0.015	220.5
3.42	-0.013	226.8
3.69	-0.006	228.9
3.95	0.002	224.1
4.20	-0.002	220.0
4.45	-0.002	220.7
4.73	-0.007	222.0
4.97	-0.010	224.5
5.22	-0.015	224.5
5.48	-0.015	221.9
5.76	-0.016	219.9
5.98	-0.016	219.2
6.25	-0.017	219.1
6.49	-0.017	219.6
6.74	-0.016	219.9
6.98	-0.016	219.8
7.24	-0.016	219.8
7.49	-0.016	220.3
7.74	-0.016	219.8
7.99	-0.018	219.9
8.24	-0.021	219.5
8.50	-0.024	220.2
8.74	-0.026	220.6
9.00	-0.027	220.7
9.26	-0.029	221.2
9.50	-0.030	221.0
9.76	-0.035	221.2
10.01	-0.039	220.5
10.25	-0.042	221.4
10.49	-0.047	221.9
10.75	-0.049	221.9
10.99	-0.051	221.9
11.24	-0.054	222.1
11.47	-0.056	222.4
11.72	-0.057	221.7
11.96	-0.059	222.1
12.20	-0.060	221.9
12.43	-0.062	221.9
12.65	-0.065	221.6
12.88	-0.067	221.6
13.11	-0.069	221.4
13.34	-0.071	221.3
13.57	-0.073	221.6
13.82	-0.075	221.4
14.04	-0.077	221.3
14.26	-0.080	221.3

EBA Engineering Consultants Ltd.

Direct Shear Test

Peak Stress = 229 kPa



Sample Number: Tailings 001
Normal Stress(kPa): 300
Displ. Rate(mm/min.): 0.012
Test No.: DS-3

SAMPLE INFORMATION

Project: Flame & Moth BSTF Drilling & Design
Address:
Project Number: W14101178.003
Date Tested: 09.10.09 By: S.K.
Test Apparatus: Direct Shear
Machine Number: 3
Rate of Strain: .012 mm / minute
Normal Stress: 300 kPa
Cell Pressure: kPa
Back Pressure: kPa
Head Differential: kPa
Swelling Pressure: kPa

Borehole Number: Tailings 001
Depth:
Test Number: DS-3
Sample Description:

	Sample Description Diameter (mm)	Height (mm)
1		
2		
3		
4		
Mean	63.50	19.06

$\rho_{max} = 1.770$ Mg/m^3 @ 16.8 % Opt. m.c. V = 60.36 cm^3

	Trimmings	Initial	Final
Tare Number			
Mass of Wet Soil & Tare g		194.17	(126.65) 129.90
Mass of Dry Soil & Tare g			(101.53) 105.46
Mass of Tare g		75.94	6.67
Mass of Dry Soil g			
Mass of Moisture g			
Moisture Content %		16.45	24.74
Wet Density Mg/m^3		1.959	
Dry Density Mg/m^3		1.682	

9.30
6.56
2.74

95.0 % SPD

Sketch and Remarks:

300 kPa = 43.5 psi × 4.91 in^2 = 213.6 lbs.
≈ 13.2 lbs. on Lv. hanger

Angle of Shear:

EBA Engineering Consultants Ltd.

Direct Shear Test **Flame and Moth BSTF Drilling and Design**

Project No.: W14101178.003
Date Tested: 09-10-13
Sample No.: Tailings 001
Test Number: DS-4

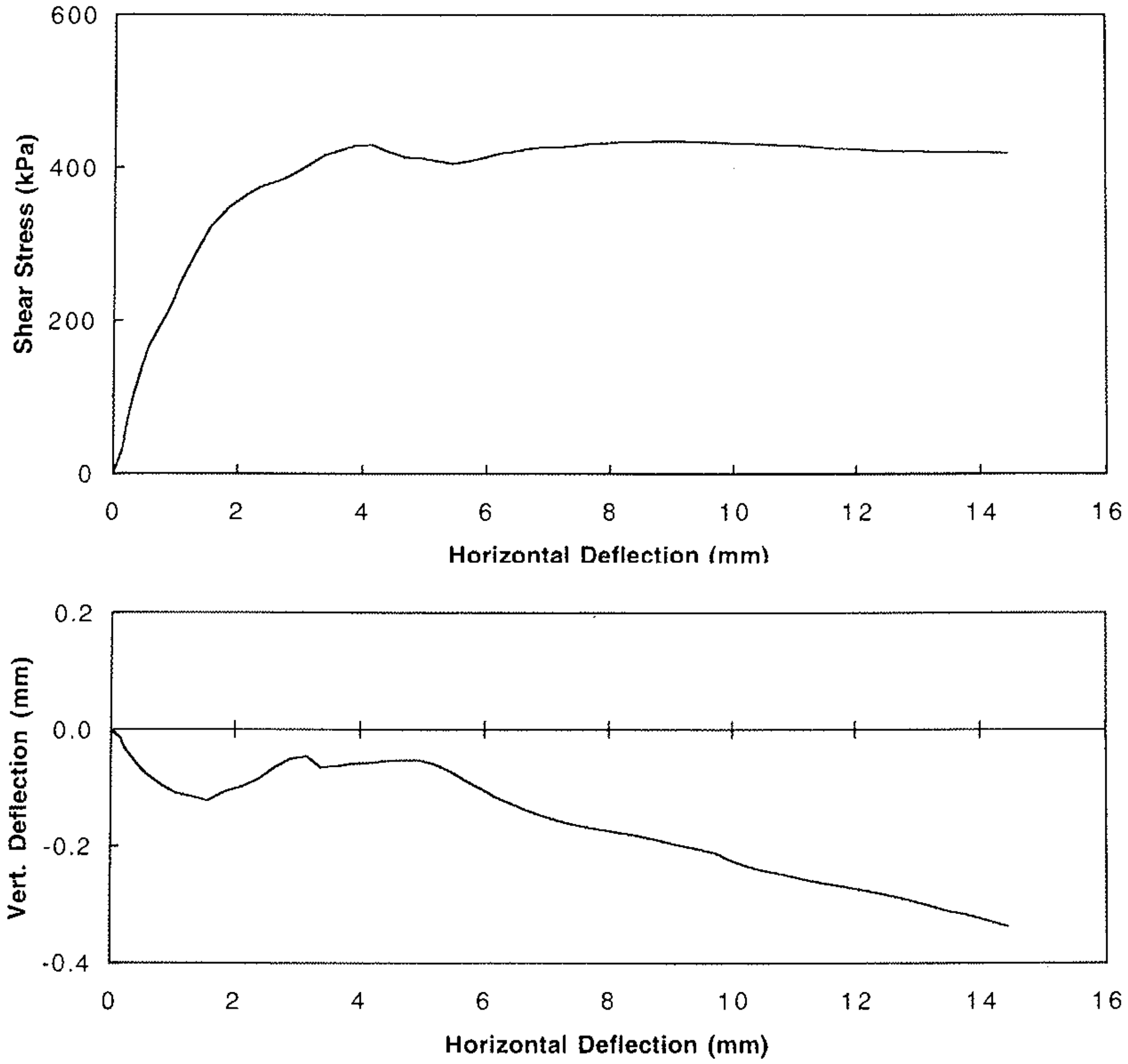
Initial Sample Conditions

Moisture Content (%): 16.8
Wet Density (Mg/m^3): 1.959
Dry Density (Mg/m^3): 1.678

Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)	Horiz. Disp. (mm)	Vert Disp. (mm)	Shear Stress (kPa)
0.00	0.000	0.0	7.19	-0.157	427.1
0.15	-0.015	34.5	7.45	-0.163	428.8
0.22	-0.031	65.3	7.70	-0.169	431.2
0.33	-0.046	102.4	7.95	-0.173	432.2
0.45	-0.063	136.8	8.19	-0.178	433.6
0.57	-0.076	166.0	8.45	-0.182	433.7
0.71	-0.087	185.3	8.71	-0.187	434.5
0.83	-0.096	203.9	8.97	-0.194	434.6
0.96	-0.104	223.7	9.21	-0.200	434.0
1.07	-0.110	247.3	9.47	-0.205	433.5
1.33	-0.116	287.7	9.72	-0.211	432.9
1.56	-0.122	321.6	9.96	-0.224	431.9
1.85	-0.106	347.1	10.20	-0.233	431.5
2.12	-0.098	363.7	10.46	-0.241	430.5
2.37	-0.086	374.9	10.70	-0.246	430.1
2.64	-0.064	382.8	10.95	-0.252	429.2
2.88	-0.051	391.5	11.19	-0.259	428.8
3.14	-0.047	404.6	11.45	-0.263	426.6
3.37	-0.066	415.2	11.68	-0.267	425.2
3.61	-0.063	422.2	11.93	-0.272	425.0
3.88	-0.059	428.1	12.16	-0.277	423.6
4.15	-0.058	429.8	12.40	-0.281	421.8
4.40	-0.055	421.2	12.64	-0.287	421.9
4.68	-0.053	413.6	12.87	-0.292	421.2
4.95	-0.053	412.1	13.09	-0.300	421.5
5.18	-0.059	408.4	13.31	-0.306	420.5
5.47	-0.072	404.9	13.54	-0.312	420.2
5.69	-0.088	407.9	13.78	-0.318	420.2
5.96	-0.103	412.9	14.01	-0.325	420.2
6.19	-0.117	418.0	14.22	-0.331	419.5
6.46	-0.128	421.5	14.45	-0.337	419.3
6.69	-0.139	425.2			
6.93	-0.148	426.0			

Direct Shear Test

Peak Stress = 435 kPa



Sample Number: Tailings 001
Normal Stress(kPa): 600
Displ. Rate(mm/min.): 0.012
Test No.: DS-4

SAMPLE INFORMATION

Project: Flame & Moth BSTF Drilling & Design
Address:
Project Number: W14101178.003
Date Tested: 09.10.13 By: S.K.
Test Apparatus: Direct Shear
Machine Number: 3
Rate of Strain: .012 mm / minute
Normal Stress: 600 kPa
Cell Pressure: kPa
Back Pressure: kPa
Head Differential: kPa
Swelling Pressure: kPa

Borehole Number: Tailings 001
Depth:
Test Number: DS-4
Sample Description:

Sample Description	Diameter (mm)	Height (mm)
1		
2		
3		
4		
Mean	63.50	19.06

$\rho max = 1.770\ Mg/m^3$ @ 16.8 % Opt. m.c. $V = 60.36\ cm^3$

	Trimmings	Initial	Final
Tare Number			
Mass of Wet Soil & Tare g		194.19	(126.31) 129.39
Mass of Dry Soil & Tare g			(101.28) 105.05
Mass of Tare g		75.94	6.55
Mass of Dry Soil g			
Mass of Moisture g			
Moisture Content %		16.75	24.71
Wet Density Mg/m³		1.959	
Dry Density Mg/m³		1.678	

9.34
6.56
2.78

94.8 % SPD

Sketch and Remarks:

600 kPa = 87.0 psi x 4.91 in² = 427.3 lbs.
= 34.5 lbs. on Lv. hanger

Angle of Shear:

eba

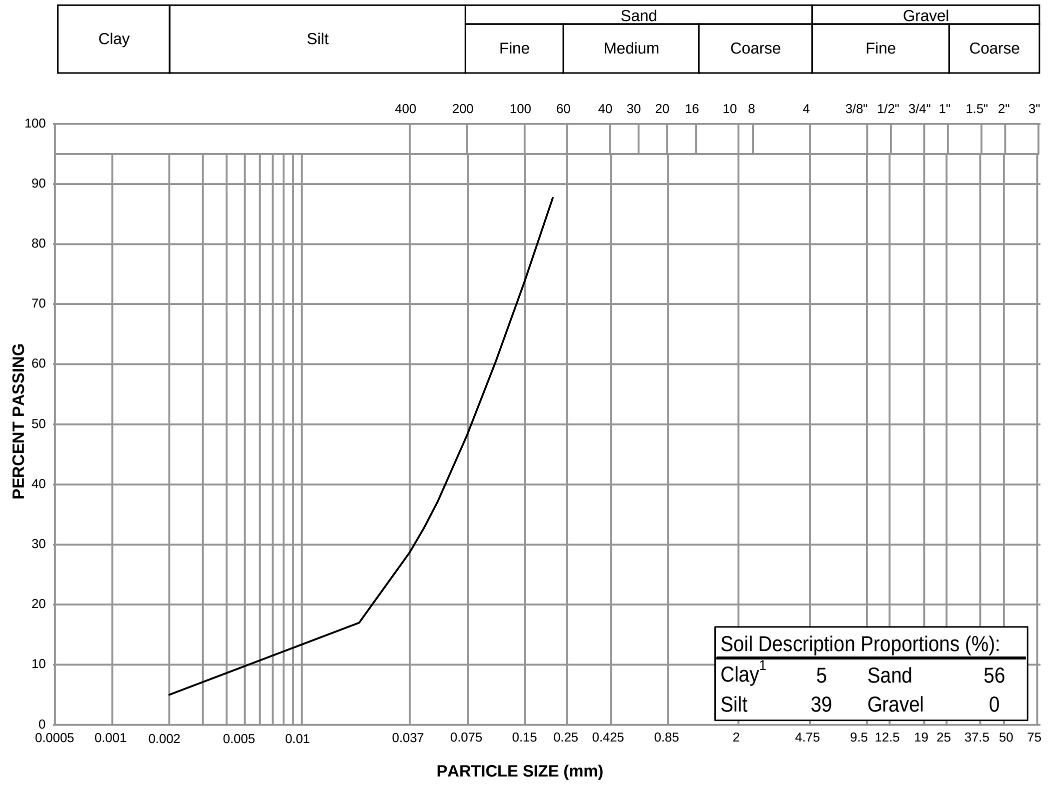
PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

Project:	Flame & Moth DSTF Design	Client:	Alexco Resource Corp
Project No.:	W14101178.003	Client Rep.:	
Site:	Bellekeno Mine Mill		

Material Type:			Date Tested:		By:
Sample No.:	Provided by PRA		Soil Description[2]:	Sand and Silt - trace clay	
Sample Loc.:					
Sample Depth:			USC Classification:		Cu: 10.9
Sampling Method:					Cc: 1.6
Date sampled:		By: Client	Moisture Content:	0.0	

Particle Size (mm)	Percent Passing
75	
50	
38	
25	
0.4	
0.21	88
0.149	74
0.105	61
0.074	48
0.052	37
0.044	33
0.037	29
0.02	17
0.002	5



Soil Description Proportions (%):

Clay[1]	5	Sand	56
Silt	39	Gravel	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: ____________________

Remarks: ____________________

Reviewed By: ____________________

PARTICLE SIZE ANALYSIS TEST REPORT

ASTM D422 & C136

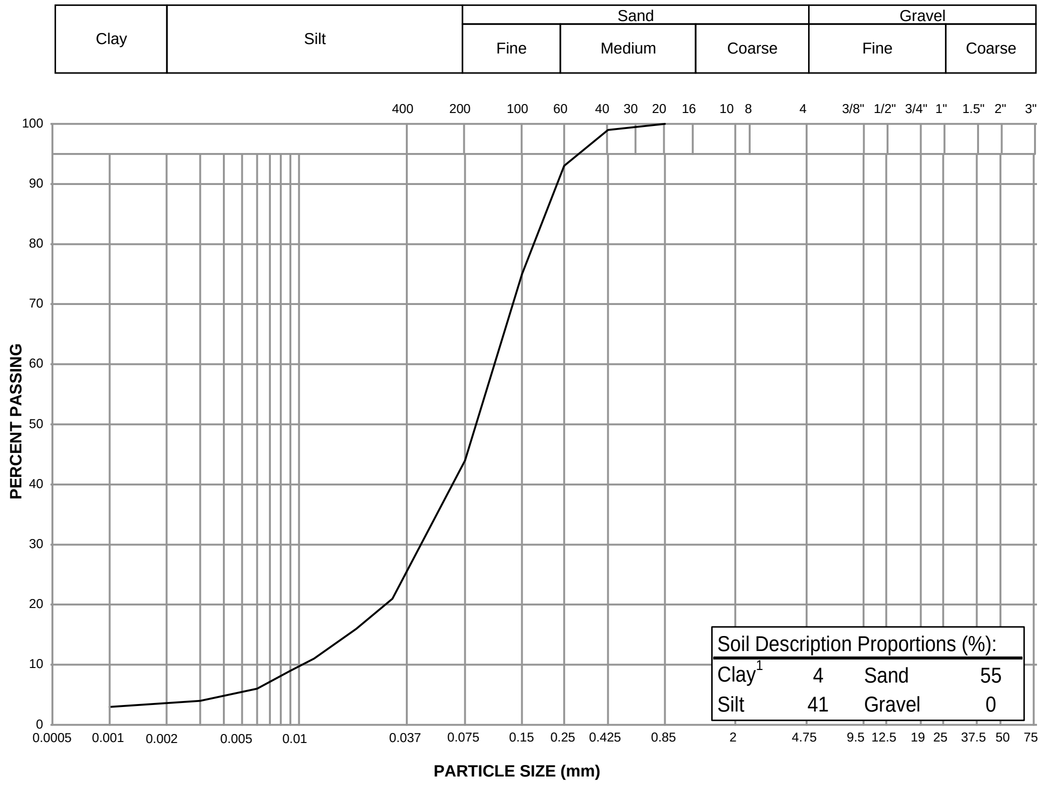
Project: Flame & Moth DSTF Design
Project No.: W14101178.003
Site: Bellekeno Mine Mill

Client: Alexco Resource Corp
Client Rep.:

Material Type:
Sample No.: Tailings 001
Sample Loc.: Elsa Tailings Facility
Sample Depth:
Sampling Method:
Date sampled: By: Client

Date Tested: Oct. 15, 2009 By:
Soil Description[2]: Sand and Silt - trace clay
USC Classification: Cu: 10.8
Cc: 1.9
Moisture Content: 0.0

Particle Size (mm)	Percent Passing
5	
2	
0.85	100
0.425	99
0.25	93
0.15	75
0.075	44
0.031	21
0.02	16
0.012	11
0.009	9
0.006	6
0.003	4
0.001	3



Soil Description Proportions (%):

Clay[1]	4	Sand	55
Silt	41	Gravel	0

Notes:

[1] The upper clay size of 2 um, per the Canadian Foundation Engineering Manual

[2] The description is visually based & subject to EBA description protocols

Specification: __________

Remarks: __________

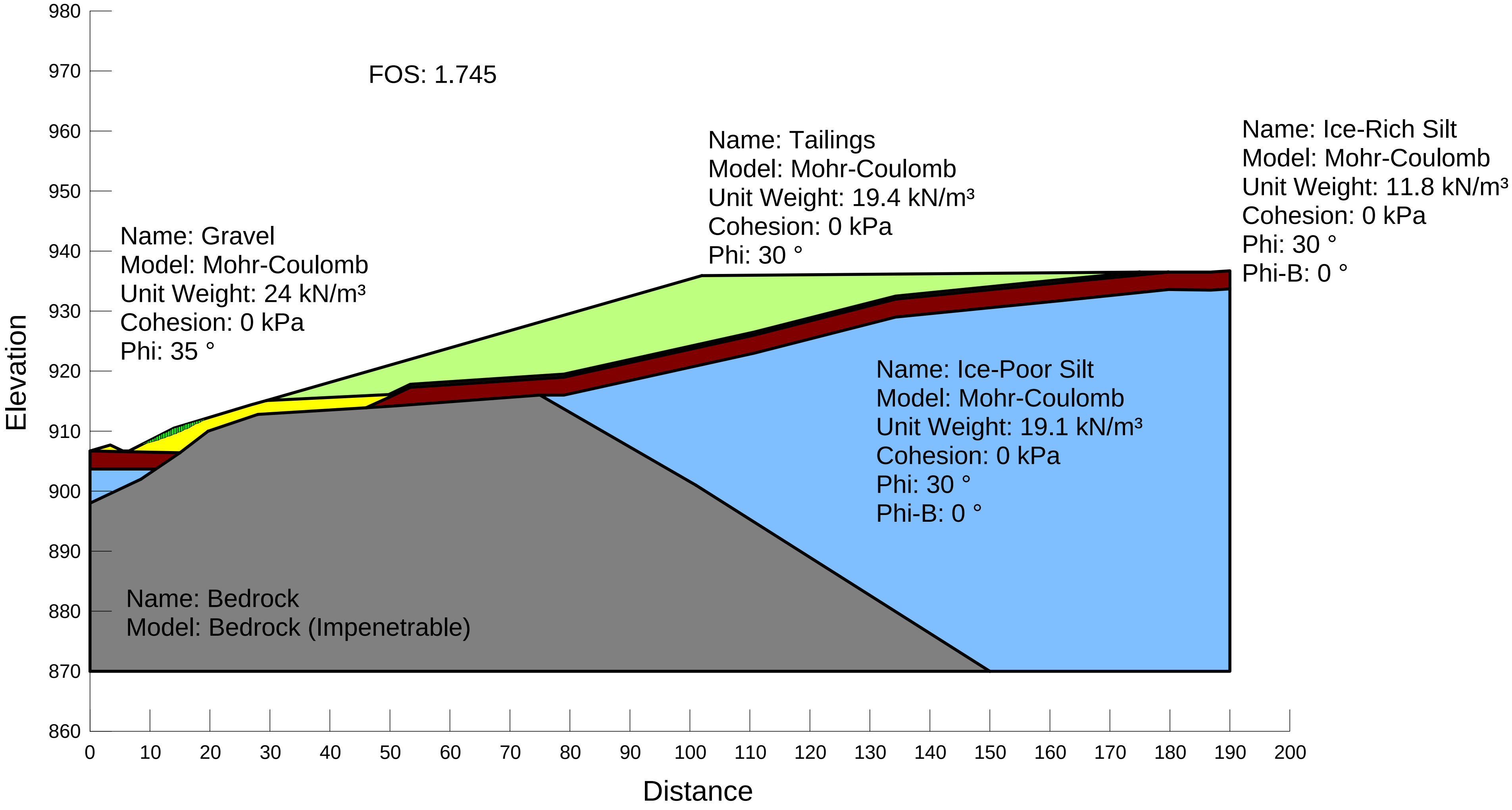
Reviewed By: __________

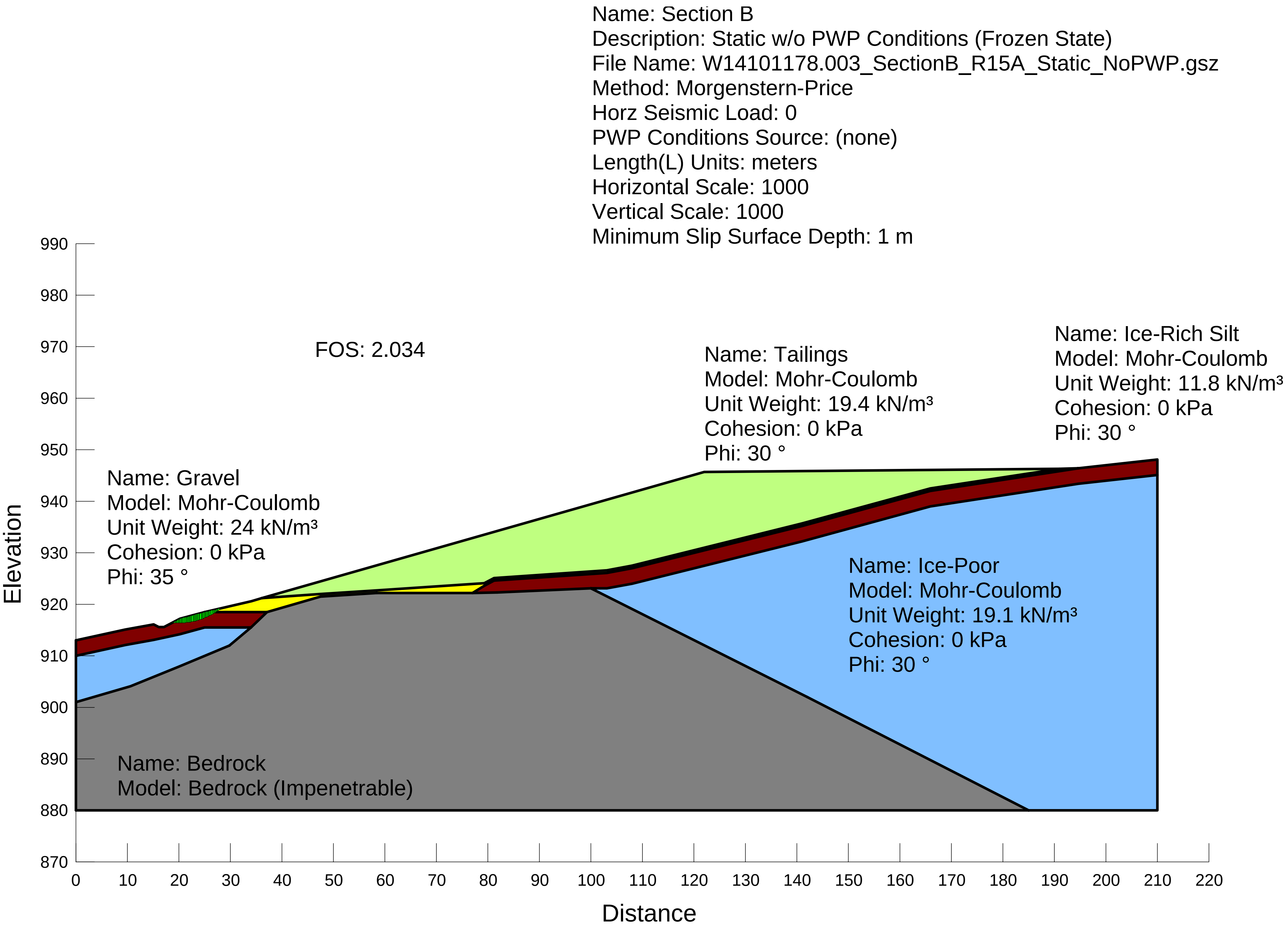
EBA Engineering Consultants Ltd.

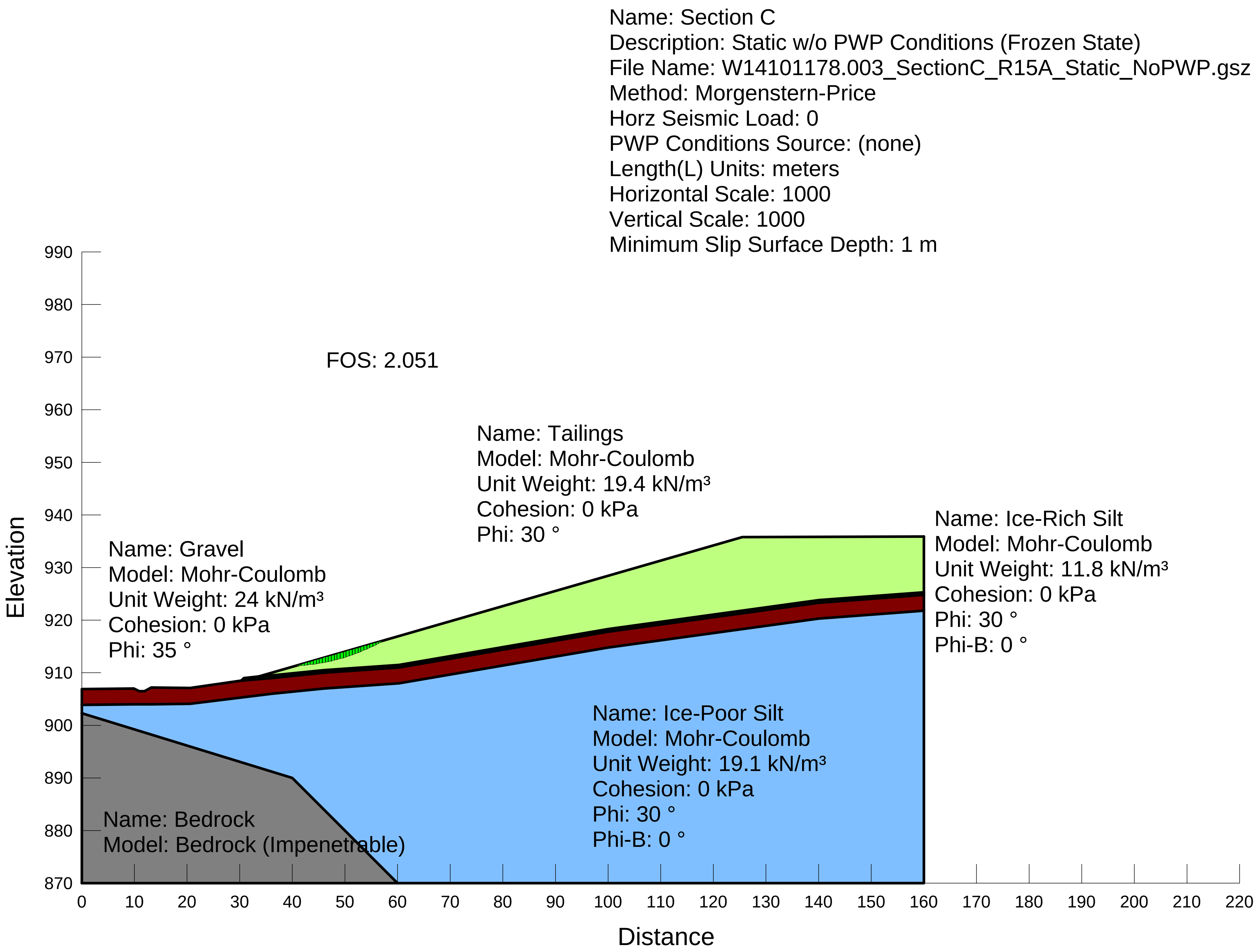
APPENDIX C

APPENDIX C SLOPE STABILITY PLOTS – FULLY FROZEN CASE

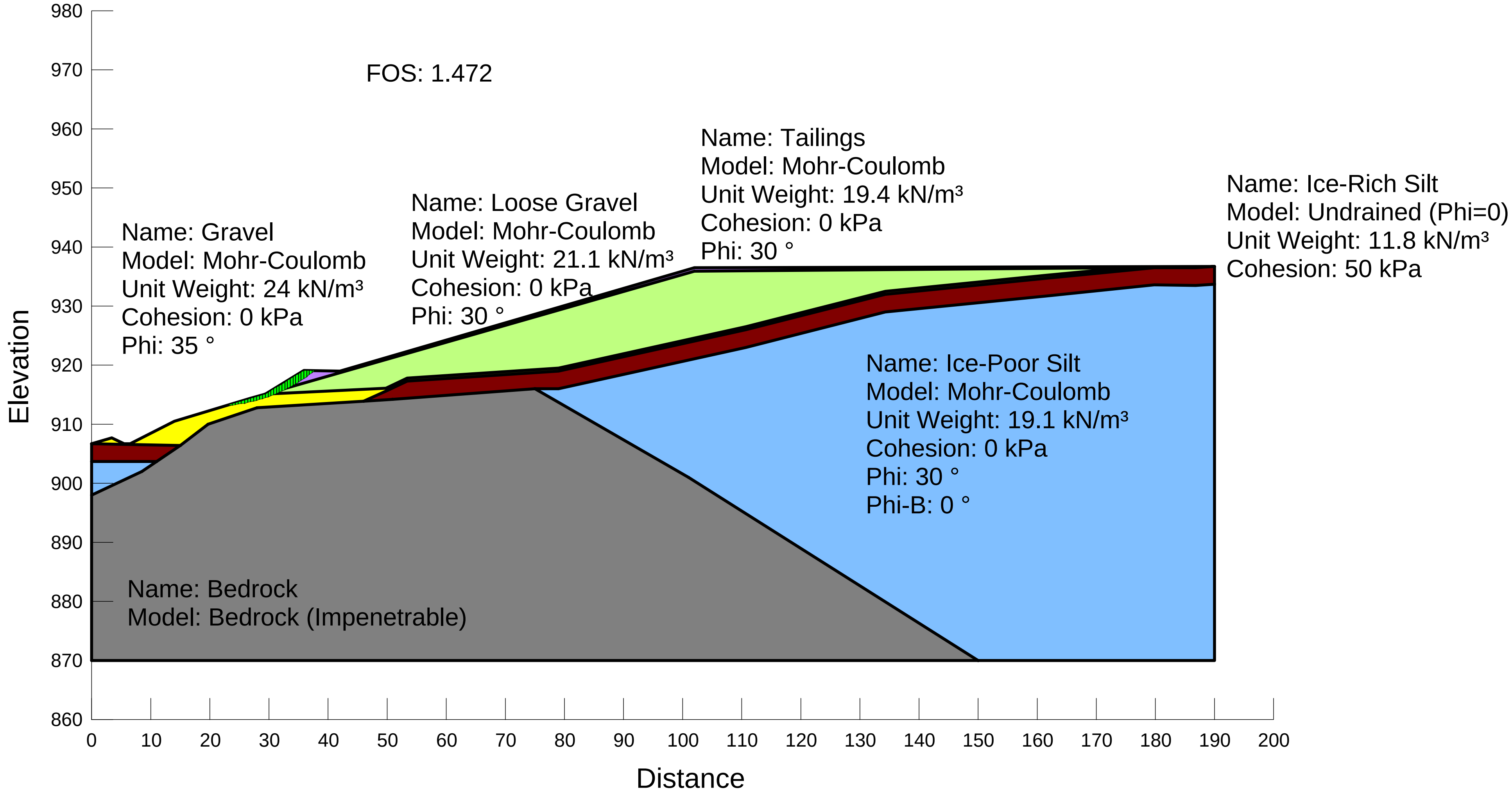
Name: Section A
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionA_R15A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



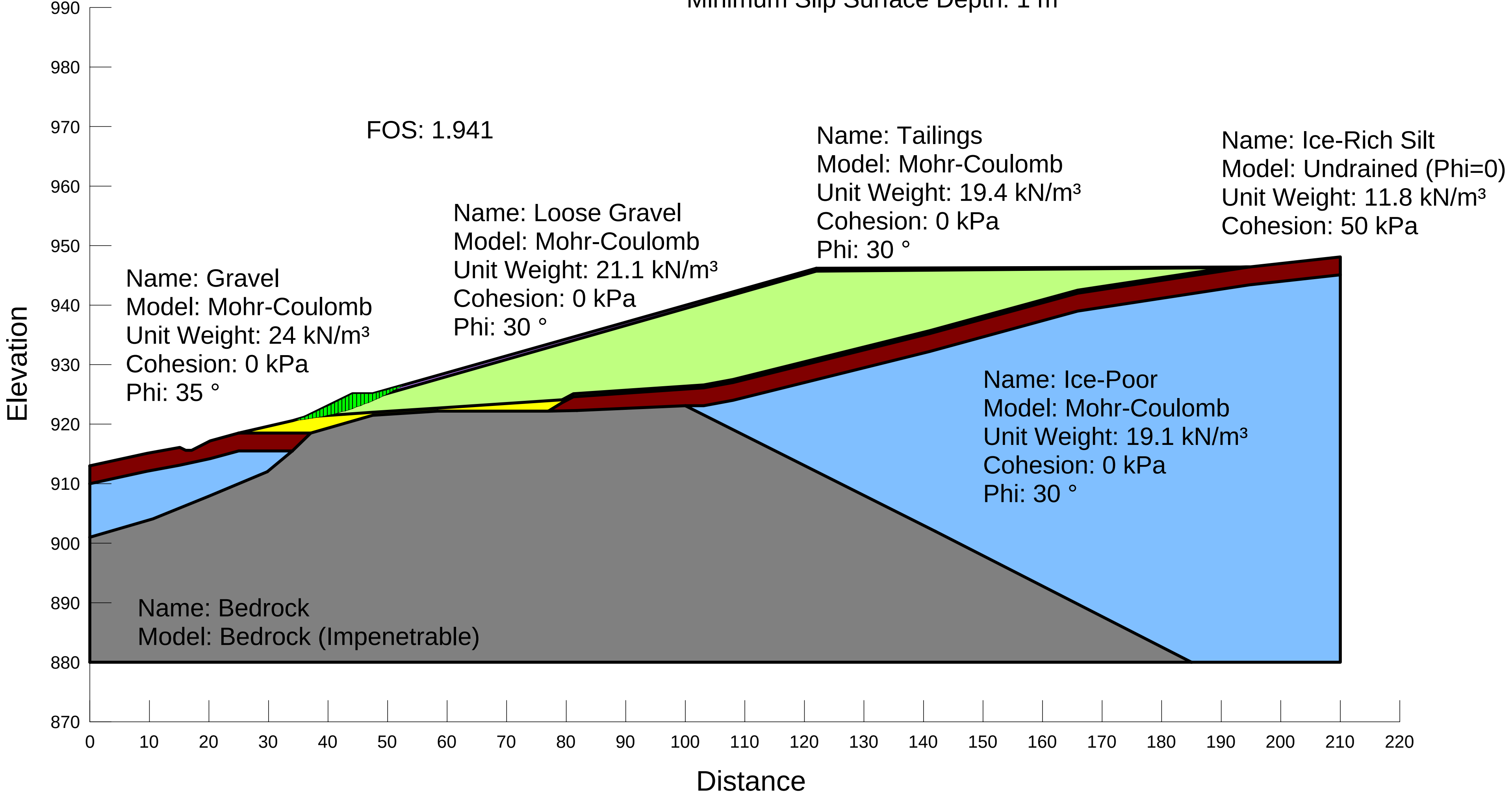

Name: Section B
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionB_R15A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 2.034
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Poor
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
Distance

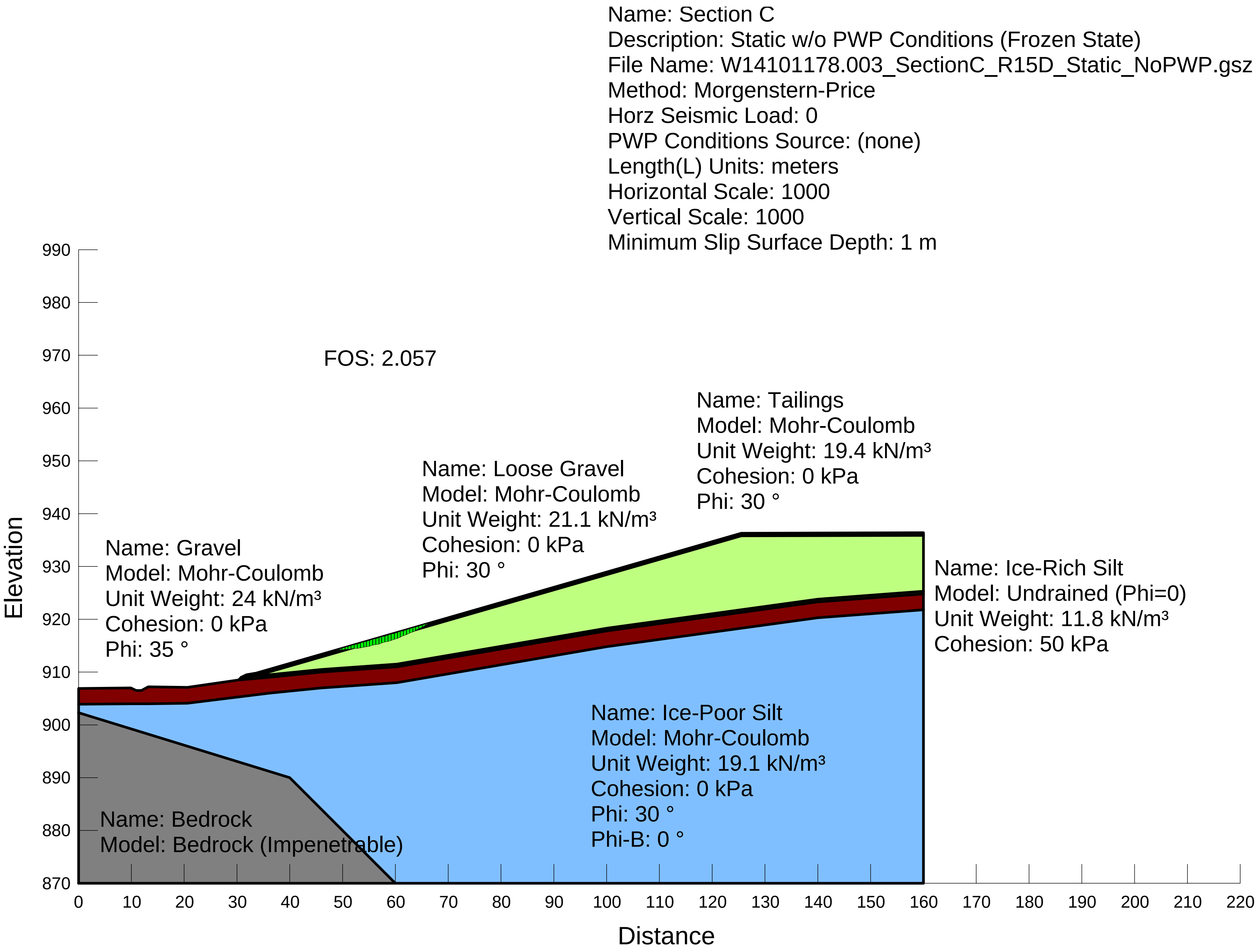

Name: Section C
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionC_R15A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 2.051
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
Distance
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

Name: Section A
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionA_R15D_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

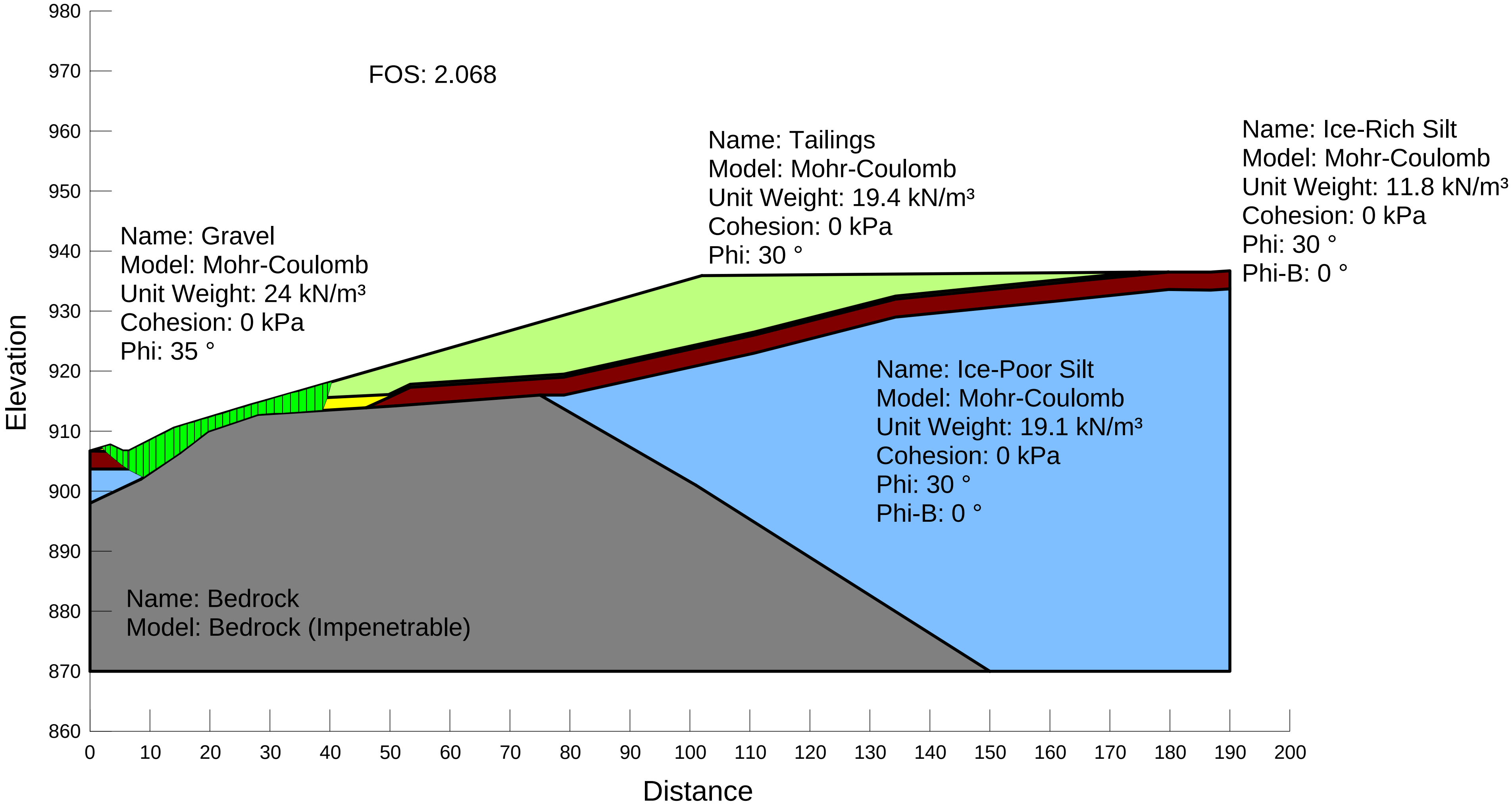


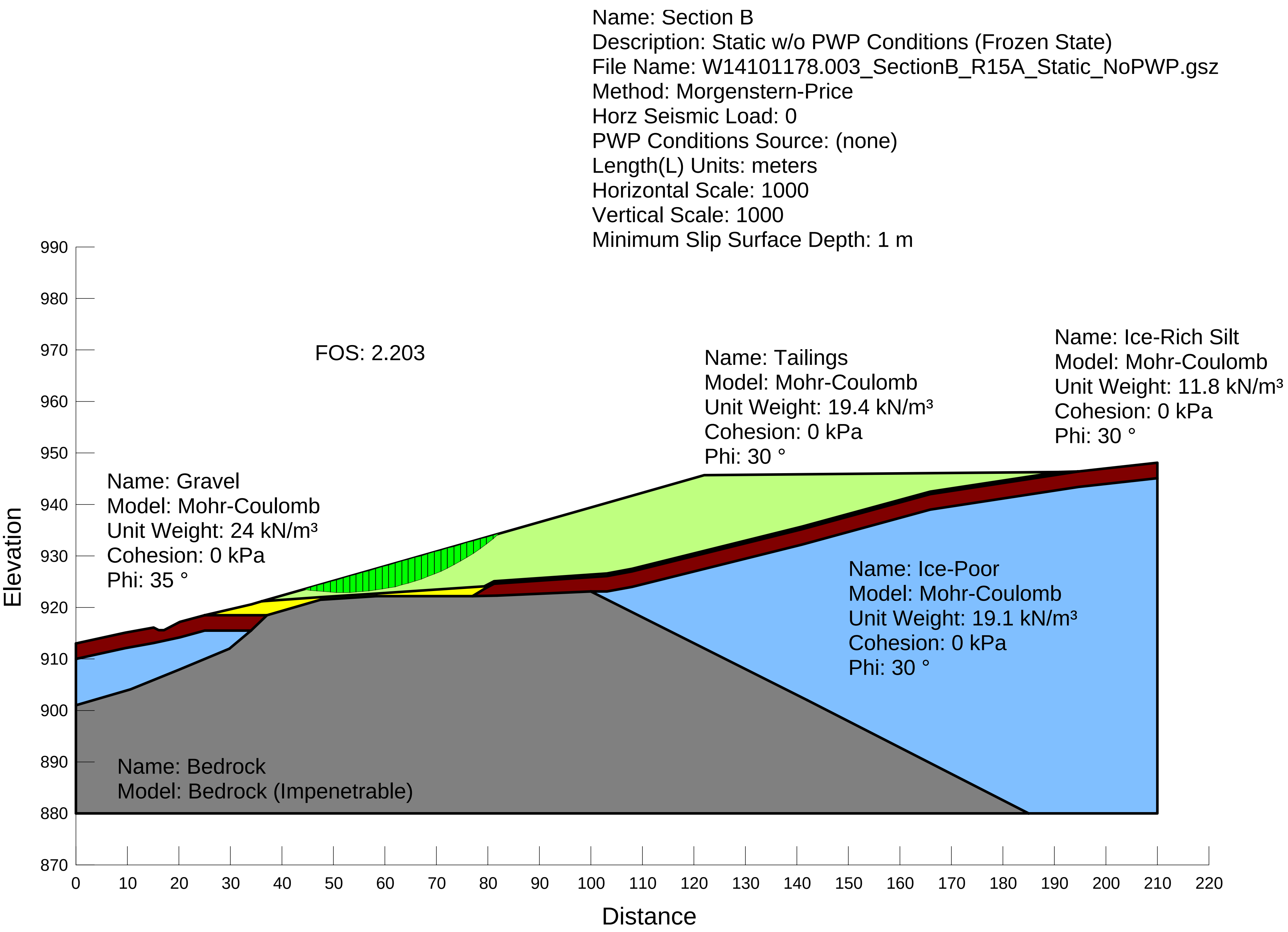
Name: Section B
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionB_R15D_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m




Name: Section C
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionC_R15D_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 2.057
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Rich Silt
Model: Undrained (Phi=0)
Unit Weight: 11.8 kN/m³
Cohesion: 50 kPa
Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
Distance
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

Name: Section A
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionA_R15A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m




Name: Section B
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionB_R15A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °

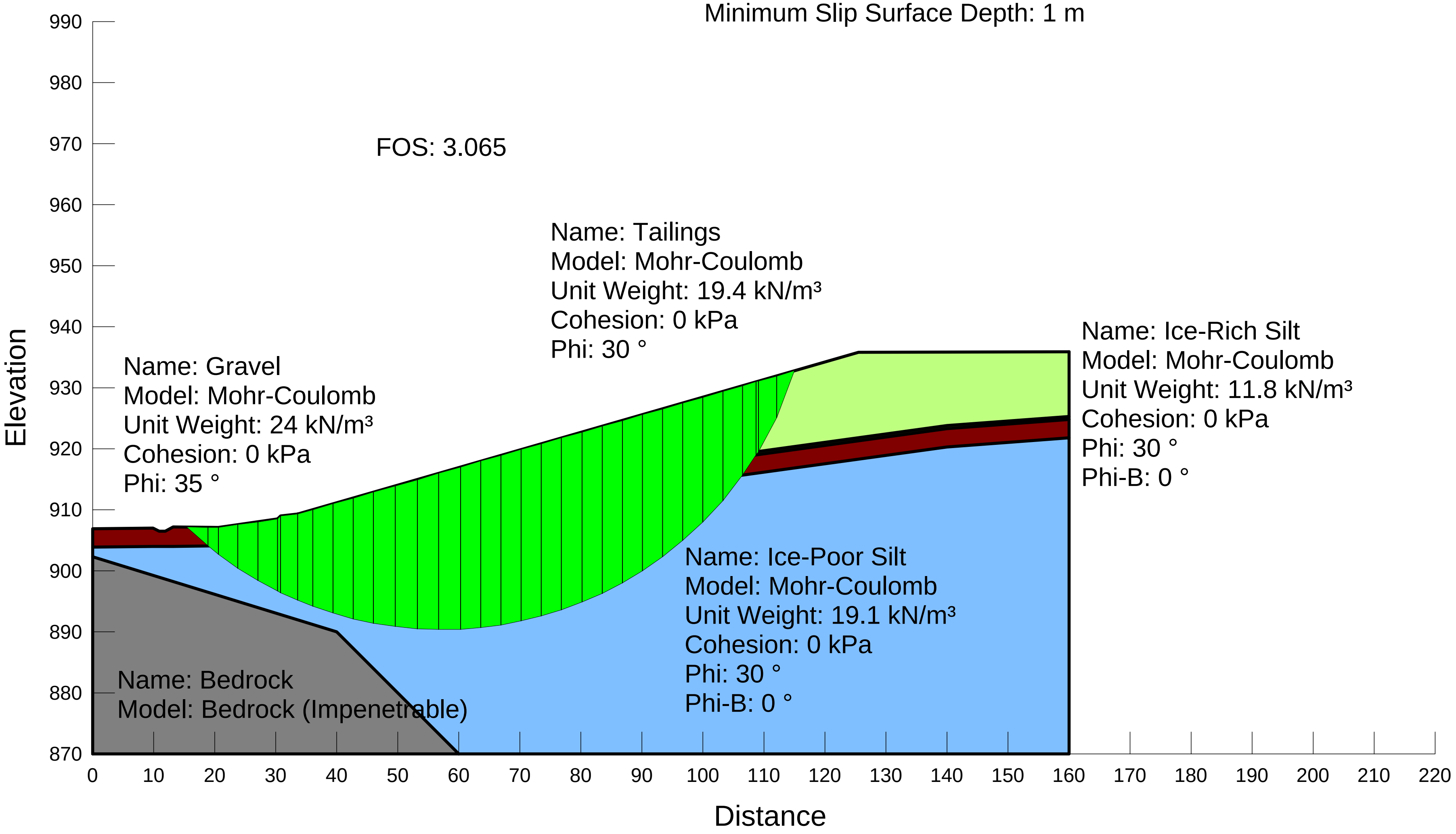
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °

Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °

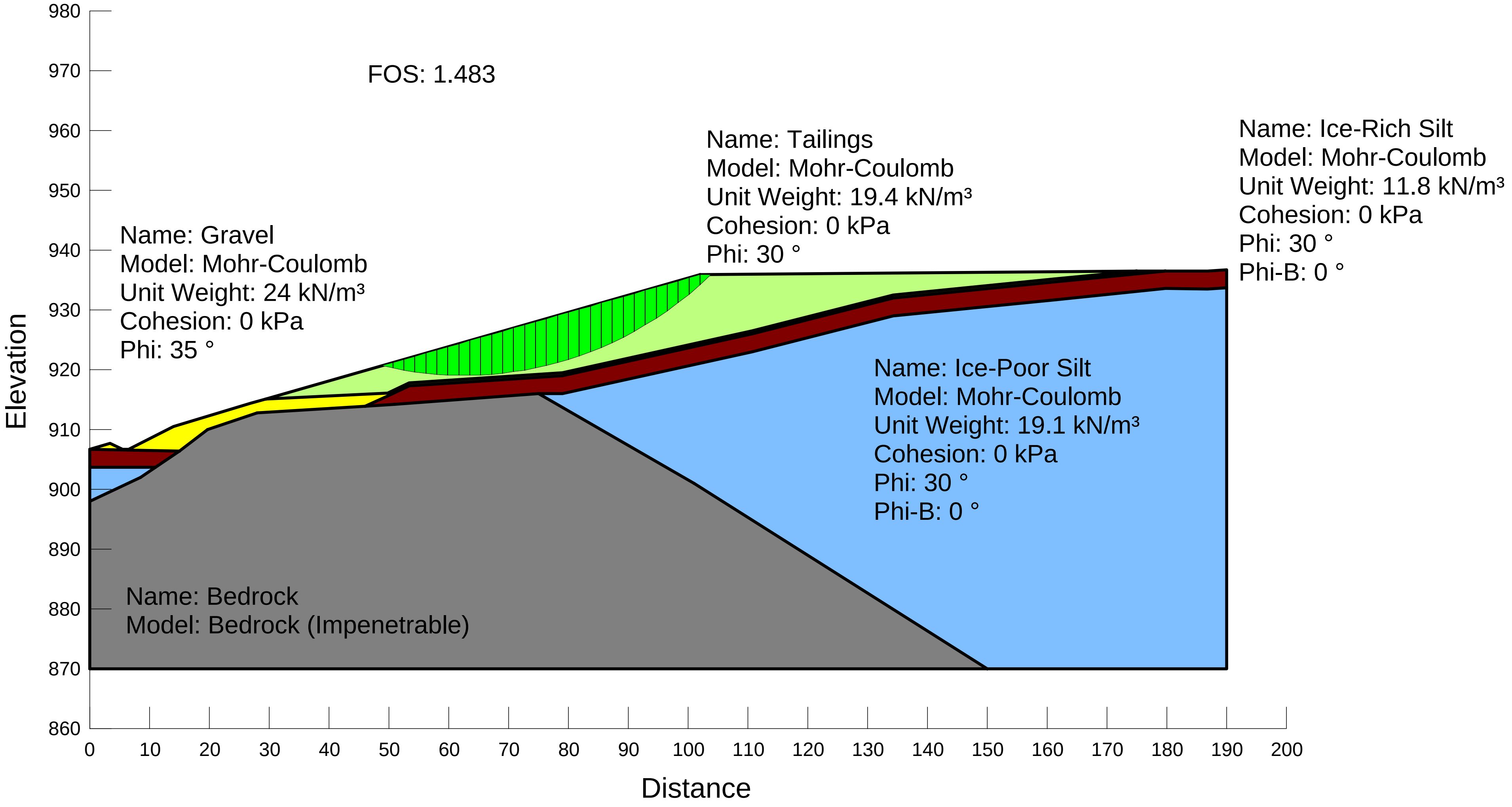
Name: Ice-Poor
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °

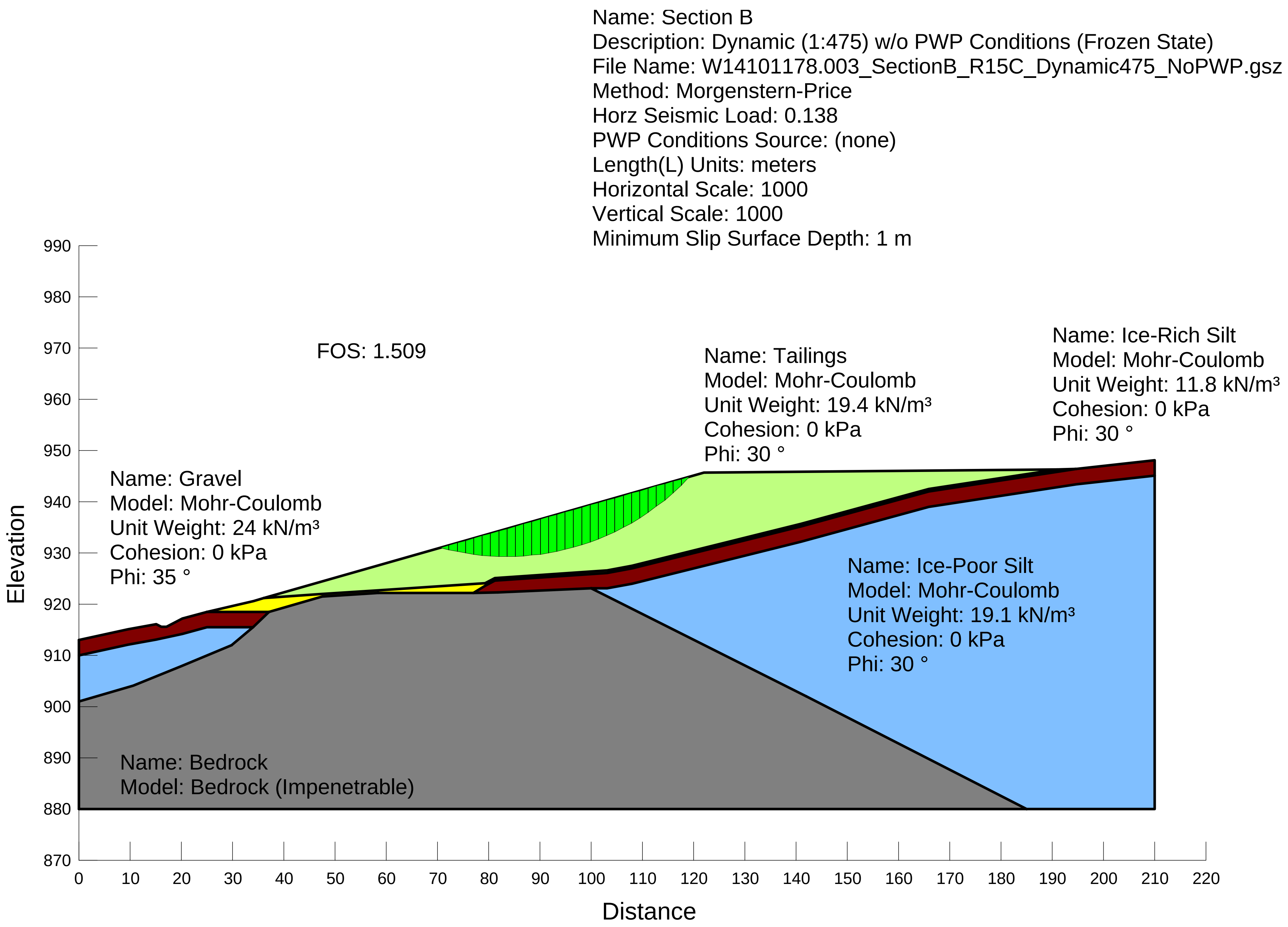
Name: Bedrock
Model: Bedrock (Impenetrable)

Name: Section C
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionC_R15A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

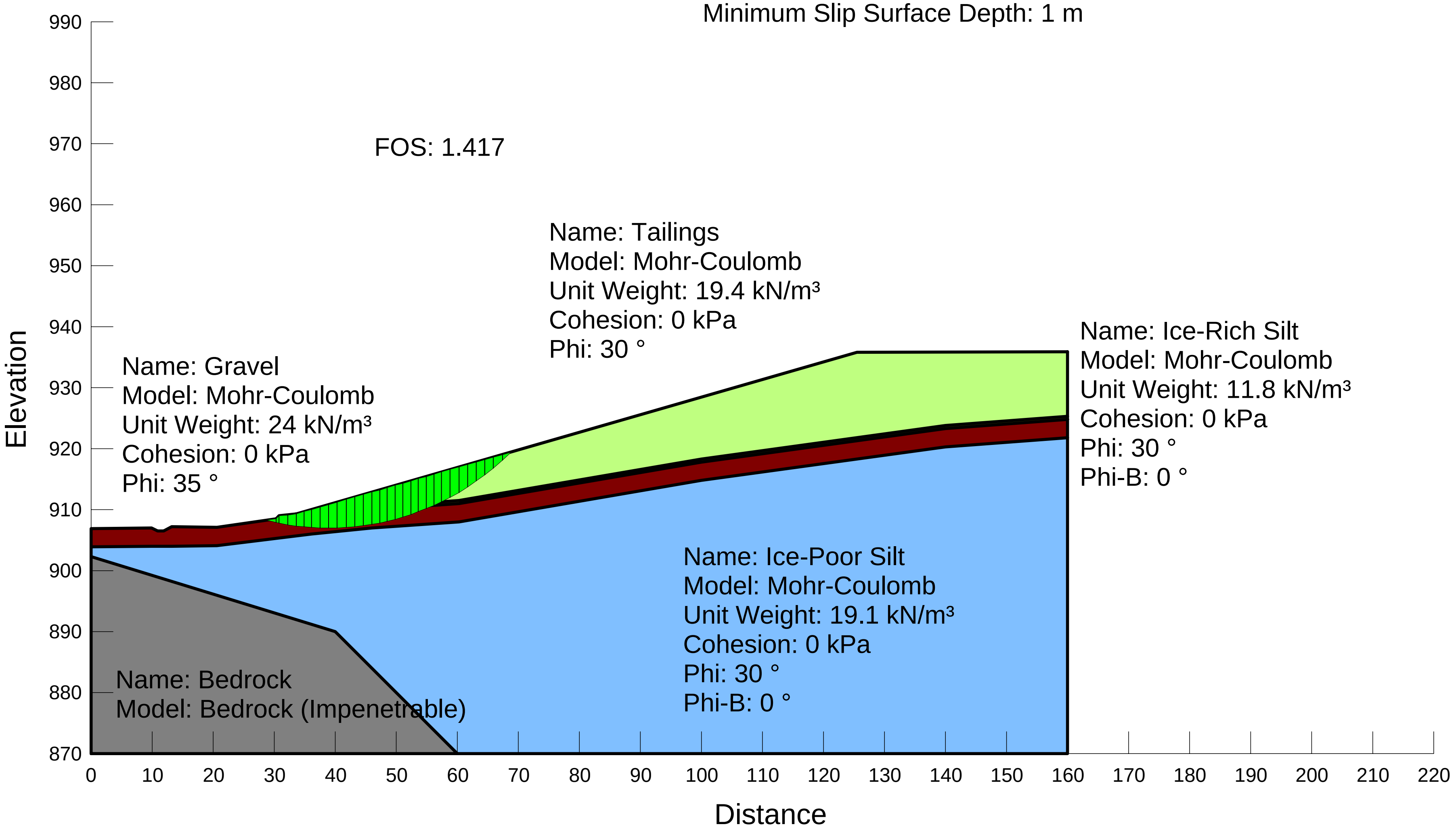


Name: Section A
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionA_R15C_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

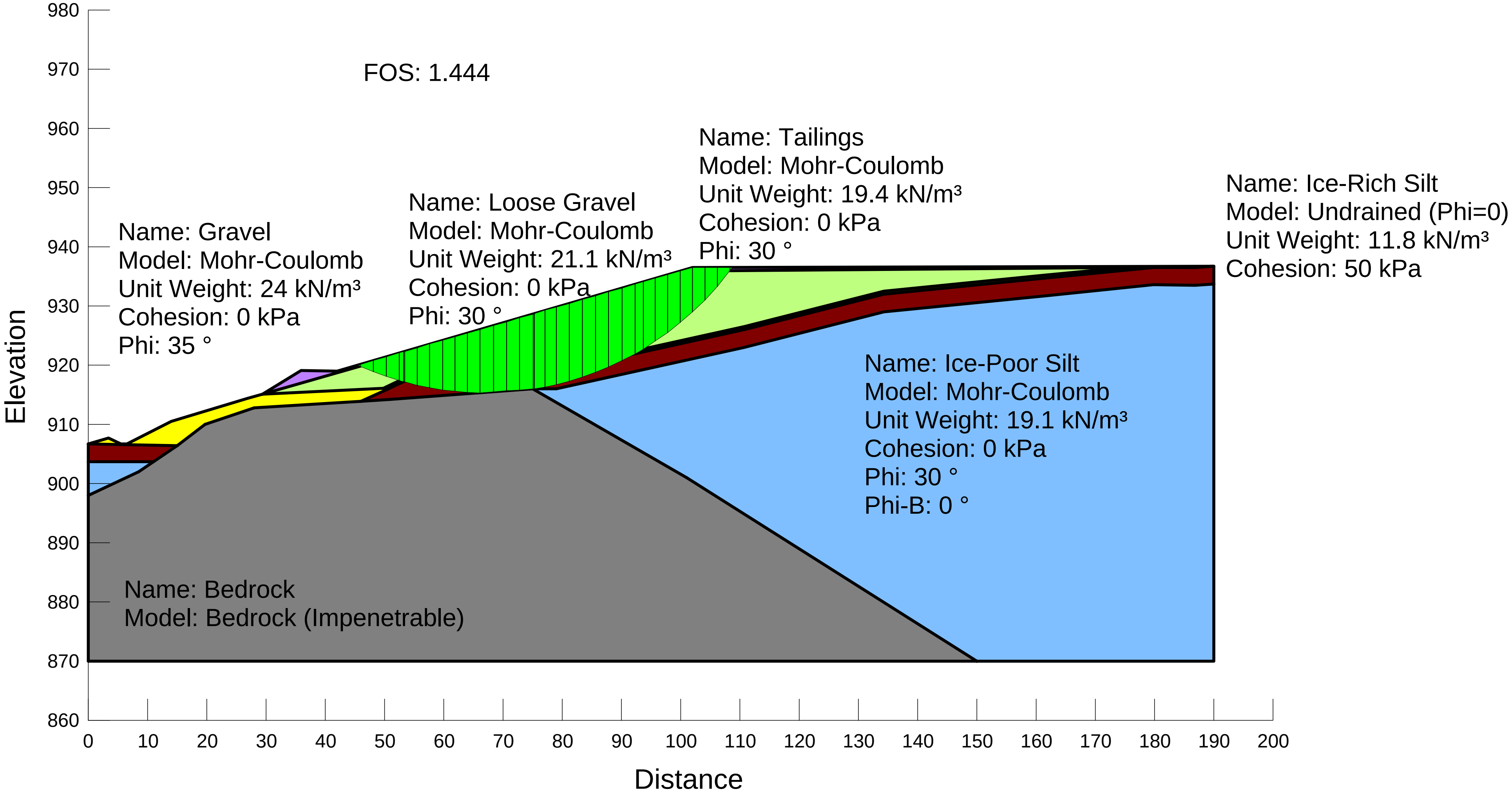


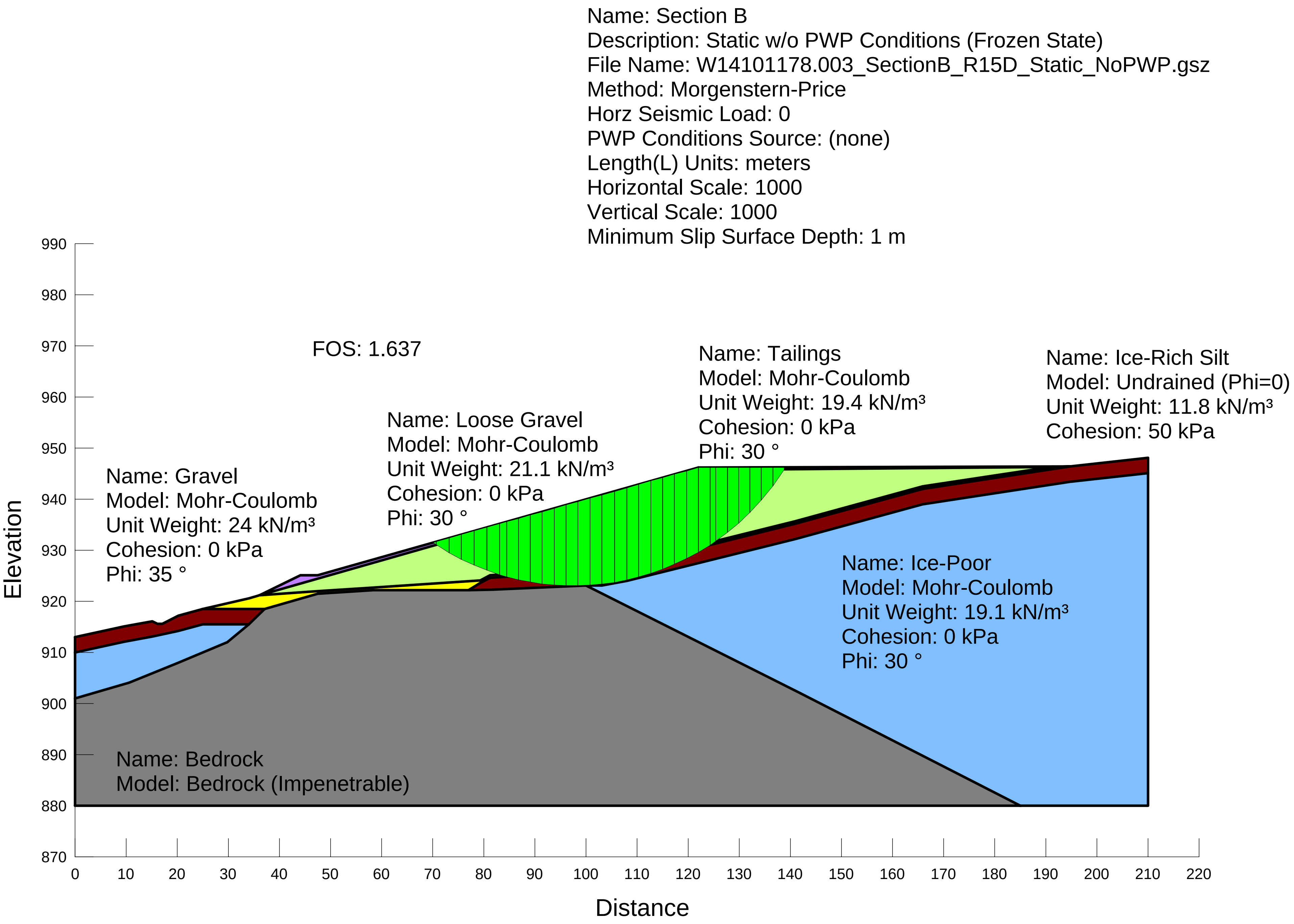

Name: Section B
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionB_R15C_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 1.509
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
Distance

Name: Section C
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionC_R15C_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

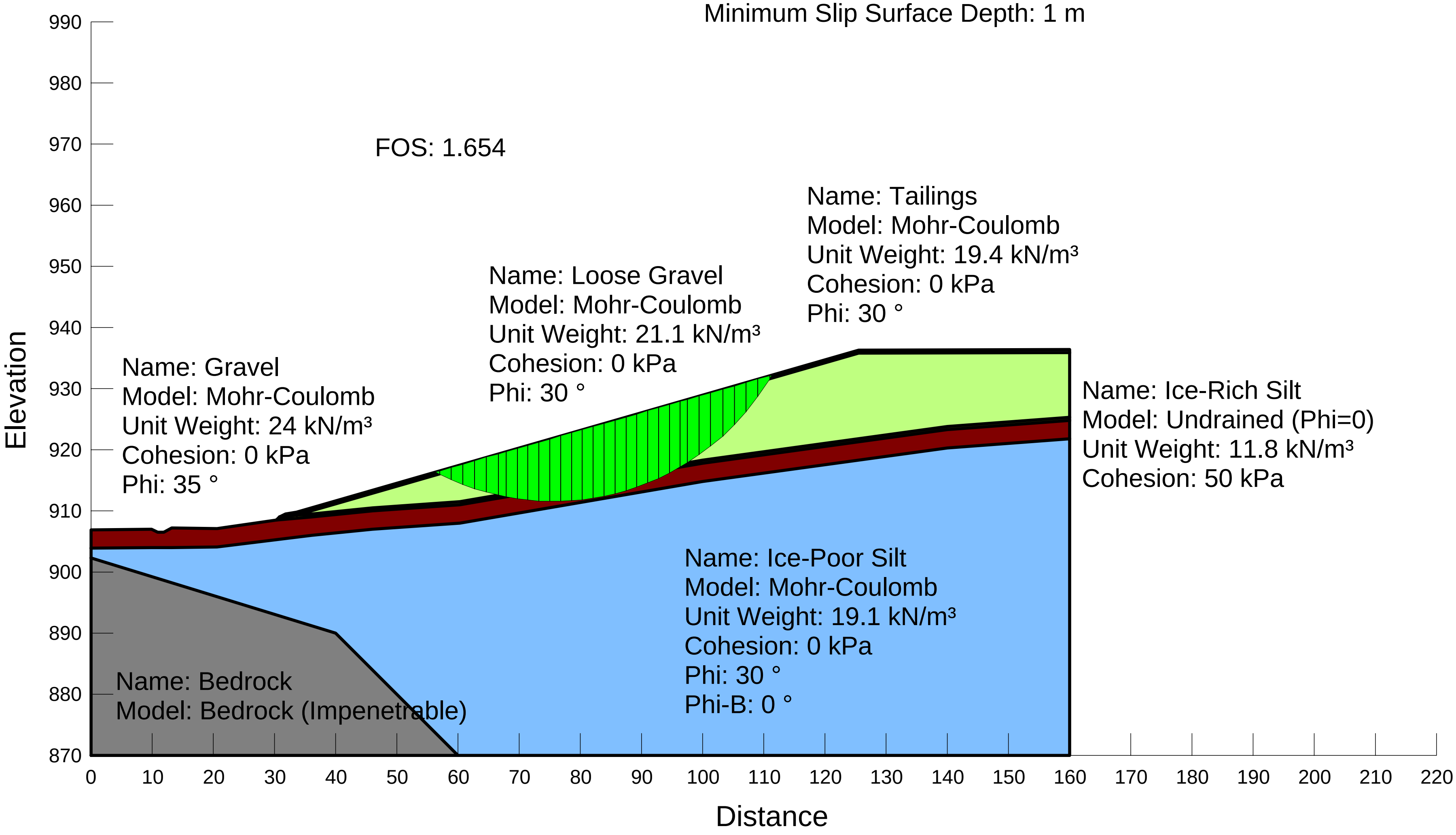


Name: Section A
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionA_R15D_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m




Name: Section B
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionB_R15D_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 1.637
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Ice-Rich Silt
Model: Undrained (Phi=0)
Unit Weight: 11.8 kN/m³
Cohesion: 50 kPa
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Ice-Poor
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220
Distance

Name: Section C
Description: Static w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionC_R15D_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



FOS: 1.654

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °

Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °

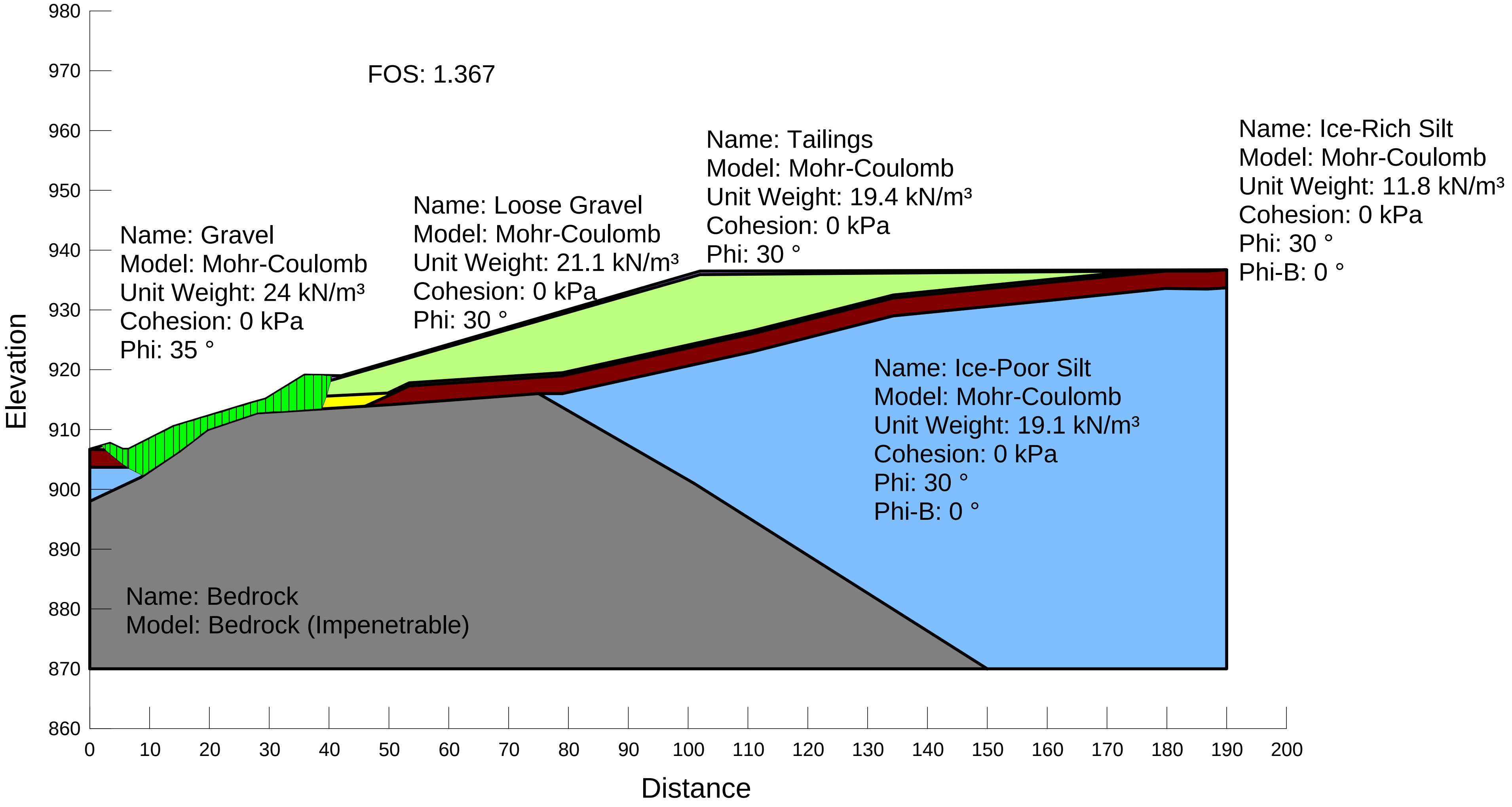
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °

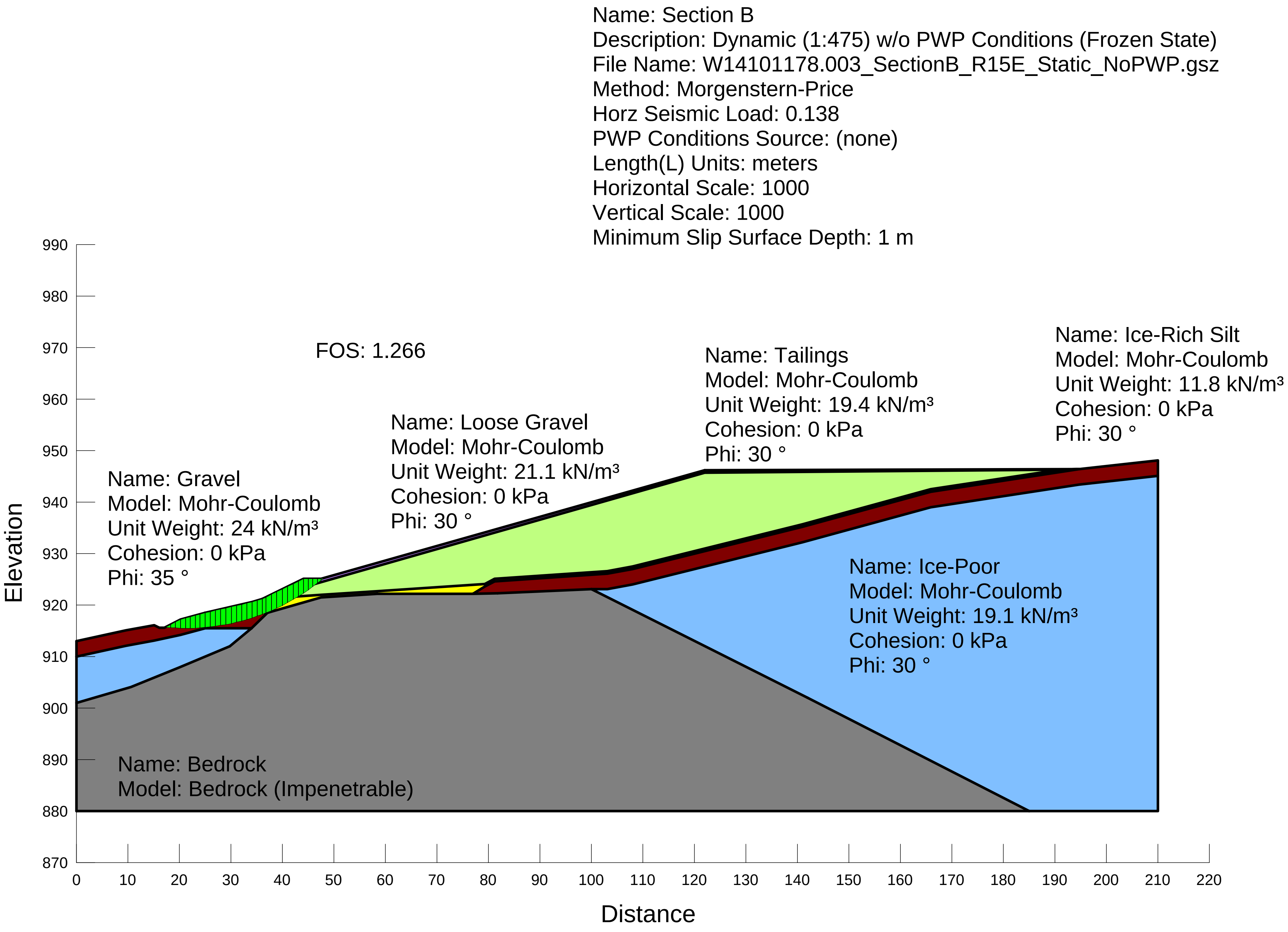
Name: Ice-Rich Silt
Model: Undrained (Phi=0)
Unit Weight: 11.8 kN/m³
Cohesion: 50 kPa

Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °

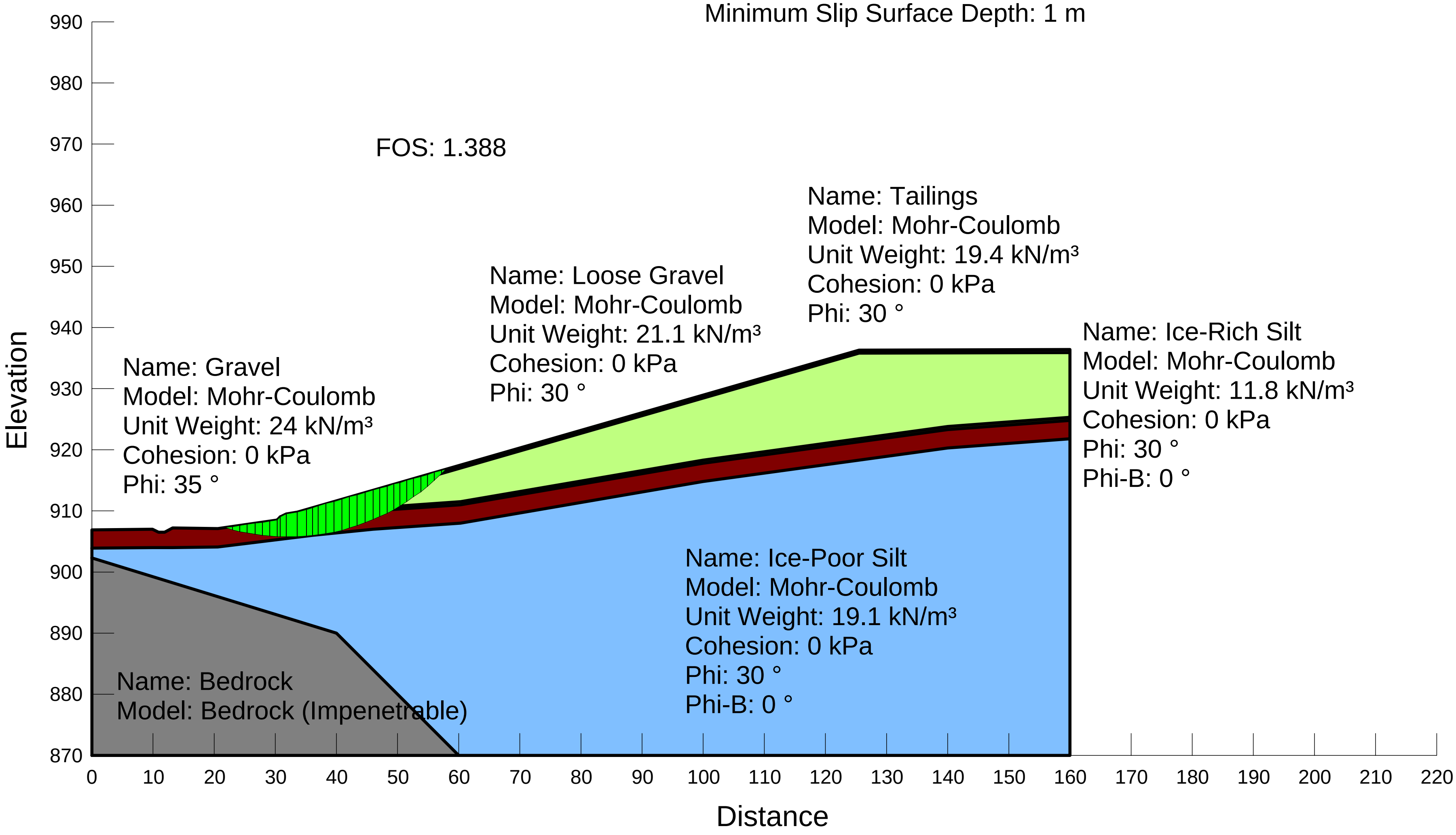
Name: Bedrock
Model: Bedrock (Impenetrable)

Name: Section A
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionA_R15E_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m




Name: Section B
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionB_R15E_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 1.266
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Ice-Poor
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
Distance
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

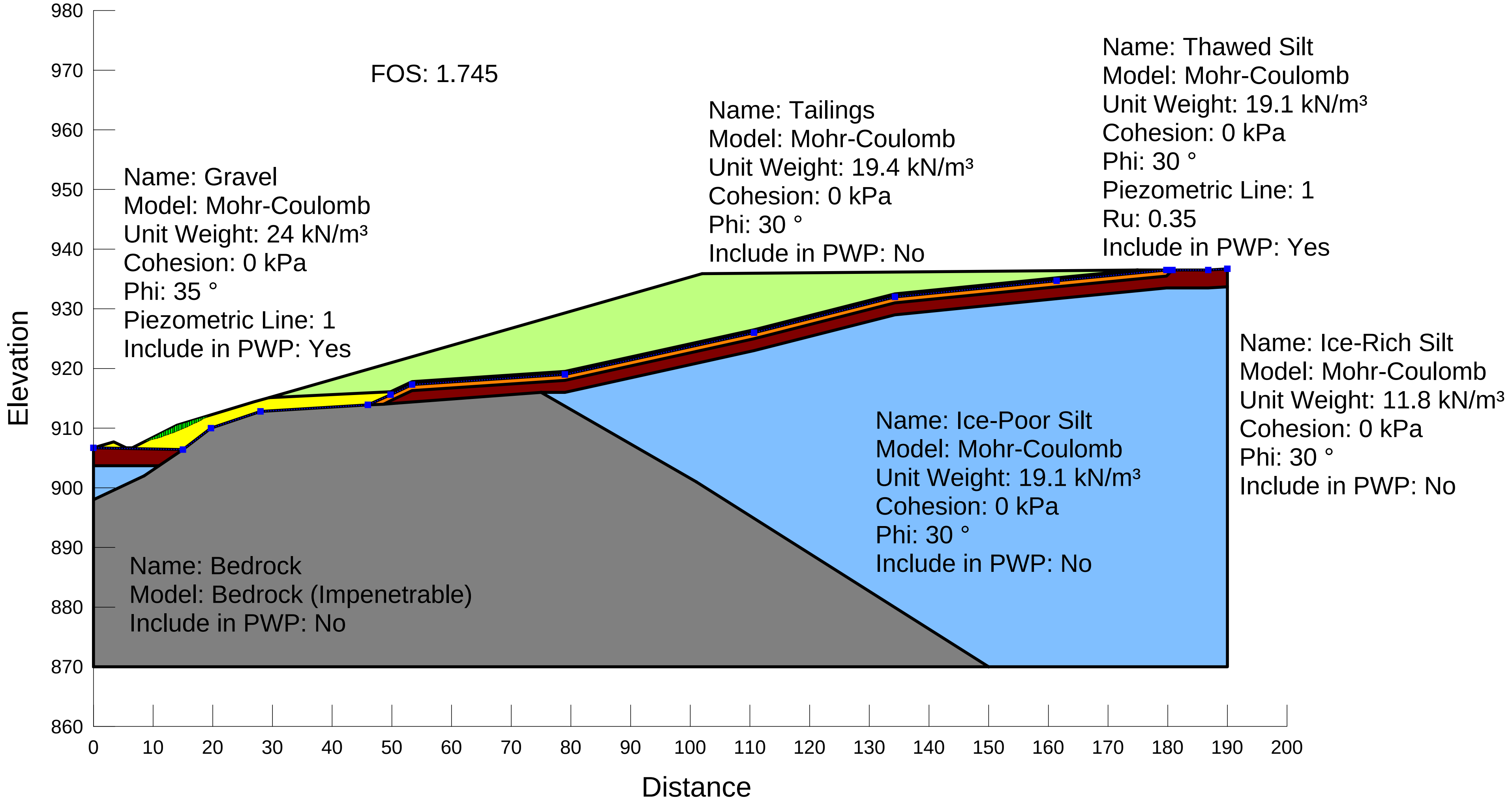
Name: Section C
Description: Dynamic (1:475) w/o PWP Conditions (Frozen State)
File Name: W14101178.003_SectionC_R15E_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



APPENDIX D

APPENDIX D SLOPE STABILITY PLOTS – 1.2 METRE THAWED CASE

Name: Section A
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionA_R16A_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



FOS: 1.745

Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Piezometric Line: 1
Include in PWP: Yes

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

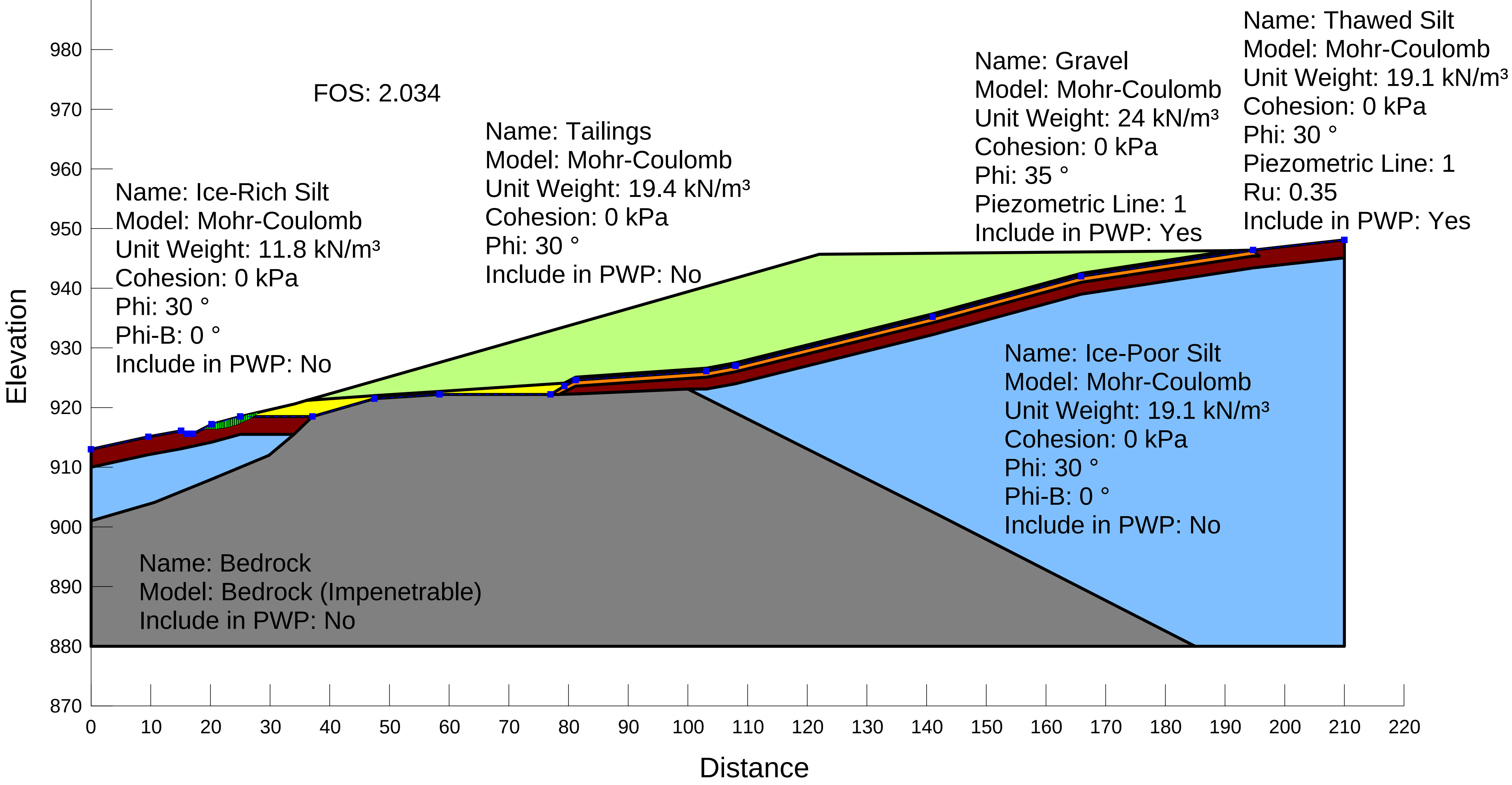
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Ru: 0.35
Include in PWP: Yes

Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

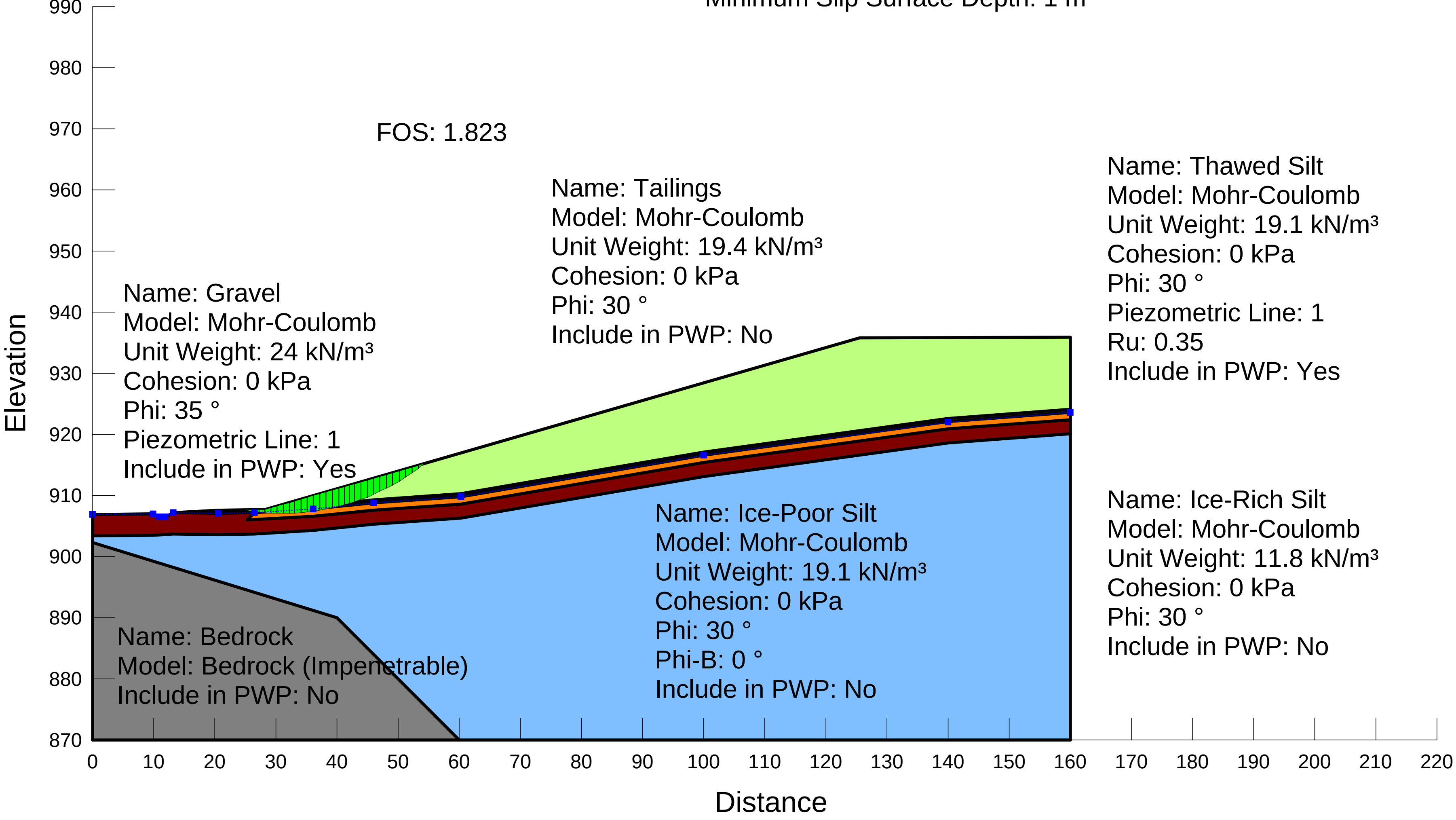
Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

Name: Bedrock
Model: Bedrock (Impenetrable)
Include in PWP: No

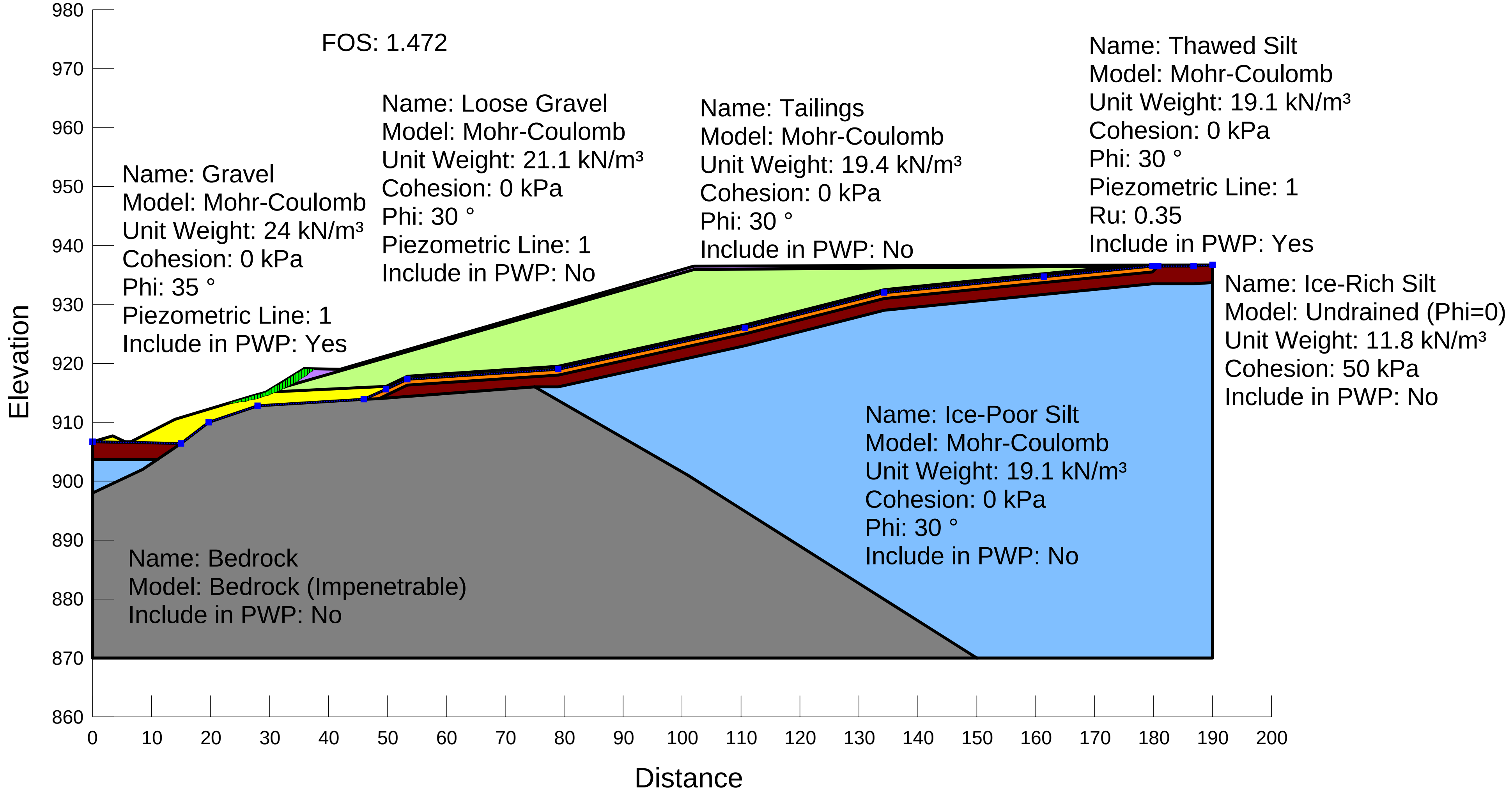
Name: Section B
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionB_R16A_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



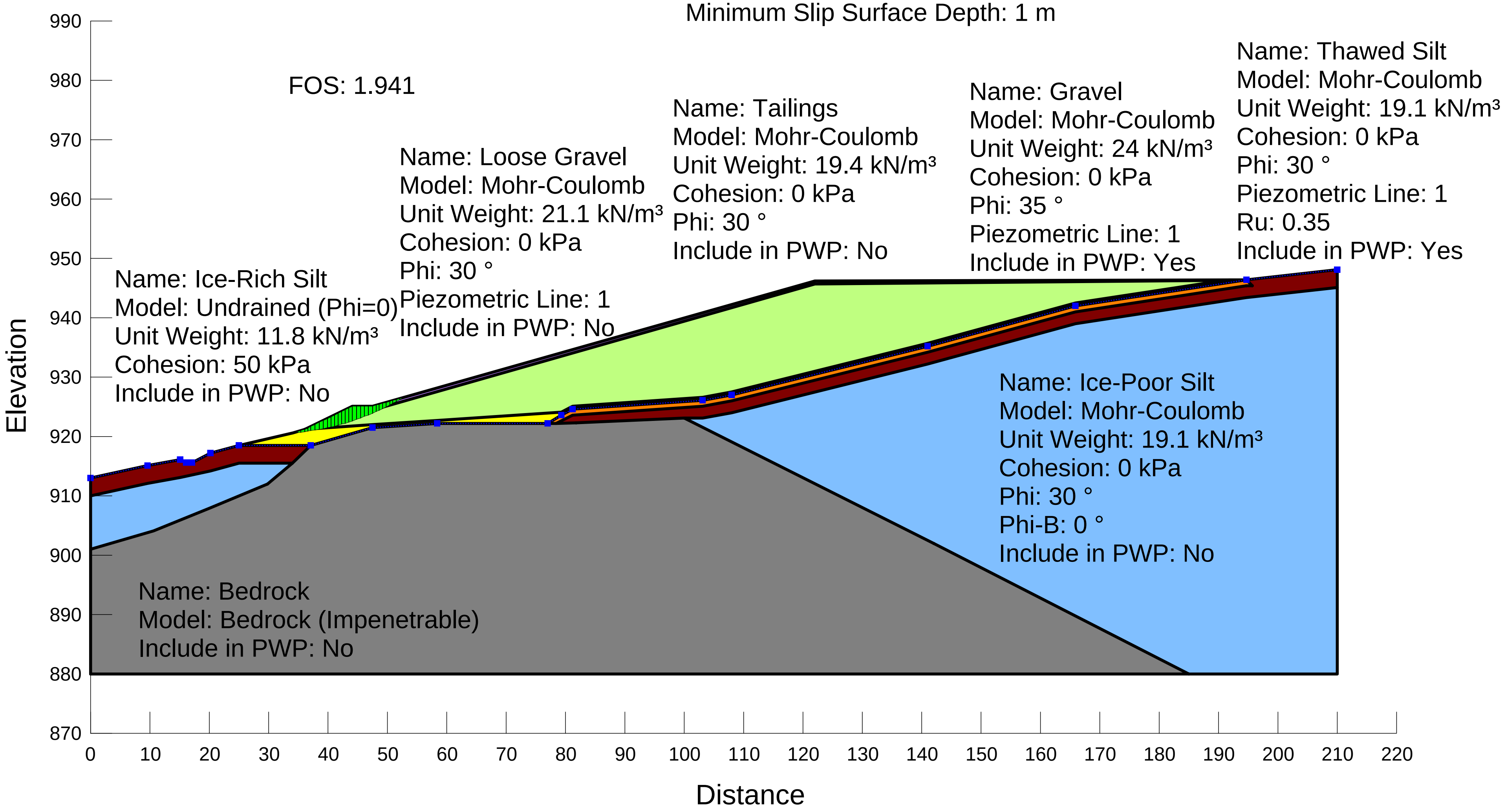
Name: Section C
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionC_R16A_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Section A
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionA_R16D_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Section B
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionB_R16D_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



FOS: 1.941

Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Ru: 0.35
Include in PWP: Yes

Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Piezometric Line: 1
Include in PWP: Yes

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

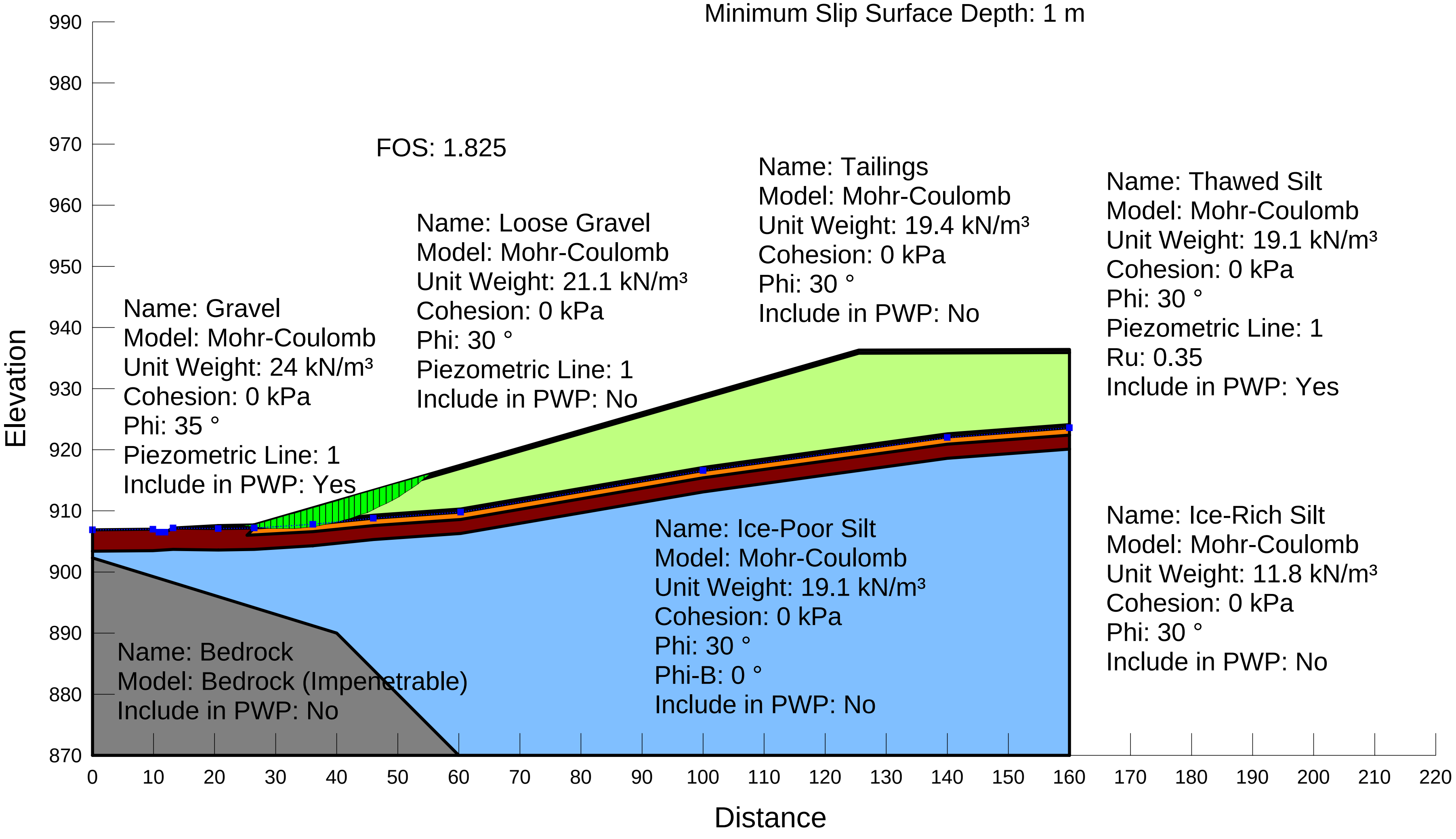
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Include in PWP: No

Name: Ice-Rich Silt
Model: Undrained (Phi=0)
Unit Weight: 11.8 kN/m³
Cohesion: 50 kPa
Include in PWP: No

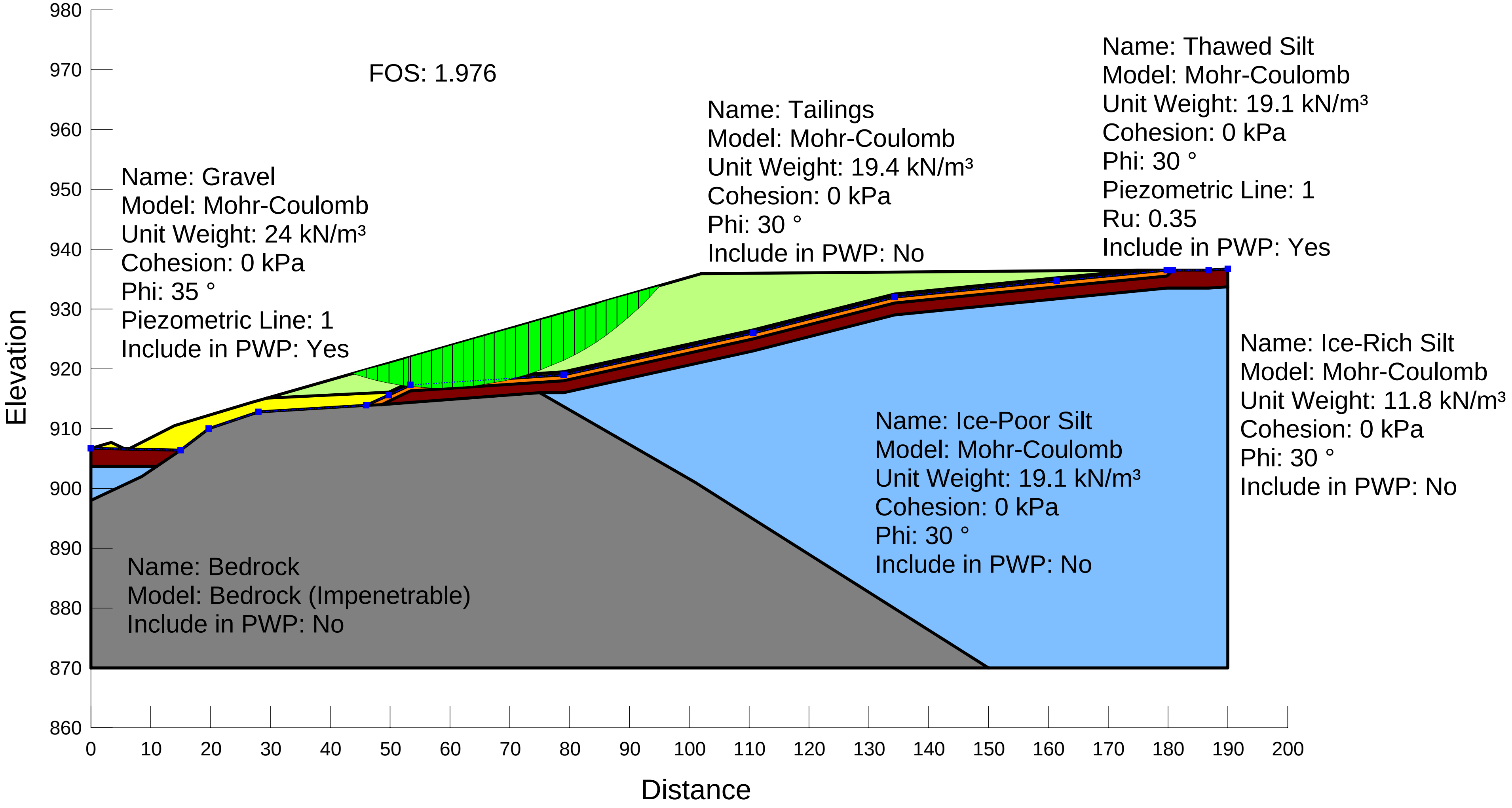
Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Include in PWP: No

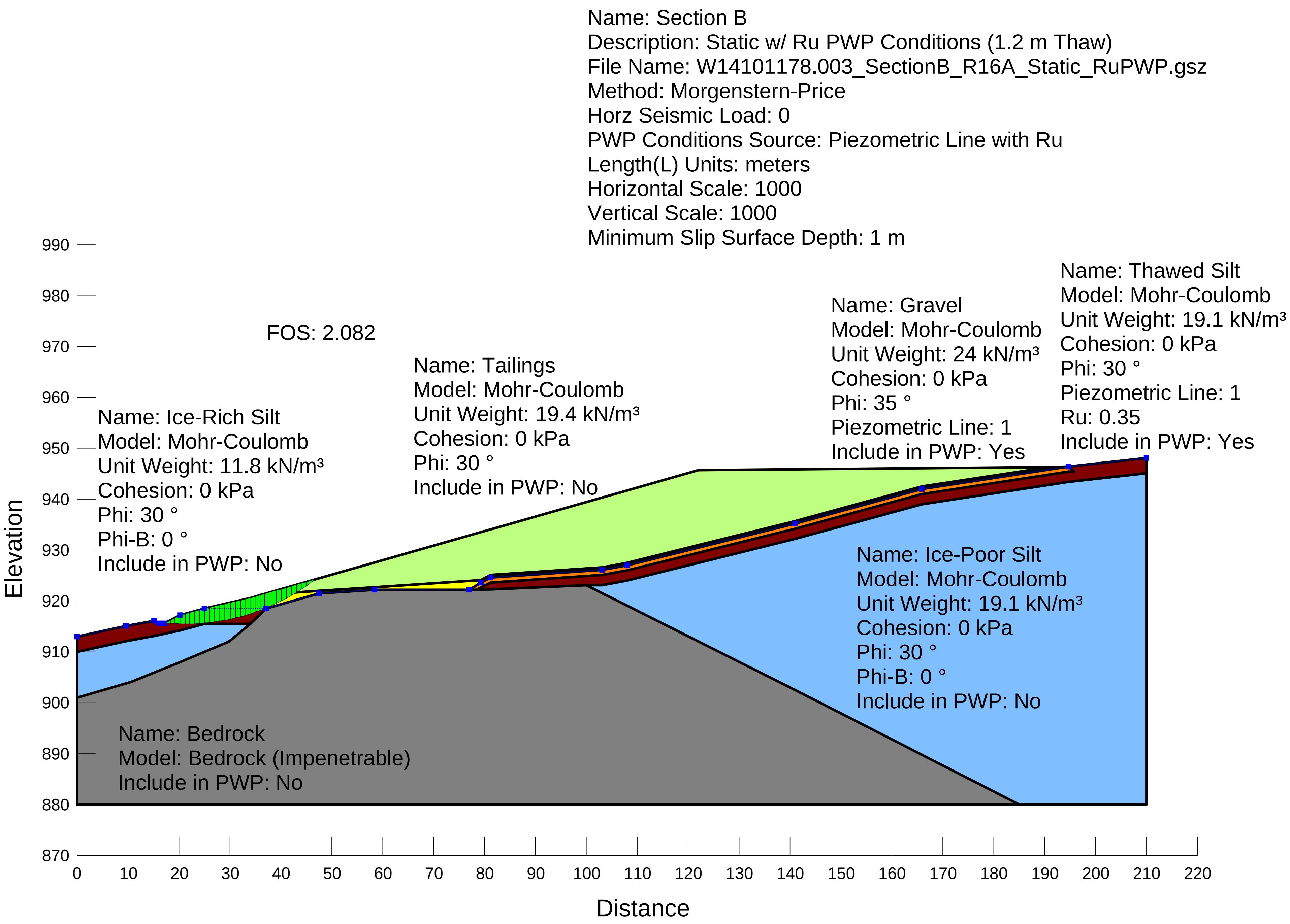
Name: Bedrock
Model: Bedrock (Impenetrable)
Include in PWP: No

Name: Section C
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionC_R16D_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Section A
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionA_R16A_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m





Name: Section B
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionB_R16A_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

FOS: 2.082

Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Include in PWP: No

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

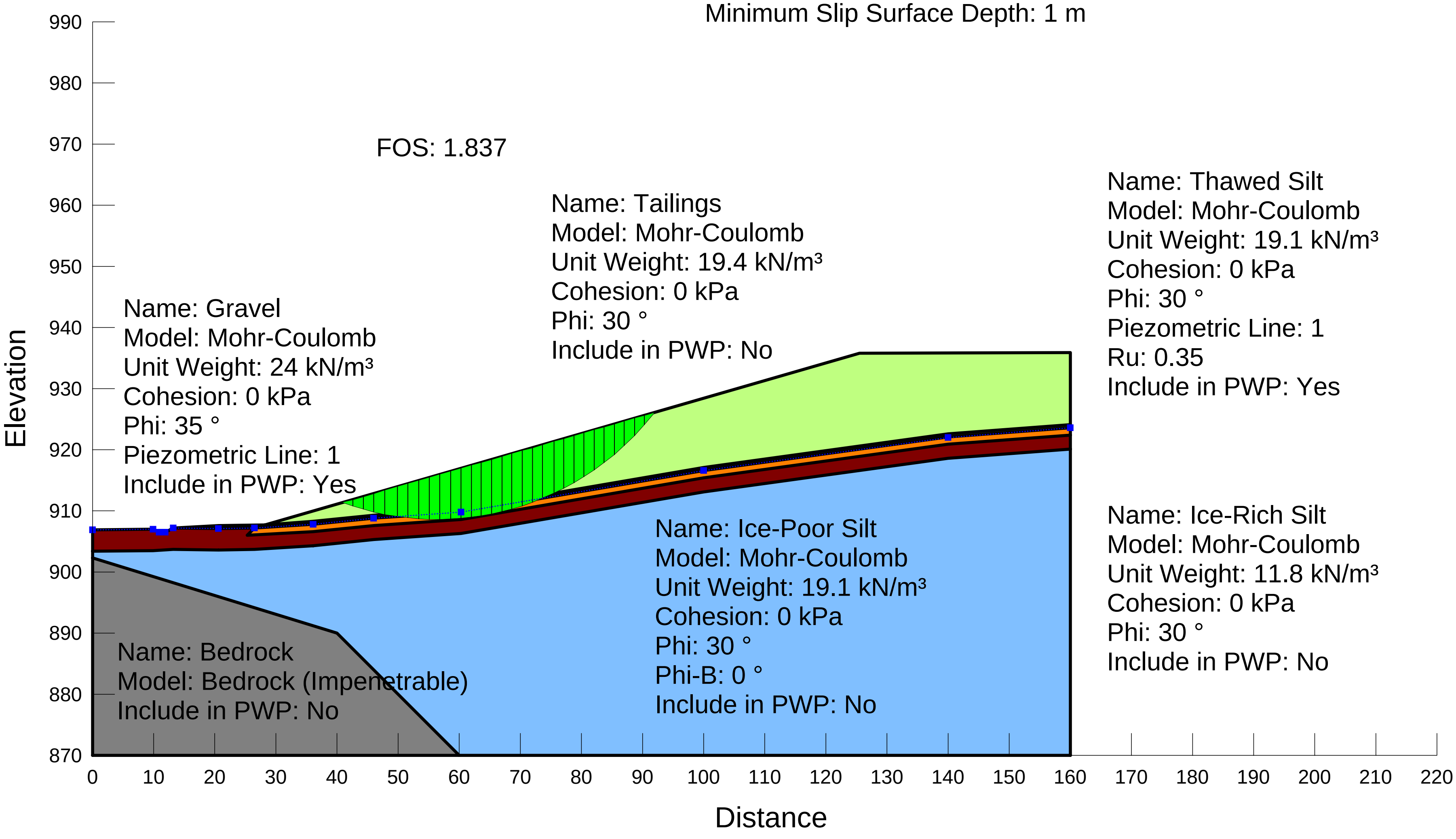
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Piezometric Line: 1
Include in PWP: Yes

Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Ru: 0.35
Include in PWP: Yes

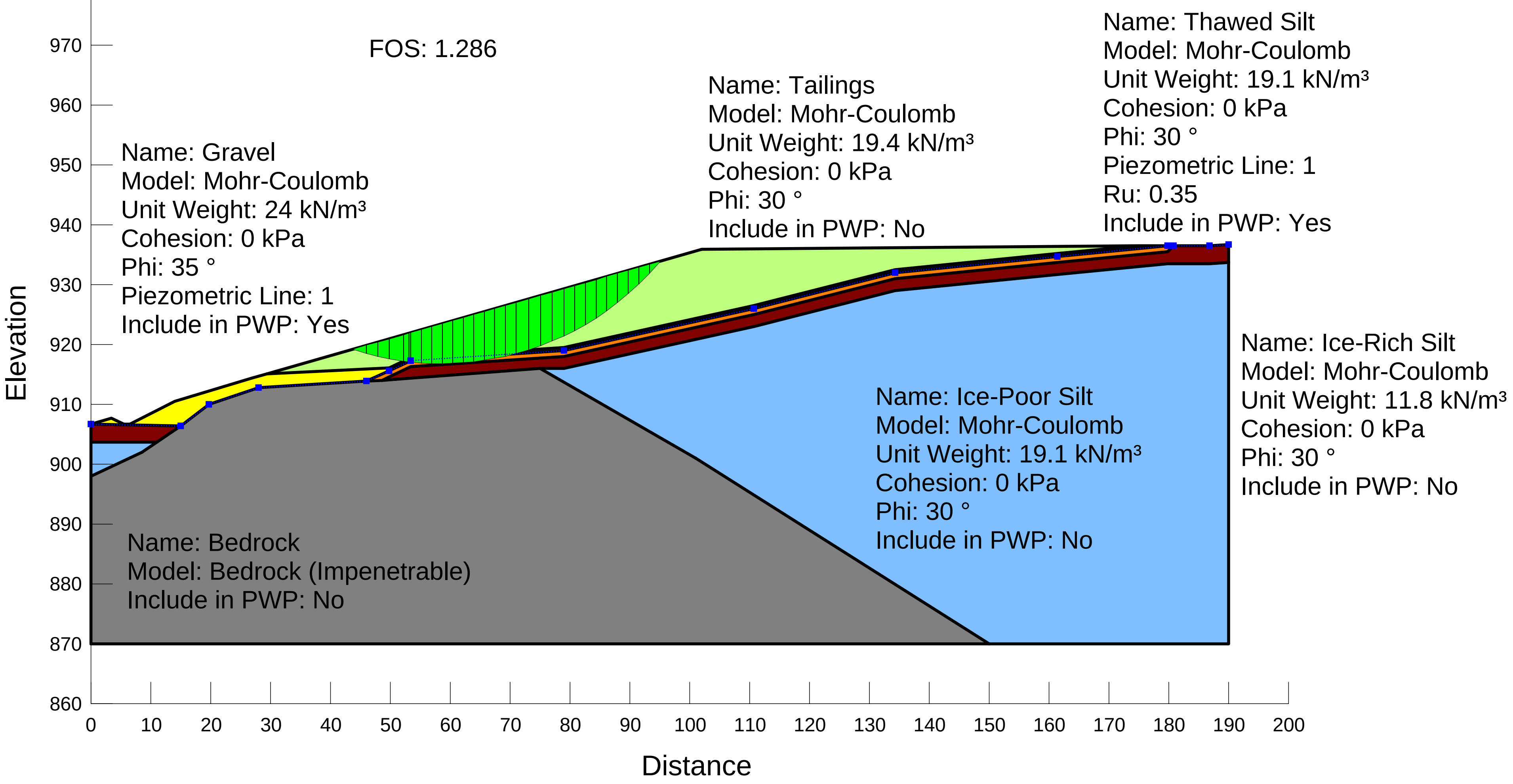
Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Include in PWP: No

Name: Bedrock
Model: Bedrock (Impenetrable)
Include in PWP: No

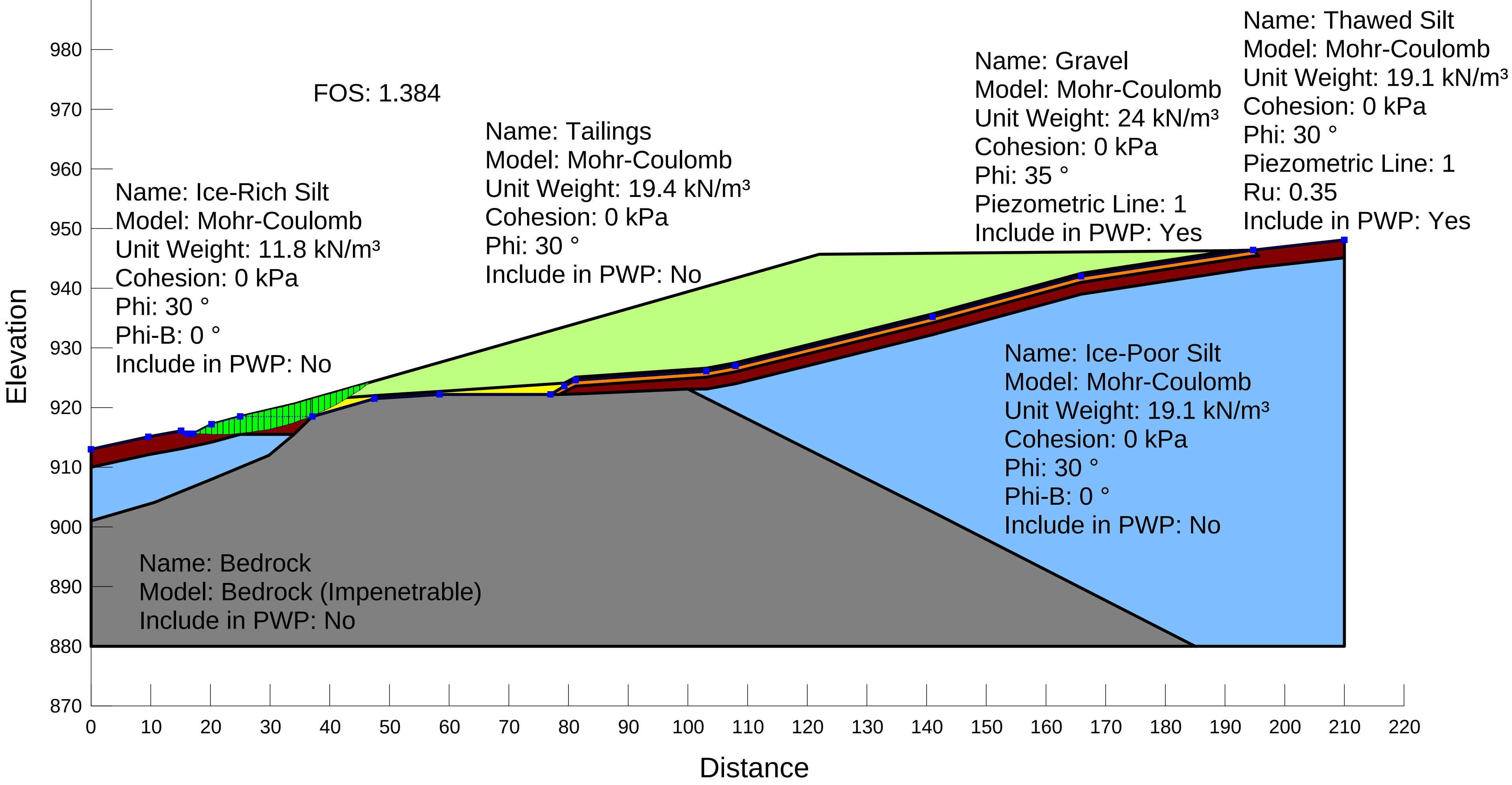
Name: Section C
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionC_R16A_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



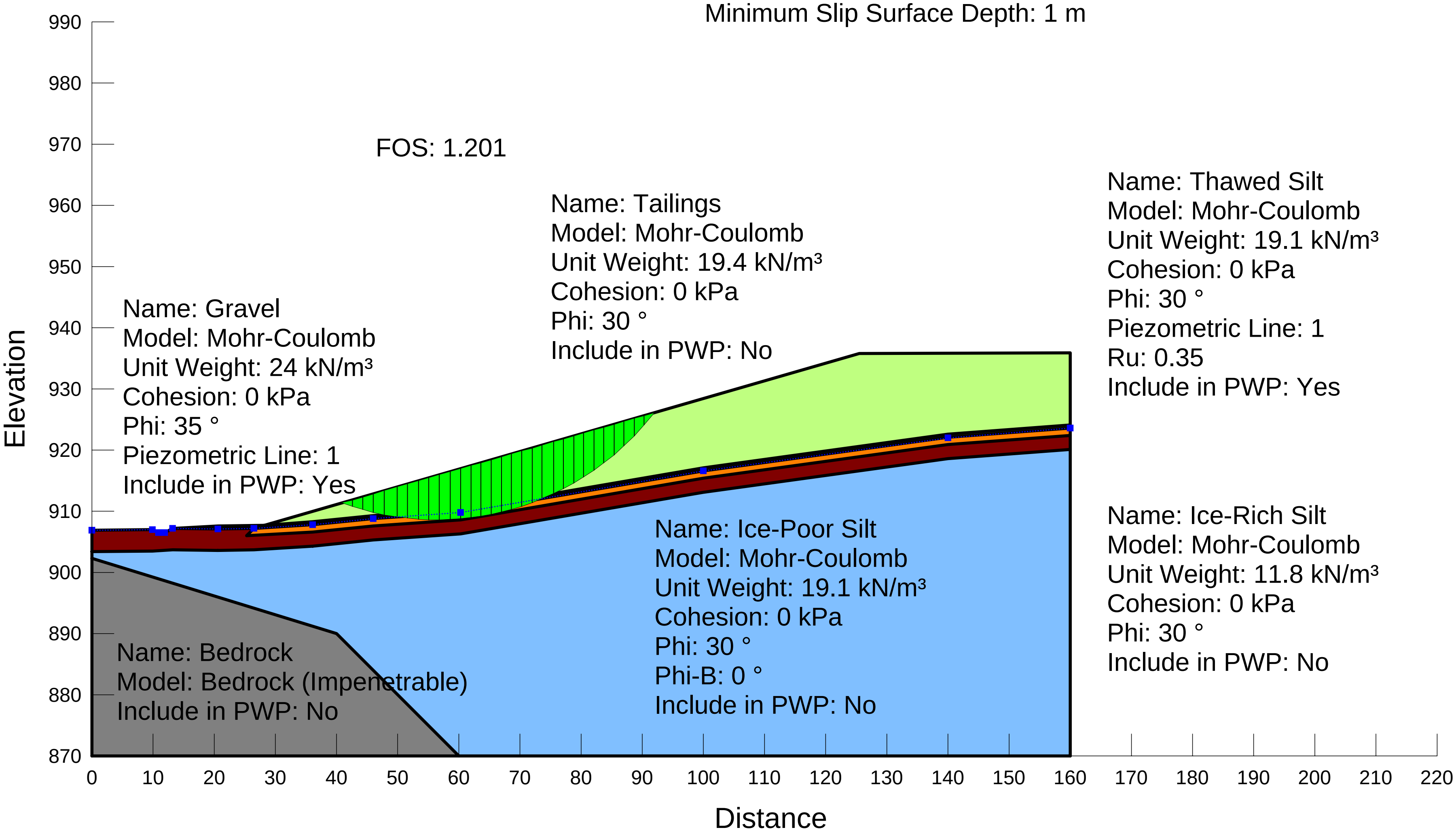
Name: Section A
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionA_R16C_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



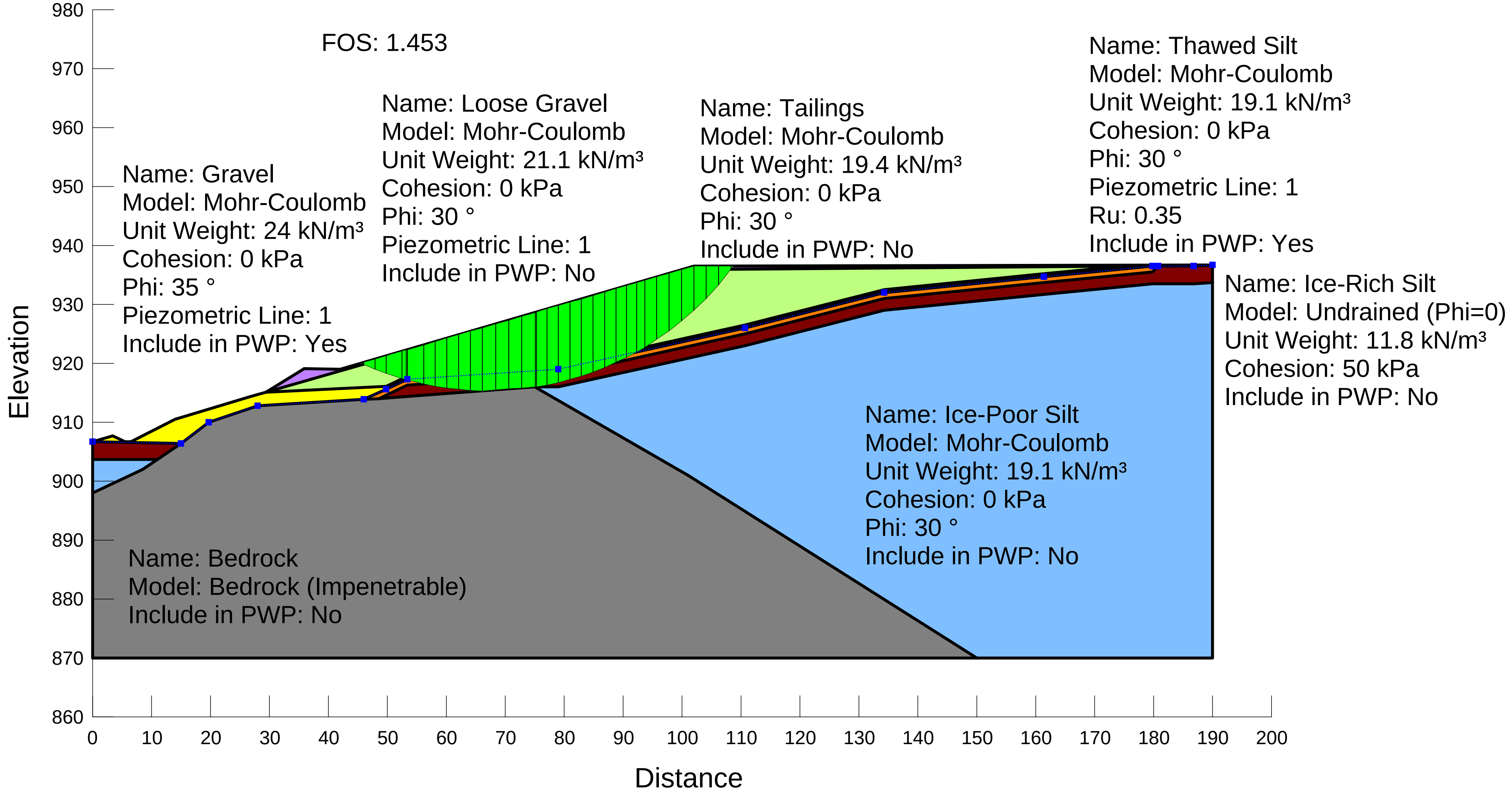
Name: Section B
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionB_R16C_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



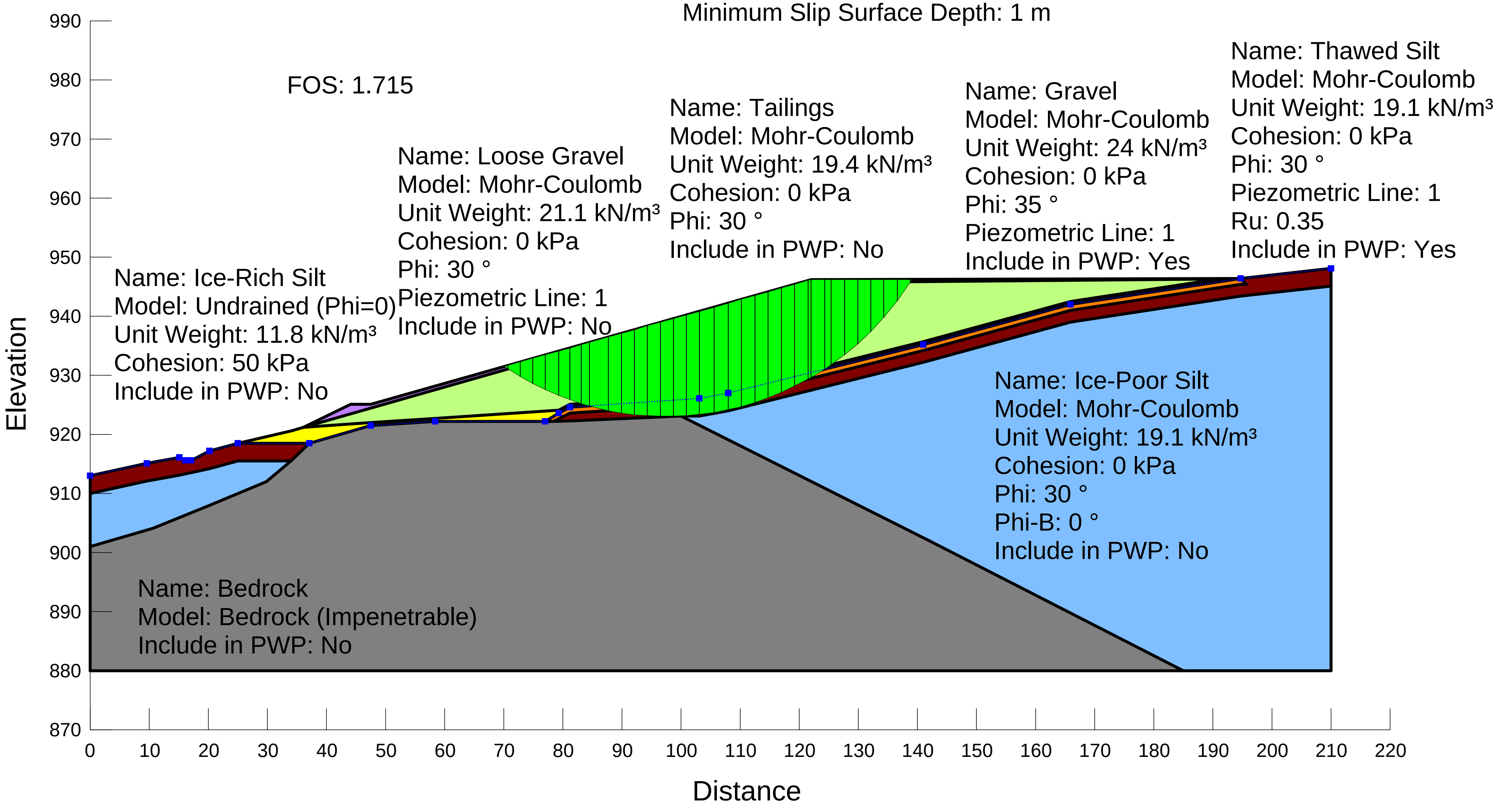
Name: Section C
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionC_R16C_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Section A
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionA_R16D_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Section B
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionB_R16D_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Ice-Rich Silt
Model: Undrained (Phi=0)
Unit Weight: 11.8 kN/m³
Cohesion: 50 kPa
Include in PWP: No

Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Include in PWP: No

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

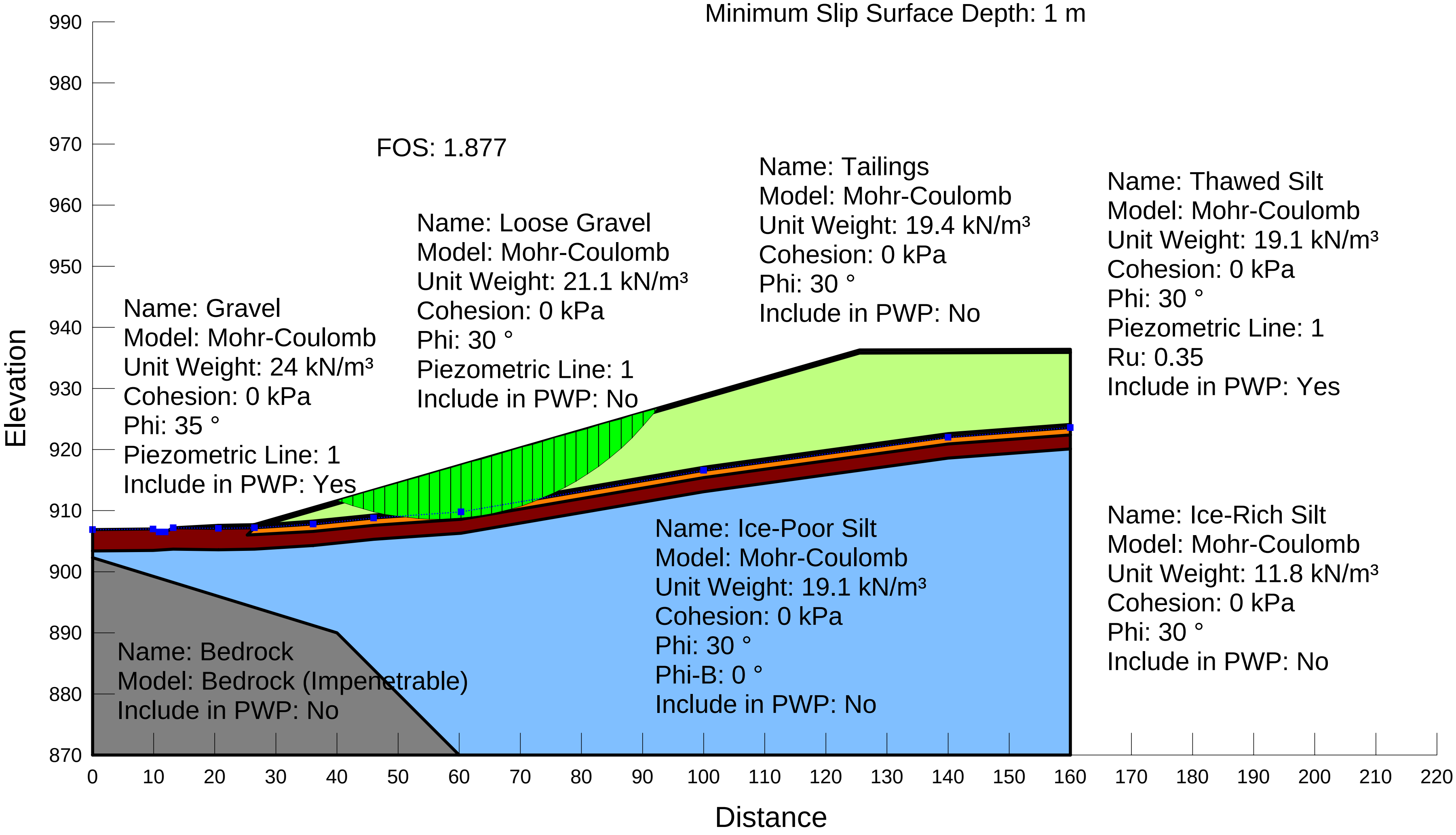
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Piezometric Line: 1
Include in PWP: Yes

Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Ru: 0.35
Include in PWP: Yes

Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Include in PWP: No

Name: Bedrock
Model: Bedrock (Impenetrable)
Include in PWP: No

Name: Section C
Description: Static w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionC_R16D_Static_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



FOS: 1.877

Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Piezometric Line: 1
Include in PWP: Yes

Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Include in PWP: No

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

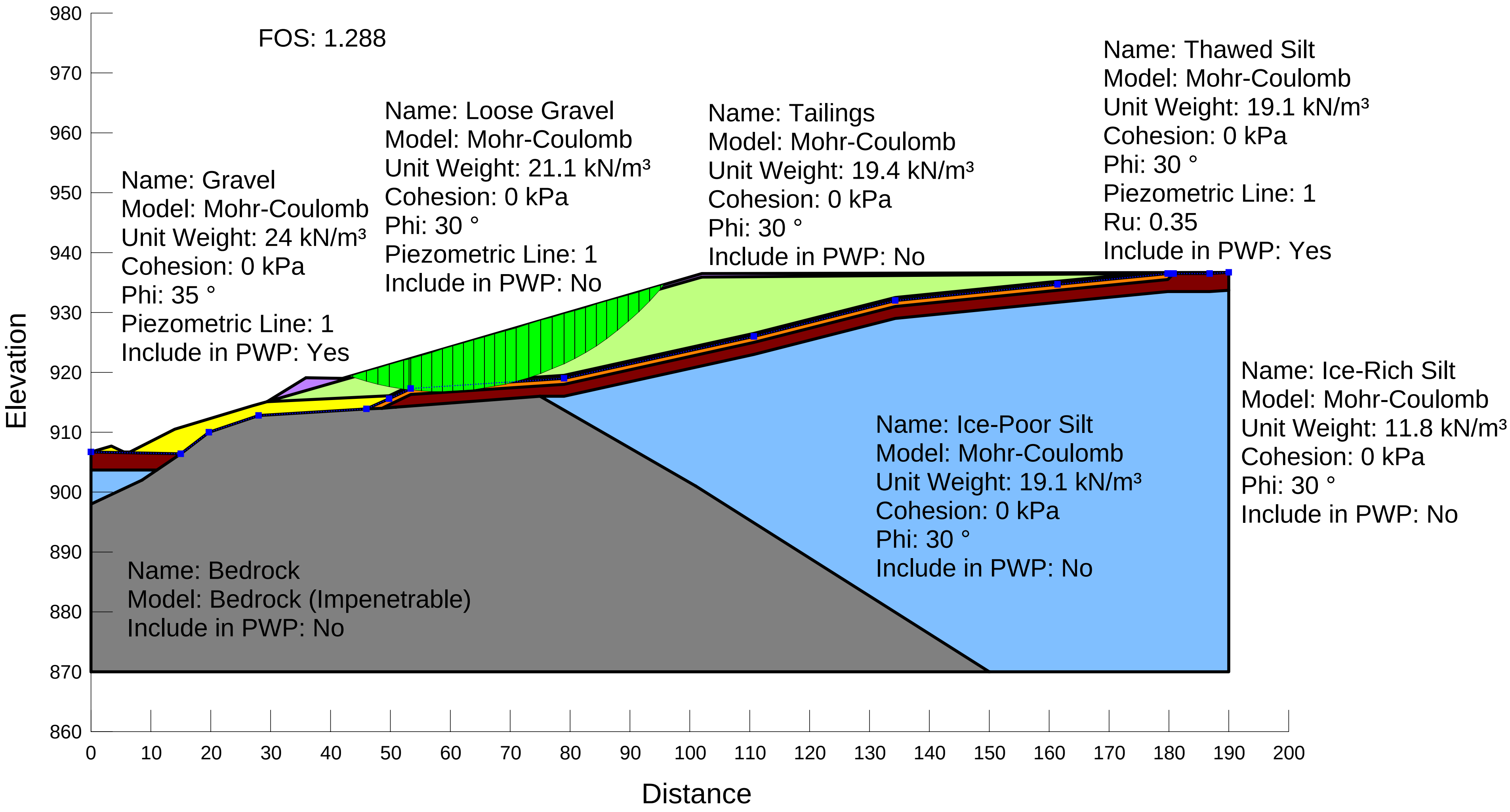
Name: Thawed Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Piezometric Line: 1
Ru: 0.35
Include in PWP: Yes

Name: Ice-Poor Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Include in PWP: No

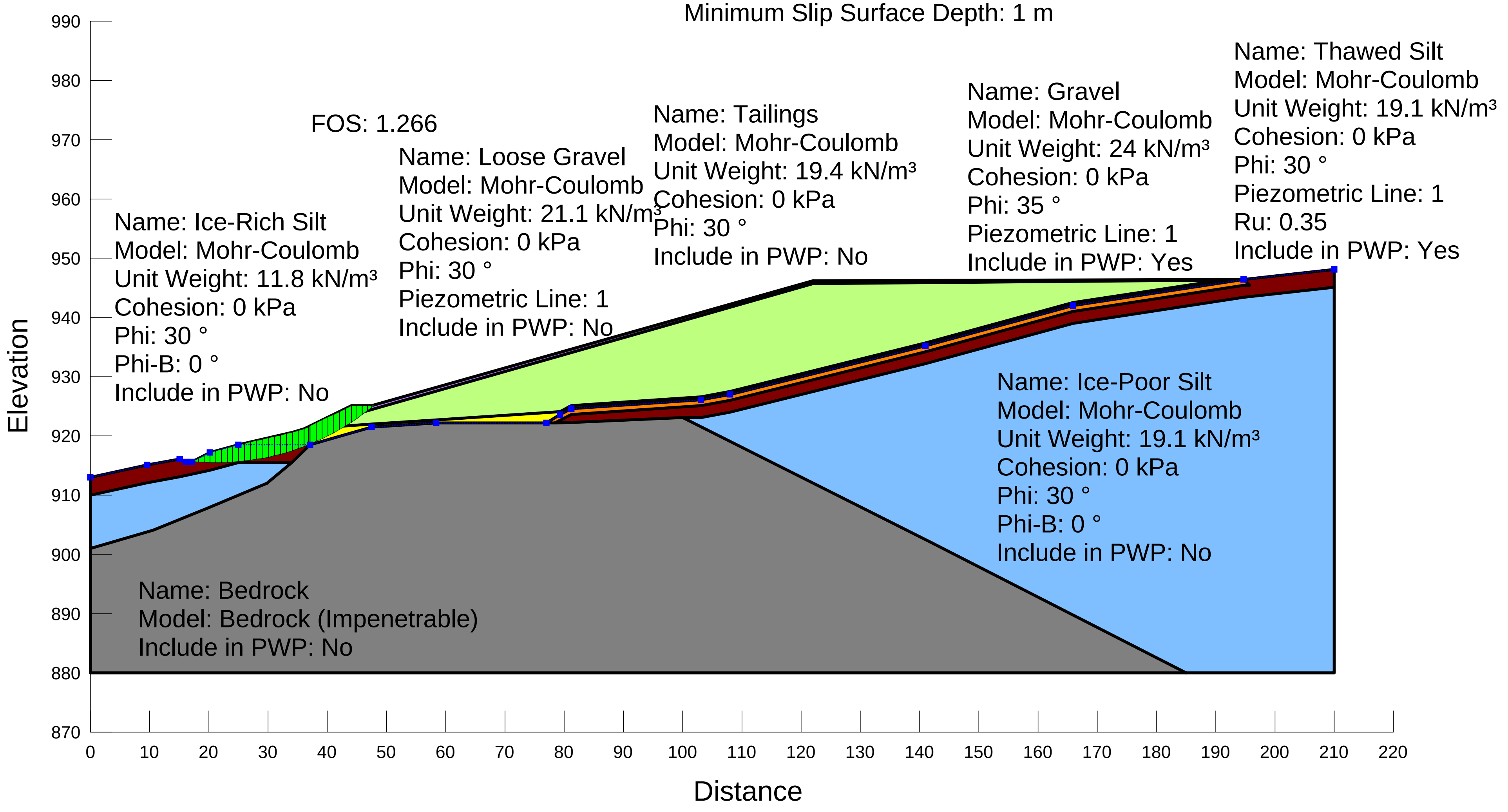
Name: Ice-Rich Silt
Model: Mohr-Coulomb
Unit Weight: 11.8 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Include in PWP: No

Name: Bedrock
Model: Bedrock (Impenetrable)
Include in PWP: No

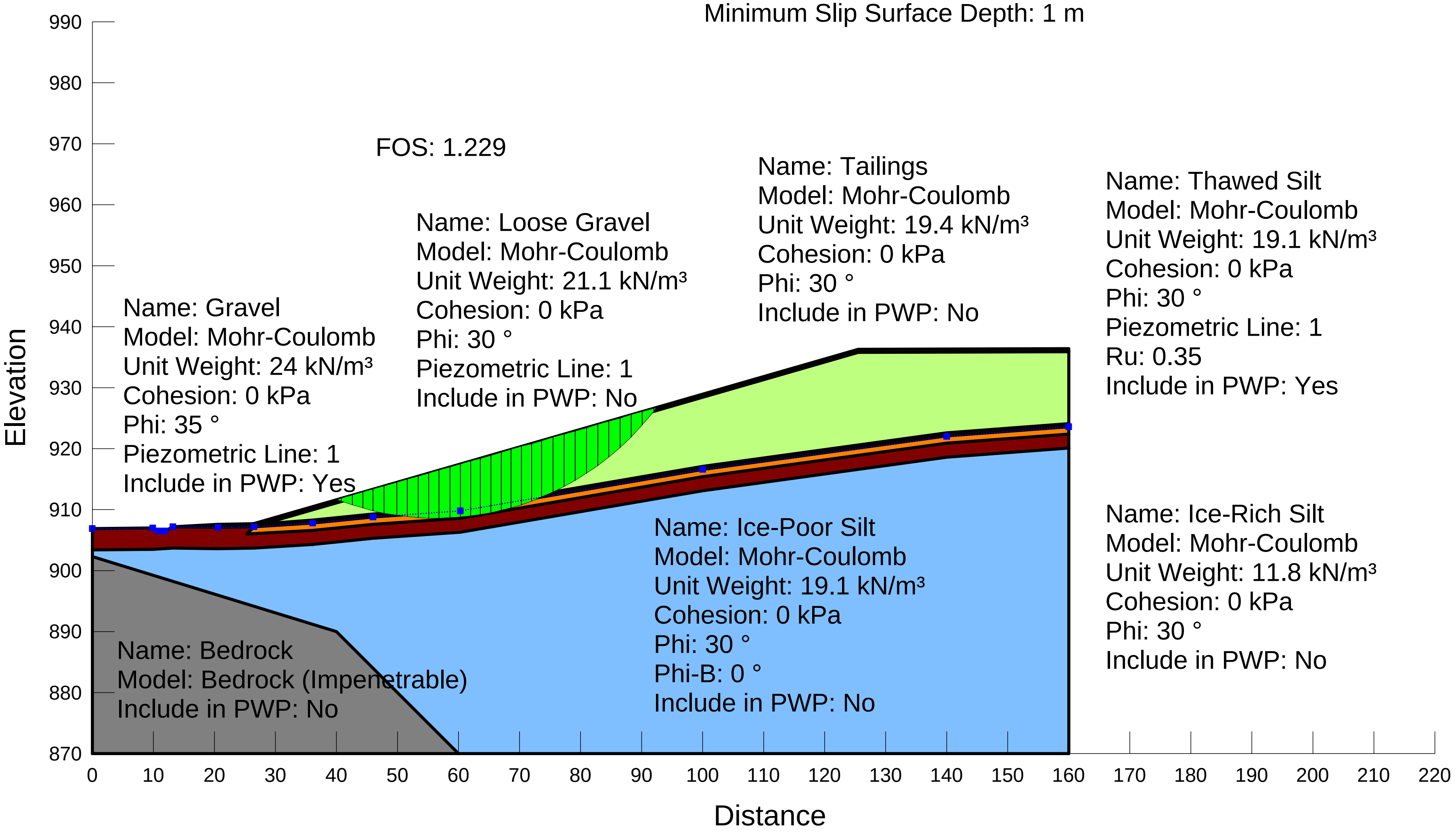
Name: Section A
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionA_R16E_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



Name: Section B
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionB_R16E_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



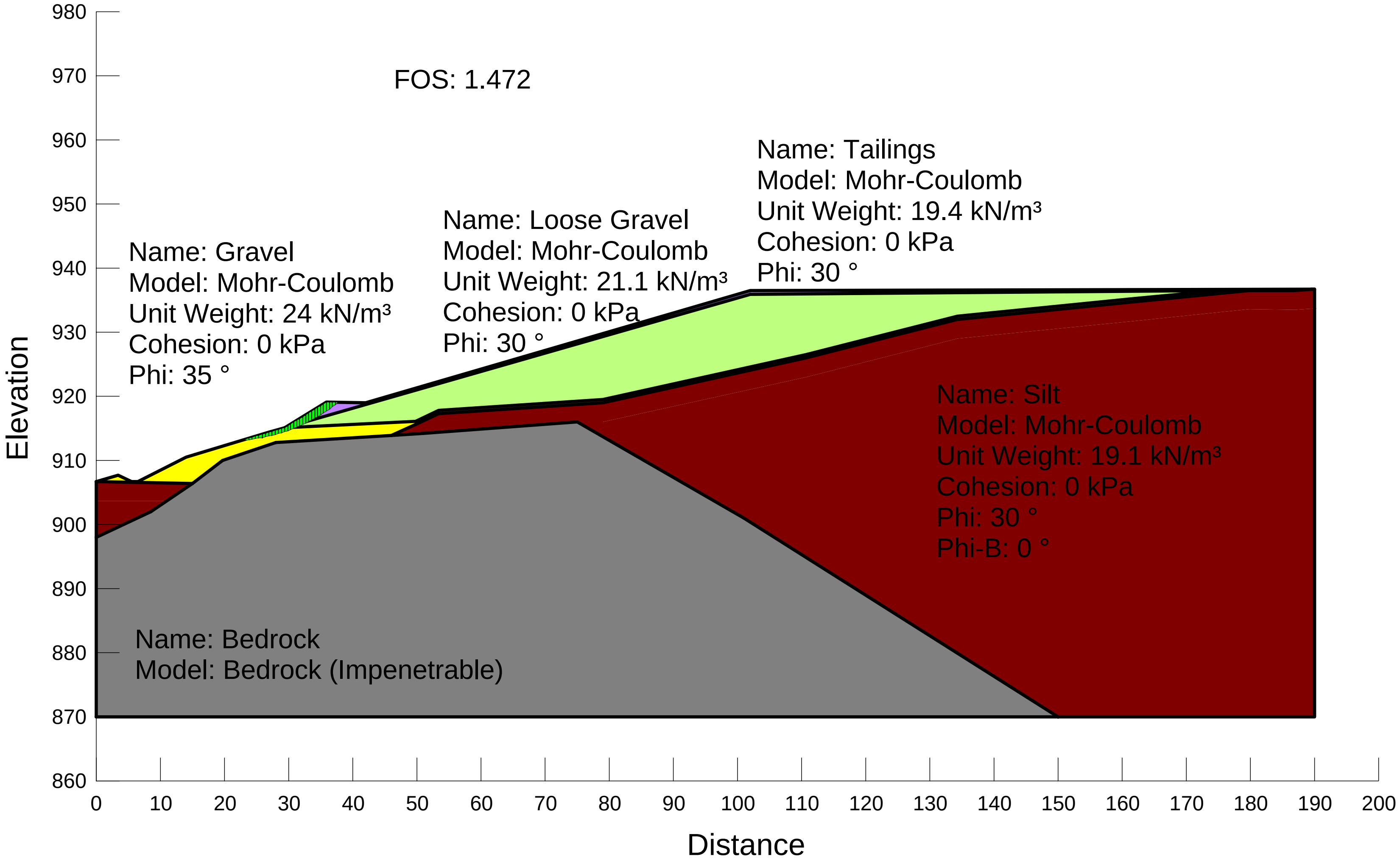
Name: Section C
Description: Dynamic (1:475) w/ Ru PWP Conditions (1.2 m Thaw)
File Name: W14101178.003_SectionC_R16E_Dynamic475_RuPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: Piezometric Line with Ru
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



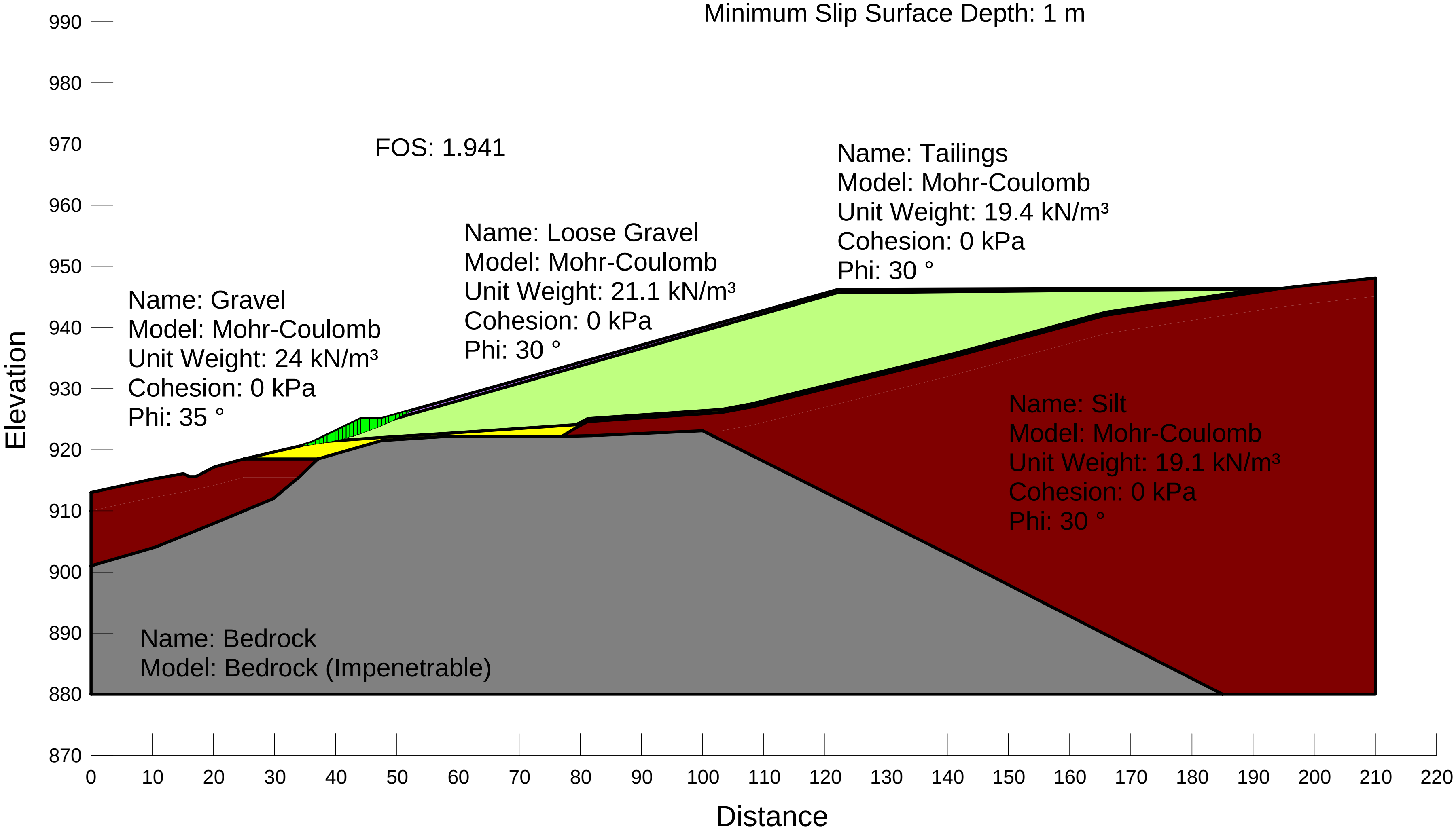
APPENDIX E

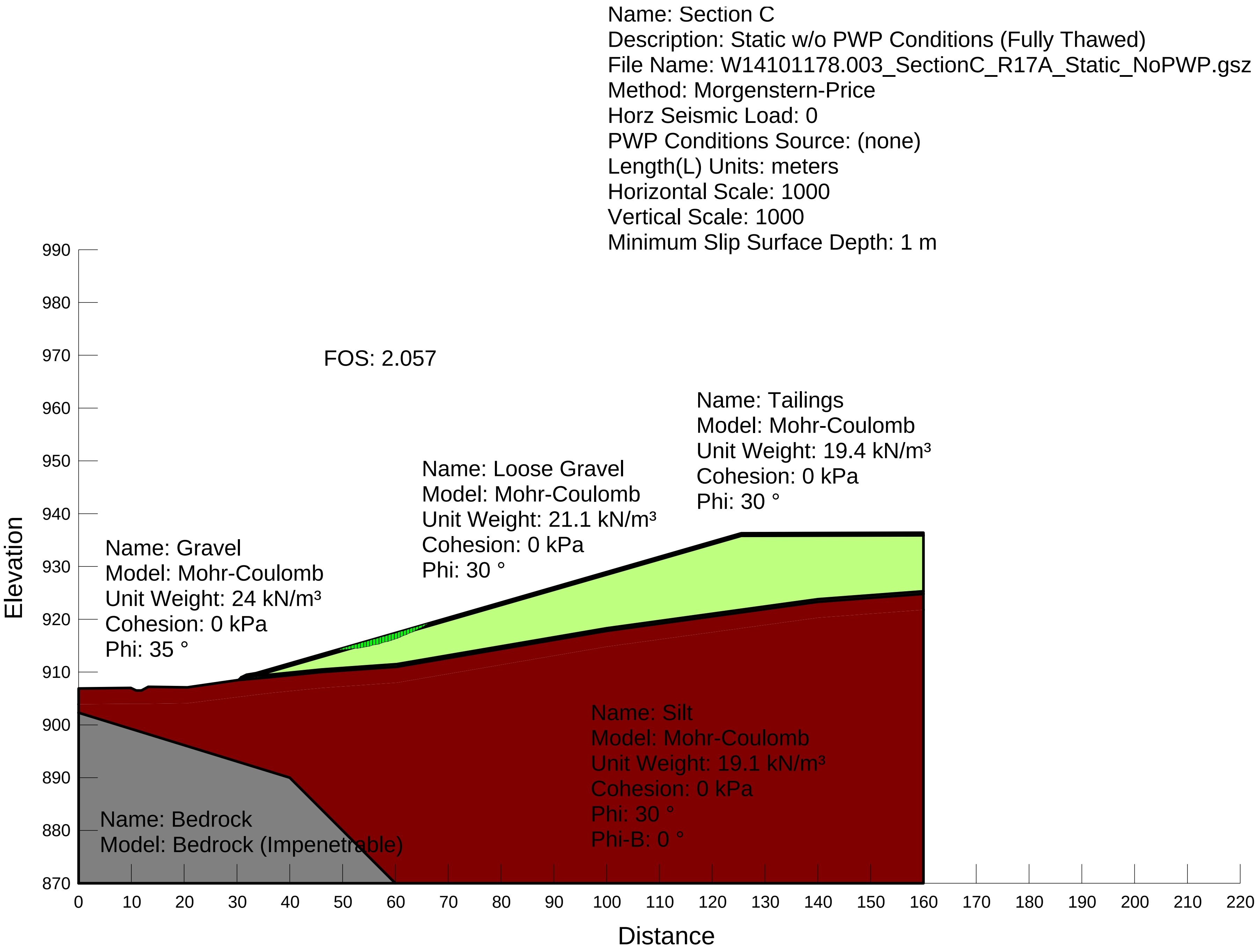
APPENDIX E SLOPE STABILITY PLOTS – FULLY THAWED CASE

Name: Section A
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionA_R17A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

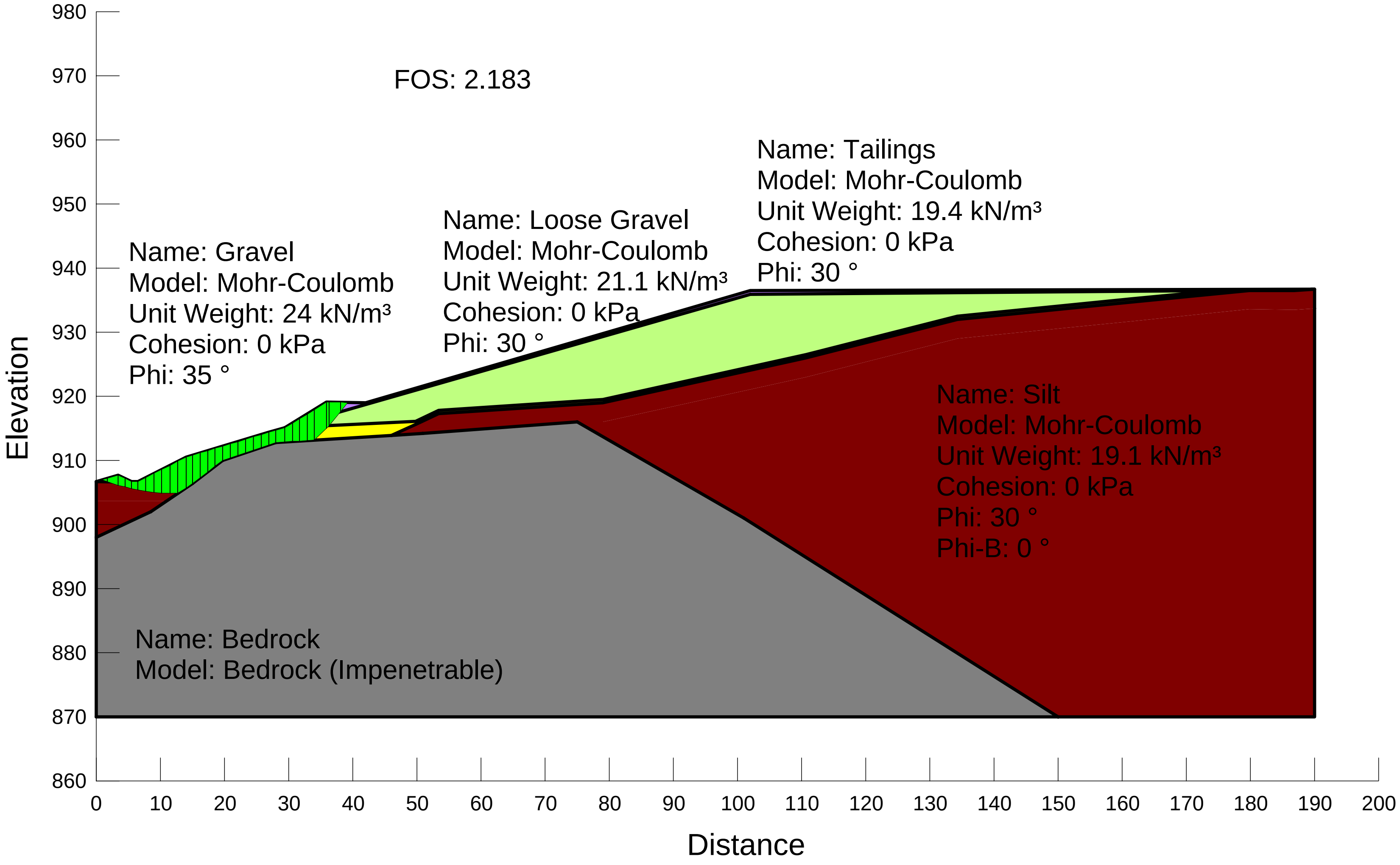


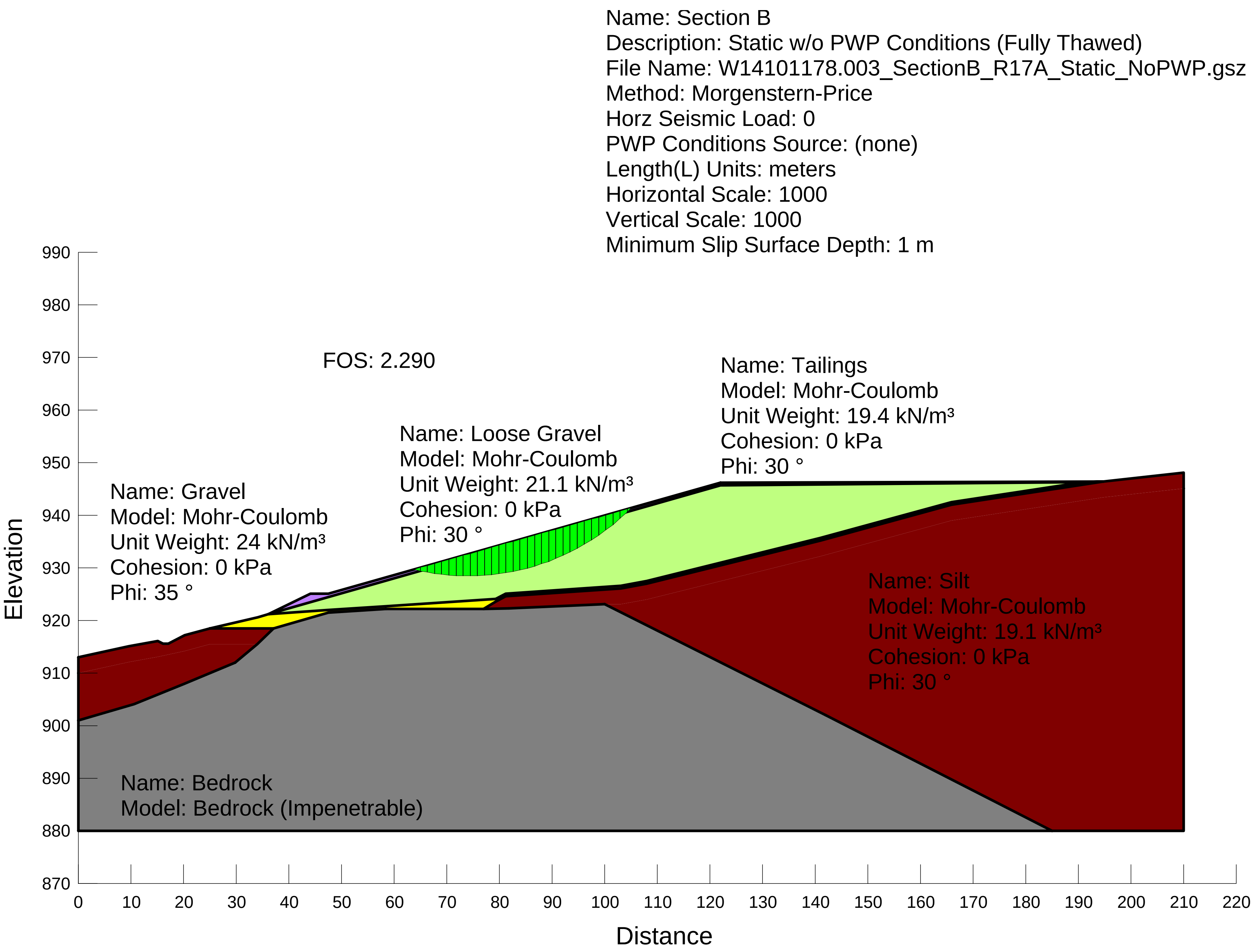
Name: Section B
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionB_R17A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m




Name: Section C
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionC_R17A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 2.057
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
Distance
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

Name: Section A
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionA_R17A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m





Name: Section B
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionB_R17A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

FOS: 2.290

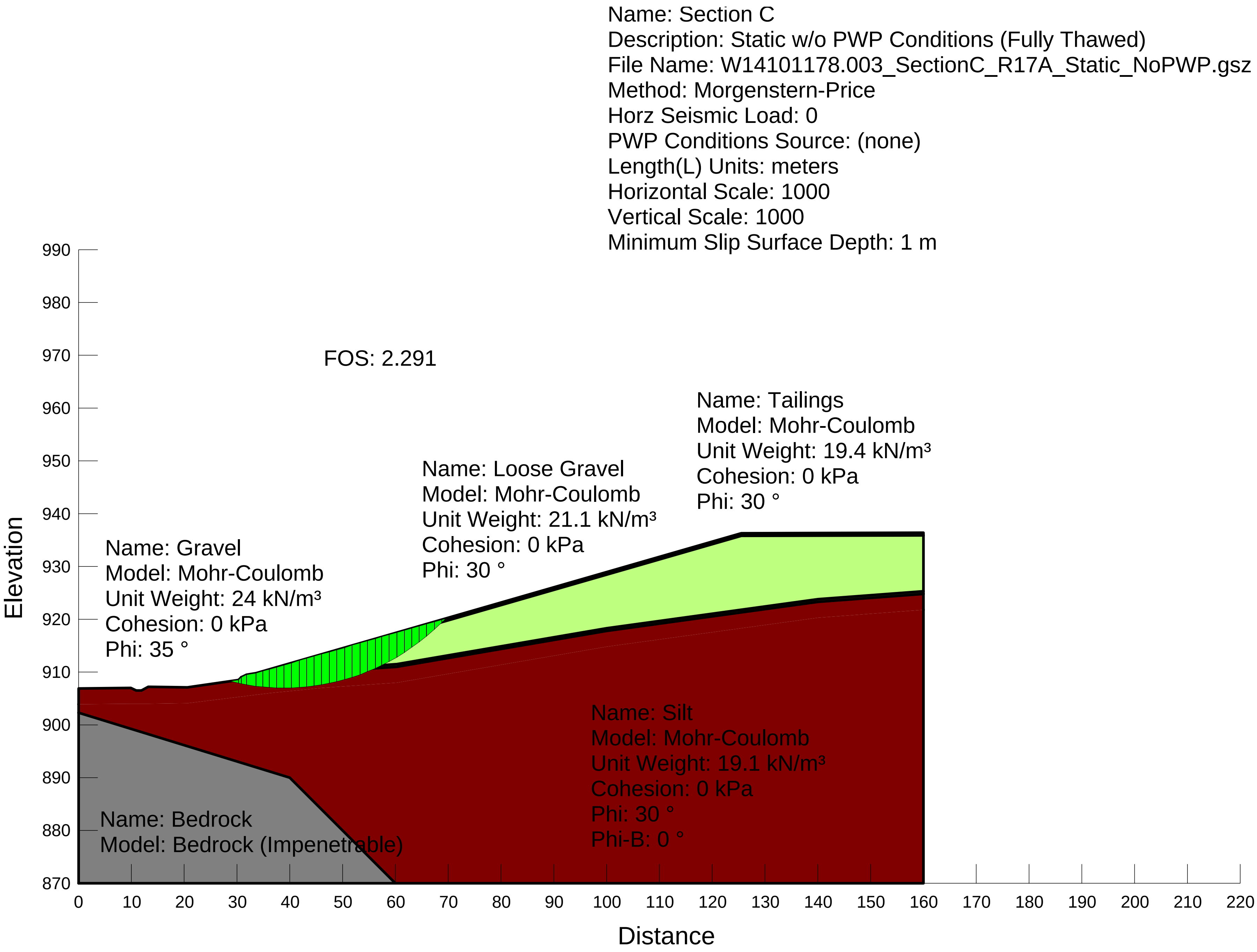
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °

Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °

Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °

Name: Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °

Name: Bedrock
Model: Bedrock (Impenetrable)



Name: Section C
Description: Static w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionC_R17A_Static_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m

FOS: 2.291

Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °

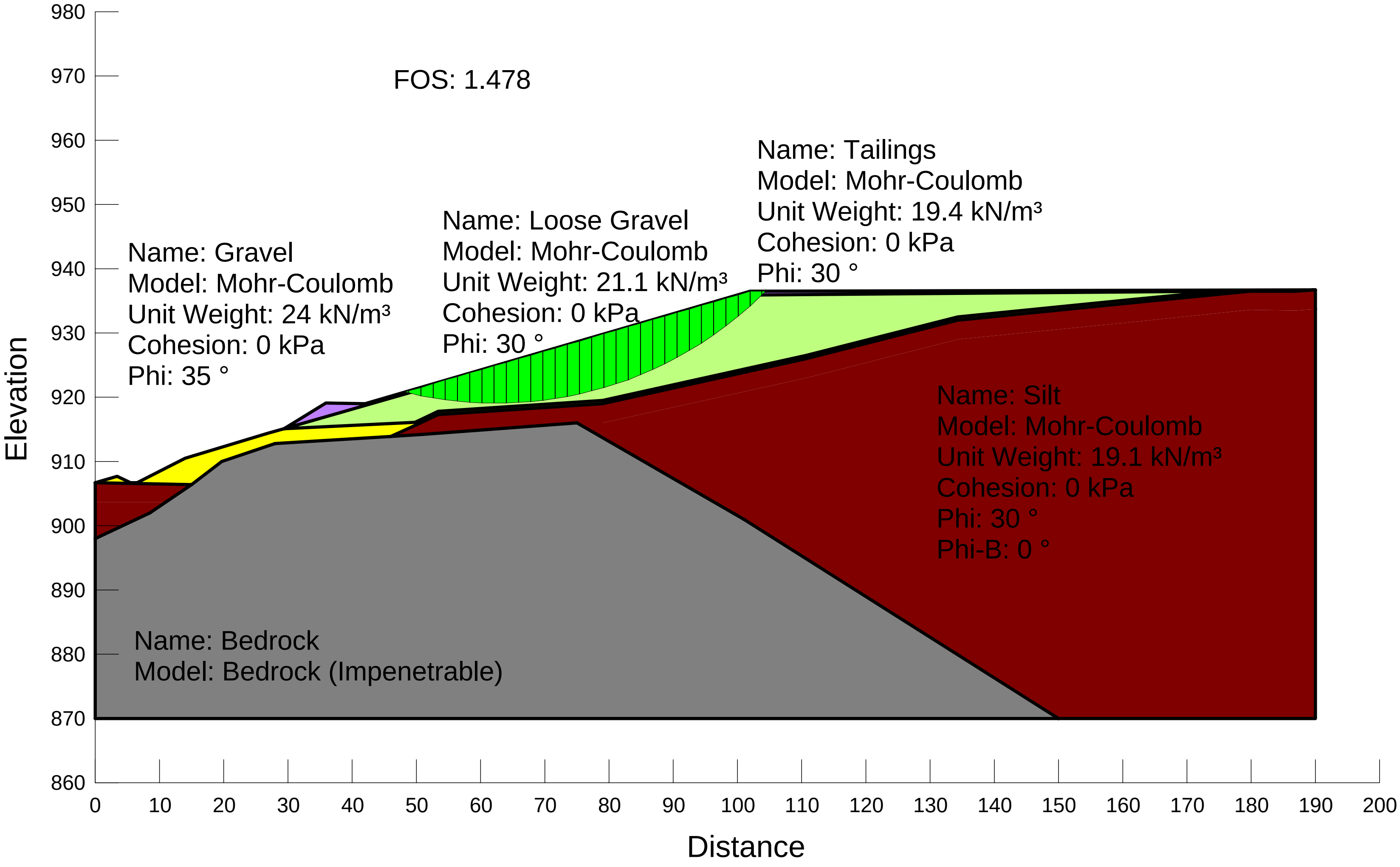
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °

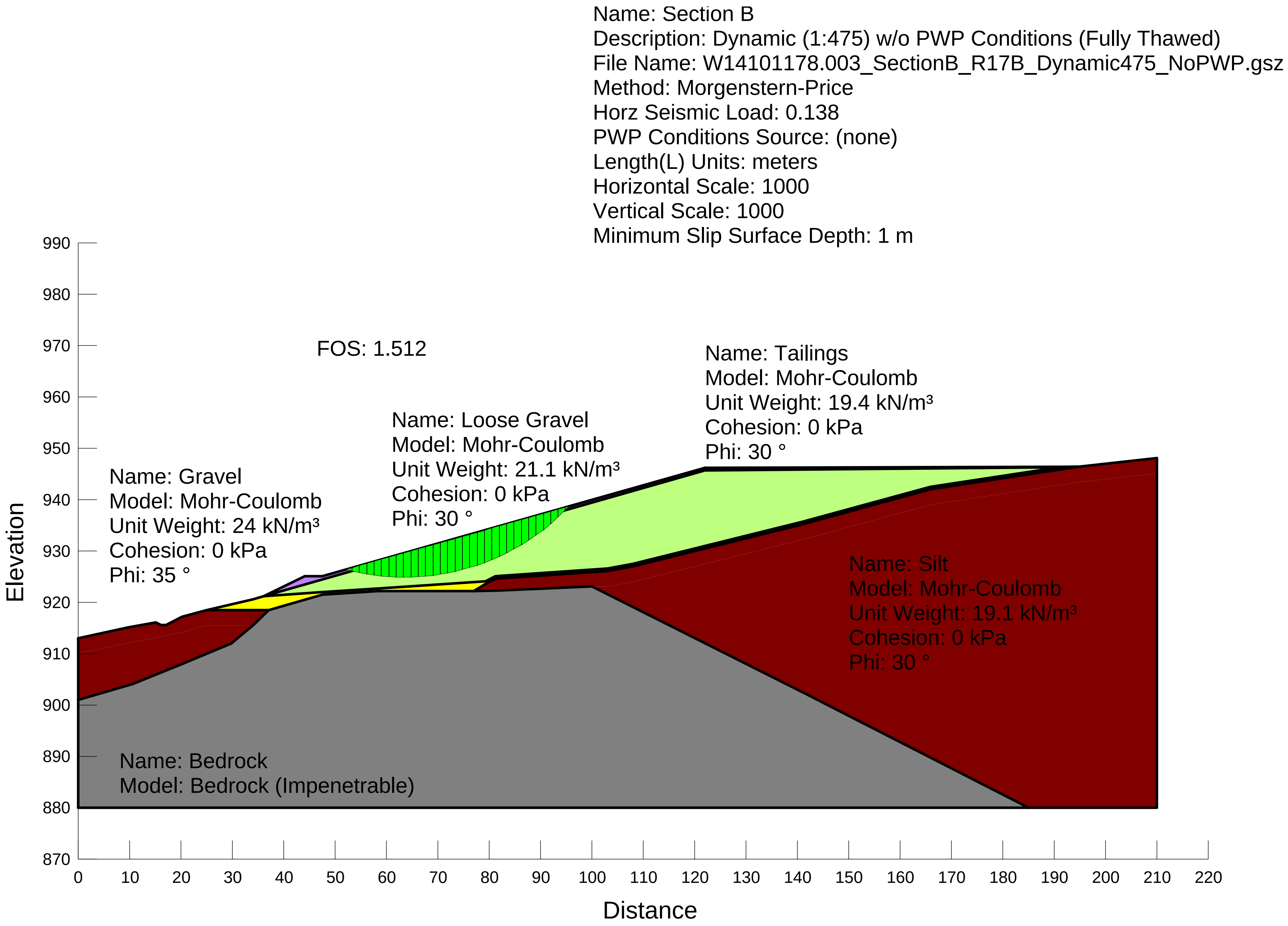
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °

Name: Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Phi-B: 0 °

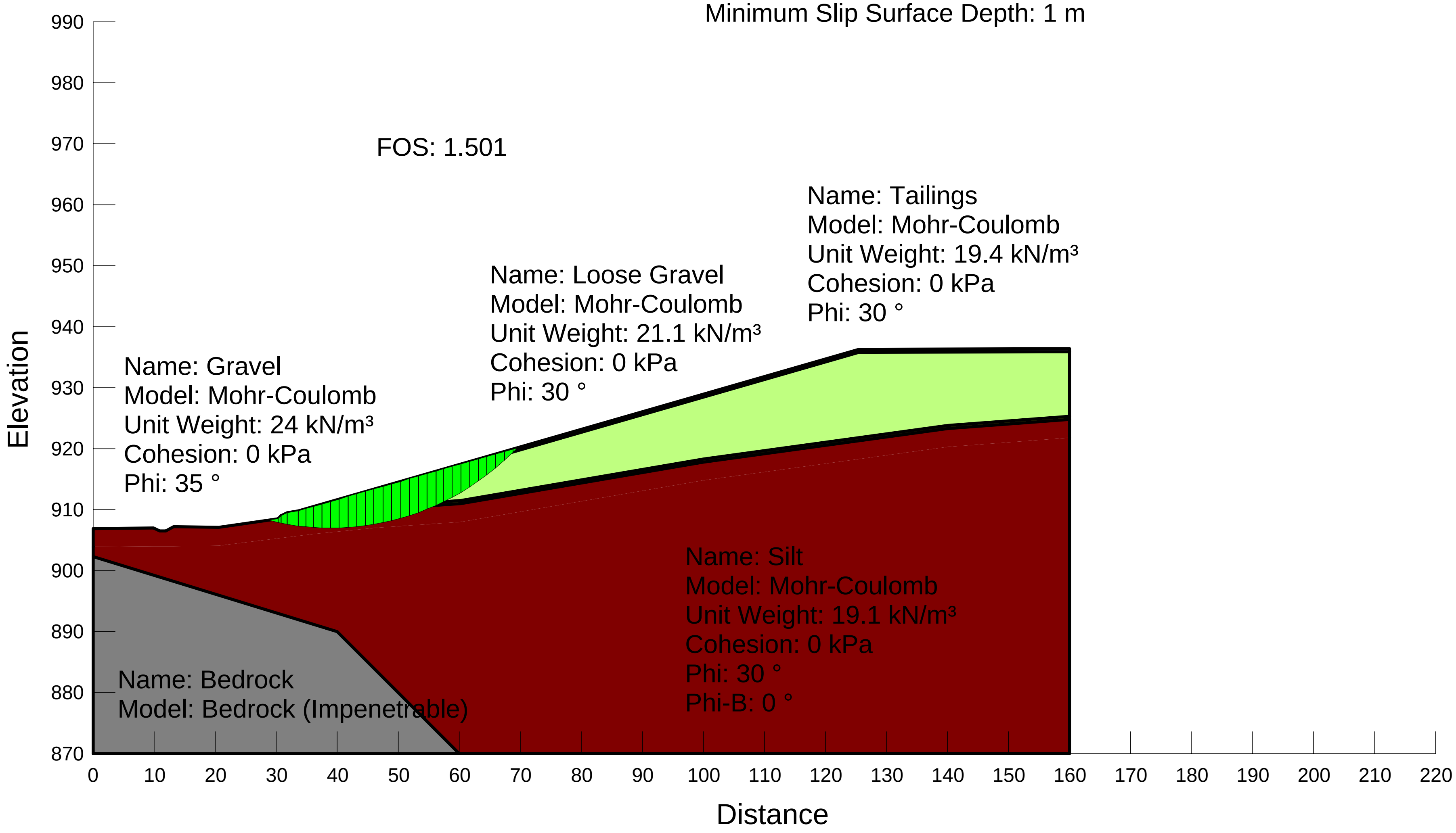
Name: Bedrock
Model: Bedrock (Impenetrable)

Name: Section A
Description: Dynamic (1:475) w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionA_R17B_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m




Name: Section B
Description: Dynamic (1:475) w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionB_R17B_Dynamic475_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m
FOS: 1.512
Name: Tailings
Model: Mohr-Coulomb
Unit Weight: 19.4 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Loose Gravel
Model: Mohr-Coulomb
Unit Weight: 21.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Gravel
Model: Mohr-Coulomb
Unit Weight: 24 kN/m³
Cohesion: 0 kPa
Phi: 35 °
Name: Silt
Model: Mohr-Coulomb
Unit Weight: 19.1 kN/m³
Cohesion: 0 kPa
Phi: 30 °
Name: Bedrock
Model: Bedrock (Impenetrable)
Elevation
990
980
970
960
950
940
930
920
910
900
890
880
870
Distance
0
10
20
30
40
50
60
70
80
90
100
110
120
130
140
150
160
170
180
190
200
210
220

Name: Section C
Description: Dynamic (1:475) w/o PWP Conditions (Fully Thawed)
File Name: W14101178.003_SectionC_R17B_Dynamic_NoPWP.gsz
Method: Morgenstern-Price
Horz Seismic Load: 0.138
PWP Conditions Source: (none)
Length(L) Units: meters
Horizontal Scale: 1000
Vertical Scale: 1000
Minimum Slip Surface Depth: 1 m



APPENDIX F

APPENDIX F EBA'S GENERAL TERMS AND CONDITIONS

GEOTECHNICAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgemental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

8.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

9.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

10.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

11.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

12.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

13.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

14.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

DESIGN REPORT – GENERAL CONDITIONS

This Design Report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This Design Report pertains to a specific site, a specific development, and a specific scope of work. The Design Report may include plans, drawings, profiles and other support documents that collectively constitute the Design Report. The Report and all supporting documents are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, analyses or other contents of the Design Report when it is used or relied upon by any party other than EBA's Client, unless authorized in writing by EBA. Any unauthorized use of the Design Report is at the sole risk of the user.

All reports, plans, and data generated by EBA during the performance of the work and other documents prepared by EBA are considered its professional work product and shall remain the copyright property of EBA.

2.0 ALTERNATIVE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless so stipulated in the Design Report, EBA was not retained to investigate, address or consider, and has not investigated, addressed or considered any environmental or regulatory issues associated with the project specific design.

4.0 CALCULATIONS AND DESIGNS

EBA has undertaken design calculations and has prepared project specific designs in accordance with terms of reference that were previously set out in consultation with, and agreement of, EBA's client. These designs have been prepared to a standard that is consistent with industry practice. Notwithstanding, if any error or omission is detected by EBA's Client or any party that is authorized to use the Design Report, the error or omission should be immediately drawn to the attention of EBA.

5.0 GEOTECHNICAL CONDITIONS

A Geotechnical Report is commonly the basis upon which the specific project design has been completed. It is incumbent upon EBA's Client, and any other authorized party, to be knowledgeable of the level of risk that has been incorporated into the project design, in consideration of the level of the geotechnical information that was reasonably acquired to facilitate completion of the design.

If a Geotechnical Report was prepared for the project by EBA, it will be included in the Design Report. The Geotechnical Report contains General Conditions that should be read in conjunction with these General Conditions for the Design Report.

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE

APPLICATION QZ09-092 –

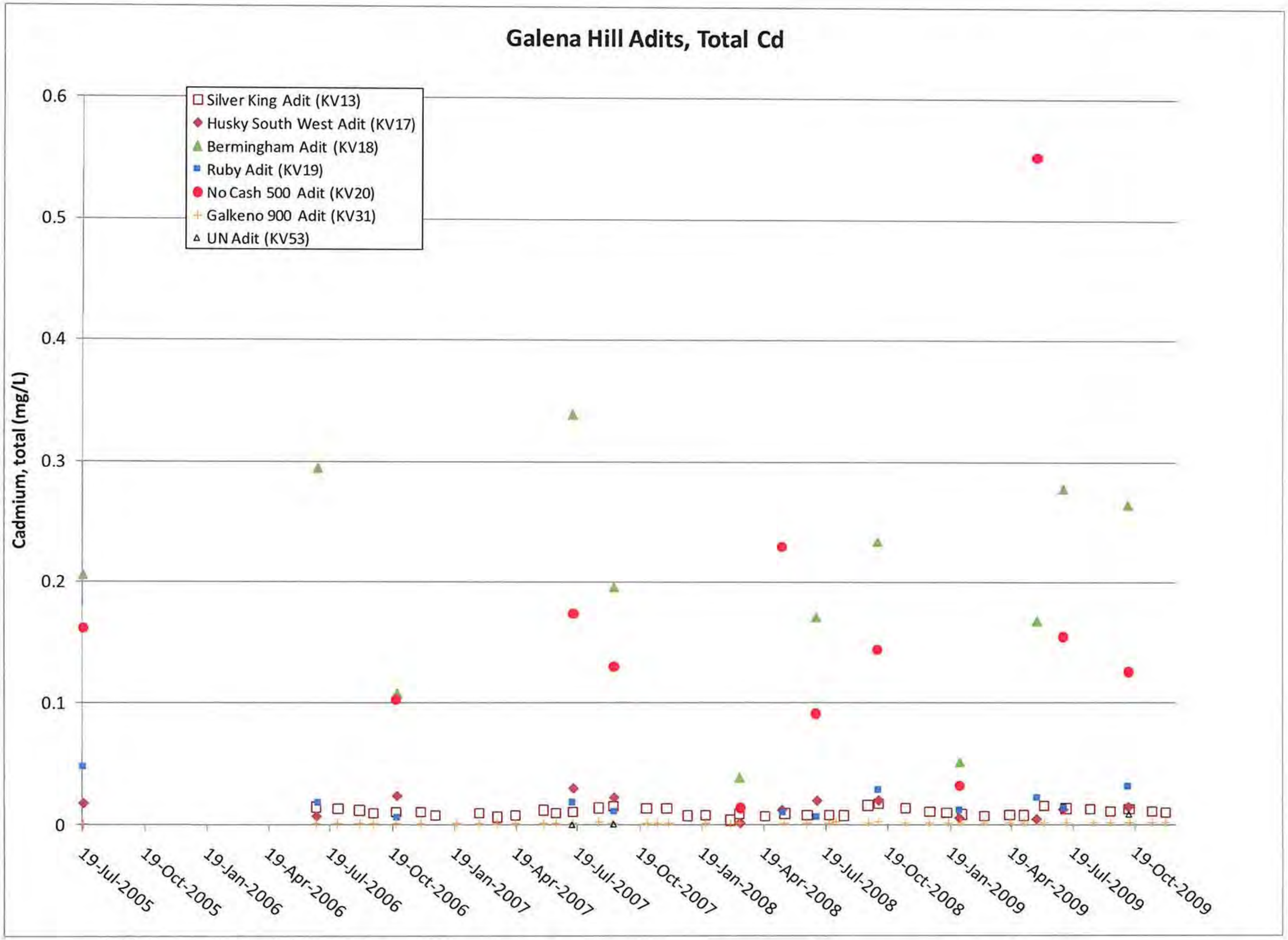
Response to Review for Adequacy and

Supplemental Information

ATTACHMENT D

(Q-33)

January 19, 2010


Galena Hill Adits, Total Cd
Silver King Adit (KV13)
Husky South West Adit (KV17)
Bermingham Adit (KV18)
Ruby Adit (KV19)
No Cash 500 Adit (KV20)
Galkeno 900 Adit (KV31)
UN Adit (KV53)
Cadmium, total (mg/L)
0.6
0.5
0.4
0.3
0.2
0.1
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
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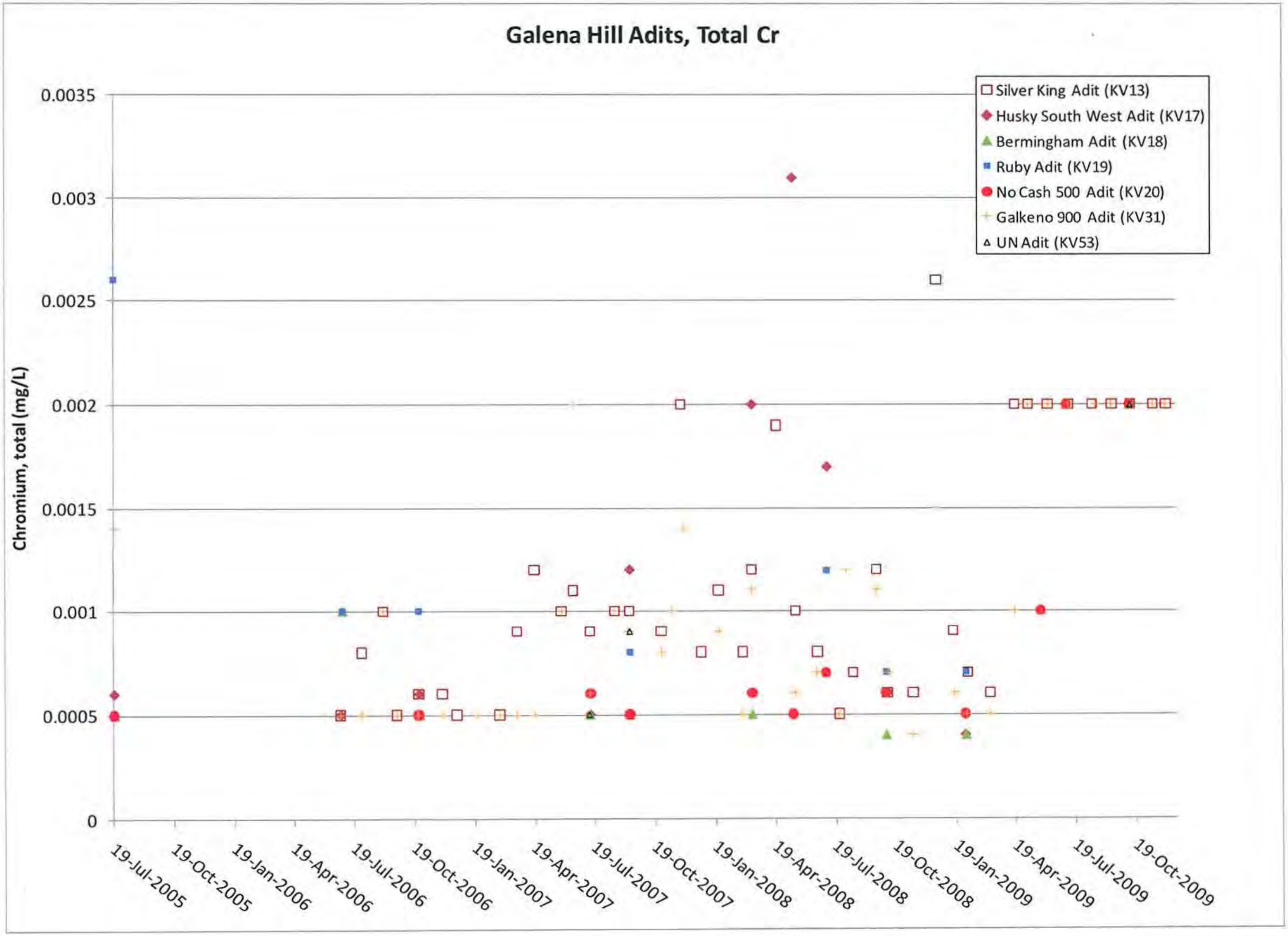
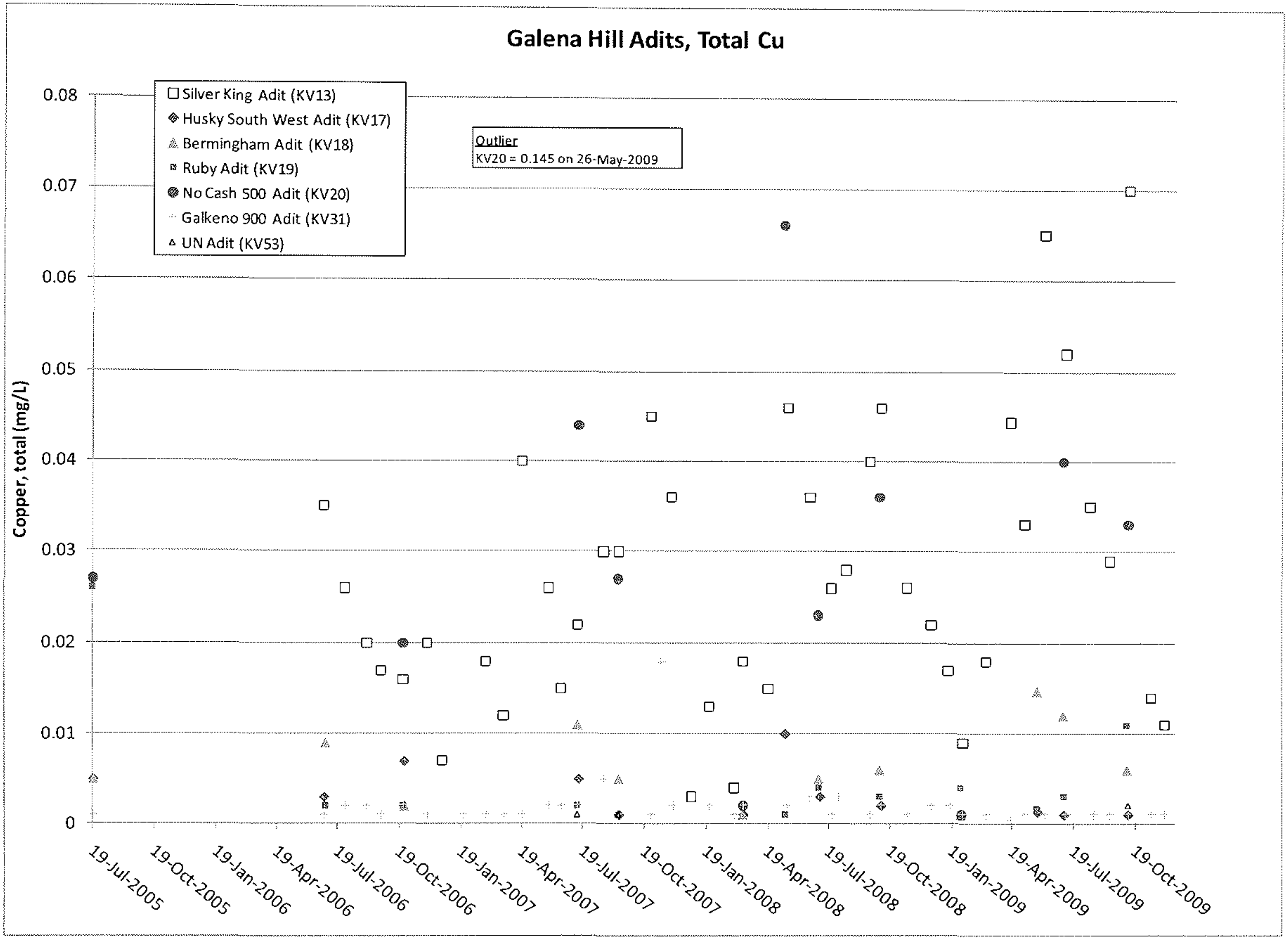
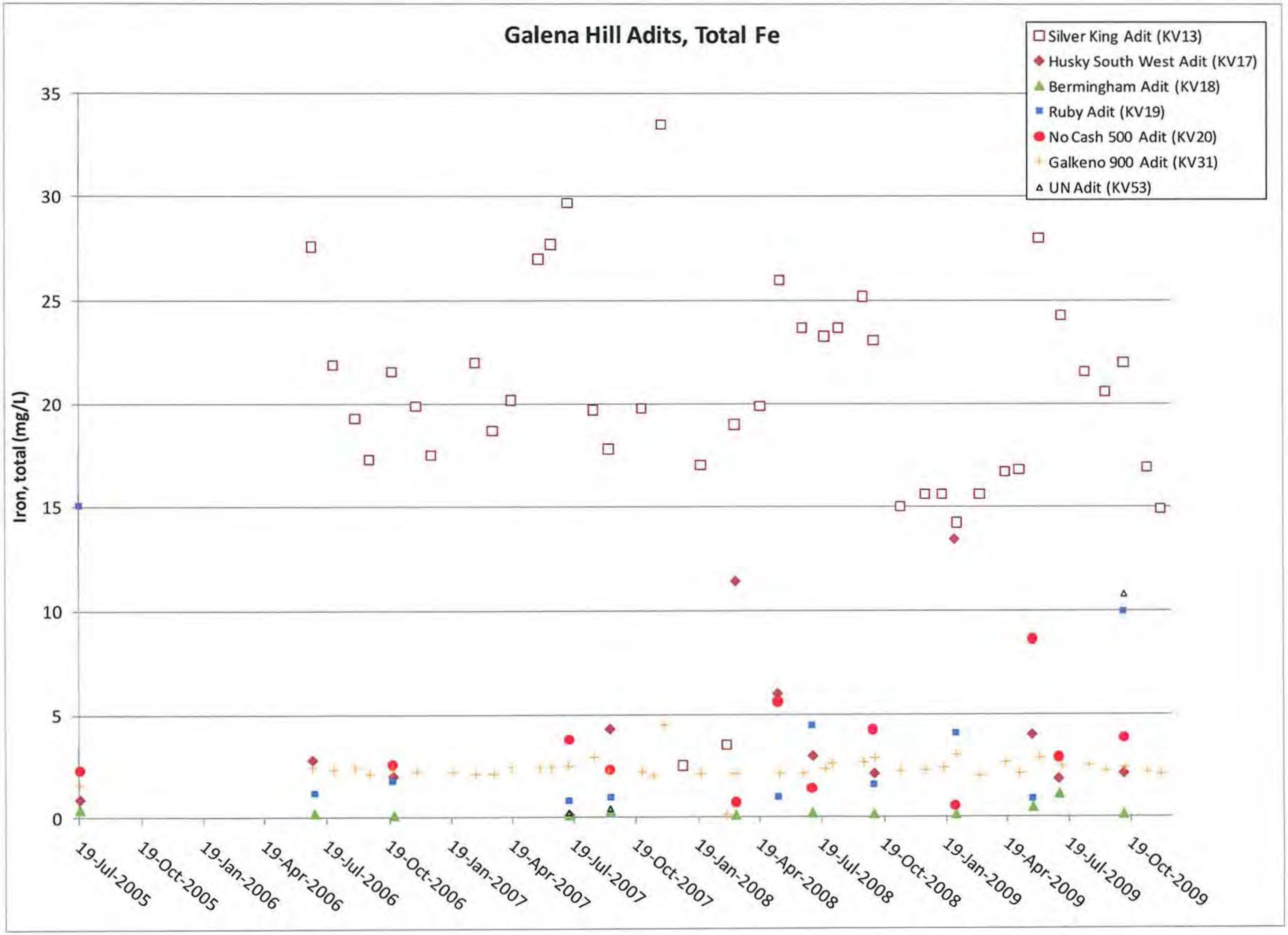
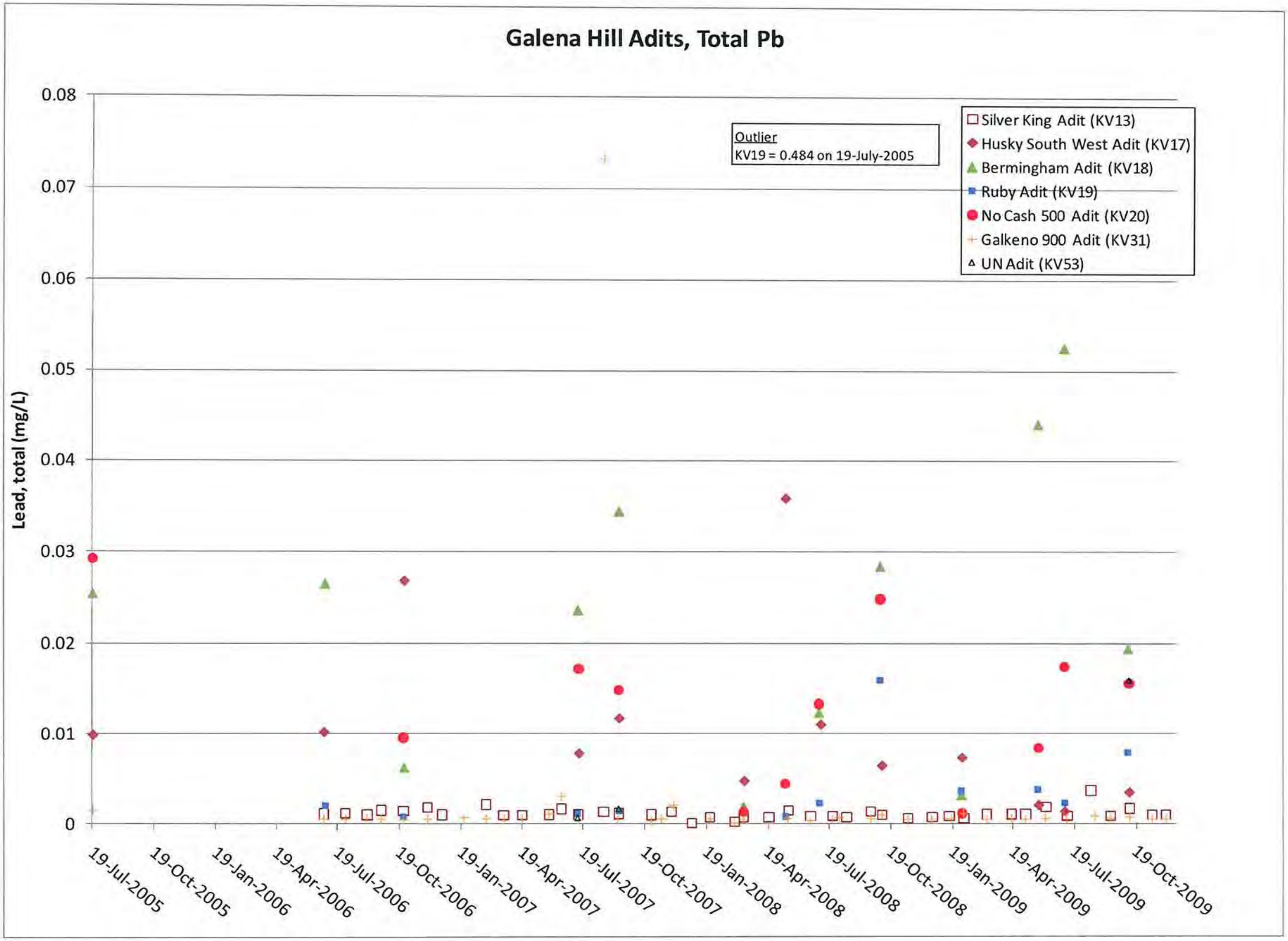
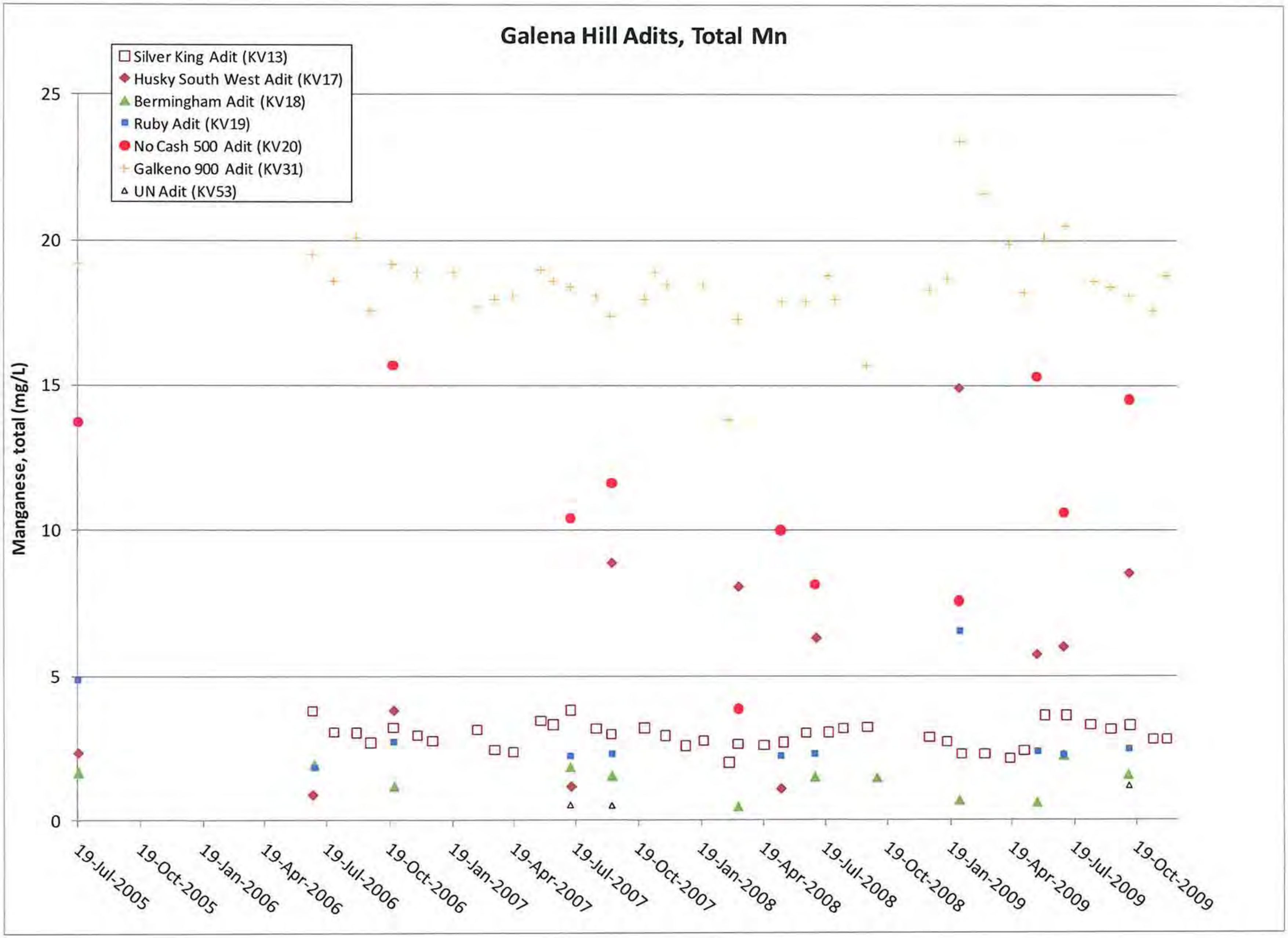
19-Jul-2009
19-Oct-2009

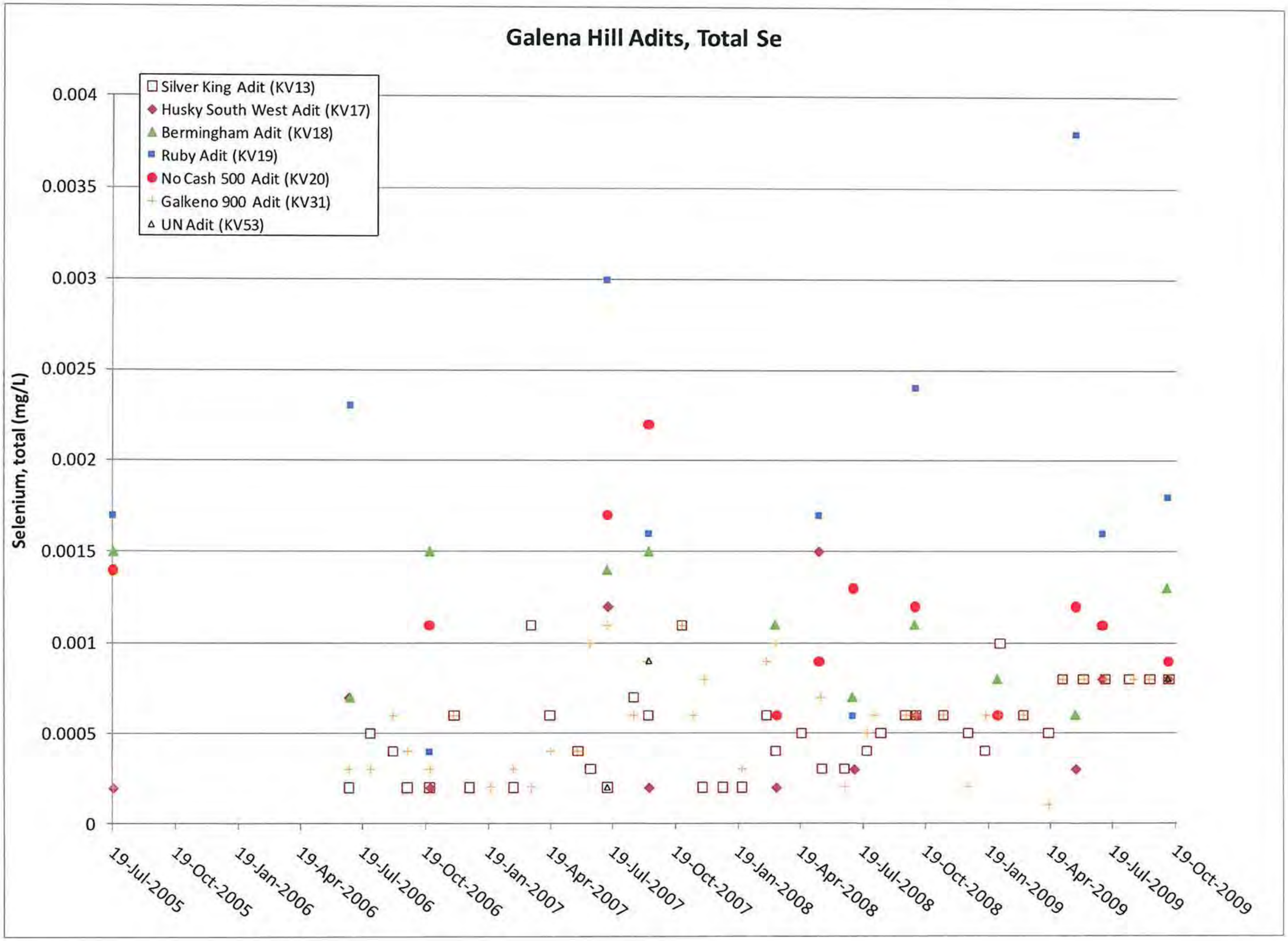

Galena Hill Adits, Total Cr
Chromium, total (mg/L)
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009
Silver King Adit (KV13)
Husky South West Adit (KV17)
Bermingham Adit (KV18)
Ruby Adit (KV19)
No Cash 500 Adit (KV20)
Galkeno 900 Adit (KV31)
UN Adit (KV53)

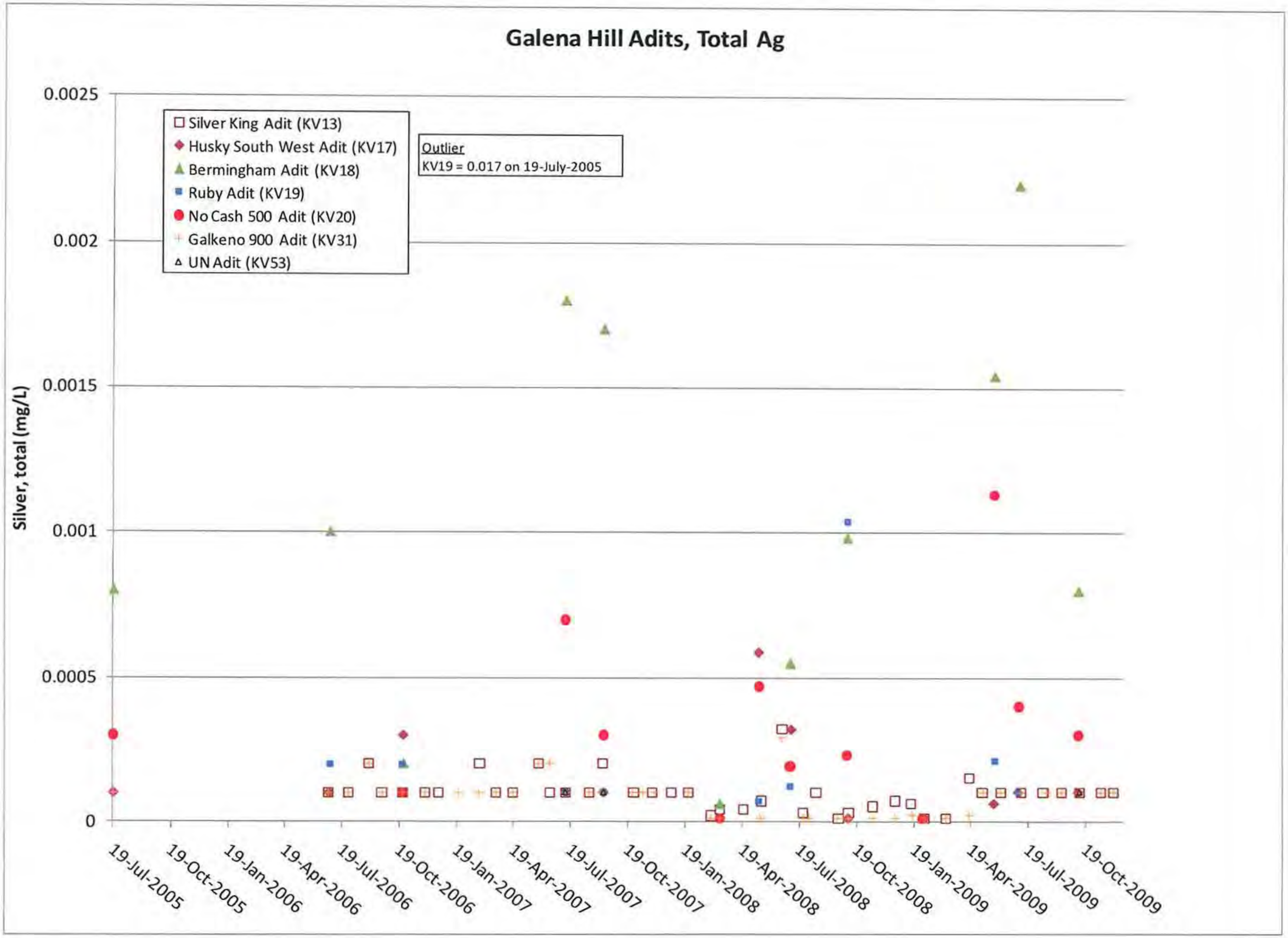

Galena Hill Adits, Total Cu
□ Silver King Adit (KV13)
◆ Husky South West Adit (KV17)
▲ Bermingham Adit (KV18)
▪ Ruby Adit (KV19)
● No Cash 500 Adit (KV20)
+ Galkeno 900 Adit (KV31)
△ UN Adit (KV53)
Outlier
KV20 = 0.145 on 26-May-2009
Copper, total (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009

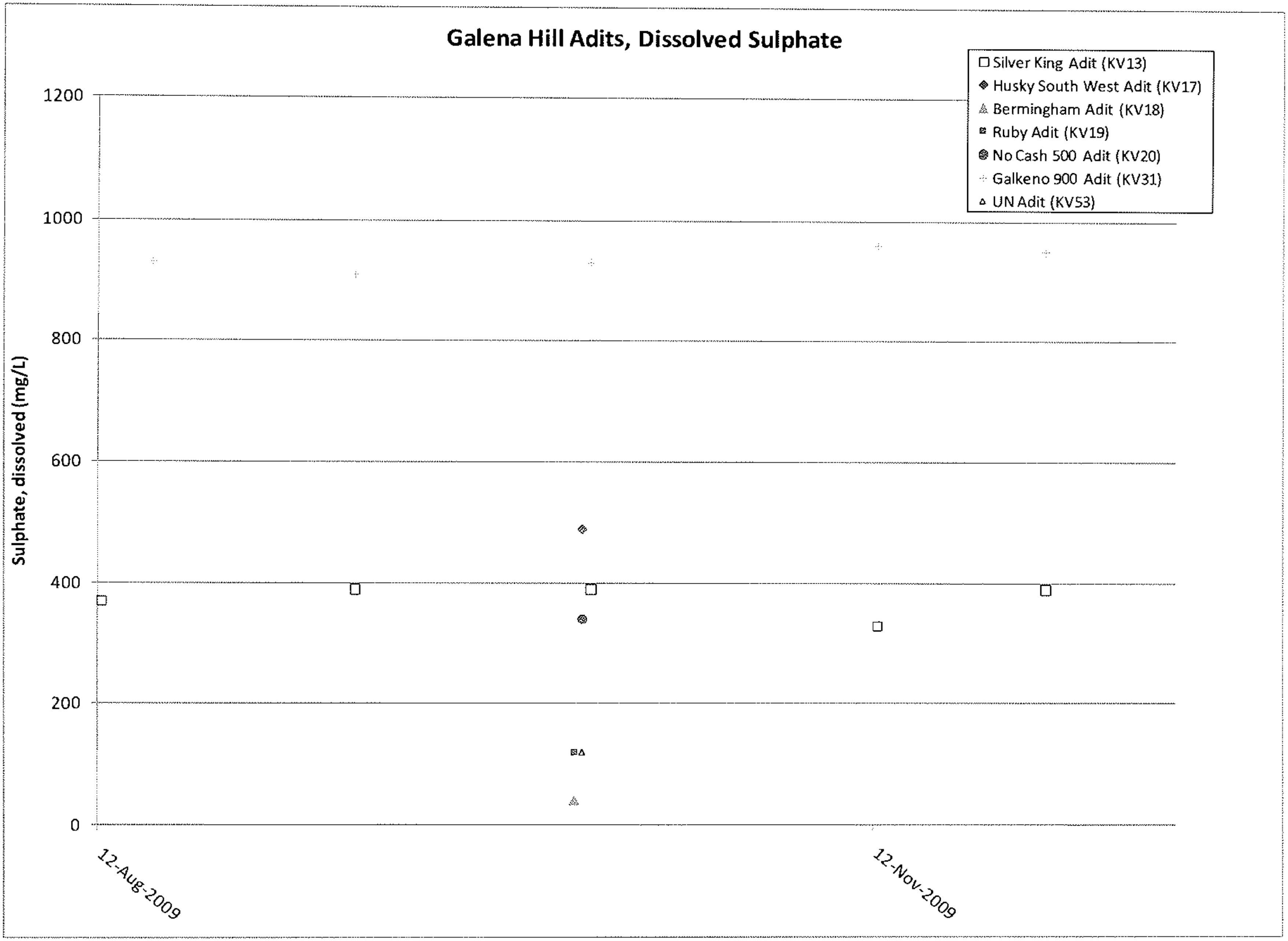

Galena Hill Adits, Total Fe
□ Silver King Adit (KV13)
◆ Husky South West Adit (KV17)
▲ Bermingham Adit (KV18)
■ Ruby Adit (KV19)
● No Cash 500 Adit (KV20)
+ Galkeno 900 Adit (KV31)
△ UN Adit (KV53)
Iron, total (mg/L)
35
30
25
20
15
10
5
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009

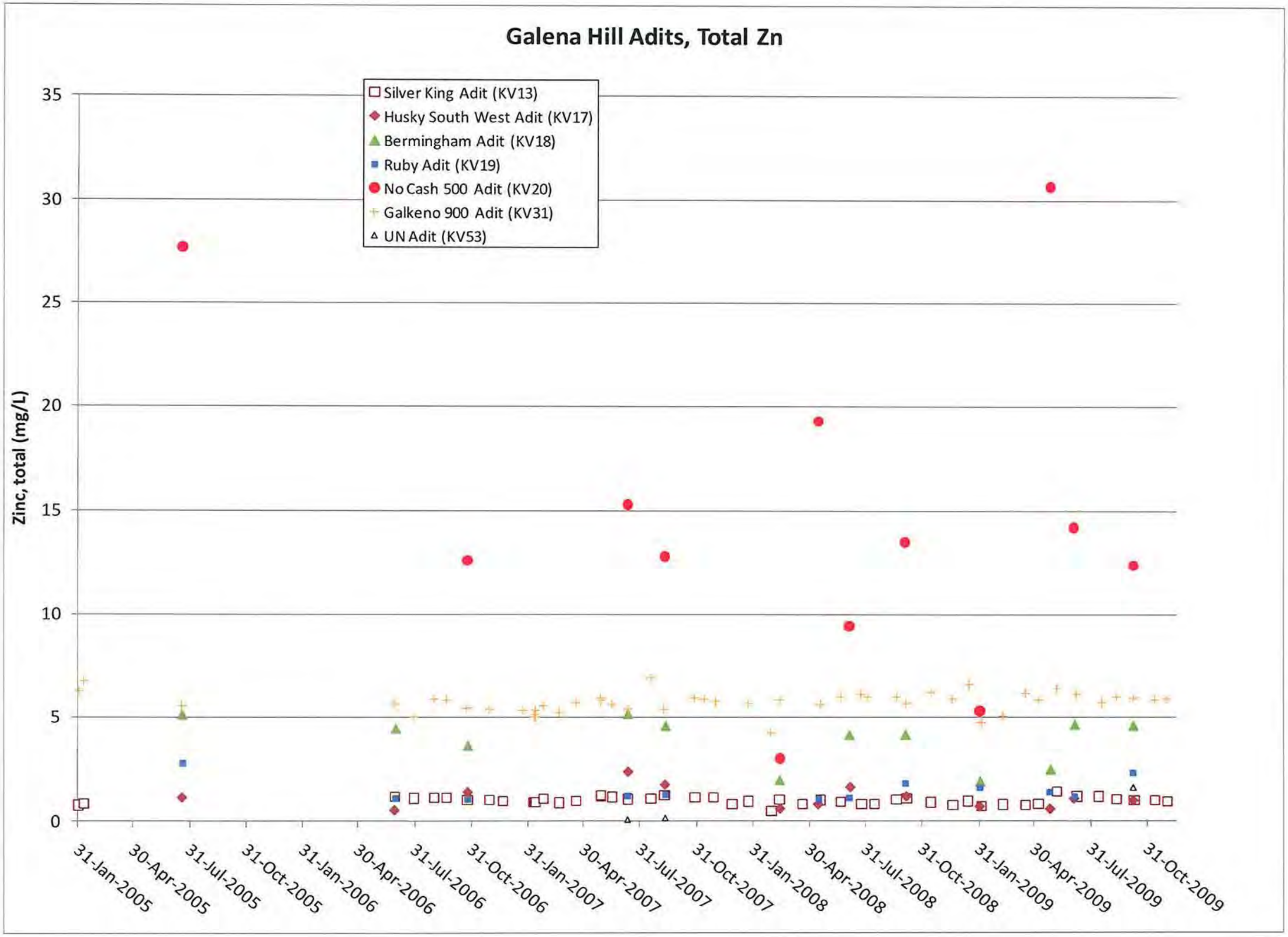

Galena Hill Adits, Total Pb
Lead, total (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009
Outlier
KV19 = 0.484 on 19-July-2005
Silver King Adit (KV13)
Husky South West Adit (KV17)
Bermingham Adit (KV18)
Ruby Adit (KV19)
No Cash 500 Adit (KV20)
Galkeno 900 Adit (KV31)
UN Adit (KV53)

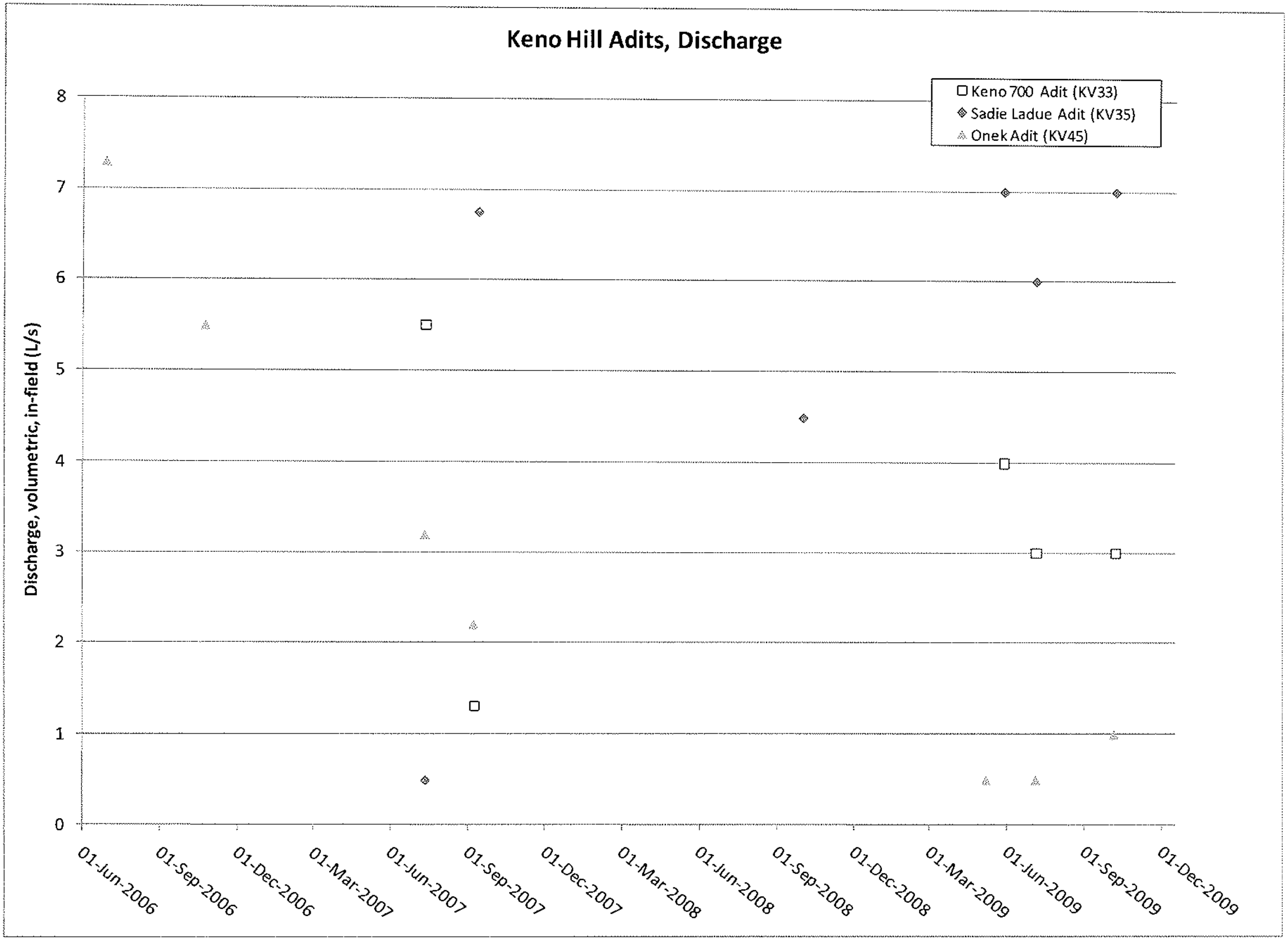

Galena Hill Adits, Total Mn
□ Silver King Adit (KV13)
◆ Husky South West Adit (KV17)
▲ Bermingham Adit (KV18)
■ Ruby Adit (KV19)
● No Cash 500 Adit (KV20)
+ Galkeno 900 Adit (KV31)
△ UN Adit (KV53)
Manganese, total (mg/L)
0
5
10
15
20
25
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009

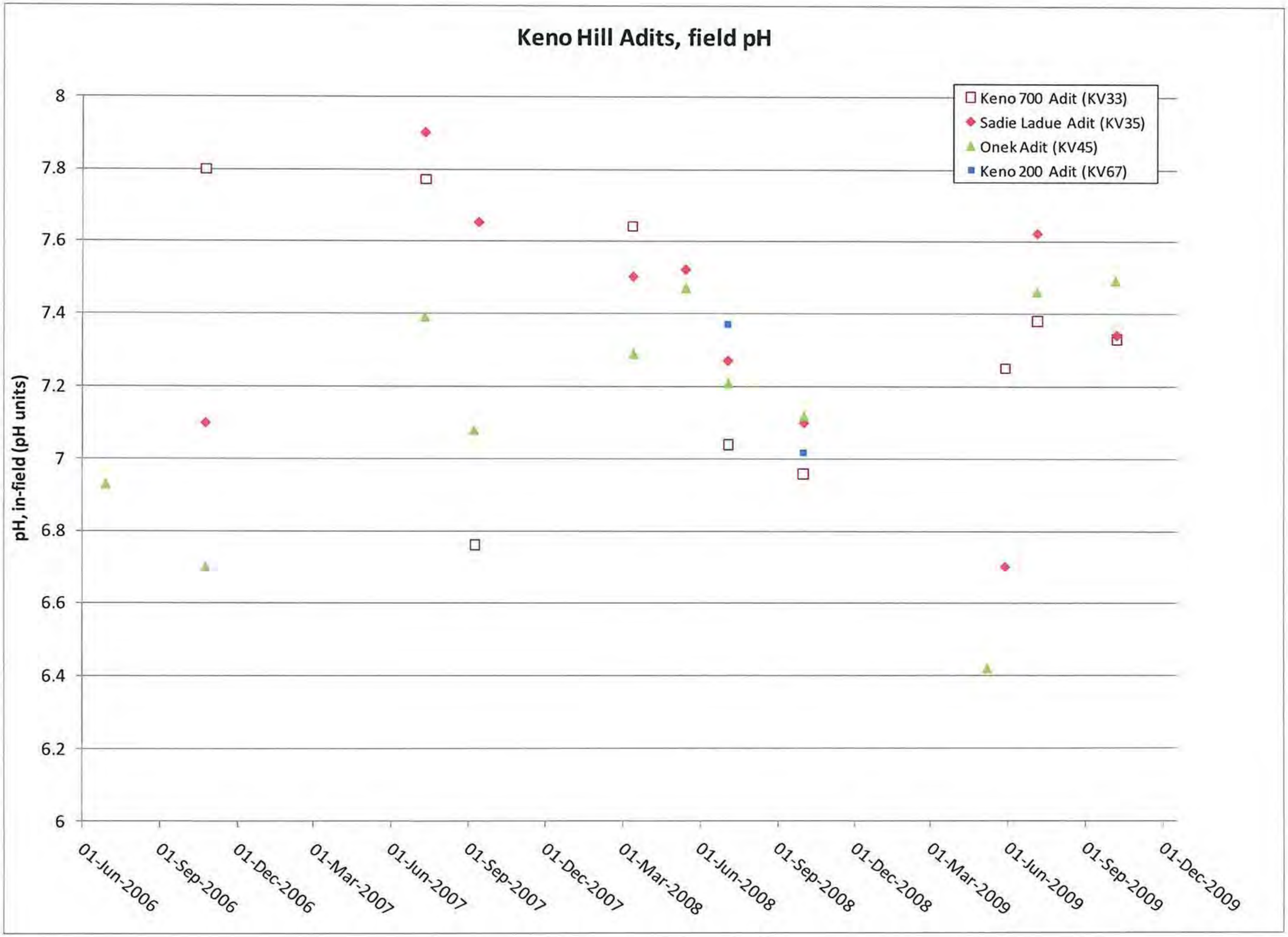

Galena Hill Adits, Total Se
□ Silver King Adit (KV13)
◆ Husky South West Adit (KV17)
▲ Bermingham Adit (KV18)
■ Ruby Adit (KV19)
● No Cash 500 Adit (KV20)
+ Galkeno 900 Adit (KV31)
△ UN Adit (KV53)
Selenium, total (mg/L)
0.004
0.0035
0.003
0.0025
0.002
0.0015
0.001
0.0005
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009

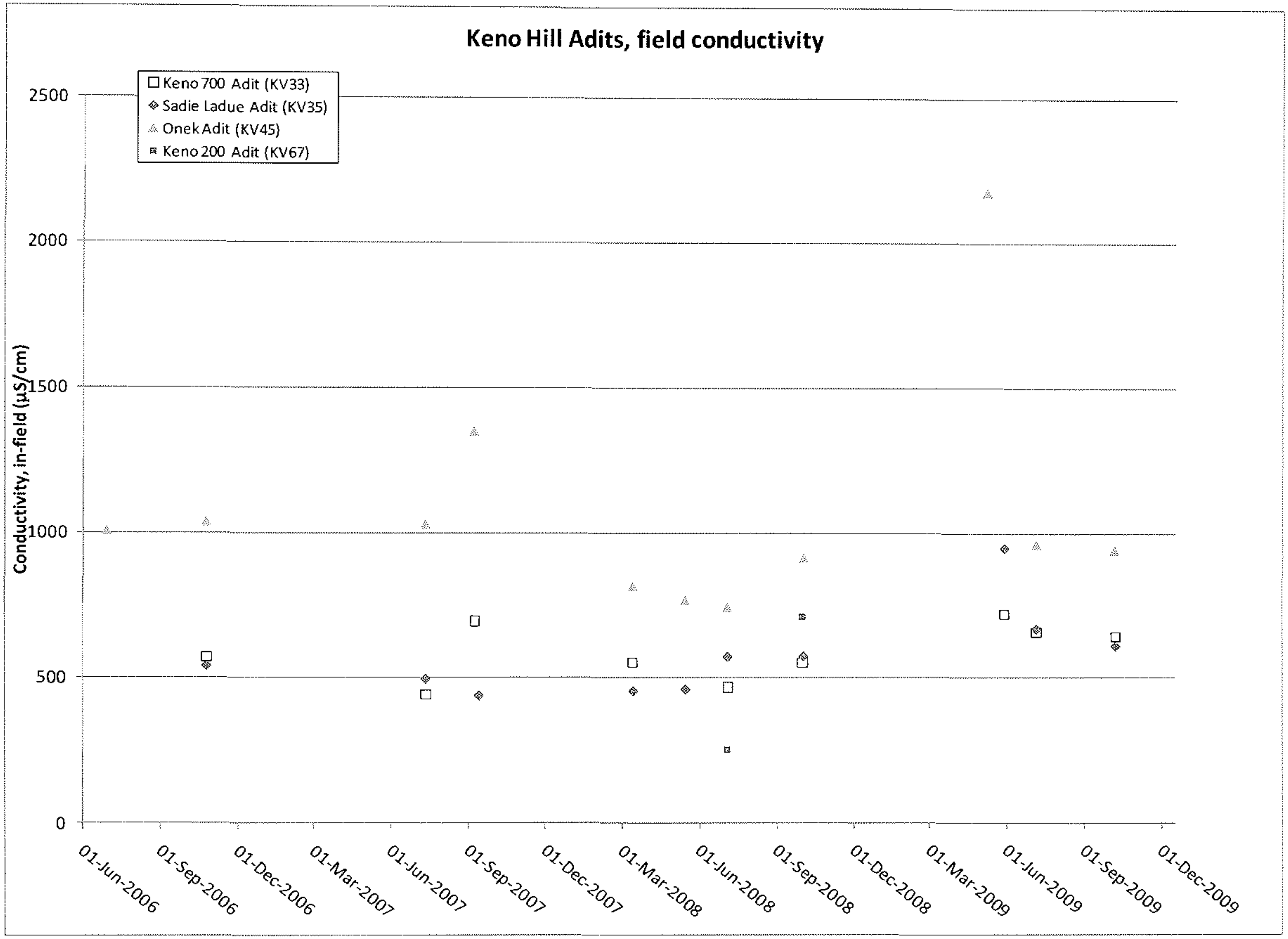

Galena Hill Adits, Total Ag
□ Silver King Adit (KV13)
◆ Husky South West Adit (KV17)
▲ Bermingham Adit (KV18)
■ Ruby Adit (KV19)
● No Cash 500 Adit (KV20)
+ Galkeno 900 Adit (KV31)
△ UN Adit (KV53)
Outlier
KV19 = 0.017 on 19-July-2005
Silver, total (mg/L)
0.0025
0.002
0.0015
0.001
0.0005
0
19-Jul-2005
19-Oct-2005
19-Jan-2006
19-Apr-2006
19-Jul-2006
19-Oct-2006
19-Jan-2007
19-Apr-2007
19-Jul-2007
19-Oct-2007
19-Jan-2008
19-Apr-2008
19-Jul-2008
19-Oct-2008
19-Jan-2009
19-Apr-2009
19-Jul-2009
19-Oct-2009

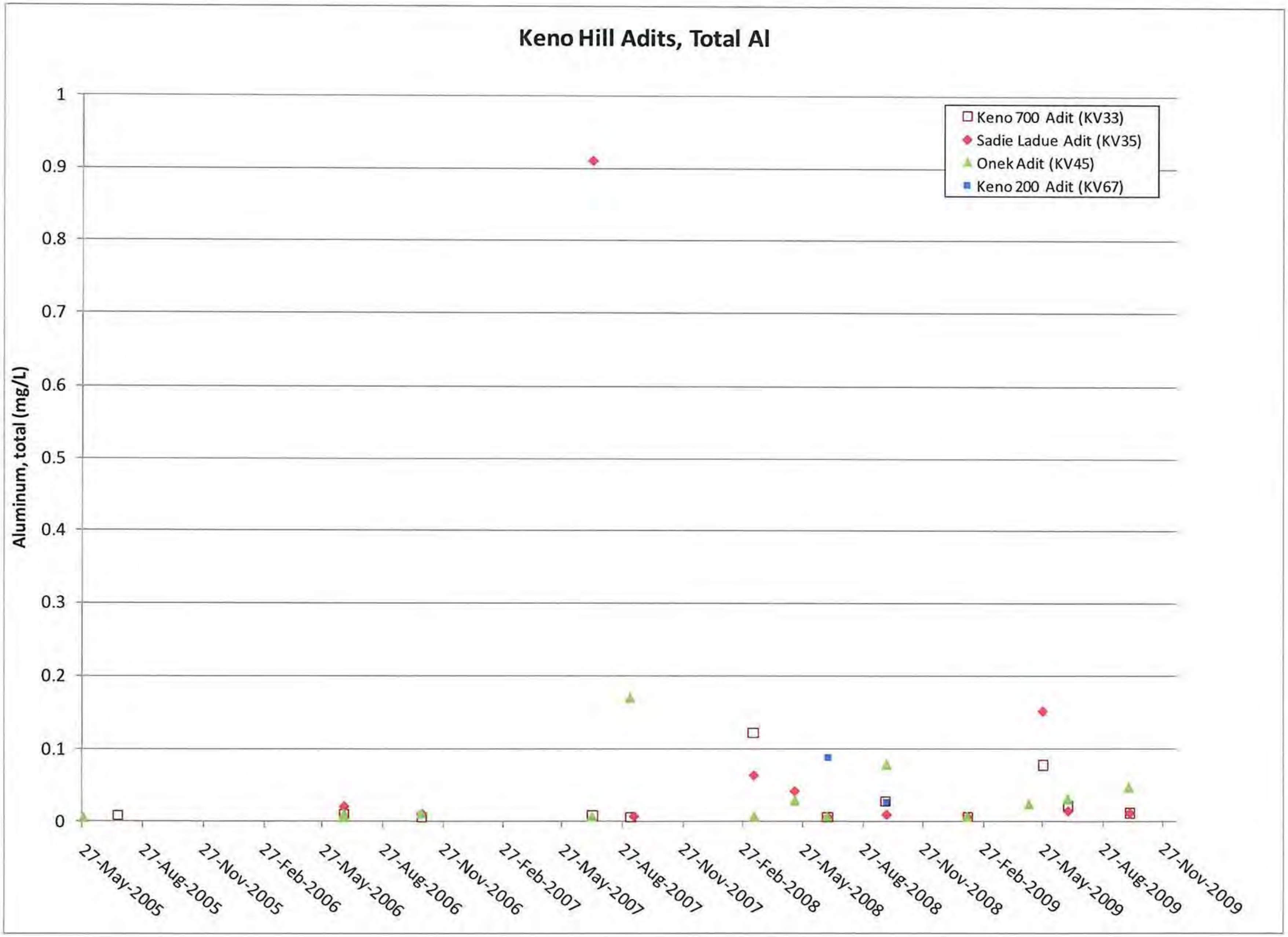

Galena Hill Adits, Dissolved Sulphate
Silver King Adit (KV13)
Husky South West Adit (KV17)
Bermingham Adit (KV18)
Ruby Adit (KV19)
No Cash 500 Adit (KV20)
Galkeno 900 Adit (KV31)
UN Adit (KV53)
Sulphate, dissolved (mg/L)
1200
1000
800
600
400
200
0
12-Aug-2009
12-Nov-2009

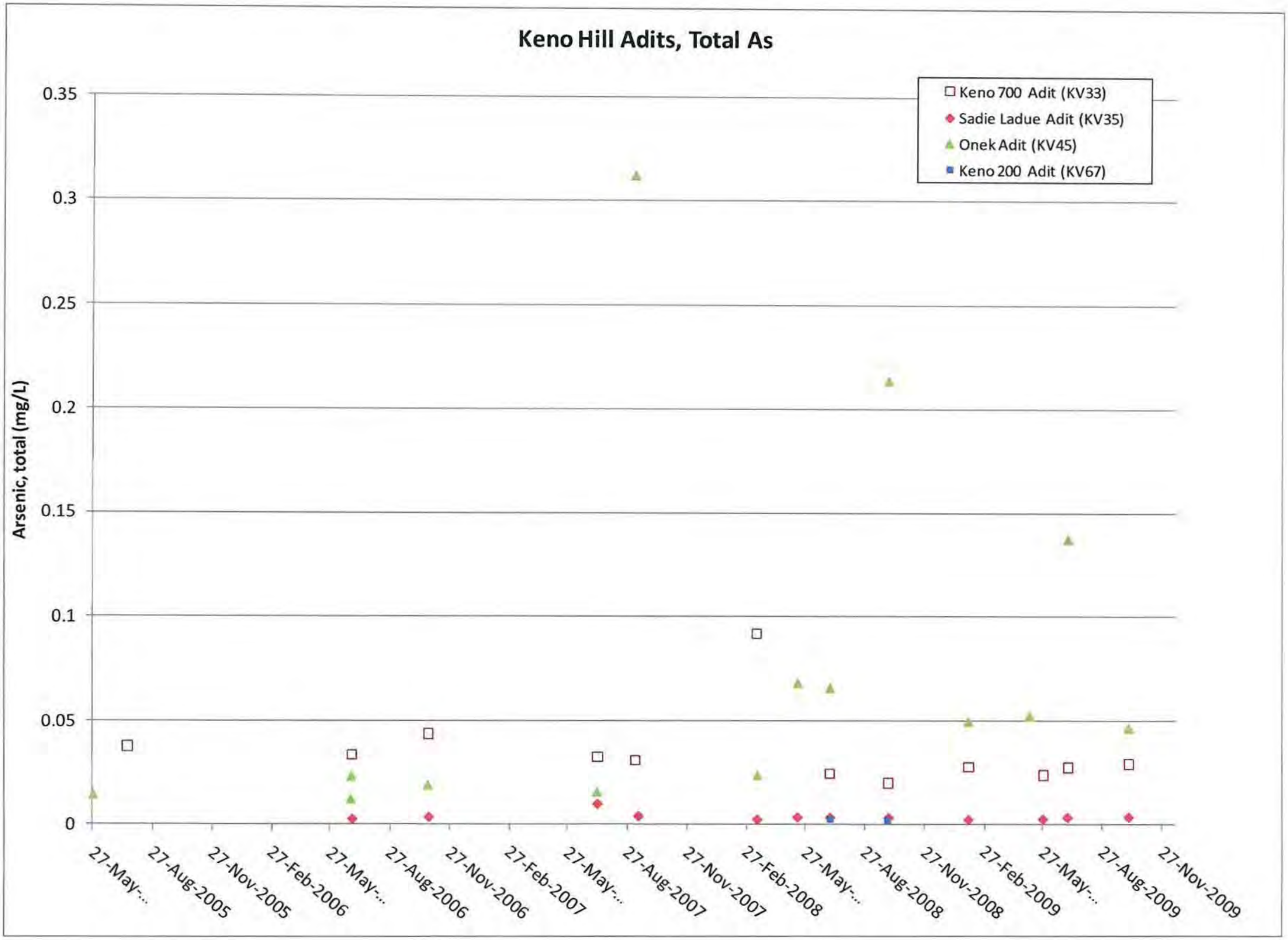

Galena Hill Adits, Total Zn
Silver King Adit (KV13)
Husky South West Adit (KV17)
Bermingham Adit (KV18)
Ruby Adit (KV19)
No Cash 500 Adit (KV20)
Galkeno 900 Adit (KV31)
UN Adit (KV53)
Zinc, total (mg/L)
35
30
25
20
15
10
5
0
31-Jan-2005
30-Apr-2005
31-Jul-2005
31-Oct-2005
31-Jan-2006
30-Apr-2006
31-Jul-2006
31-Oct-2006
31-Jan-2007
30-Apr-2007
31-Jul-2007
31-Oct-2007
31-Jan-2008
30-Apr-2008
31-Jul-2008
31-Oct-2008
31-Jan-2009
30-Apr-2009
31-Jul-2009
31-Oct-2009

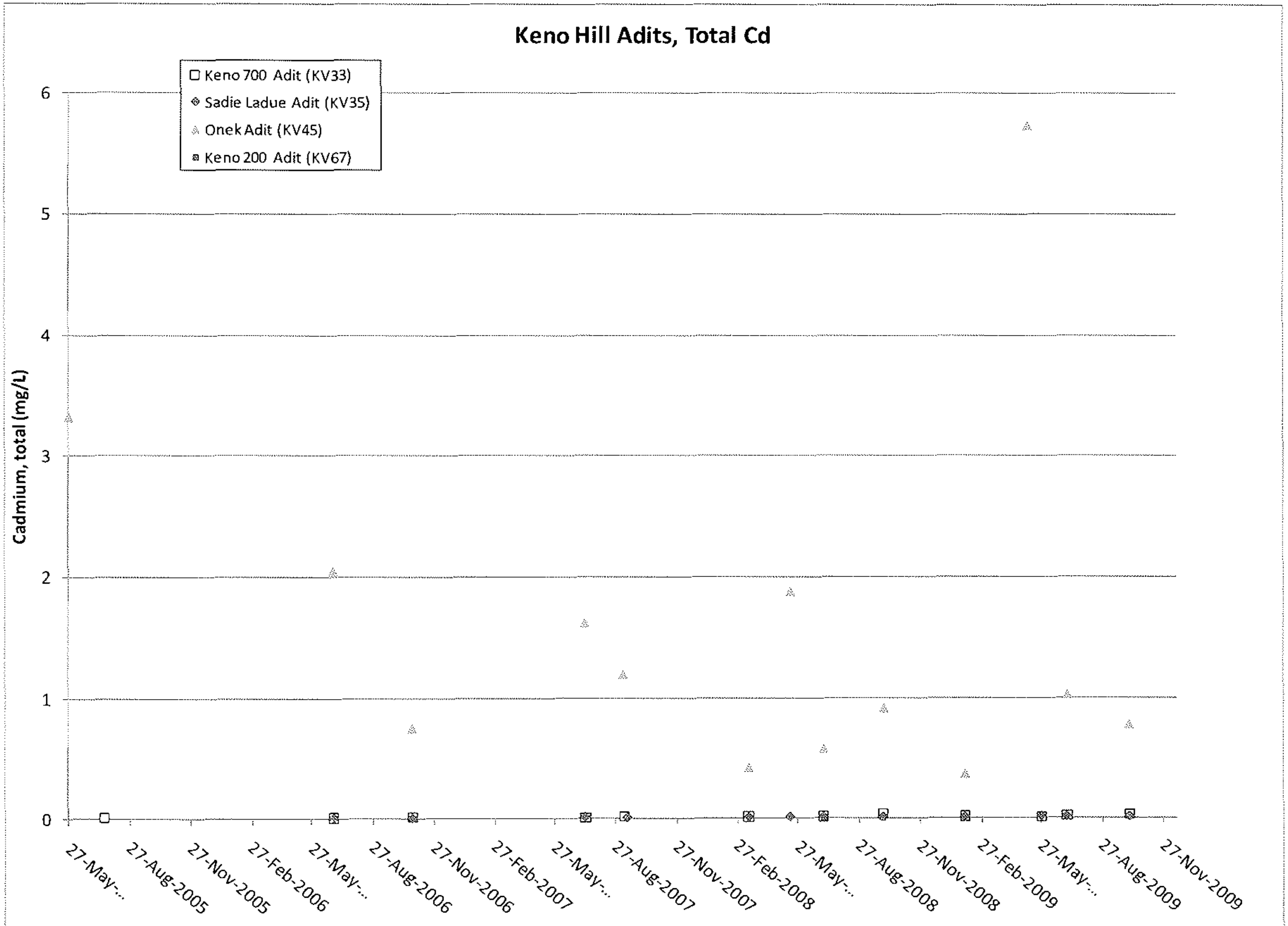

Keno Hill Adits, Discharge
□ Keno 700 Adit (KV33)
◆ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
Discharge, volumetric, in-field (L/s)
0
1
2
3
4
5
6
7
8
01-Jun-2006
01-Sep-2006
01-Dec-2006
01-Mar-2007
01-Jun-2007
01-Sep-2007
01-Dec-2007
01-Mar-2008
01-Jun-2008
01-Sep-2008
01-Dec-2008
01-Mar-2009
01-Jun-2009
01-Sep-2009
01-Dec-2009

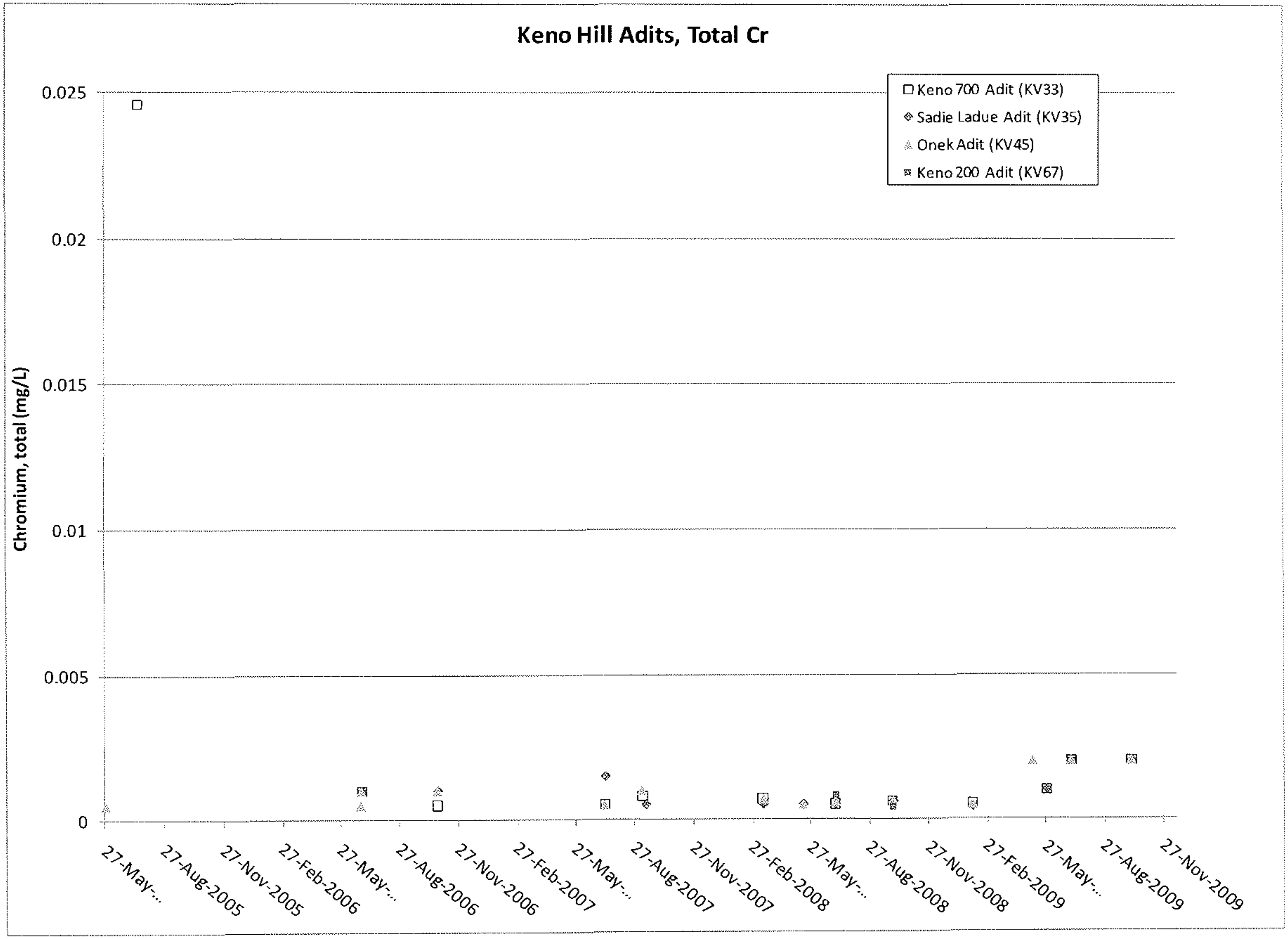

Keno Hill Adits, field pH
□ Keno 700 Adit (KV33)
◆ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
■ Keno 200 Adit (KV67)
pH, in-field (pH units)
8
7.8
7.6
7.4
7.2
7
6.8
6.6
6.4
6.2
6
01-Jun-2006
01-Sep-2006
01-Dec-2006
01-Mar-2007
01-Jun-2007
01-Sep-2007
01-Dec-2007
01-Mar-2008
01-Jun-2008
01-Sep-2008
01-Dec-2008
01-Mar-2009
01-Jun-2009
01-Sep-2009
01-Dec-2009

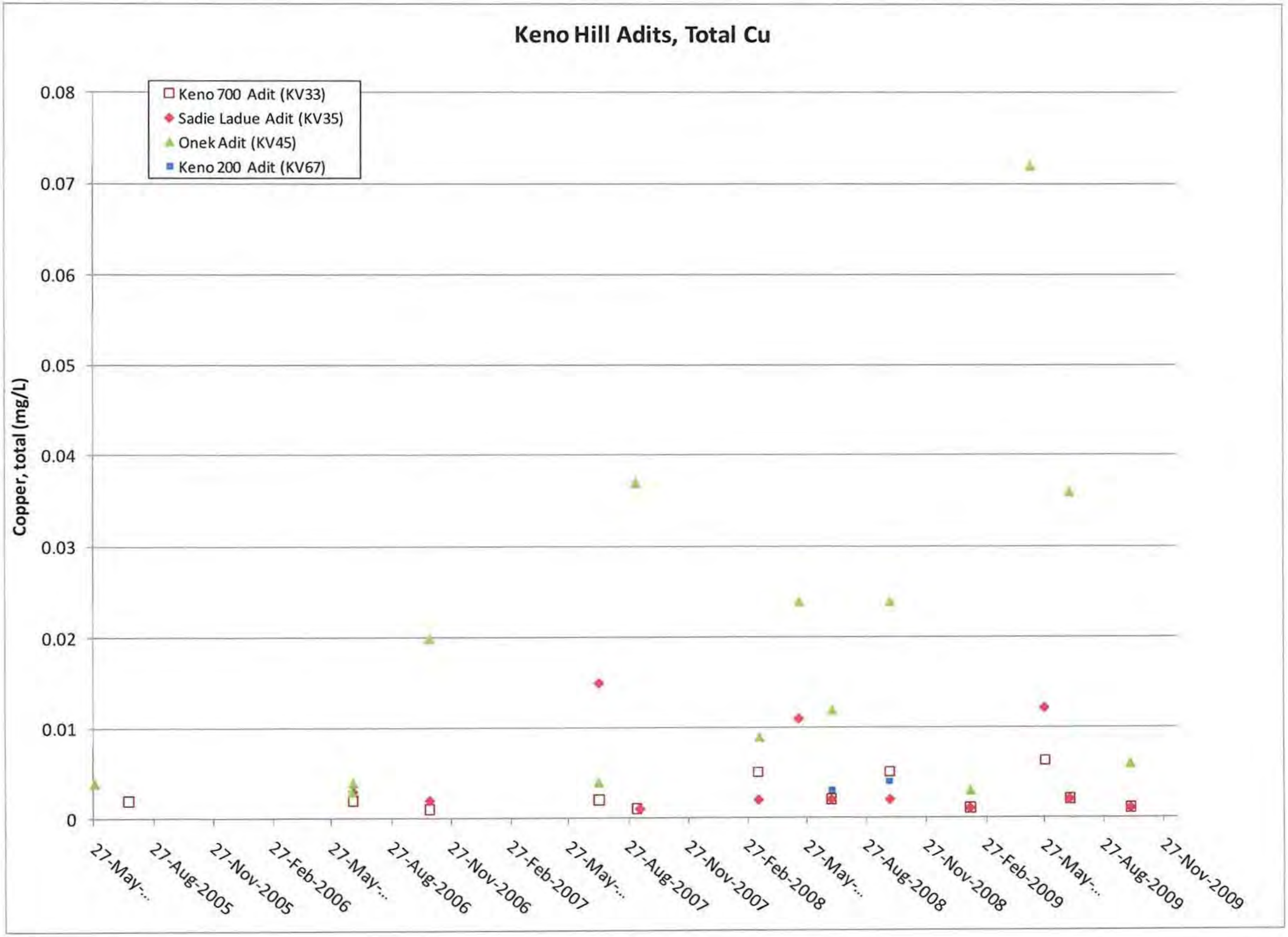

Keno Hill Adits, field conductivity
☐ Keno 700 Adit (KV33)
◈ Sadie Ladue Adit (KV35)
△ Onek Adit (KV45)
▪ Keno 200 Adit (KV67)
Conductivity, in-field (µS/cm)
2500
2000
1500
1000
500
0
01-Jun-2006
01-Sep-2006
01-Dec-2006
01-Mar-2007
01-Jun-2007
01-Sep-2007
01-Dec-2007
01-Mar-2008
01-Jun-2008
01-Sep-2008
01-Dec-2008
01-Mar-2009
01-Jun-2009
01-Sep-2009
01-Dec-2009

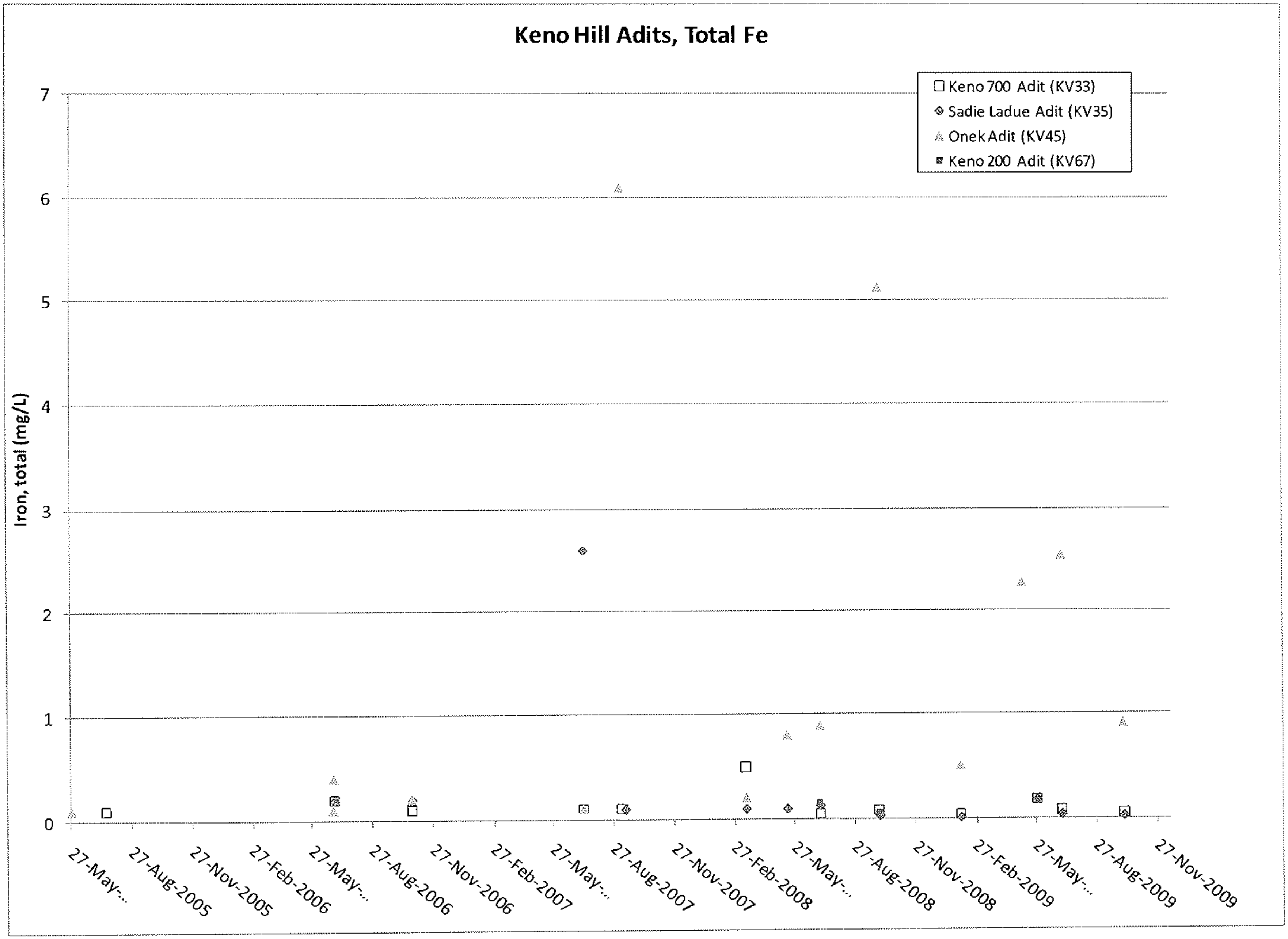

Keno Hill Adits, Total Al
Aluminum, total (mg/L)
1
0.9
0.8
0.7
0.6
0.5
0.4
0.3
0.2
0.1
0
□ Keno 700 Adit (KV33)
◆ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
■ Keno 200 Adit (KV67)
27-May-2005
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-2006
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-2007
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-2008
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-2009
27-Aug-2009
27-Nov-2009

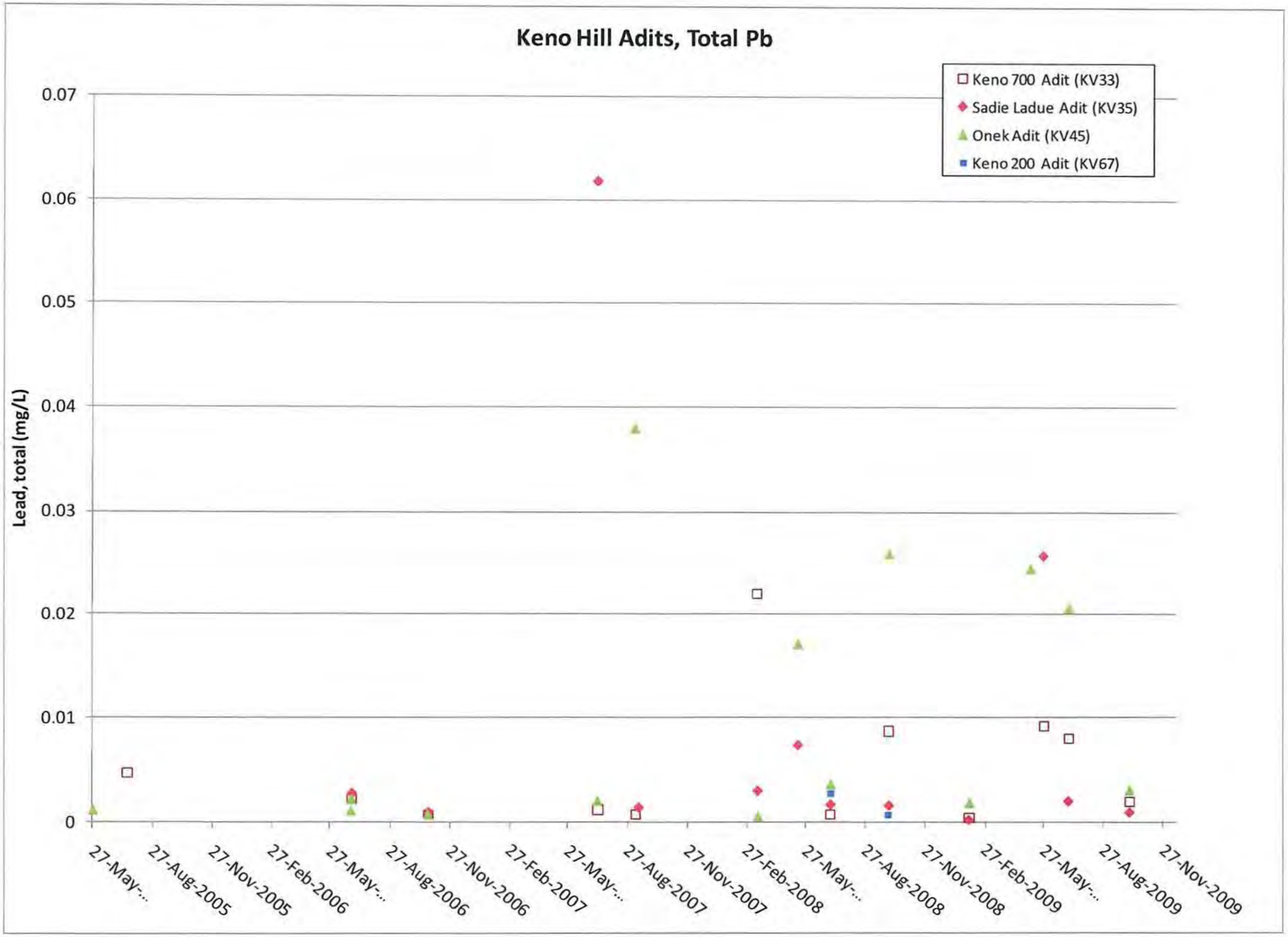

Keno Hill Adits, Total As
Arsenic, total (mg/L)
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
□ Keno 700 Adit (KV33)
◆ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
■ Keno 200 Adit (KV67)
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009

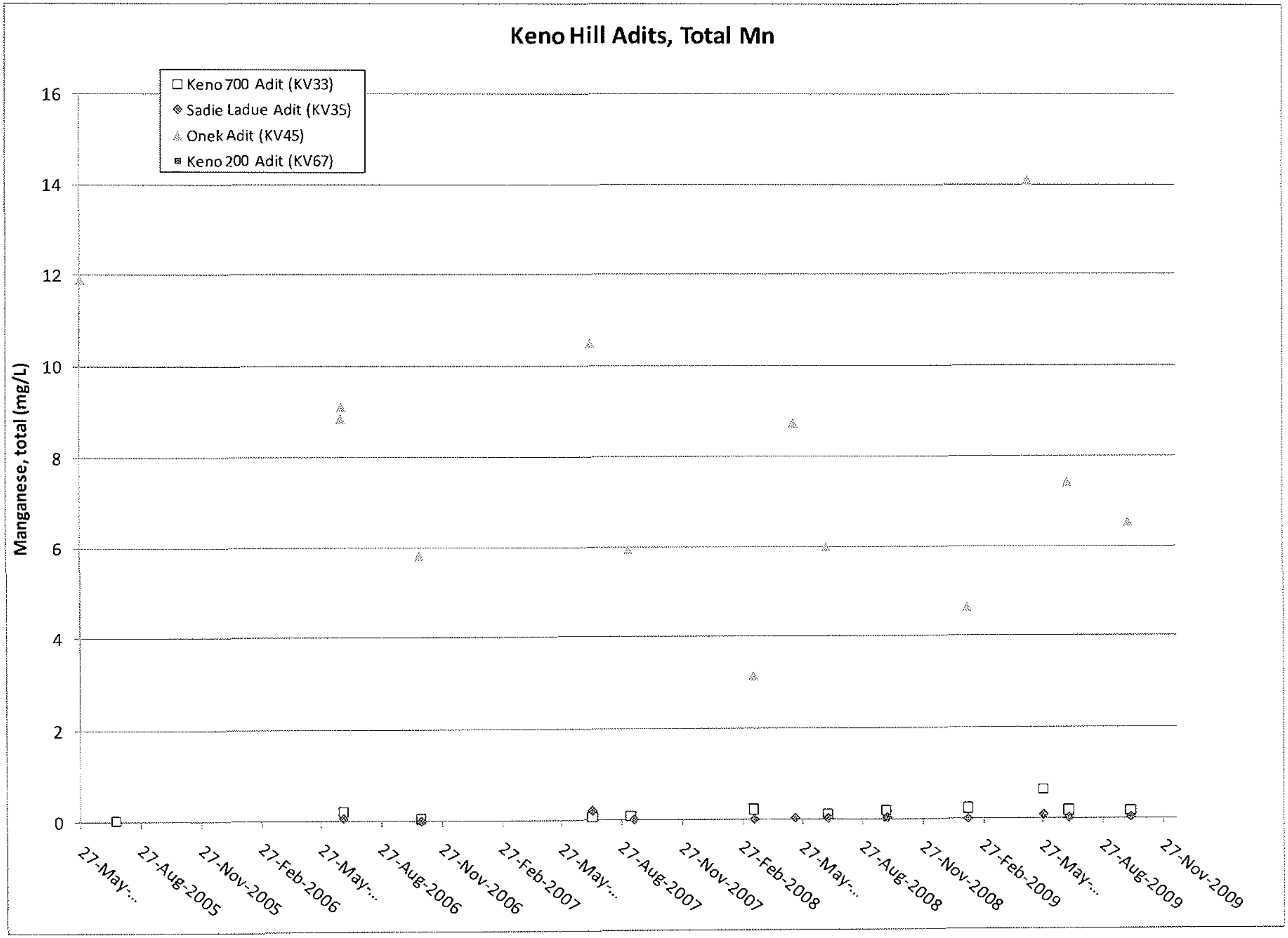

Keno Hill Adits, Total Cd
☐ Keno 700 Adit (KV33)
◈ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
▨ Keno 200 Adit (KV67)
Cadmium, total (mg/L)
0
1
2
3
4
5
6
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009

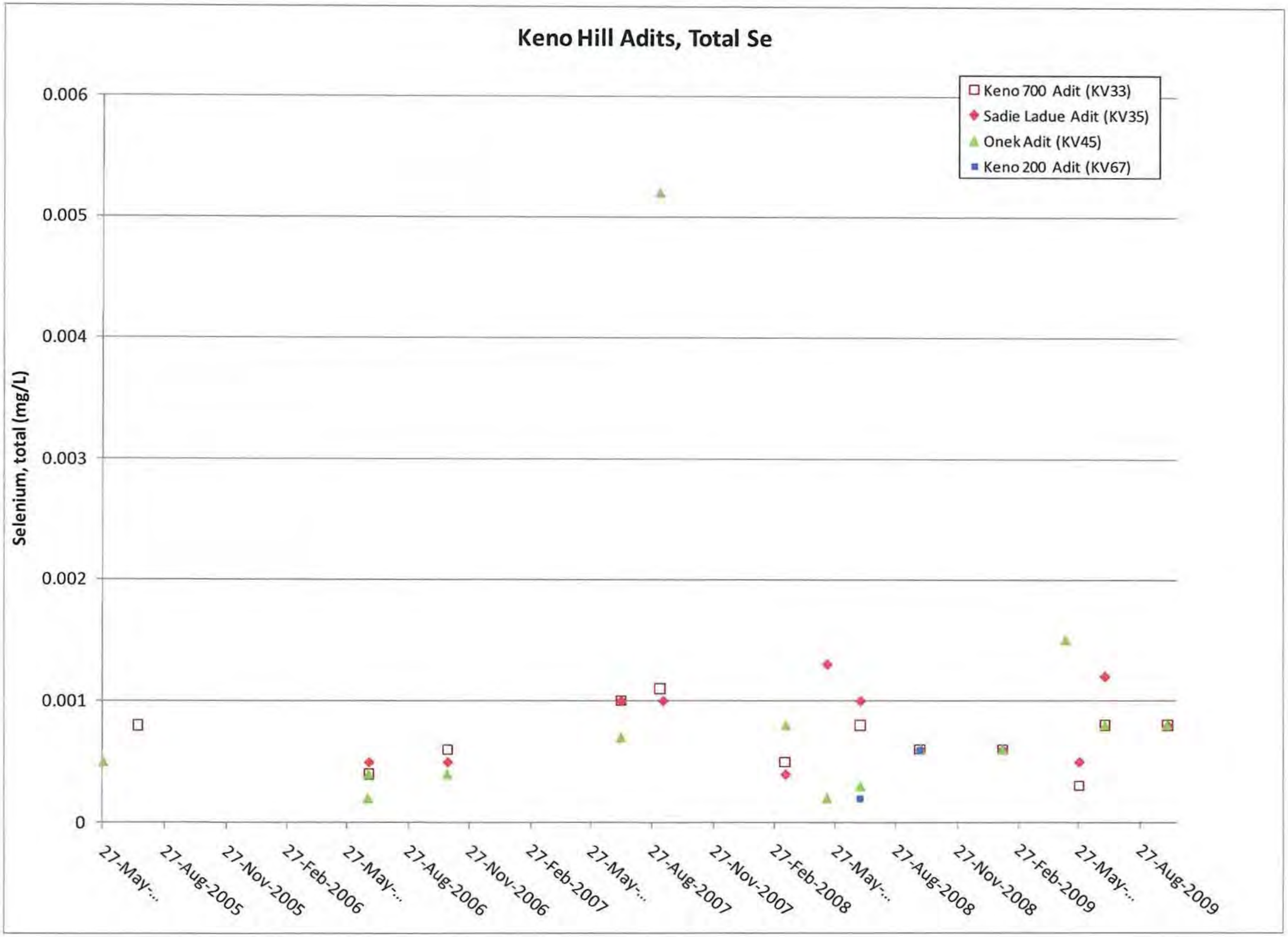

Keno Hill Adits, Total Cr
Chromium, total (mg/L)
0.025
0.02
0.015
0.01
0.005
0
□ Keno 700 Adit (KV33)
◈ Sadie Ladue Adit (KV35)
△ Onek Adit (KV45)
▨ Keno 200 Adit (KV67)
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009

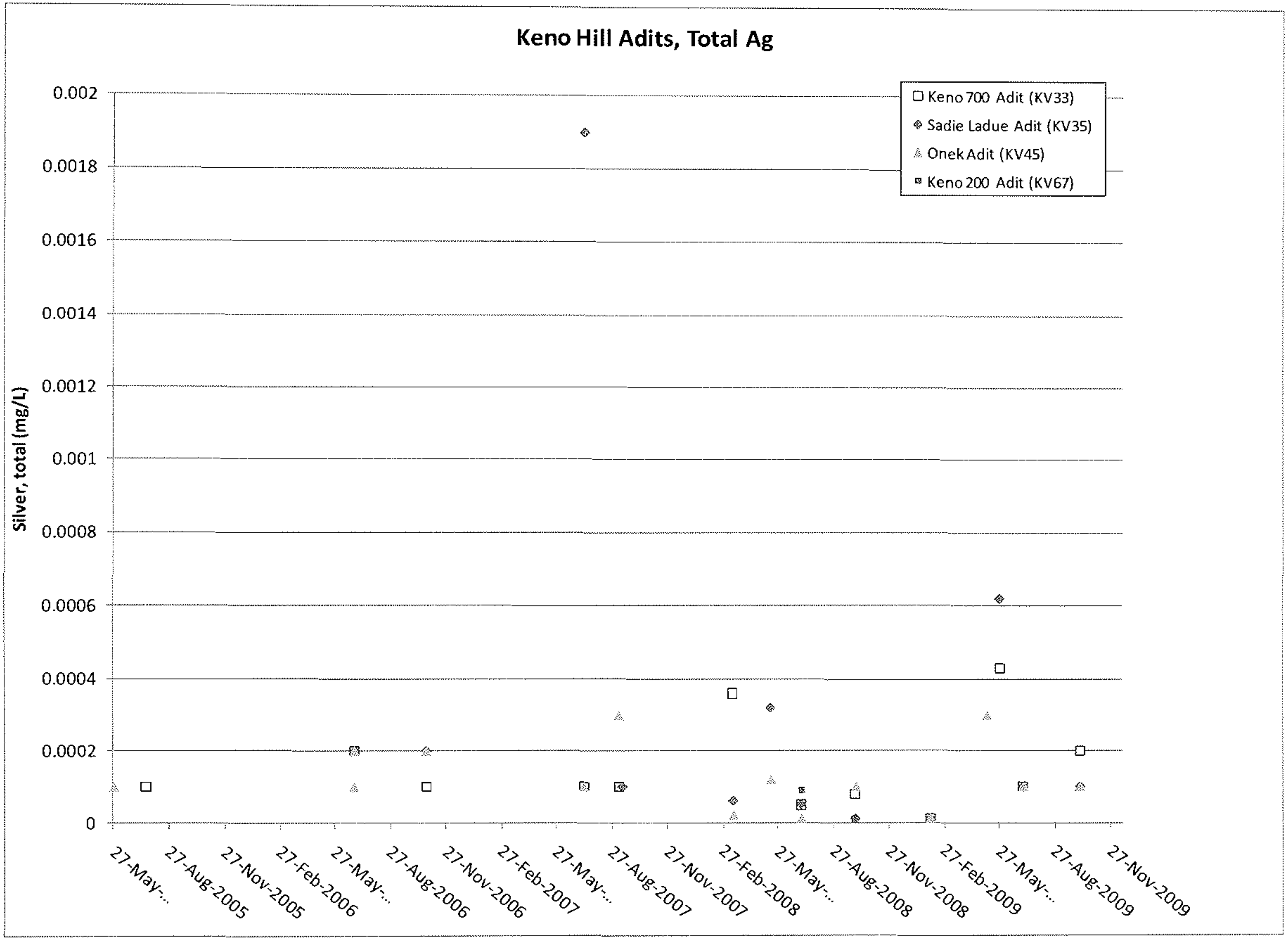

Keno Hill Adits, Total Cu
Keno 700 Adit (KV33)
Sadie Ladue Adit (KV35)
Onek Adit (KV45)
Keno 200 Adit (KV67)
Copper, total (mg/L)
0.08
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009

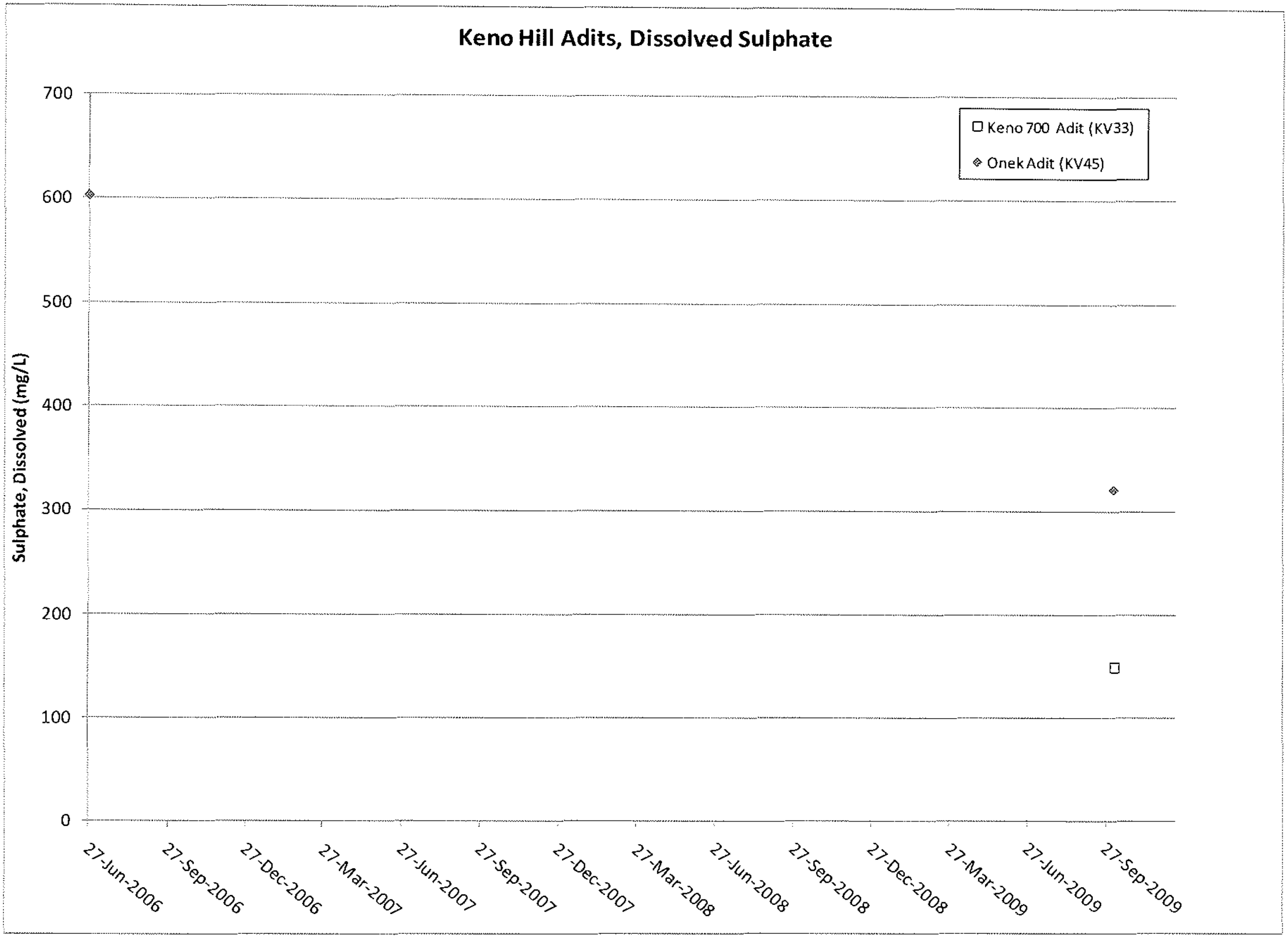

Keno Hill Adits, Total Fe
Iron, total (mg/L)
0
1
2
3
4
5
6
7
☐ Keno 700 Adit (KV33)
◈ Sadie Ladue Adit (KV35)
△ Onek Adit (KV45)
▨ Keno 200 Adit (KV67)
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009

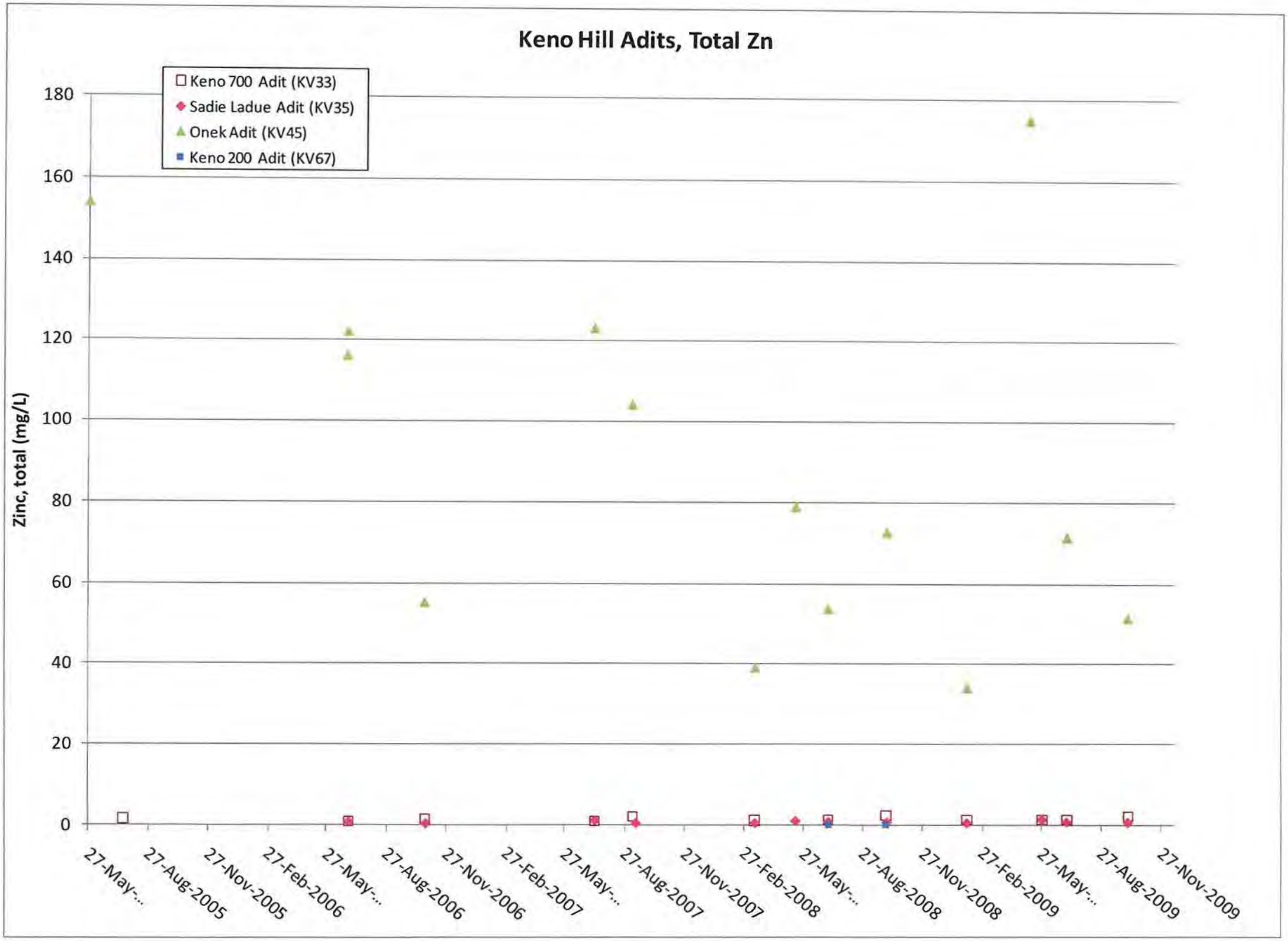

Keno Hill Adits, Total Pb
Keno 700 Adit (KV33)
Sadie Ladue Adit (KV35)
Onek Adit (KV45)
Keno 200 Adit (KV67)
Lead, total (mg/L)
0.07
0.06
0.05
0.04
0.03
0.02
0.01
0
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009


Keno Hill Adits, Total Mn
☐ Keno 700 Adit (KV33)
◈ Sadie Ladue Adit (KV35)
△ Onek Adit (KV45)
▣ Keno 200 Adit (KV67)
Manganese, total (mg/L)
16
14
12
10
8
6
4
2
0
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009


Keno Hill Adits, Total Se
Selenium, total (mg/L)
0.006
0.005
0.004
0.003
0.002
0.001
0
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
☐ Keno 700 Adit (KV33)
◆ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
■ Keno 200 Adit (KV67)


Keno Hill Adits, Total Ag
Silver, total (mg/L)
0.002
0.0018
0.0016
0.0014
0.0012
0.001
0.0008
0.0006
0.0004
0.0002
0
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009
Keno 700 Adit (KV33)
Sadie Ladue Adit (KV35)
Onek Adit (KV45)
Keno 200 Adit (KV67)


Keno Hill Adits, Dissolved Sulphate
Sulphate, Dissolved (mg/L)
700
600
500
400
300
200
100
0
27-Jun-2006
27-Sep-2006
27-Dec-2006
27-Mar-2007
27-Jun-2007
27-Sep-2007
27-Dec-2007
27-Mar-2008
27-Jun-2008
27-Sep-2008
27-Dec-2008
27-Mar-2009
27-Jun-2009
27-Sep-2009
☐ Keno 700 Adit (KV33)
◈ Onek Adit (KV45)


Keno Hill Adits, Total Zn
☐ Keno 700 Adit (KV33)
◆ Sadie Ladue Adit (KV35)
▲ Onek Adit (KV45)
■ Keno 200 Adit (KV67)
Zinc, total (mg/L)
180
160
140
120
100
80
60
40
20
0
27-May-...
27-Aug-2005
27-Nov-2005
27-Feb-2006
27-May-...
27-Aug-2006
27-Nov-2006
27-Feb-2007
27-May-...
27-Aug-2007
27-Nov-2007
27-Feb-2008
27-May-...
27-Aug-2008
27-Nov-2008
27-Feb-2009
27-May-...
27-Aug-2009
27-Nov-2009

KV-42 Bellekeno 625 Adit External WQ Testing Results			20-Dec-2008	28-Dec-2008	4-Jan-2009	9-Jan-2009	13-Jan-2009	1-Feb-2009	3-Feb-2009	12-Feb-2009	20-Feb-2009	1-Mar-2009	10-Mar-2009	19-Mar-2009
pH-L	pH, Laboratory	pH units	7.94	7.96	7.97	7.84	7.69	7.9	7.22	7.16	7.56	7.37	7.83	7.72
Cond-L	Conductivity, Laboratory	µS/cm	1870	1780	1750	1870	1930	578	2090	2050	2080	1950	569	2210
TSS	Total Suspended Solids	mg/L	14	4	3	2	10	209	76	22	16	39	<5	12
N-NH3	Ammonia Nitrogen (NH3), as N	mg/L	1.9	1.38	1.06	0.79	0.67	0.1	0.7	0.48	0.36	0.46	0.07	0.86
Hard-D	Hardness calculated from dissolved metal scan	mg/L	1160	1080	1140	1200	1180	316	1280	1360	1380	1340	282	1310
Al-T	Aluminum, total	mg/L	0.301	0.056	0.069	0.047	0.028	1.99	0.82	0.059	0.102	0.426	0.013	0.218
Sb-T	Antimony, total	mg/L	0.0058	0.0047	0.0048	0.0046	0.0048	0.0025	0.0058	0.0045	0.0049	0.0058	0.0009	0.004
As-T	Arsenic, total	mg/L	0.0452	0.0217	0.023	0.0174	0.0133	0.039	0.0354	0.0136	0.0226	0.0365	0.0053	0.022
Ba-T	Barium, total	mg/L	0.014	0.012	0.011	0.013	0.012	0.025	0.022	0.011	0.012	0.014	0.007	0.03
Be-T	Beryllium, total	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.0002
Bi-T	Bismuth, total	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005
B-T	Boron, total	mg/L	0.005	0.006	0.01	0.008	0.006	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.02
Cd-T	Cadmium, total	mg/L	0.036	0.0311	0.0284	0.0263	0.0255	0.00832	0.017	0.00792	0.00759	0.00448	0.00273	0.00385
Ca-T	Calcium, total	mg/L	316	294	298	324	347	107	373	346	358	374	88.7	381
Cr-T	Chromium, total	mg/L	0.0013	0.0009	0.001	0.0014	<0.0005	0.0043	0.0021	0.0009	0.0008	0.0026	0.002	0.005
Co-T	Cobalt, total	mg/L	0.0134	0.0127	0.0127	0.0146	0.0155	0.0036	0.015	0.0128	0.0146	0.0137	0.00146	0.0131
Cu-T	Copper, total	mg/L	0.004	0.002	0.003	0.003	0.003	0.028	0.004	<0.001	<0.001	0.01	0.037	0.006
Fe-T	Iron, total	mg/L	1.16	0.15	0.39	0.27	0.12	7.68	3.41	1.2	2.25	6.25	0.34	3.05
Pb-T	Lead, total	mg/L	0.0248	0.0132	0.0226	0.011	0.0066	0.0425	0.027	0.016	0.0326	0.225	0.077	0.018
Li-T	Lithium, total	mg/L	0.047	0.052	0.046	0.047	0.046	0.008	0.037	0.032	0.04	0.028	0.005	0.03
Mg-T	Magnesium, total	mg/L	93.5	85.6	87	95.7	101	16.2	108	96.8	99.7	102	13.4	115
Mn-T	Manganese, total	mg/L	5.02	4.45	4.52	5.31	5.61	0.968	6.31	5.55	6.21	6.7	0.615	5.2
Mo-T	Molybdenum, total	mg/L	<0.001	<0.001	<0.001	0.001	<0.001	0.00081	0.00078	0.00114	0.00104	0.0017	0.00087	0.0047
Ni-T	Nickel, total	mg/L	0.0767	0.0822	0.0812	0.0906	0.091	0.011	0.094	0.075	0.082	0.073	0.008	0.07
K-T	Potassium, total	mg/L	1.4	1.1	1.2	1	1	0.9	1.1	1.1	0.9	3.2	0.6	1.9
Se-T	Selenium, total	mg/L	0.0021	0.0021	0.0028	0.0018	0.0015	0.0041	<0.0006	<0.0006	<0.0006	<0.0006	0.0028	<0.003
Si-T	Silicon, total	mg/L	3.79	2.86	3.52	3.65	3.68	6.58	4.52	3.88	3.74	4.87	3.64	2.62
Ag-T	Silver, total	mg/L	0.00023	0.0001	0.00015	0.00007	0.00008	0.013	0.00058	0.00016	<0.00001	0.00346	0.00062	0.00338
Na-T	Sodium, total	mg/L	3.7	2.2	2.3	2.2	3.5	2.55	2.27	2.36	1.75	6.81	2.42	4.03
Sr-T	Strontium, total	mg/L	0.69	0.684	0.718	0.756	0.794	0.185	0.795	0.714	0.928	0.812	0.172	0.842
S-T	Sulphur, Total	mg/L	307	277	286	314	336	59	417	363	332	326	50.5	394
Tl-T	Thallium, total	mg/L			0.00019	0.00018		0.0001	0.0002	0.00013	0.00015	0.00018	0.00005	0.00016
Sn-T	Tin, total	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0002	<0.0001	<0.0001	<0.0001	0.0003	<0.0001	<0.0005
Ti-T	Titanium, total	mg/L	0.0217	0.0174	0.0177	0.0182	0.0196	0.045	0.0326	0.0012	0.0016	0.0071	0.0009	0.002
U-T	Uranium, total	mg/L	0.0188	0.0177	0.0202	0.0219	0.0228	0.0046	0.0276	0.0207	0.0268	0.0272	0.0047	0.031
V-T	Vanadium, total	mg/L	0.0016	0.0004	0.0004	0.0003	0.0002	0.0095	0.00448	0.00024	0.00029	0.00107	0.00012	0.0006
Zn-T	Zinc, total	mg/L	8.5	7.79	7.66	8.49	8.75	0.778	5.85	4.01	4.19	2.86	0.309	2.03
Zr-T	Zirconium, total	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.0004	0.0009	0.0002	0.0003	0.0007	<0.0001	0.0006
Al-D	Aluminum, dissolved	mg/L	0.007	<0.005	<0.005	<0.005	<0.005	0.007	<0.005	<0.005	<0.005	<0.005	<0.005	<0.02
Sb-D	Antimony, dissolved	mg/L	0.0054	0.0052	0.0055	0.0047	0.005	0.0012	0.0055	0.0049	0.0043	0.0068	0.001	0.003
As-D	Arsenic, dissolved	mg/L	0.014	0.0106	0.0075	0.007	0.0082	0.004	0.0014	0.0024	0.0062	0.0078	0.0051	0.0083
Ba-D	Barium, dissolved	mg/L	0.012	0.011	0.011	0.011	0.011	0.008	0.012	0.012	0.01	0.01	0.007	0.02
Be-D	Beryllium, dissolved	mg/L	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.00004	<0.0002
Bi-D	Bismuth, dissolved	mg/L	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0005
B-D	Boron, dissolved	mg/L	0.004	0.005	0.005	0.006	0.005	<0.004	<0.004	0.008	0.006	<0.004	<0.004	<0.02
Cd-D	Cadmium, dissolved	mg/L	0.0353	0.034	0.0292	0.026	0.0264	0.00203	0.0141	0.0076	0.00624	0.00245	0.0024	0.00255
Ca-D	Calcium, dissolved	mg/L	307	287	304	317	335	102	344	374	378	370	90.2	352
Cr-D	Chromium, dissolved	mg/L	<0.0005	0.0009	<0.0005	0.0012	<0.0005	0.0004	<0.0004	0.001	0.0013	0.0017	<0.0004	<0.002
Co-D	Cobalt, dissolved	mg/L	0.014	0.0129	0.0118	0.0138	0.015	0.00184	0.0146	0.014	0.0172	0.0154	0.00152	0.0117
Cu-D	Copper, dissolved	mg/L	0.002	<0.001	0.003	0.003	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.005
Fe-D	Iron, dissolved	mg/L	0.01	<0.01	0.01	<0.01	<0.01	0.04	0.22	0.32	1.54	2.51	0.04	0.46
Pb-D	Lead, dissolved	mg/L	0.001	0.0024	0.0014	0.0011	0.0017	0.0008	0.0002	0.0002	0.0006	0.0025	0.0014	0.0008
Li-D	Lithium, dissolved	mg/L	0.05	0.041	0.042	0.041	0.047	0.006	0.037	0.032	0.039	0.036	0.005	0.03
Mg-D	Magnesium, dissolved	mg/L	94.6	89.7	92.9	98.3	100	14.7	102	104	106	101	13.7	105
Mn-D	Manganese, dissolved	mg/L	4.65	4.32	4.59	5.22	5.31	0.739	5.87	5.8	6.09	4.84	0.666	4.51
Mo-D	Molybdenum, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	0.00048	0.00073	0.00117	0.00088	0.00163	0.00053	0.004
Ni-D	Nickel, dissolved	mg/L	0.083	0.0816	0.0732	0.0825	0.0973	0.007	0.095	0.082	0.096	0.082	0.006	0.058
K-D	Potassium, dissolved	mg/L	1.4	1.2	1.1	1	1.1	0.6	1.1	1.3	0.6	2.4	0.6	1.6
Se-D	Selenium, dissolved	mg/L	0.0019	0.002	0.0024	0.0019	0.0016	0.0042	<0.0006	0.0006	<0.0006	<0.0006	0.0039	<0.003
Si-D	Silicon, dissolved	mg/L	3.43	3.42	3.46	3.43	3.57	3.74	3.3	3.65	3.7	3.36	3.63	1.89
Ag-D	Silver, dissolved	mg/L	<0.00001	0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00005
Na-D	Sodium, dissolved	mg/L	4	2.3	2.4	2.3	3.8	2.5	2.3	2.4	1.9	4.9	2.4	3.3
Sr-D	Strontium, dissolved	mg/L	0.665	0.703	0.69	0.737	0.73	0.205	0.858	0.752	0.887	0.781	0.177	0.728
S-D	Sulphur, Dissolved	mg/L	303	286	293	312	323	55.9	389	344	341	320	51.4	347
Tl-D	Thallium, dissolved	mg/L			0.00019	0.00018	0.00019	0.00004	0.00021	0.00014	0.00019	0.00016	0.00005	0.0002
Sn-D	Tin, dissolved	mg/L	<0.001	<0.001	<0.001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	0.0008
Ti-D	Titanium, dissolved	mg/L	0.017	0.003	<0.0005	0.0189	0.0108	0.0005	0.0006	0.0003	0.0006	0.0003	0.0004	<0.0005
U-D	Uranium, dissolved	mg/L	0.0177	0.0195	0.0194	0.0211	0.0219	0.0049	0.0253	0.0232	0.0246	0.0244	0.0046	0.0283
V-D	Vanadium, dissolved	mg/L	0.0004	0.0011	0.0011	0.0016	0.0006	<0.00004	0.00006	0.00026	0.00036	0.00053	0.00009	0.0004
Zn-D	Zinc, dissolved	mg/L	8.33	8.24	8.15	8.42	8.65	0.338	6.86	4.64	4.78	3.43	0.314	1.74
Zr-D	Zirconium, dissolved	mg/L						<0.0001	0.0001	<0.0001	<0.0001	0.0001	<0.0001	<0.0005

KV-42 Bellekeno 625 Adit External WQ Testing Results			29-Mar-2009	2-Apr-2009	10-Apr-2009	16-Apr-2009	23-Apr-2009	30-Apr-2009	7-May-2009	7-May-2009	14-May-2009	21-May-2009	28-May-2009	4-Jun-2009
pH-L	pH, Laboratory	pH units	7.8	7.69	7.85	8.1	8	8.1	7.9	8.2	7.9	7.9	8	8
Cond-L	Conductivity, Laboratory	µS/cm	1810	1950	1550	520	1700	1700	370	510	1800	1800	1800	1900
TSS	Total Suspended Solids	mg/L	141	42	9	5	45	570	41	1	290	230	32	25
N-NH3	Ammonia Nitrogen (NH3), as N	mg/L		3	1.3	0.18	1.7	0.72	0.324	0.14	0.45	0.36	0.19	0.32
Hard-D	Hardness calculated from dissolved metal scan	mg/L	1160	1320	903	264	988	1150	828	256	1130	1130	1220	1140
Al-T	Aluminum, total	mg/L	0.779		0.05	0.022	0.224	0.784	0.091	0.026	0.956	1.47	0.139	0.435
Sb-T	Antimony, total	mg/L	0.0062		0.003	0.0005	0.0057	0.0068	0.006	0.0006	0.0054	0.0064	0.0031	0.005
As-T	Arsenic, total	mg/L	0.0947		0.025	0.0056	0.0706	0.0622	0.0212	0.0056	0.0581	0.0653	0.0214	0.0422
Ba-T	Barium, total	mg/L	0.03		0.015	0.009	0.018	0.0246	0.0077	0.0097	0.0282	0.0332	0.0148	0.0273
Be-T	Beryllium, total	mg/L	<0.00004		<0.00004	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00005	<0.0002
Bi-T	Bismuth, total	mg/L	<0.0001		<0.0001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	0.0001	<0.00003	<0.0001
B-T	Boron, total	mg/L	<0.005		<0.005	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	<0.1
Cd-T	Cadmium, total	mg/L	0.00878		0.00274	0.00332	0.00219	0.0049	0.0007	0.0034	0.0043	0.0054	0.00154	0.005
Ca-T	Calcium, total	mg/L	337		270	91	331	328	254	89	374	354	341	385
Cr-T	Chromium, total	mg/L	0.0058		0.0009	0.002	<0.001	0.003	<0.002	<0.002	0.006	0.007	<0.0005	0.005
Co-T	Cobalt, total	mg/L	0.0108		0.00693	0.0011	0.0065	0.0083	0.0027	0.001	0.0109	0.0091	0.00719	0.0114
Cu-T	Copper, total	mg/L	0.063		0.002	0.002	0.0044	0.038	0.005	0.002	0.031	0.055	0.0097	0.024
Fe-T	Iron, total	mg/L	7.22		0.96	0.095	2.43	4.79	0.925	0.099	6.68	8.4	2.81	5.4
Pb-T	Lead, total	mg/L	0.124		0.0288	0.0015	0.0477	0.105	0.0174	0.0025	0.102	0.231	0.0496	0.179
Li-T	Lithium, total	mg/L	0.028		0.026	0.005	0.029	0.025	0.024	<0.01	0.025	0.025	0.019	0.023
Mg-T	Magnesium, total	mg/L	91.4		63.3	11.6	60.6	73	66	11	89	84	83.9	93
Mn-T	Manganese, total	mg/L	4.37		2.33	0.509	1.84	2.98	0.514	0.456	3.82	3.61	2.94	3.89
Mo-T	Molybdenum, total	mg/L	0.00332		0.00213	<0.001	0.002	0.004	0.004	<0.001	0.004	0.004	0.0031	0.004
Ni-T	Nickel, total	mg/L	0.056		0.037	0.005	0.038	0.0433	0.0236	0.004	0.0512	0.0474	0.0355	0.0521
K-T	Potassium, total	mg/L	1.7		1.4	0.59	1.12	1	1	<1	1	1	1.12	1
Se-T	Selenium, total	mg/L	<0.0006		<0.0006	0.0028	0.0003	<0.0008	<0.0008	0.0028	<0.0008	<0.0008	0.0011	0.0014
Si-T	Silicon, total	mg/L	5.41		4.3	4.12	5.04	6.25	4.88	4.07	8.23	7.87	4.81	5.37
Ag-T	Silver, total	mg/L	0.0268		0.00019	<0.00002	0.00164	0.0128	0.001	<0.0001	0.0122	0.0327	0.0009	0.013
Na-T	Sodium, total	mg/L	4.33		3.77	2.36	4.31	18	10	3	10	8	5.23	5
Sr-T	Strontium, total	mg/L	0.782		0.609	0.167	0.692	0.663	0.649	0.171	0.727	0.744	0.629	0.722
S-T	Sulphur, Total	mg/L	297		224	50	272	300	275	<60	343	338	325	366
Tl-T	Thallium, total	mg/L	0.00017		0.0001	0.00006	0.00013	0.00019	0.00005	0.00006	0.00018	0.00029	0.00009	0.00018
Sn-T	Tin, total	mg/L	0.0002		0.0001	<0.005	<0.005	0.0005	<0.0002	<0.0002	0.0006	0.0007	<0.00005	0.0004
Ti-T	Titanium, total	mg/L	0.0091		0.0028	<0.005	0.005	<0.01	<0.01	<0.01	<0.01	0.018	<0.003	<0.01
U-T	Uranium, total	mg/L	0.0297		0.0237	0.0043	0.037	0.0334	0.0243	0.0045	0.0344	0.0351	0.0331	0.0328
V-T	Vanadium, total	mg/L	0.00224		0.0001	<0.005	<0.005	<0.004	<0.004	<0.004	<0.004	<0.004	<0.001	<0.004
Zn-T	Zinc, total	mg/L	1.91		0.934	0.346	0.693	0.974	0.147	0.282	1.24	1.17	0.858	1.53
Zr-T	Zirconium, total	mg/L	0.0014		0.0003	<0.0005	0.001	<0.002	<0.002	<0.002	<0.002	0.003	0.0007	<0.002
Al-D	Aluminum, dissolved	mg/L	<0.005	<0.005	<0.005	0.004	0.004	0.049	0.006	<0.004	0.008	0.01	0.003	0.005
Sb-D	Antimony, dissolved	mg/L	0.0036	0.0044	0.0026	<0.0005	0.0043	0.006	0.0058	0.0006	0.0034	0.0035	0.00307	0.0029
As-D	Arsenic, dissolved	mg/L	0.0075	0.0077	0.0054	0.0051	0.0256	0.0103	0.0102	0.0047	0.0104	0.0107	0.00763	0.0094
Ba-D	Barium, dissolved	mg/L	0.018	0.017	0.013	0.008	0.014	0.0179	0.0063	0.0082	0.0185	0.0159	0.0121	0.0159
Be-D	Beryllium, dissolved	mg/L	<0.00004	<0.00004	<0.00004	<0.0001	<0.0001	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.00001	<0.0002
Bi-D	Bismuth, dissolved	mg/L	<0.0001	<0.0001	<0.0001	<0.001	<0.001	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000005	<0.0001
B-D	Boron, dissolved	mg/L	<0.004	0.005	<0.004	<0.05	<0.05	<0.1	<0.1	<0.1	<0.1	<0.1	<0.05	<0.1
Cd-D	Cadmium, dissolved	mg/L	0.00112	0.00175	0.0011	0.00311	0.00097	0.0022	<0.0001	0.0032	0.0009	0.0016	0.00105	0.0021
Ca-D	Calcium, dissolved	mg/L	323	361	261	87.3	304	337	230	84	322	323	347	320
Cr-D	Chromium, dissolved	mg/L	<0.0004	0.0012	0.0009	0.001	<0.001	<0.002	<0.002	<0.002	<0.002	<0.002	0.0003	<0.002
Co-D	Cobalt, dissolved	mg/L	0.00972	0.00836	0.00613	0.0011	0.0055	0.0079	0.0015	0.0009	0.0088	0.0076	0.00717	0.0099
Cu-D	Copper, dissolved	mg/L	<0.001	<0.001	<0.001	0.0013	0.0004	0.002	<0.001	<0.001	0.001	0.001	0.00136	0.002
Fe-D	Iron, dissolved	mg/L	0.04	1.47	0.06	0.018	0.089	0.135	0.059	<0.02	0.231	0.113	0.049	0.277
Pb-D	Lead, dissolved	mg/L	0.0006	0.0049	0.0014	0.0006	0.0007	0.0018	0.0009	0.0007	0.0022	0.0019	0.00037	0.0015
Li-D	Lithium, dissolved	mg/L	0.026	0.023	0.022	0.005	0.025	0.026	0.024	<0.01	0.022	0.022	0.019	0.021
Mg-D	Magnesium, dissolved	mg/L	86.7	102	61	11.1	55.4	76	62	11	80	79	85.5	83
Mn-D	Manganese, dissolved	mg/L		4.24	2.33	0.481	1.73	2.85	0.168	0.419	3.12	2.95	2.98	3.18
Mo-D	Molybdenum, dissolved	mg/L	0.0028	0.00316	0.00186	<0.001	0.002	0.003	0.004	<0.001	0.003	0.003	0.00341	0.003
Ni-D	Nickel, dissolved	mg/L	0.05	0.045	0.033	0.004	0.037	0.0391	0.0152	0.0038	0.0404	0.0428	0.0347	0.0451
K-D	Potassium, dissolved	mg/L	1.5	3	1.4	0.58	1.04	1	1	<1	1	1	1.18	1
Se-D	Selenium, dissolved	mg/L	<0.0006	0.0013	<0.0006	0.0029	0.0004	<0.0008	<0.0008	0.0028	<0.0008	<0.0008	0.00142	0.0013
Si-D	Silicon, dissolved	mg/L	4.16	4.3	3.7	4.13	4.07	4.8	3.99	4.04	4.31	4.4	4.22	3.97
Ag-D	Silver, dissolved	mg/L	<0.00001	<0.00001	0.00096	<0.00002	<0.00002	<0.0001	<0.0001	<0.0001	<0.0001	<0.0001	<0.000005	<0.0001
Na-D	Sodium, dissolved	mg/L	4.1	5.6	3.7	2.27	4.2	19	9	2	9	8	5.73	5
Sr-D	Strontium, dissolved	mg/L	0.762	0.698	0.558	0.159	0.655	0.693	0.632	0.156	0.624	0.65	0.635	0.628
S-D	Sulphur, Dissolved	mg/L	279	302	179	55	260	324	271	<60	302	325	353	323
Tl-D	Thallium, dissolved	mg/L	0.00012	0.00014	0.0001	0.00005	0.0001	0.00009	0.00005	0.00006	0.00004	0.00006	0.000073	0.0001
Sn-D	Tin, dissolved	mg/L	<0.0001	<0.0001	<0.0001	<0.005	<0.005	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	0.00001	<0.0002
Ti-D	Titanium, dissolved	mg/L	0.0004	0.0004	0.0004	0.006	<0.005	0.012	<0.01	<0.01	<0.01	<0.01	<0.0005	<0.01
U-D	Uranium, dissolved	mg/L	0.0291	0.0318	0.0234	0.0041	0.03	0.0339	0.0233	0.00415	0.0309	0.0312	0.0329	0.0297
V-D	Vanadium, dissolved	mg/L	0.00012	0.00026	0.00023	<0.005	<0.005	<0.004	<0.004	<0.004	<0.004	<0.004	<0.0002	<0.004
Zn-D	Zinc, dissolved	mg/L	1.34	1.03	0.846	0.319	0.545	0.715	0.007	0.286	0.731	0.766	0.671	1.2
Zr-D	Zirconium, dissolved	mg/L	0.0001	0.0001	0.0001	<0.0005	<0.0005	<0.002	<0.002	<0.002	<0.002	<0.002	<0.0001	<0.002

Bellekeno 625 Adit
Internal Analysis

	KV-42						
Parameter	**Water Temp**	**Total Zinc**	**pH**	**Flow**	**Ammonia**	**Turbidity**	**Conductivity**
Units	**°C**	**mg/L**	**pH units**	**L/s**	**mg/L**	**NTU**	**µS/cm**
11-Dec-08	2.6	13.02	6.89	6.37	2	674	2170
12-Dec-08	2.2	10.01	7.06	4.97	2.4	279	1879
13-Dec-08	2.1	12.14	7.09	3.15	2	613	1932
14-Dec-08	2.75	7.16	7.24	2.82	2	43.9	1754
15-Dec-08	2.3	6.803	7.25	2.06	2	18.9	1794
16-Dec-08	2.5	5.179	7.14	2.59	2.4	28.6	1625
17-Dec-08	2.75	8.488	7.07	5.26	3	48.1	1784
18-Dec-08	3	8.149	7.21	5.57	0.75	17.4	1791
19-Dec-08	2.9	7.027	7.22	4.85	0.25	4.38	1678
20-Dec-08	3	8.025	7.29	4.51	0.25	4.95	1651
21-Dec-08	3.25	8.147	7.24	4.73	0.25	12.7	1738
22-Dec-08	1.5	7.785	7.71	3.76	0.8	11.2	1728
23-Dec-08	1.7	7.88	7.44	5.09	0.8	7.86	1734
24-Dec-08	0.6	8.477	7.26	5.19	0.5	10.52	1742
25-Dec-08	1.1	7.69	7.71	5.23	0.5	7.35	1752
26-Dec-08	0.6	8.316	7.44	4.10	0.5	7.18	1702
27-Dec-08	0.5	7.46	7.27	4.10	0.4	6.78	1733
28-Dec-08	0.6	7.691	7.24	4.39	0.6	5.42	1727
29-Dec-08	2.0	7.749	7.14	5.75	0.25	18.3	1724
30-Dec-08	2.5	8.097	7.20	4.98	0.4	8.06	1741
31-Dec-08	2.9	8.789	7.41	6.74	0.25	10.61	1765

Bellekeno 625 Adit
Internal Analysis

	KV-42						
Parameter	**Water Temp**	**Total Zinc**	**pH**	**Flow**	**Ammonia**	**Turbidity**	**Conductivity**
Units	**°C**	**mg/L**	**pH units**	**L/s**	**mg/L**	**NTU**	**µS/cm**
1-Jan-09	2.6	8.753	7.19	5.72	0.25	7.47	1784
2-Jan-09	2.75	7.107	7.32	6.21	0.25	9.31	1792
3-Jan-09	2.75	7.565	7.41	5.74	0.25	9.41	1727
4-Jan-09	2.5	6.58	7.31	5.12	0.3	10.71	1710
5-Jan-09	2.5	8.45	7.34	4.98	0.25	9.32	1698
6-Jan-09	0.3	7.722	6.94	4.59	0.4	8.66	1665
7-Jan-09	0.4	6.912	7.43	2.88	0.4	8.17	1700
8-Jan-09	-0.1	8.126	7.53	4.85	0.2	7.67	1862
9-Jan-09	-0.1	8.412	7.52	4.70	0.2	6.06	1749
10-Jan-09	0.8	9.06	7.46	4.77	0.2	6.15	1743
11-Jan-09	0.7	7.625	7.48	5.90	0	26.4	1788
12-Jan-09	2.6	7.196	7.32	6.21	0.3	9.8	1764
13-Jan-09	2.8	6.848	7.41	6.25	0.25	9.31	1734
14-Jan-09	2.6	7.869	7.29	7.01	0.25	13.9	1695
15-Jan-09	3.4	8.921	7.36	6.96		59.9	1734
16-Jan-09	3.3	8.785	7.22	6.76	0.5	363	1765
17-Jan-09	4.4	7.806	6.81	10.52	0.5	62.3	1869
18-Jan-09	4.2	6.682	7.07	6.76	0.5	19.4	1538
19-Jan-09	2.8	10.15	7.72	6.39	0.9	5.17	826
20-Jan-09	4.3	7.943	6.9	9.46	0.5	21.5	1961
21-Jan-09	-	-	-	-	-	-	-
22-Jan-09	-	-	-	-	-	-	-
23-Jan-09	3.5	6.255	6.4	7.57	0.5	38.5	1682
24-Jan-09	2	7.64	6.21	6.74	0.6	16	1657
25-Jan-09	2.9	5.964	5.92	7.85	0.6	18.2	1830
26-Jan-09	3	7.08	6.84	9.46	0.25	9.75	1844
27-Jan-09	3.9	6.643	6.94	5.57	0.25	12.2	1814
28-Jan-09	3.1	6.774	6.9	9.96	0.25	22.9	1828
29-Jan-09	3.4	6.290	6.90	8.49	0.2	23.2	1840
30-Jan-09	3.7	6.797	6.99	9.01	0.25	10.67	1815
31-Jan-09	2.8	6.697	6.89	8.60	0.2	13.5	1834

Bellekeno 625 Adit

Internal Analysis

	KV-42						
Parameter	Water Temp	Total Zinc	pH	Flow	Ammonia	Turbidity	Conductivity
Units	°C	mg/L	pH units	L/s	mg/L	NTU	µS/cm
1-Feb-09	3.6	6.611	6.94	8.60	0.25	44.1	1870
2-Feb-09	3.7	6.588	6.85	4.92	0.3	32.3	1838
3-Feb-09	3	4.26	6.91	9.01	0.3	77.4	1262
4-Feb-09	3	6.248	6.8	7.20	0.6	11.1	1858
5-Feb-09	3	6.609	7.15	6.74	0.6	72.1	1685
6-Feb-09	4.2	6.951	7.1	6.81	0.6	65.9	1973
7-Feb-09	3.2	5.353	7.21	6.98	0.6	20	1898
8-Feb-09	4	6.446	7.18	7.48	0.25	23.7	1935
9-Feb-09	3.2	4.34	7.01	7.00	0.25	45.3	1439
10-Feb-09	3.75	9.255	6.89	7.00	0.25	41.2	1930
11-Feb-09	3.5	6.141	6.85		0.25	20.2	1923
12-Feb-09		5.904		7.00			
13-Feb-09	3.7	5.628	6.84	7.00	0.25	33.4	1882
14-Feb-09	4.1	6.356	6.92	7.82	0.6	40.3	1938
15-Feb-09	4.2	5.444	6.92	8.00	-	-	1966
16-Feb-09	1.6	4.082	7.58	8.00	0.2	1447	1659
17-Feb-09	2.4	5.454	6.97	10.00	0.2	63	1966
18-Feb-09	2	5.76	6.58	8.00	0.2	77.5	1996
19-Feb-09	2.8	5.03	7.26	8.00	0.2	27.5	1948
20-Feb-09	2.6	5.01	6.99	8.00	0.4	20	2730
21-Feb-09	3	4.824	6.87	8.00	0.1	43.1	3240
22-Feb-09	2.8	4.636	7.10	8.00	0.0	50.6	1909
23-Feb-09	2.8	4.868	6.45	8.00	0.6	28.7	1883
24-Feb-09	3.6	4.622	6.79	7.89	0.5	51	1835
25-Feb-09	4	4.066	6.8	8.00	0.5	49.9	1842
26-Feb-09	3.9	3.874	6.95	8.00	0.5	30.2	1839
27-Feb-09	3.3	3.766	6.97	8.00	0.5	24.1	1877
28-Feb-09	4	3.95	7.03	8.00	0.5	53.4	1819

Bellekeno 625 Adit
Internal Analysis

	KV-42						
Parameter	**Water Temp**	**Total Zinc**	**pH**	**Flow**	**Ammonia**	**Turbidity**	**Conductivity**
Units	**°C**	**mg/L**	**pH units**	**L/s**	**mg/L**	**NTU**	**µS/cm**
1-Mar-09	4.3	-	7.03	8.00	0.5	68.8	1836
2-Mar-09	2.6	-	6.88	8.00	8.4	123	1880
3-Mar-09	3.5	-	7.07	4.00	0.8	27.8	1735
4-Mar-09	3.5	-	6.95	8.00	0.4	17	1795
5-Mar-09	2.8	-	6.9	7.56	0.7	26.5	1806
6-Mar-09	2	-	7.08	7.40	0.5	58.7	1746
7-Mar-09	2.7	-	6.82	7.24	0.5	148	1815
8-Mar-09	-	-	-	-	-	-	-
9-Mar-09	-	-	-	-	-	-	-
10-Mar-09	-	-	-	-	-	-	-
11-Mar-09	3.7	-	7.1	6.54	0.5	46.8	1818
12-Mar-09	4.3	-	7.23	6.18	0.8	62.6	1817
13-Mar-09	3.5	2.479	7.15	6.43	-	-	1877
14-Mar-09	3.25	2.291	7.27	7.00	0.6	47.8	1878
15-Mar-09	3.5	2.210	7.34	7.56	-	22.1	1839
16-Mar-09	3	2.172	7.44	8.14	0.6	24.2	1870
17-Mar-09	4	2.155	7.48	8.46	0.5	-	1862
18-Mar-09	4	2.103	7.22	9.74	0.4	15.1	1892
19-Mar-09	3.3	1.777	7.34	9.26	0.4	31.1	1901
20-Mar-09	2.9	2.068	7.15	meter offli	0.5	37.4	1856
21-Mar-09	2.8	2.028	7.25	8.68	0.4	26	1877
22-Mar-09	3.0	1.958	7.14	8.02	0.4	46.5	1929
23-Mar-09	4.4	1.868	7.19	9.01	0.6	41.8	1945
24-Mar-09	4	2.317	7.15	5.41	0.5	58.8	1939
25-Mar-09	4.5	1.483	7.22	9.46	0.5	49.4	1895
26-Mar-09	4.5	1.692	7.3	8.49	0.6	58.5	1805
27-Mar-09	4.75	1.793	7.23	9.01	0.6	29.3	1739
28-Mar-09	5	1.665	7.38	8.60	0.6	22.2	1734
29-Mar-09	5	2.721	7.42	9.06	-	-	1659
30-Mar-09	5	1.365	7.41	7.60	0.6	42.6	-
31-Mar-09	6	1.446	7.64	7.22	0.6	31.5	-

Bellekeno 625 Adit
Internal Analysis

	KV-42						
Parameter	**Water Temp**	**Total Zinc**	**pH**	**Flow**	**Ammonia**	**Turbidity**	**Conductivity**
Units	**°C**	**mg/L**	**pH units**	**L/s**	**mg/L**	**NTU**	**µS/cm**
1-Apr-09	4	-	7.76	0.63	0.5	6.8	561
2-Apr-09	3.7	0.09	7.16	4.42	1	55.2	1423
3-Apr-09	3	1.72	7.54	6.53	0.8	112	1449
4-Apr-09	3.2	1.47	7.61	3.70	0.8	44.4	1420
5-Apr-09	4	1.40	7.43	7.71	0.5	82.3	1313
6-Apr-09	4.4	1.04	7.54	5.58	0.2	75.4	1174
7-Apr-09	4.6	1.27	7.38	5.81	0.30	49.20	1341
8-Apr-09	4.8	0.78	7.61	6.46	0.2	45.5	1186
9-Apr-09	4.8	1.36	7.41	5.73	0.2	43.2	1306
10-Apr-09	4.4	0.96	7.63	3.12	0.5	57.7	1151
11-Apr-09	5	0.84	7.31	7.58	0.5	32.7	1792
12-Apr-09	5.4	0.9912	7.21	8.77	0.8	35.8	1808
13-Apr-09	5.1	0.8229	7.5	7.62	-	-	-
14-Apr-09	4.5	0.884	7.36	-	-	-	1857
15-Apr-09	6	0.7938	7.32	10.00	1	10.36	1672
16-Apr-09	6	0.7122	7.56	5.30	1	45.7	1647
17-Apr-09	6	0.7396	7.62	7.63	1	19	1709
18-Apr-09	5.3	0.8492	7.61	7.86	1	36.9	1830
19-Apr-09	5.8	0.6268	7.5	7.63	1	15	1675
20-Apr-09	6	0.4887	7.57	7.93	1	47.2	1629
21-Apr-09	5.9	0.557	7.24	10.00	1.0	36.7	1668
22-Apr-09	5.5	0.7418	7.29	7.60	1	35.5	1767
23-Apr-09	5.5	0.6452	7.34	6.20	1	27.2	1690
24-Apr-09	5.8	0.5151	7.34	5.81	1	28.8	1633
25-Apr-09	6.1	0.6118	7.48	6.05	1	84.2	1682
26-Apr-09	5.7	0.5741	7.65	8.03	0.8	57.7	1500
27-Apr-09	6.5	0.7139	7.56	5.91	0.5	61.9	1603
28-Apr-09	1.4	1.001	7.18	5.75	0.4	83.7	1785
29-Apr-09	6.5	1.086	7.08	5.29	0.4	132	1739
30-Apr-09	6.4	0.9526	7.26	6.10	0.4	170	1748

Bellekeno 625 Adit
Internal Analysis

	KV-42						
Parameter	**Water Temp**	**Total Zinc**	**pH**	**Flow**	**Ammonia**	**Turbidity**	**Conductivity**
Units	**°C**	**mg/L**	**pH units**	**L/s**	**mg/L**	**NTU**	**µS/cm**
1-May-09	6.0	1.164	7.26	5.00	0.3	252	1603
2-May-09	6.6	0.977	7.53	3.75	0.2	167	1557
3-May-09	5.8	1.302	7.37	2.87	0.2	141	1764
4-May-09	6.0	1.128	7.27	5.65	0.2	147	1800
5-May-09	5.7	1.027	7.24	2.78	0.1	25	1664
6-May-09	5.8	0.924	7.39	3.51	0.0	88	1558
7-May-09	6.3	0.848	7.30	8.14	0.1	160	1652
8-May-09	6.7	0.760	7.35	3.27	0.0	183	1514
9-May-09	6.8	0.884	7.35	4.46	0.0	132	1579
10-May-09	6.5	0.871	7.40	3.72	0.0	114	1543
11-May-09	6.1	1.076	7.12	4.92	0.0	76	1756
12-May-09	5.6	1.289	7.03	6.51	0.0	87	1882
13-May-09	5.6	1.153	7.44	1.02	0.0	84	1715
14-May-09	5.9	1.100	7.98	5.39	0.0	136	1849
15-May-09	6.0	1.448	7.31	5.50	0.0	133	2170
16-May-09	5.2	1.477	7.33	5.53	0.0	138	2230
17-May-09	-	-	-	-	-	-	-
18-May-09	6.9	1.143	7.03	5.92	0.0	147	1888
19-May-09	6.9	1.193	7.19	4.59	0.0	137	2190
20-May-09	7.0	1.120	7.08	6.70	0.0	138	1859
21-May-09	7.8	1.354	7.09	6.31	0.0	148	1802
22-May-09	7.6	1.032	7.15	6.24	0.0	133	1840
23-May-09	9.0	1.082	7.18	7.25	0.0	202	1795
24-May-09	6.6	0.877	7.14	5.34	0.0	72	1547
25-May-09	10.0	1.112	7.42	7.77	0.0	36	1771
26-May-09	7.3	1.028	7.25	7.25	0.0	63	1810
27-May-09	7.1	0.844	7.20	7.06	0.0	47	1769
28-May-09	6.5	0.870	7.05	6.40	0.0	25	1745
29-May-09	7.2	0.834	7.16	6.29	0.0	26	1742
30-May-09	6.8	0.890	7.20	7.90	0.0	49	1814
31-May-09	7.0	1.269	7.22	9.25	0.0	46	1815

Bellekeno 625 Adit
Internal Analysis

	KV-42						
Parameter	**Water Temp**	**Total Zinc**	**pH**	**Flow**	**Ammonia**	**Turbidity**	**Conductivity**
Units	**°C**	**mg/L**	**pH units**	**L/s**	**mg/L**	**NTU**	**µS/cm**
1-Jun-09	7.3	0.920	7.38	6.26	0.0	36	1769
2-Jun-09	8.1	0.980	7.27	7.55	0.0	50	1784
3-Jun-09	8.0	1.215	6.94	6.41	0.0	12	1768
4-Jun-09	7.6	1.221	7.18	9.37	0.0	64	1801
5-Jun-09	7.7	1.320	7.02	9.61	0.0	29	1752
6-Jun-09	7.7	0.990	7.04	4.51	0.0	13	1623
7-Jun-09	7.0	0.830	7.11	2.17	0.0	27	1477
8-Jun-09	7.5	0.860	7.31	6.90	0.0	124	1662
9-Jun-09	7.5	0.870	7.27	4.94	0.0	139	1557
10-Jun-09	7.5	1.020	6.98	8.60	0.0	68	1733
11-Jun-09	8.0	0.800	7.18	4.05	0.0	38	1503
12-Jun-09	7.4	1.070	6.87	7.38	0.0	78	1863
13-Jun-09	7.0	0.900	6.93	7.16	0.0	29	1878
14-Jun-09	7.0	0.750	7.12	5.13	0.0	11	1548
15-Jun-09	8.4	0.690	7.29	2.00	0.0	17	1598
16-Jun-09	8.0	1.070	7.29	3.00	0.0	88	1611

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE

APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT E

(Q-36d)

January 19, 2010

chlorine levels. To date, a limited number of moose (2 samples) and caribou samples have been specifically collected from the South McQuesten River area. Although a detailed comparison is not possible, metal levels from the moose tissue were not atypical of other animal results in the territory. A detailed summary of all wildlife test results by local communities is being compiled (M. Palmer, M. Gamberg, 1996) Y.T.G. Renewable Resources routinely accepts wildlife tissue samples for metal analyses. It is expected that a database of metal levels in local wildlife species will develop as additional data is compiled.

3.6 Climate

3.6.1 General

This section presents an assessment of two climatic variables which were required to develop an overall water balance for the UKHM mine site (as described in Section 8.2). The two variables are average precipitation and average evaporation. These two variables were considered the key parameters in developing the water balance for the UKHM site.

3.6.2 Available Data

The climate records from a total of eleven climate stations were assembled to assist in characterizing the climate of the UKHM mine site. Details of these stations are presented in Table 3-5. The table also identifies the type of climatic information each station provided for the study.

Table 3-5 Details of Regional Climate Stations

Station Name[3]	Latitude		Longitude		Elevation (m.a.s.l.)	Period of Record	Mean Annual Precipitation (mm)	Information Applicable To This Study
	Deg.	Min.	Deg.	Min.				
AES[1]								
Boundary/ Mile 34 Boundary Rd	64	14	140	21	1036	1967 - 1978	576	Precipitation
Clinton Creek	64	28	140	44	576	1964 - 1978	370	Precipitation
Dawson	64	3	139	26	320	1897 - 1979	306	Precipitation/ Humidity/ Temperature
Dawson Airport	64	3	139	8	369	1976 - 1995	340	Precipitation/ Humidity/ Temperature
Elsa	63	55	135	29	814	1948 - 1965, 1974 - 1989	413	Precipitation
Pelly Ranch/ Fort Selkirk	62	49	137	22	454	1954 - 1995	286	Precipitation/ Bright Sunshine
Keno Hill	63	56	135	12	1472	1974 - 1982	590	Precipitation
Klondike/ Dempster	64	27	138	13	960	1966 - 1995	469	Precipitation
Mayo Airport/ Mayo/ Mayo Landin	63	37	135	52	504	1924 - 1995	306	Precipitation/ Humidity/ Temperature
Snag Airport	62	22	140	24	587	1943 - 1966	339	Humidity/ Temperature
DIAND[2]								
Flat Creek	63	55	135	30	730 (approx.)	1992 - 1994 (summers only)	Not available	Humidity/ Temperature

Notes: 1. Environment Canada, Atmospheric Environment Service

2. Department of Indian Affairs and Northern Development, Fire Management Program

3. For some stations, more than one name is presented. Where this happens, the first name given is the current official designation of the station. Other names represent past designations of the station. Name changes appear to have most often been triggered by the slight relocation of the station.

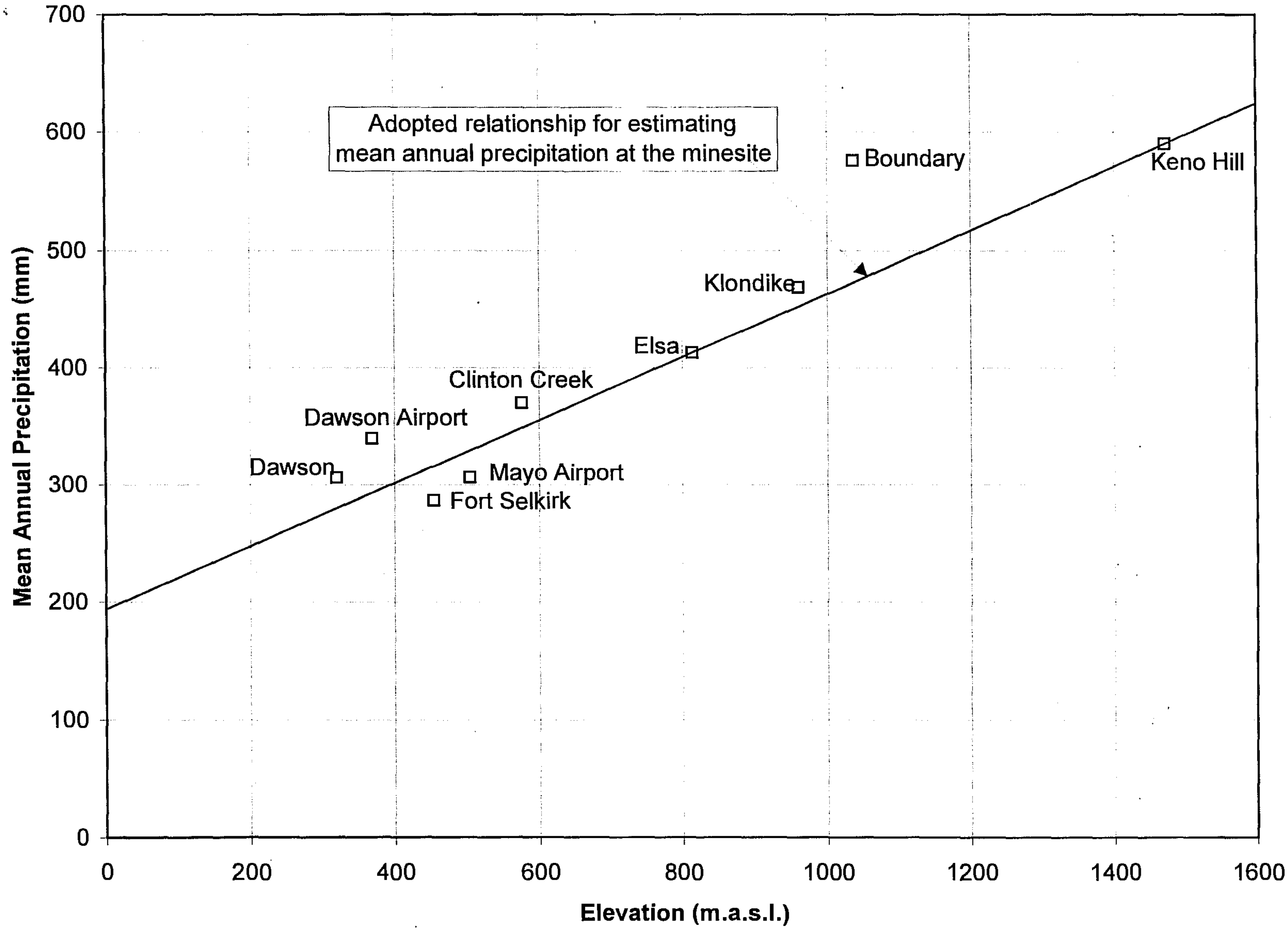
The region around the UKHM mine site is well served by a reasonably dense network of climate monitoring stations, a most unusual situation for a mine site located in the sparsely populated regions of northern Canada. Of particular noteworthiness is the fact that at least three climate stations have been operated within the boundaries of the mine site. Two of these stations were maintained by the Atmospheric Environment Service (AES) and were located at the Elsa townsite and on the southern flank of Keno Hill. The third station was operated on a seasonal basis by DIAND at a site in the Flat Creek catchment near the Elsa townsite. In addition to these mine site stations, the AES operate a principal climatological station at the Mayo Airport, located some 40 km southwest of Elsa. The data from the Mayo Airport can be combined with that of two discontinued stations in the near vicinity of the airport (i.e. Mayo Landing and Mayo) to construct a long-term climate record spanning 72 years.

Another source of information, but not included in Table 3-5, is climate data collected at the Dublin Gulch property, a proposed heap-leach gold operation located approximately 21 km northwest of Elsa. These data have not been used in the present study but may be incorporated into future analyses related to the water licence application.

3.6.3 Precipitation

Mean annual precipitation (MAP) within a mountainous region typically increases with increasing elevation. The region around the UKHM mine site is no exception to this rule as illustrated by the graph of MAP versus elevation shown on Figure 3-3. The data points on this graph were obtained from the information assembled in Table 3-5 for the regional AES climate stations.

Figure 3-3 Mean Annual Precipitation as a Function of Elevation



The UKHM mine site is in an area of significant relief. Accordingly, MAP can be expected to vary considerably within the boundaries of the mine site. In order to quantify this variation, an empirical relationship was derived between MAP and elevation using the data from the two AES stations which were operated on the mine property, namely the Elsa and Keno Hill stations. These are suitable stations for deriving the relationship since their elevations are widely separated (i.e. 814 m versus 1472 m). Assuming a linear relationship between MAP and elevation, a line was fitted to the data of these two mine site stations (see Figure 3-3). The slope of this line indicates that MAP increases by an average of 27 mm for every 100 m of ascent, a value not too dissimilar from that observed in other regions of the Yukon interior.

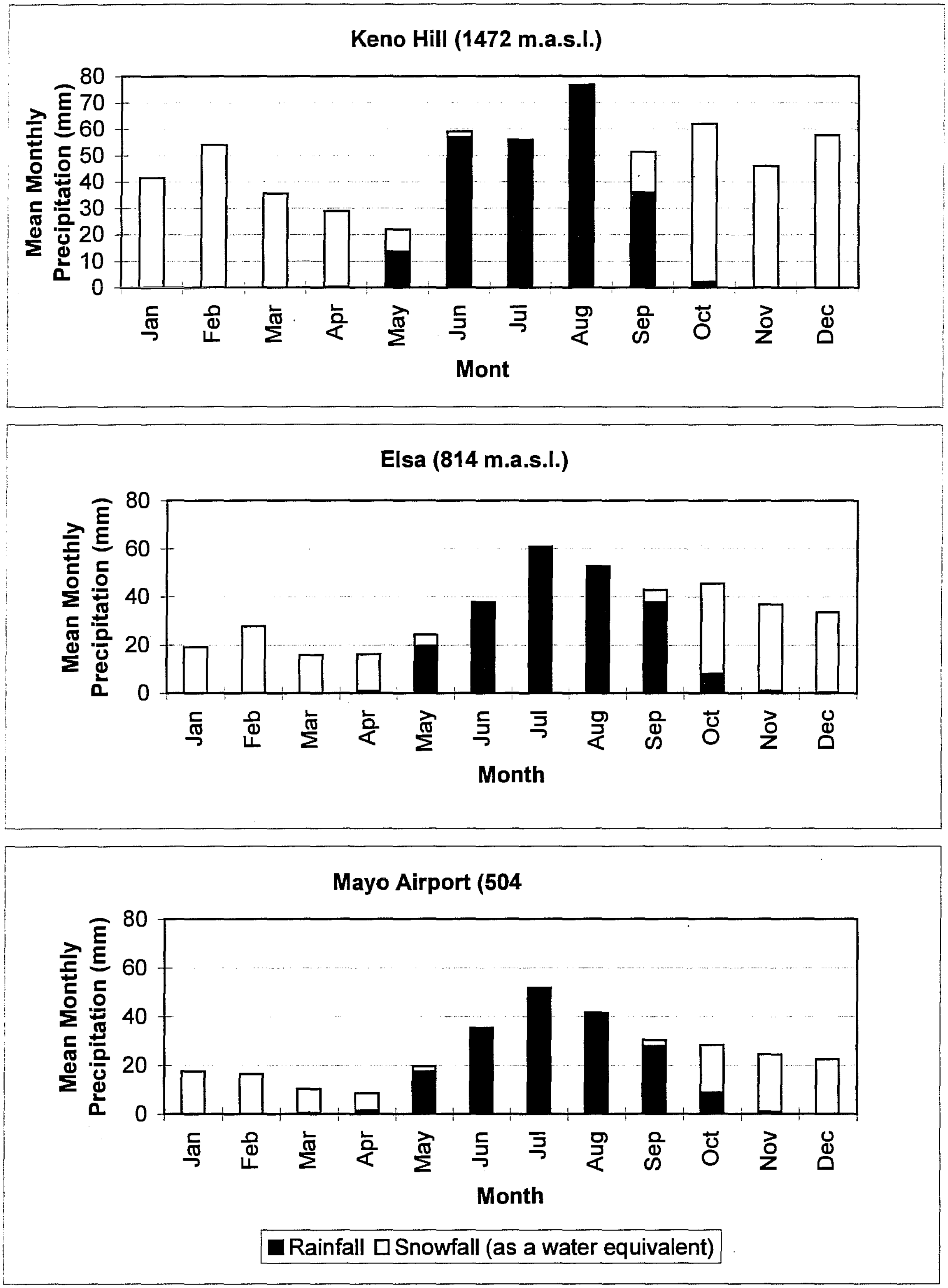
The curve fitted exclusively to the Elsa and Keno Hill data seems to also explain much of the variation in MAP observed at the other regional AES climate stations. The scatter about the line drawn on Figure 3-3 can largely be attributed to a mild drying trend as one moves from the northwest to the southeast across the region. This drying trend is made apparent by noting where the individual climate stations are located in relation to the mine site. All stations plotting above the line are located north and west of the UKHM site. In contrast, the two stations plotting below the line are found south of the mine site.

The adopted empirical relationship shown on Figure 3-3 should be viewed as providing only approximate estimates of MAP for ungauged points within the mine site. Although elevation is the principal control, precipitation also varies according to other variables such as slope and aspect which are not explicitly accounted for in the empirical relationship.

Figure 3-4 was prepared to illustrate the seasonal distribution of precipitation at the mine site. As with MAP, the seasonal distribution is influenced by elevation. To demonstrate this influence, the seasonal distributions for Mayo Airport (504 m), Elsa (814 m), and Keno Hill (1472 m) have been plotted on Figure 3-4. The following observations can be drawn from examining these distributions:

- precipitation is common throughout the year;
- the wettest period is normally the summer months of July and August;

FIGURE 3-4 Mean Monthly Precipitation



- the driest month of the year is typically April;
- the proportion of total precipitation which falls as rain decreases as elevation increases (60% of total precipitation at Mayo Airport, 53% at Elsa, and 41% at Keno Hill); and,
- the precipitation gradient during winter is steeper than that during summer (which suggests orographic effects are more pronounced during snowfall than during rainfall).

Evaporation

Two rates of evaporation are of interest, namely lake evaporation and evapotranspiration. The former refers to evaporation from a free-water surface while the latter refers to evaporation from a land surface including transpiration from plants. Both rates were estimated from meteorological data using a computer program known as WREVAP which was developed by Environment Canada's National Hydrology Research Institute (Morton, 1985).

The meteorological inputs to the WREVAP model comprise humidity, temperature, and sunshine duration. In order to obtain valid estimates of evaporation, the model must be provided with accurate measurements of the first two climatic variables. Model results are less sensitive to the accuracy of the third input requirement, i.e., sunshine duration. Thus, the use of sunshine duration records from another nearby climate station provides adequate accuracy. With this in mind, a search was made for climate stations which met the following two criteria:

- the station experiences a comparable climate to the mine site; and,
- as a minimum, the station monitors both humidity and air temperature.

Using these criteria, a total of four climate stations were selected for the evaporation modelling, one located at the mine site itself (Flat Creek) and three located in the general region (Dawson, Dawson Airport, and Mayo Airport). At none of these locations was sunshine duration monitored. To obtain this additional information, reference was made to the closest climate station equipped to measure sunshine duration (viz, Pelly Ranch or, as it was formerly known, Fort Selkirk).

Figure 3-5 displays the results of applying the WREVAP model to the meteorological conditions at each of the four climate stations. The top graph shows estimates of mean monthly evapotranspiration while the bottom graph shows the monthly distribution of lake evaporation. As can be observed, all four stations experience similar rates of both lake evaporation and actual evapotranspiration. Based on this similarity, the average of the evaporation rates at the four stations was selected to represent the conditions at the mine site. The average annual lake evaporation is about 460 mm while the estimated actual evapotranspiration is about 200 mm per annum, or 43% of lake evaporation.

3.7 Hydrology

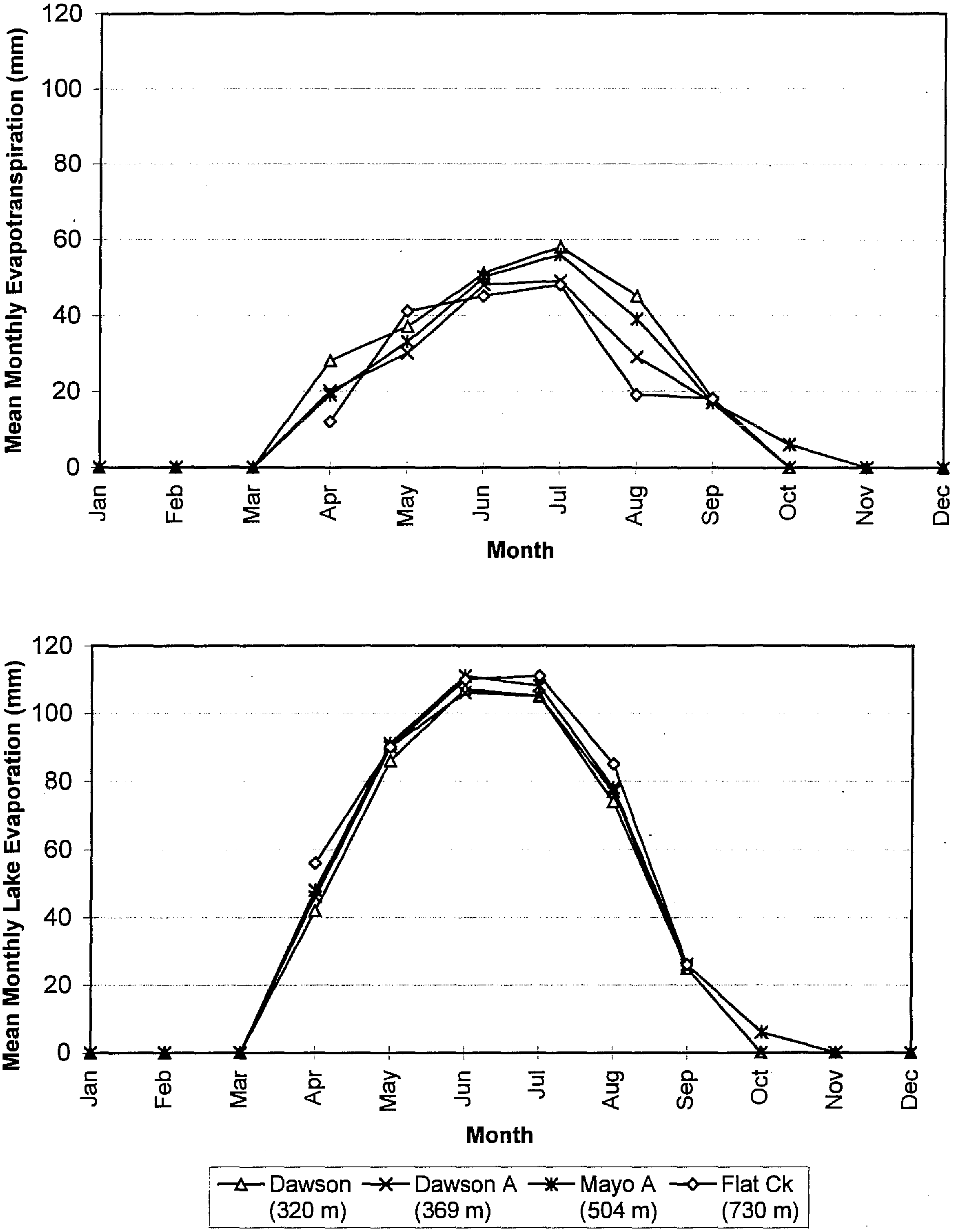
3.7.1 General

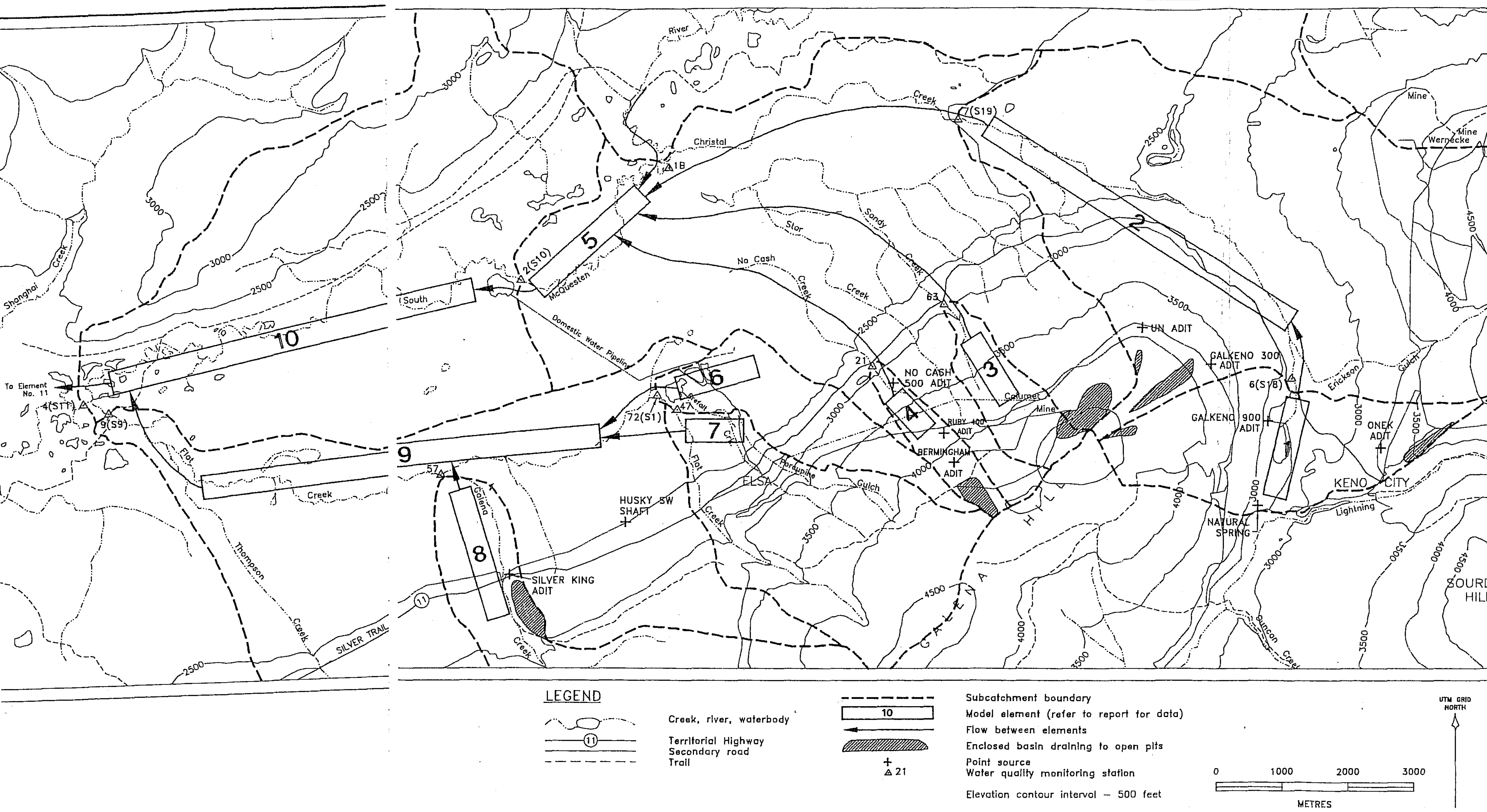
This section describes an analysis undertaken to estimate the average flows at key locations on the mine site streams. This information was required to construct an overall site water balance and chemical load balances for the UKHM mine site.

3.7.2 Available Data

The hydrology of the mine site streams was characterized using a mix of both site-specific and regional data. The site-specific data can be categorized into two groups. The first group encompasses a series of spot flow measurements made at the mine site water quality stations by UKHM personnel, government agencies, and consultants. The second group is data collected at five streamflow gauging stations established on mine site streams during 1994 and 1995 by Laberge Environmental Services. One of these stations is automatically monitored using a pressure transducer and data logger. The other four stations are equipped with staff gauges and must be manually read. The data collected to date at the five gauging stations are presented in Technical Appendix III. Maps showing the gauge locations and the catchment boundaries are shown in Figures 3-6 and 3-7.

Figure 3-5 Mean Monthly Evaporation Data



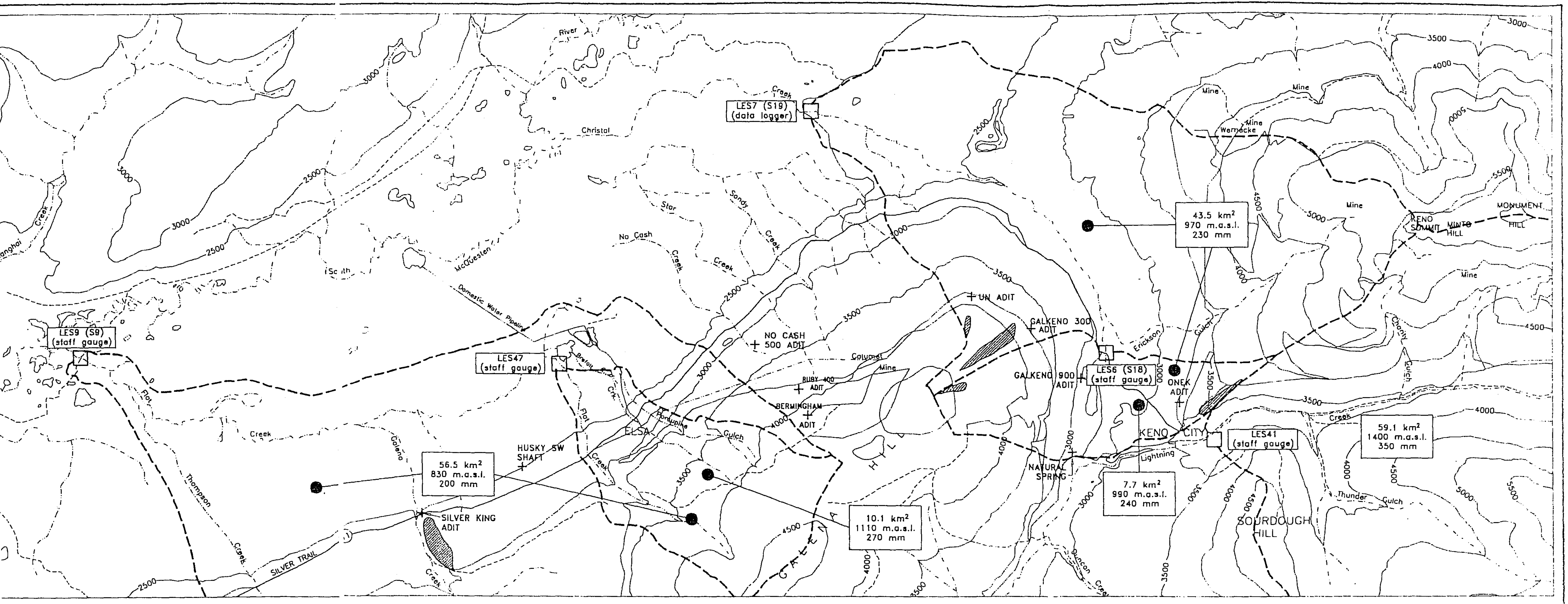


UNITED KENO HILL MINES LIMITE

MODEL REPRESENTATION OF MINESITE DRAINAGI
WITHIN THE SOUTH MCQUESTEN RIVER WATERSH

ACCESS MINING CONSULTANTS LTD.

SCALE: 1 : 50 000	FILE: 224_1.DWG	DATE: 30/05/
DRAWN:	DWG: 95UK23	FIGURE: 3-6



LEGEND

	Creek, river, waterbody
	Territorial Highway
	Secondary road
	Trail
— — — — —	Subcatchment boundary
□	Streamflow gauging station
10.1 km² 1110 m.a.s.l. 270 mm	Area, median elevation, and mean annual runoff of the gauging station's catchment
▨	Enclosed basin within the catchments of the gauging stations
+	Point source discharges within the catchments of the gauging stations
LES9	Laberge Environmental Services site description number
(S9)	UKHM site description number

Elevation contour interval ~ 500 feet

0 1000 2000 3000

METRES

UTM GRID NORTH

UNITED KENO HILL MINES LIMITED

LOCATION OF MINESITE STREAMFLOW GAUGING STATIONS

ACCESS MINING CONSULTANTS LTD.

SCALE: 1 : 50 000	FILE: 224_4.DWG	DATE: 30/05/96
DRAWN:	DWG: 95UK23A	FIGURE: 3–7

The site-specific data on their own are inadequate to fully characterize the hydrology of the mine site streams. This is because the spot flow measurements collected at the water quality monitoring stations are sparse and generally do not cover all seasons. Also, the streamflow records at the five mine site gauging stations are still of short length and, in the case of the manual gauges, are also intermittent.

In the absence of long-term and complete records of streamflow for the mine site streams, resort was made to data collected at the hydrometric networks of the Water Survey of Canada (WSC) and the Water Resources Division of DIAND. The streamflow gauges operated by the WSC are typically sited on streams with large catchments (say greater than 500 km^2) and are monitored on a year-round basis. In contrast, the DIAND gauges are normally located on streams with small catchments and are operated seasonally during the period of open water. The networks of both government agencies were examined to identify regional gauging stations which could be useful in characterizing the average flows of the mine site streams. A total of fifteen stations were selected for this purpose, fourteen operated by the WSC and one operated by DIAND. Table 3-6 provides details of these stations, including period of record, catchment area, catchment median elevation, and mean annual runoff (MAR). Median elevation is a physical characteristic of the catchment and is defined as the contour which divides the catchment exactly into halves. The mean annual runoff for each regional gauge is expressed in two types of units, namely a long-term average flow rate and a depth. The latter unit may be interpreted as the depth to which the average annual runoff volume would spread uniformly over the total catchment area.

All of the selected WSC stations gauge unregulated flows, or flows which have been minimally influenced by human activity. The flows measured at the DIAND station, on the other hand, are characterized as being partially regulated owing to the placer mining activity upstream of the gauge.

The data collected by the WSC and DIAND were used to characterize the mine site hydrology using a technique known as regional analysis. Essentially, this involved deriving empirical relationships between the measured streamflow of the regional

Table 3-6 Details of Regional Streamflow Gauging Stations

Streamflow Gauging Station		Period of Record	Catchment Area	Catchment Median Elevation	Mean Annual Runoff	
ID No.	Name		(km²)	(m.a.s.l.)	(m³/s)	(mm)
WATER SURVEY OF CANADA						
10MA003	Blackstone River near Chapman Lake Airstrip	1984 - 1994	1130	1400	9.14	255
10MB004	Bonnet Plume River above Gillespie Creek	1981 - 1994	3760	1390	53.2	447
09DA001	Hess River above Emerald Creek	1976 - 1994	4840	1400	80	522
09EB003	Indian River above the mouth	1982 - 1994	2220	770	6.31	90
09EA003	Klondike River above Bonanza Creek	1965 - 1994	7800	1040	63.1	255
09EA005	Little South Klondike River below Ross Creek	1983 - 1994	860	1190	7.07	259
09BB002	MacMillan River near the mouth	1984 - 1994	13800	1130	150	343
09DD004	McQuesten River near the mouth	1979 - 1994	4760 [1]	1030	36.9	245
09EA004	North Klondike River near the mouth	1974 - 1994	1100	1290	13.1	376
09BB001	South MacMillan River at km 407 Canol Road	1974 - 1994	997	1470	20.2	639
09DC003	Stewart River above Fraser Falls	1980 - 1994	30600	1240	383	395
09DC002	Stewart River at Mayo	1949 - 1979	31600	1230	370	370
09DD002	Stewart River at Stewart Crossing	1961 - 1973	35000	1210	415	374
09DD003	Stewart River at the mouth	1963 - 1994	51000	1090	469	290
DEPARTMENT OF INDIAN AFFAIRS AND NORTHERN DEVELOPMENT						
29DC001	Duncan Creek at Mayo Lake Road	1979 - 1982	228	1200	1.8	250 [2]

2870 → 400 km2

Notes:
1. Publications of the Water Survey of Canada show an incorrect catchment area for this station of 2870 km².
2. This station was operated on a seasonal basis and has a record with 7 complete months of streamflow data. These data were correlated with the observed flows at neighbouring streamflow gauging stations operated by the Water Survey of Canada. This correlation indicated Duncan Creek has a long-term average flow of approximately 1.8 m³/s at the DIAND gauging site.

stations and the physical characteristics of the catchments which generated the streamflow. These empirical relationships then formed the basis for estimating flows at ungauged mine site streams (or, as was often the case with the UKHM mine site, streams with limited flow measurements).

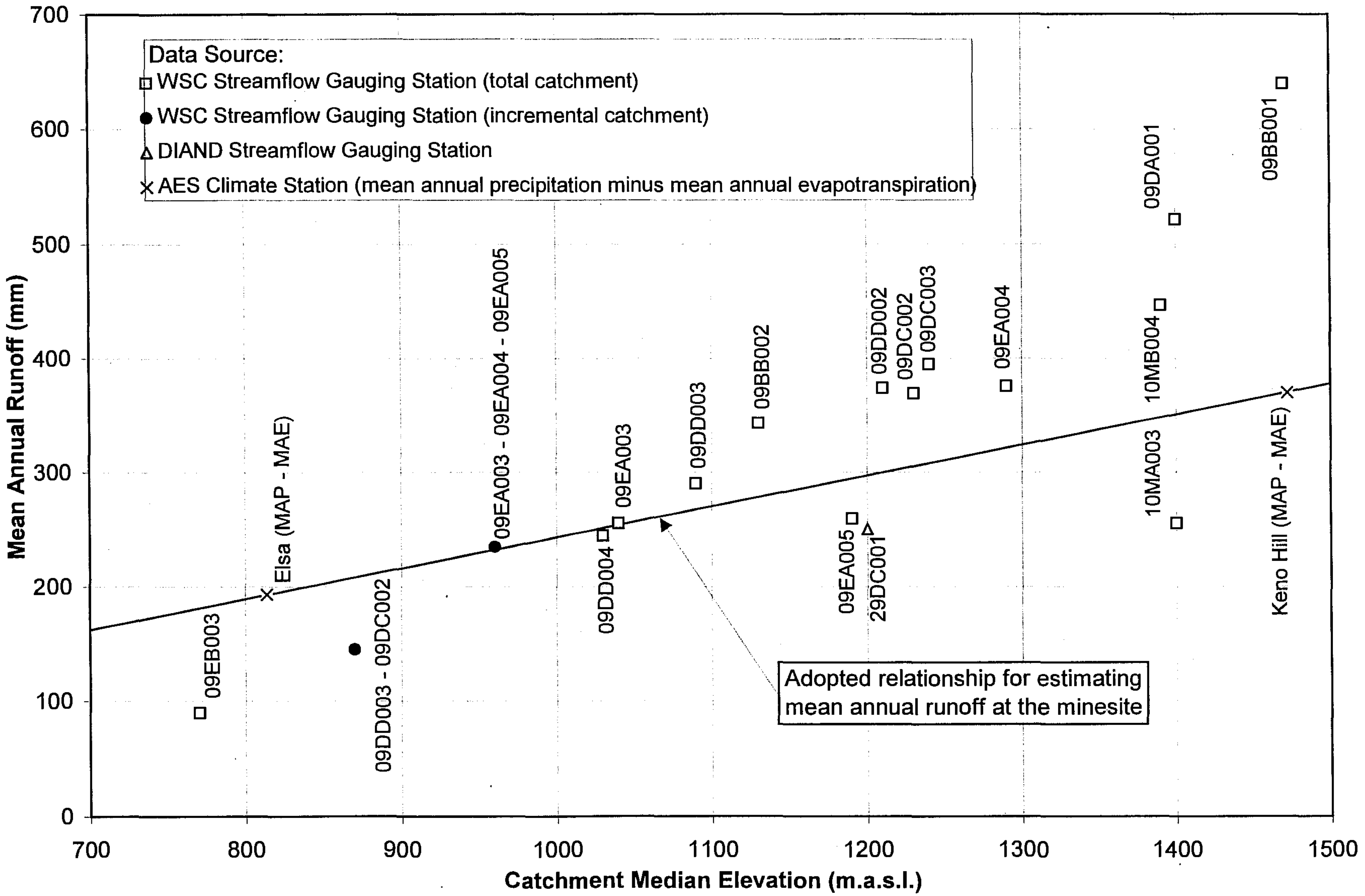
The subsections below describe the steps undertaken to apply the regional analysis to the mine site streams. Missing from these subsections is a discussion of how the site-specific data were used to validate flow estimates made by the regional analysis. In general, the measured flows at the mine site were found to closely match the estimated flows derived by regional analysis.

3.7.3 Mean Annual Runoff

As noted in Section 3.6.3, elevation generally accounts for a large proportion of the variation in mean annual precipitation within a mountainous region. It follows, therefore, that mean annual runoff (MAR) would also be a function of elevation. Figure 3-8 shows how this observation was used to estimate the average flows of the mine site streams. The vertical axis of this figure displays values of MAR expressed as equivalent depths of water. The horizontal axis, on the other hand, shows values of median elevation, which is the variable adopted to characterize the elevation characteristics of the regional and mine site catchments. The following sources of data were assembled to derive a relationship between these two variables for the study area:

- fifteen pairs of MAR and median elevation data provided by the WSC and DIAND stations listed in Table 3-6;
- two pairs of MAR and median elevation values provided by two incremental catchments monitored by the WSC (as explained below); and,
- two point estimates of unit runoff based on the climatic data presented in Section 3.5 (as also explained below).

Figure 3-8 Mean Annual Runoff as a Function of Elevation



Some preparatory work was required to assemble the first source of data. In all but one case, the MAR for the regional station was simply extracted from the agency's published streamflow records. For the one exceptional case, the gauging station was operated on a seasonal basis and, accordingly, a correlation had to be conducted to infill missing data so that the MAR could be estimated. Median elevations for all the stations were measured from topographic maps using a planimeter.

The second source of data is essentially a subset of the first. Where more than one streamflow gauge was located on a stream, it was possible to provide a set of MAR and median elevation values for the intervening catchment area between the gauges. For example, the runoff generated by the lower Stewart River watershed was quantified by subtracting the flows measured at Station 09DC002 from those at Station 09DD003. The median elevation of this incremental catchment was measured by examining only the area which lies between these two gauging stations.

The third source of information made use of climatic data to derive indirect estimates of runoff. Essentially, this was done by subtracting an estimate of average annual evapotranspiration from the average annual precipitation measured at each of the Elsa and Keno Hill climate stations. For example, the Keno Hill station has a MAP of 590 mm and an estimated average annual evapotranspiration of 200 mm. Subtraction of the evapotranspiration rate from the MAP suggests that the area in the immediate vicinity of the Keno Hill station generates an average of 390 mm of runoff per year.

Once all the data were assembled and processed, a curve was fitted to the data to develop a relationship which was believed to represent the conditions at the mine site. Fitting this curve was a somewhat subjective exercise, involving a comparison between the physical characteristics of the WSC and DIAND catchments with those of the mine site catchments. In addition, emphasis was placed on the point estimates of unit runoff derived from the climatic data. In the end, a straight line running through the two estimates provided by the climatic data was adopted to represent the conditions at the mine site. It is of interest to note that this line intersects the data point provided by the WSC station on the McQuesten River, which is of course the catchment which contains the mine site.

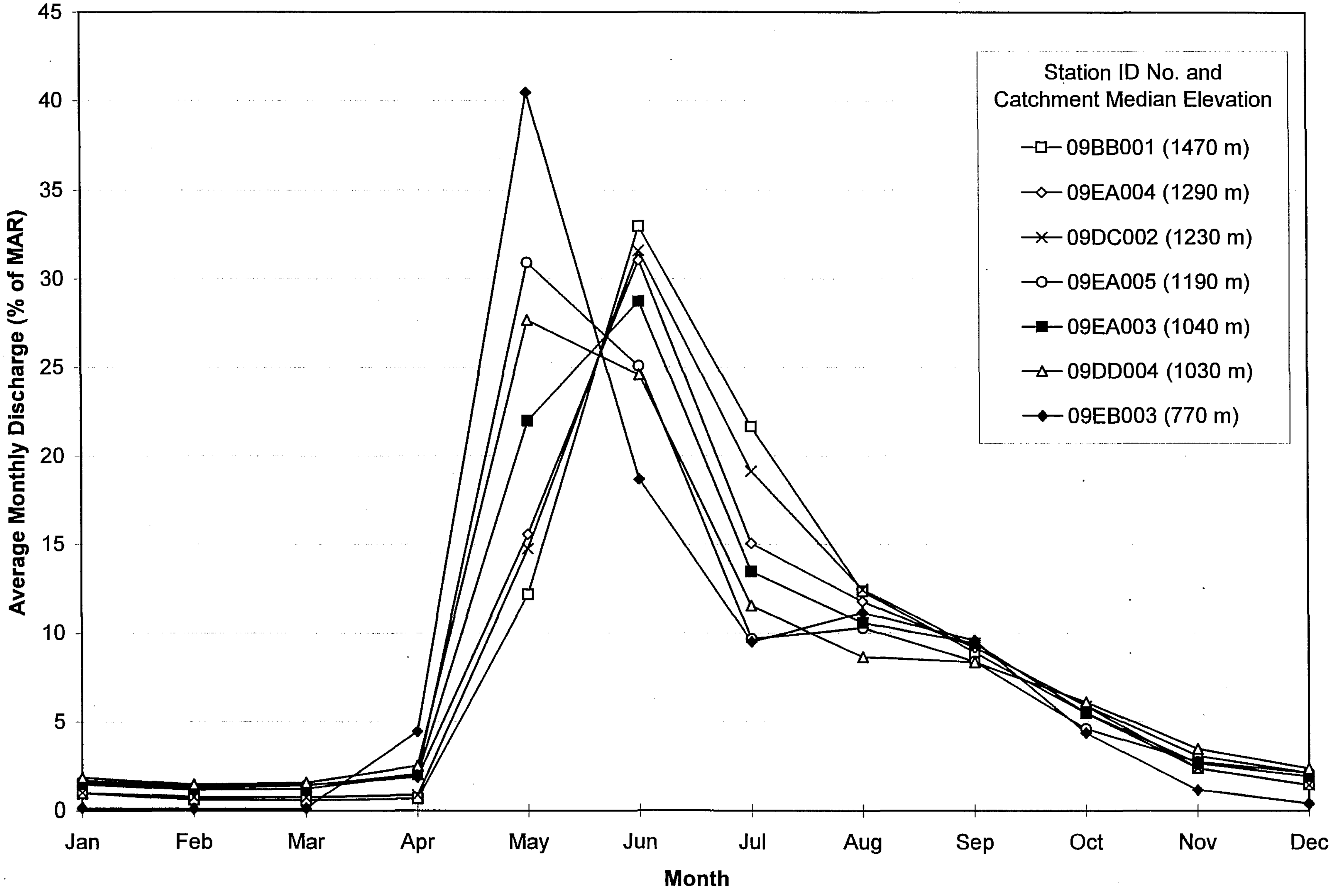
The relationship on Figure 3-8 was used to estimate the average flows on the mine site streams using the following four-step algorithm:

- a point of interest was defined and its catchment boundary outlined on a topographic map;
- using a planimeter, both the catchment area and catchment median elevation were measured;
- the curve on Figure 3-8 was entered at the appropriate value of median elevation and the corresponding unit MAR value was read from the graph's vertical axis; and,
- the product of unit MAR and measured catchment area was calculated to estimate the long-term average annual runoff volume for the point of interest.

3.7.4 Seasonal Runoff Distribution

The runoff pattern at the mine site was estimated by examining the average monthly hydrographs of regional gauging stations. Figure 3-9 graphically presents the monthly distributions, expressed as percentages of MAR, of seven regional stations. These stations were selected to illustrate the distributions from catchments with a broad range of physical characteristics. All distributions are characterized by high spring flows during snowmelt and low winter flows during prolonged freezing conditions. Examination of the distributions indicates median elevation is a reasonably good predictor of the shape of a stream's average monthly hydrograph. Two trends with median elevation are apparent. Firstly, the occurrence of the peak monthly flow is correlated with median elevation. As expected, low elevation catchments generally experience earlier peaks than high elevation catchments. Secondly, the relative magnitude of the winter base flow appears related to elevation. The relative magnitude of the base flow seems to increase as the median elevation increases from about 700 m to 1200 m. Above approximately 1200 m, the trend reverses.

Figure 3-9 Monthly Discharge (MAR)



A comparison between the physical characteristics of the mine site catchments and those of the WSC catchments indicated the McQuesten River (Station No. 09DD004) likely best represents the streamflow distributions of most of the mine site drainages. For some of the higher elevation catchments, such as Lightning Creek, the distribution for the North Klondike River may be more suitable.

3.8 Aquatic Resources

3.8.1 Benthic Invertebrates

The following sections summarize the benthic investigations in the Elsa area. The detailed report on the biological monitoring survey conducted at UKHM in 1994 is provided in Technical Appendix IV.

3.8.1.1 Review of Benthic Community Monitoring

According to licence number Y2S3-2014 effective August 1, 1980 to July 31, 1985 and licence number Y1N85-02Rl effective September 26, 1985 to September 25, 1990, benthic fauna sampling was to be conducted by UKHM on an annual basis at four specified locations. These locations were:

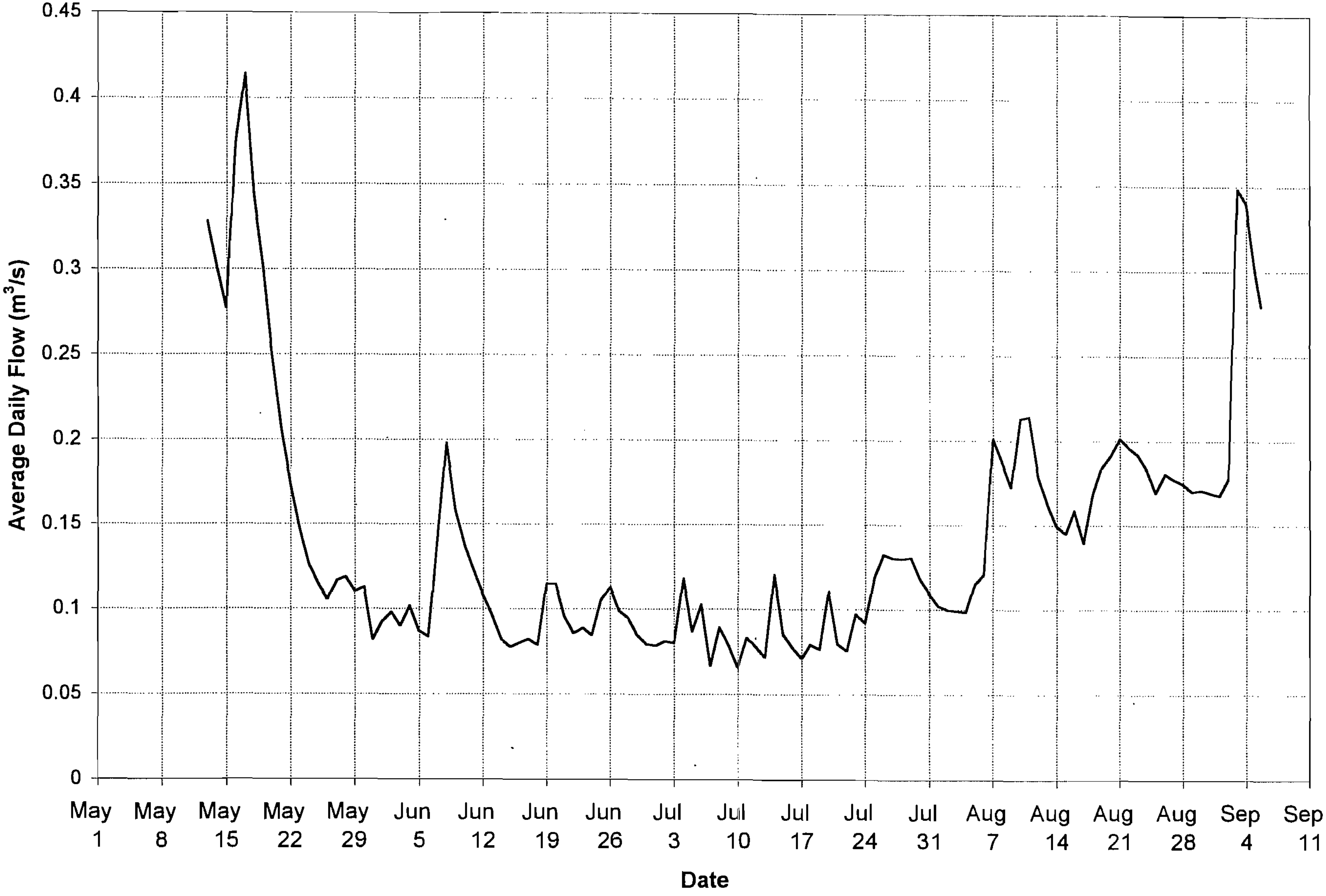
- at Elsa Valley tailings decant (2DD-S1);
- Flat Creek upstream from South McQuesten River (2DD-S9);
- South McQuesten River upstream from Flat Creek; and,
- South McQuesten River downstream from Flat Creek (2DD-S11).

UKHM hired various consultants to carry out this program from 1986 to 1990 inclusive, but no mine sponsored invertebrate sampling was conducted from 1980 to 1985 (Northern Biomes Limited, 1986; Northern Biomes Limited, 1987; Leverton and Associates, 1988; Burns 1989; and Burns 1990) Environmental Protection Services carried out biological monitoring at these and other sites in the Elsa area, in 1975, 1985 and 1990 (Environmental Protection Services, 1978; Davidge & MacKenzie Grieve, 1989; and Environmental Protection Services, 1995). UKHM contracted Laberge Environmental Services (LES) in 1994 to carry out a biological monitoring program in the Elsa area.

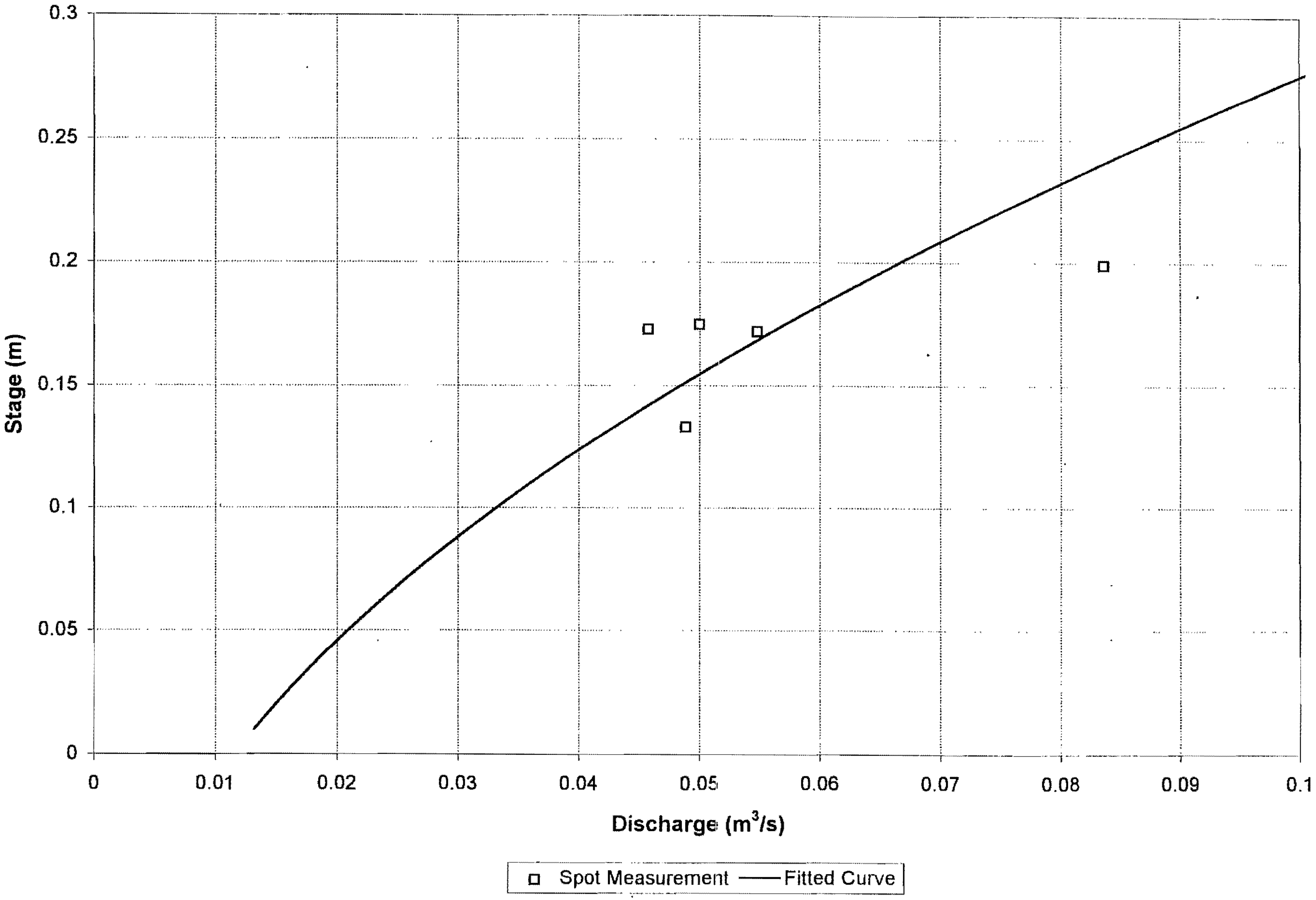
Appendix III

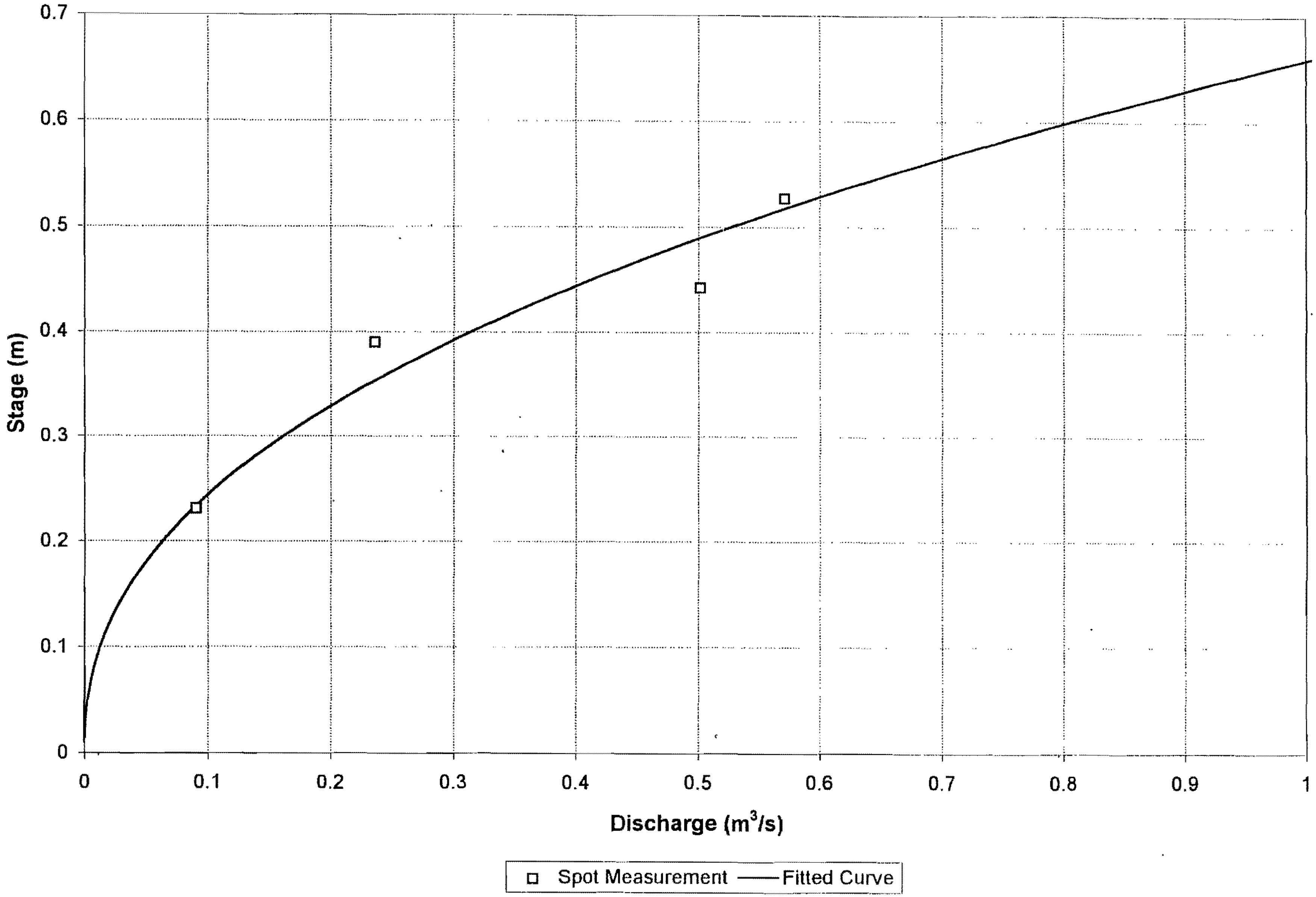
Hydrology Data

- Streamgauge Data
- Rating Curves
- Catchment Elevation, Area and Flow Data


0.45
0.4
0.35
0.3
0.25
0.2
0.15
0.1
0.05
0
Average Daily Flow (m³/s)
May 1
May 8
May 15
May 22
May 29
Jun 5
Jun 12
Jun 19
Jun 26
Jul 3
Jul 10
Jul 17
Jul 24
Jul 31
Aug 7
Aug 14
Aug 21
Aug 28
Sep 4
Sep 11
Date

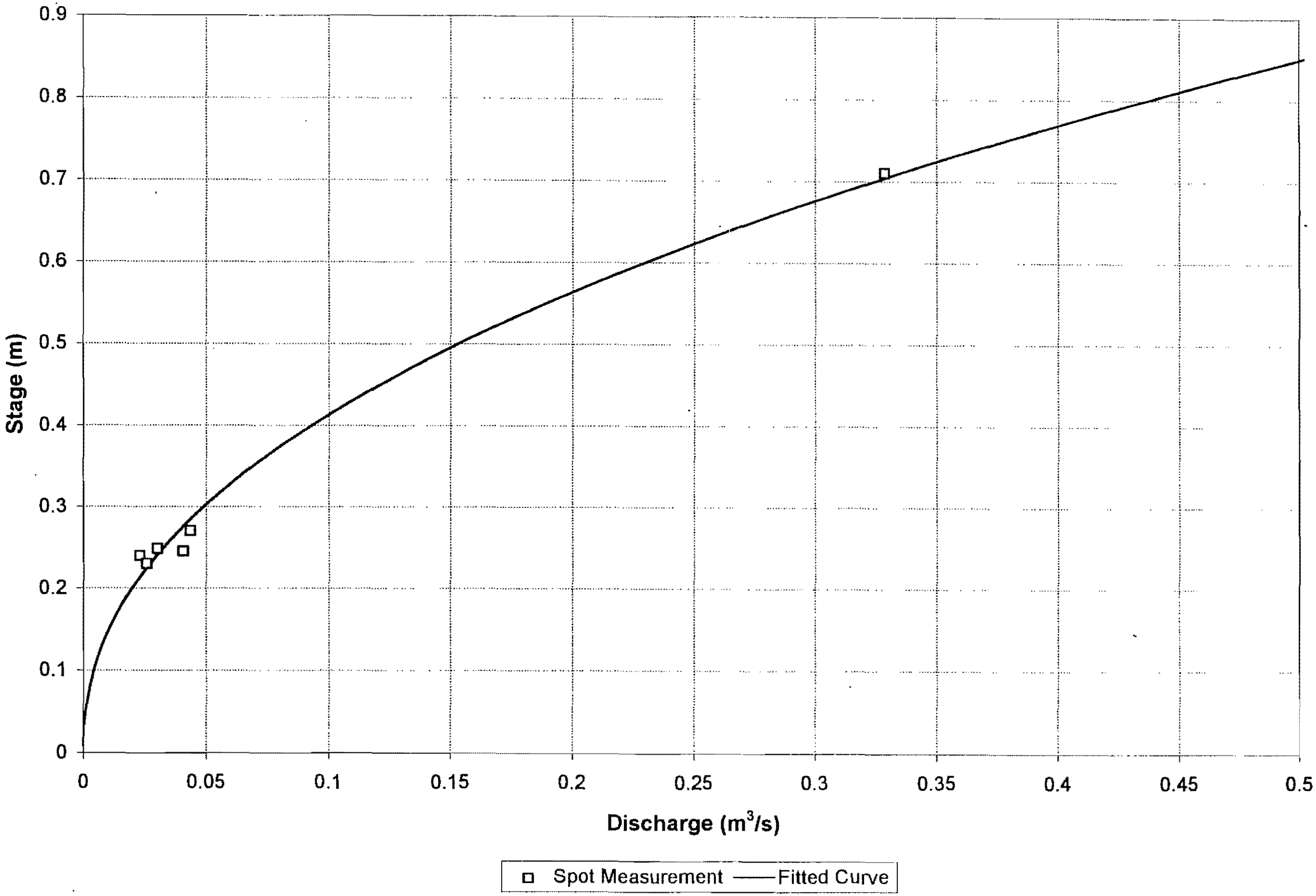
Rating Curve, Chris (Keno)



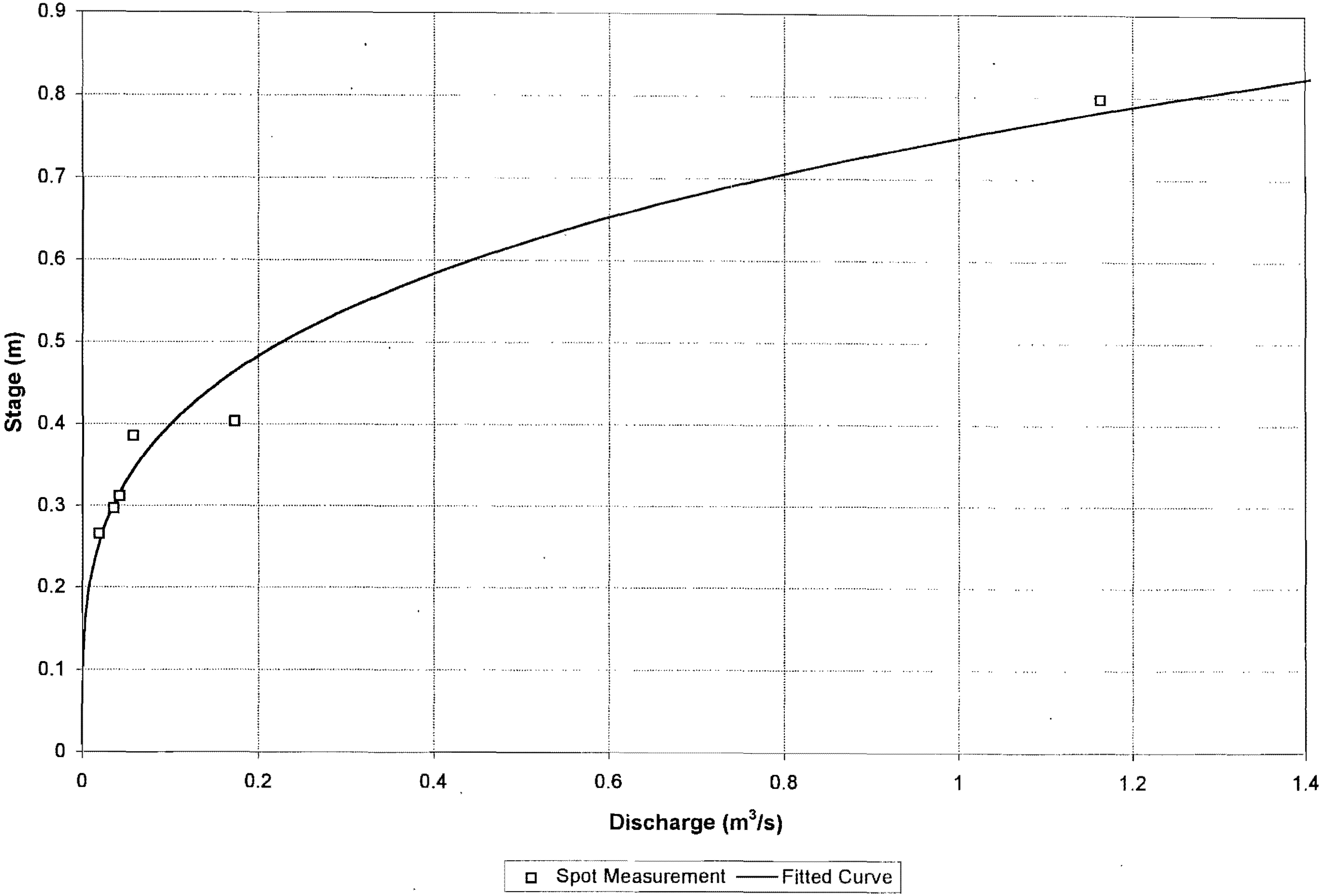


Rating Curve, H.R.

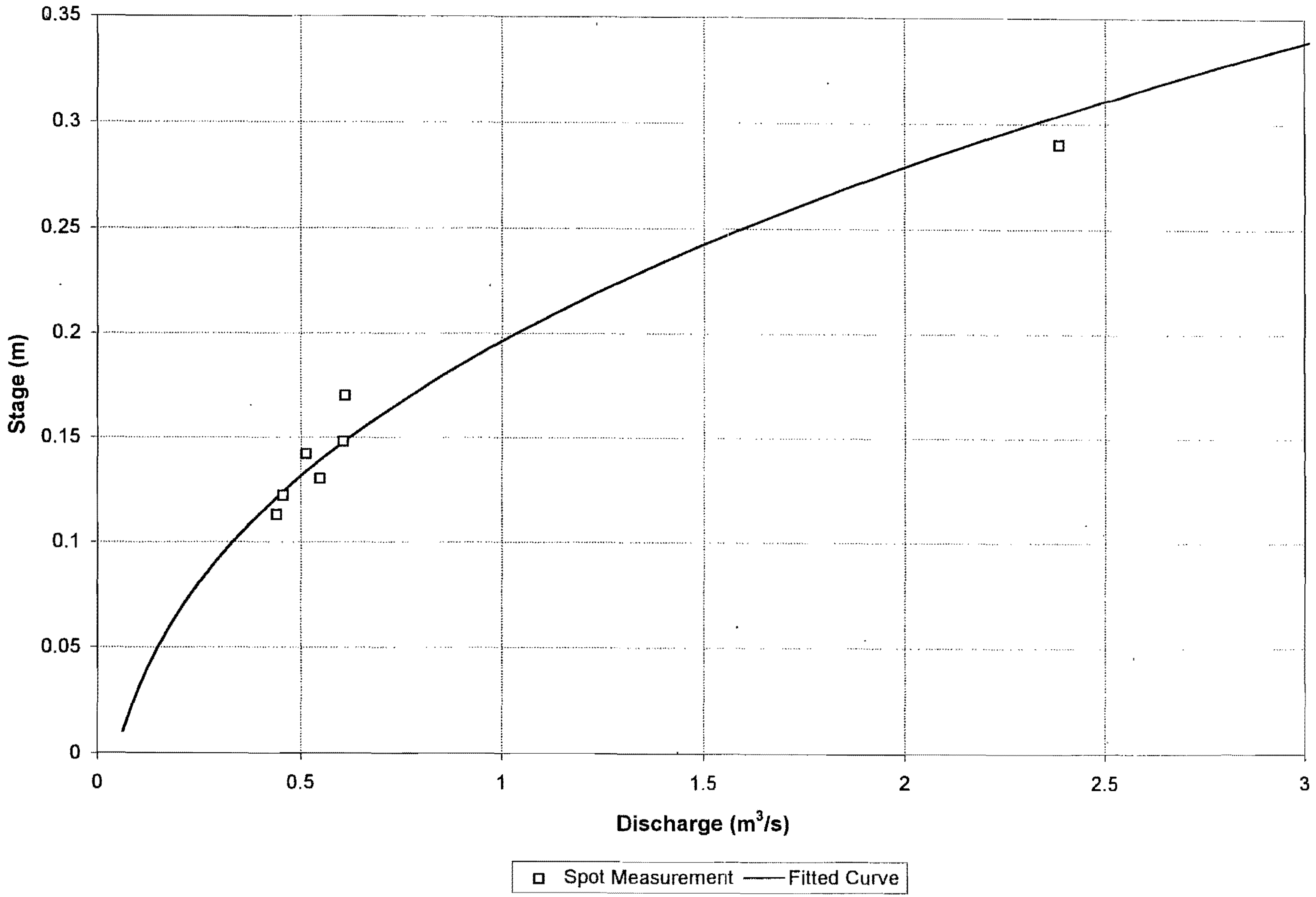
Rating Curve, Flat C.



Rating Curve, Flat (mouth)



Rating Curve, Lightning



United Keno Hill Mines Ltd.
Present-Day Water Quality Model

Details of minesite catchments:

Catchment Description	Catchment Area (km^2)	Catchment Median Elevation (m.a.s.l.)	MAR - Mean Annual Runoff (mm)
Christal Creek above Station S18	7.7	990	240
Christal Creek between Stations S19 and S18	35.8	970	230
Sandy Creek above LES-63	2.3	1180	290
No Cash Creek above LES-21	1.5	1200	300
South McQuesten River above S10 and below LES-1, S19, LES-21, and LES-63	32.9	650	150
South McQuesten River above LES-1	476	940	230
Catchment of Dam No. 3 of Elsa Tailings Impoundment	4.3	760	180
Porcupine Creek Diversion Channel above LES-47	10.1	1110	270
Galena Creek above the mouth	10.9	970	240
Flat Creek above S9 and below LES-57, LES-47, and S1	31.2	700	170
South McQuesten River above S11 and below S10 and S9	29.9	670	160
South McQuesten River above LES-5 and below S11 and LES-10	95.0	850	200
Haldane Creek above South McQuesten Road	88.8	830	200

Details of enclosed basins created by open pits:

Enclosed Basin Description	Total Catchment Area (km^2)	Catchment Median Elevation (m.a.s.l.)	MAR - Mean Annual Runoff (mm)
Open pits within catchment of Element 1 (Calumet "C" and Onek)	0.09	1180	290
Open pits within incremental catchment of Element 2 (Sime 6, Sime 4, 35 Vein, and Miller)	0.19	1280	320
Open pits within catchment of Element 3 (Western portion of Calumet 4-11 Veins)	0.05	1400	350
Open pits within catchment of Element 4 (Bermingham and Bermingham SW)	0.18	1350	340
Open pits within incremental catchment of Element 5 (Calumet 3, Calumet 2, and part of Calumet 4-11 Veins)	0.23	1380	350
Open pits within catchment of Element 8 (Silver King)	0.27	860	210

Seasonal Distributions:

Description	Jan - Mar	Apr - Jun	Jul - Sep	Oct - Dec	Annual	Source of Data/ Comment
Number of days in period	90.25	91	92	92	365.25	
Average monthly flows for minesite streams (% of MAR)	4.8	54.8	28.5	11.9	100	Distribution of WSC Station 09DD004 (McQuesten R.)
Average discharge from Galkeno 900 Adit (L/s)	5.5	8	8	6	6.9	Average of measured flows (UKHM/Govt/LES data)
Average discharge from Onek Adit (L/s)	0.23	0.32	0.35	0.32	0.31	Average of measured flows (UKHM/Govt/LES data)
Average flow from natural spring near Christal Lake (L/s)	2.5	2.5	2.5	2.5	2.5	Average of two spot measurements taken in 1995 by LE
Average discharge from Galkeno 300 Adit (L/s)	0.1	0.1	0.1	0.1	0.1	One spot measurement taken in July 1994 by LES
Average discharge from UN Adit (L/s)	0.3	0.3	0.3	0.3	0.3	Average of measured flows (UKHM/Govt/LES data)
Average discharge from Bermingham Adit (L/s)	1.2	3.6	1.6	1.5	2.0	Average of measured flows (UKHM/Govt/LES data)
Average discharge from Ruby 400 Adit (L/s)	1.2	1.5	1.9	1.5	1.5	Average of measured flows (UKHM/Govt/LES data)
Average discharge from No Cash 500 Adit (L/s)	4.1	4.1	5.1	4.1	4.4	Average of measured flows (UKHM/Govt/LES data)
Seepage from Dam No.3 of Elsa Tailings Impoundment (L/	0	0	0	0	0	No data available - assumed negligible
Average discharge from Silver King Adit (L/s)	6	8	6	6	6.5	Average of measured flows (UKHM/Govt/LES data)
Average discharge from Husky SW Adit (L/s)	3.3	3.3	3.3	3.3	3.3	Average of measured flows (UKHM/LES data)
Average discharge from Bellekeno 600 Adit (L/s)	2	2	2.5	2.5	2.3	Average of measured flows (UKHM/Govt/LES data)
Average discharge from Keno 700 Adit (L/s)	0.3	3.5	3	1.5	2.1	Average of measured flows (UKHM/Govt/LES data)
Average discharge from Lucky Queen Adit (L/s)	0.9	0.9	0.9	0.9	0.9	Average of measured flows (UKHM/Govt data)
Average discharge from Sadie Ladue Adit (L/s)	9	11	11	11	10.5	Average of measured flows (UKHM/Govt/LES data)

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE

APPLICATION QZ09-092 –

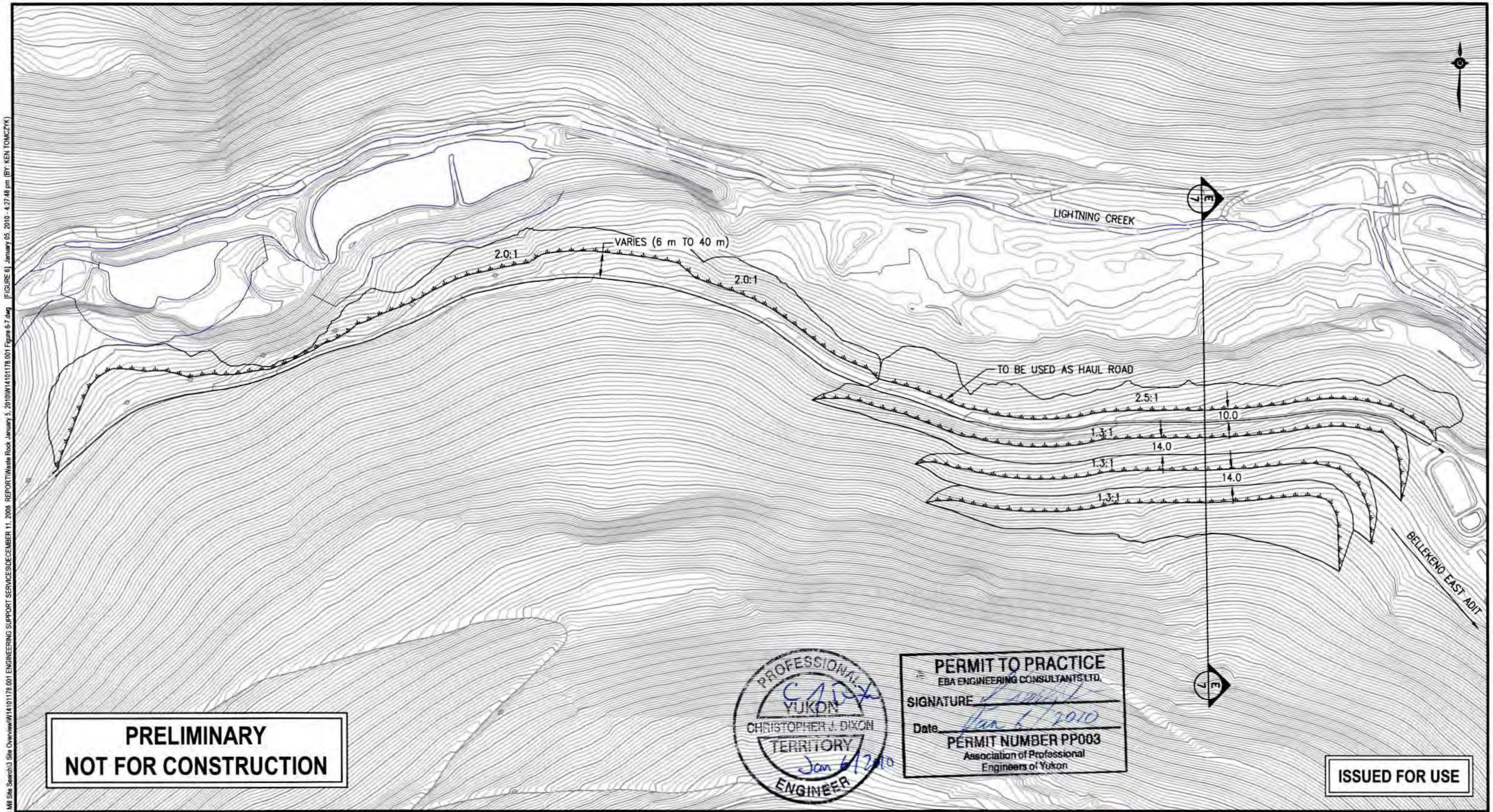
Response to Review for Adequacy and

Supplemental Information

ATTACHMENT F

(Q-77)

January 19, 2010



PRELIMINARY
NOT FOR CONSTRUCTION

CHRISTOPHER J. DIXON
Jan 6/2010

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date Jan 6/2010
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

ISSUED FOR USE

WASTE ROCK VOLUME = 200,000 m³

NOTE:
BASE PLAN PROVIDED BY
ALEXCO RESOURCE CANADA CORP.

0 100
Scale: 1: 3,000 (metres)

THIS DRAWING IS TO BE READ ONLY IN CONJUNCTION WITH REPORT "CONCEPTUAL TAILINGS AND WASTE ROCK MANAGEMENT PLANS - BELLEKENO PROJECT NEAR KENO CITY, YUKON" DATED DECEMBER 12, 2008

CLIENT
ALEXCO

EBA Engineering
Consultants Ltd.

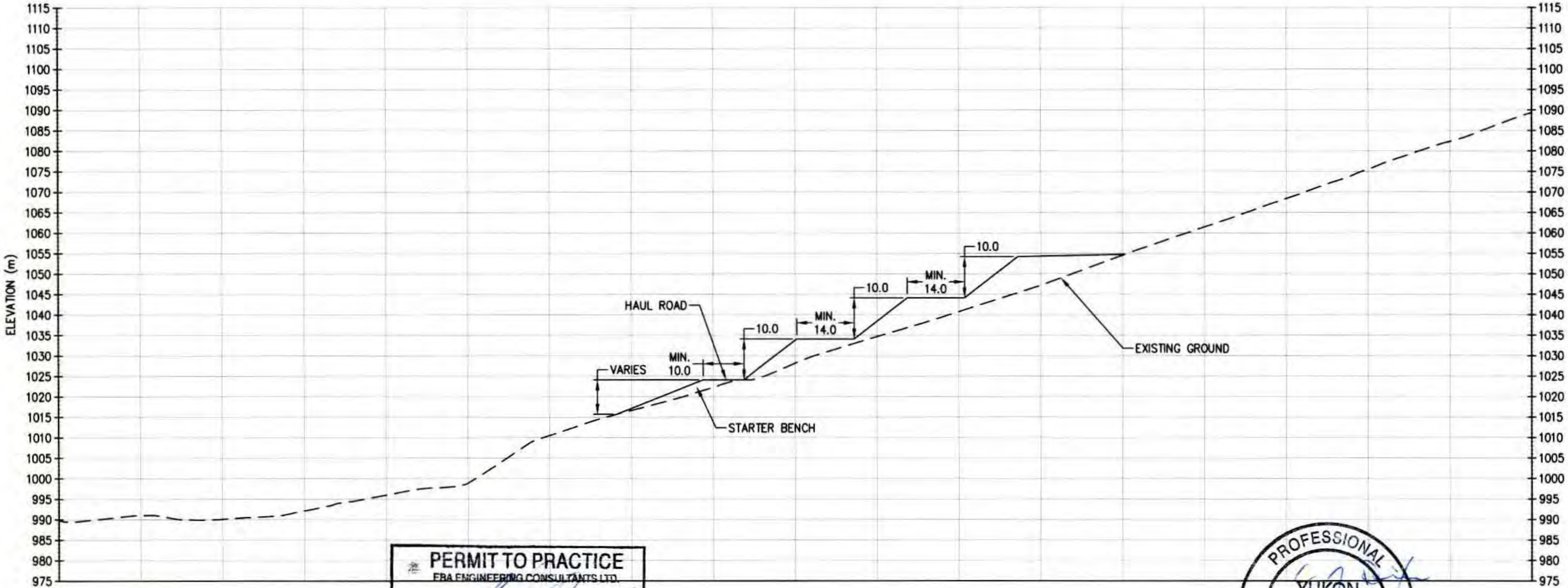
ENGINEERING SUPPORT SERVICES
BELLEKENO MINE PROJECT, YUKON

WASTE ROCK DISPOSAL AREA
PLAN

PROJECT NO	DWN	CKD	REV	
W14101178.001	KJT	CJD	2	**Figure 6**
OFFICE	DATE			
EBA-WHSE	January 5, 2010			

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.001 ENGINEERING SUPPORT SERVICES\DECEMBER 11, 2008 REPORT\Waste Rock January 5, 2010\W14101178.001 Figure 6-7.dwg [FIGURE 6] January 05, 2010 - 4:27:48 pm (BY: KEN TOMCZYK)

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.001 ENGINEERING SUPPORT SERVICES\DECEMBER 11, 2008 REPORT\Waste Rock January 5, 2010\W14101178.001 Figure 6-7.dwg [FIGURE 7] January 05, 2010 - 4:28:48 pm (BY: KEN TOMCZYK)



PRELIMINARY
NOT FOR CONSTRUCTION

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date Jan 6 /2010
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

E/6 WASTE ROCK PILE PROFILE
SCALE 1:1,000

0 50
Scale: 1: 1,000 (metres)

PROFESSIONAL ENGINEER
YUKON TERRITORY
CHRISTOPHER J. DIXON
Jan 6/2010

ISSUED FOR USE

NOTE
1. ALL UNITS IN METRES UNLESS OTHERWISE NOTED
2. BASE PLAN PROVIDED BY ALEXCO RESOURCE CANADA CORP.

THIS DRAWING IS TO BE READ ONLY IN CONJUNCTION WITH REPORT "CONCEPTUAL TAILINGS AND WASTE ROCK MANAGEMENT PLANS - BELLEKENO PROJECT NEAR KENO CITY, YUKON" DATED DECEMBER 12, 2008

CLIENT
ALEXCO

EBA Engineering
Consultants Ltd.

ENGINEERING SUPPORT SERVICES
BELLEKENO MINE PROJECT, YUKON

WASTE ROCK DISPOSAL AREA
PROFILE

PROJECT NO	DWN	CKD	REV	
W14101178.001	KJT	CJD	2	**Figure 7**
OFFICE EBA-WHSE	DATE January 5, 2010			

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT G

(Q-56)

January 19, 2010

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Galkeno 900 Sulfate-Reducing Bioreactor Interim Report

2008 Closure Studies

Prepared by:

Alexco Resource US Corp
For ERDC

June 2009

ERDC

TABLE OF CONTENTS

1. PROJECT SUMMARY

A bioreactor has been constructed in the Keno Hill mining district at the Galkeno 900 adit to demonstrate the viability of sulfate reduction technology for the removal of metals, especially zinc and other metals that react with aqueous sulfide. The bioreactor solid phase substrate is coarse rock from a nearby placer mining operation. The organic substrate includes dissolved organic carbon forms, with sugars, alcohols and complex carbohydrates and proteins from milk being used during the growth phase of the bioreactor operation. The purpose of the organic substrate is to support microbial growth until sulfate reduction is the predominant microbial activity in the reactor, and then to support microbial sulfate reduction, which is a microbial reaction that transfers electrons from organic carbon, causing sulfate to be reduced to sulfide. Sulfide reacts with many dissolved metals, forming very insoluble precipitates. The reactor also has the potential for other reactions to occur as a result of alkalinity being formed from the oxidation of organic carbon, and it is common to observe carbonate mineral formation within the reactor. The bioreactor demonstration is being completed under the technical guidance of James Harrington, VP Engineering and Environmental Services with Alexco Resource (US) Corp. Alexco owns six patents and has additional patents allowed and pending for the in-situ use of nutrients in earthen materials. Alexco's technologies and patents provide in-situ encapsulation technologies whereby soluble toxic metals including arsenic, copper, zinc, selenium and uranium, among other heavy metals are geochemically encapsulated by more benign minerals within the groundwater aquifer or within and down-gradient of sources of contamination such as within a pit lake, tailings impoundment, heap leach pad, earth- or rock-filled bioreactor or waste storage area.

Galkeno 900 has water chemistry and flow characteristics that are typical of several other adits in the district. The test is of sufficient scale and will be operated long enough to provide design information that will allow the design of either a large scale bioreactor or an *in situ* reduction field at several other adit drainage locations in the Keno Hill district. The test is operated in a lined bioreactor so that the performance of the technology will be assessed while still in containment, but the results of the tests (reaction rates and stoichiometry) can be extended in the design of either a lined or an unlined system. The operation of the reactor will be continued for at least the next year to demonstrate wintertime operation and compare with summertime operation for metals removal and microbial activity. During the course of the bioreactor demonstration, the conventional lime treatment system is maintained to ensure water licence discharge compliance criteria are met.

Interim results to this point show metals removal close to 88% zinc has been achieved since early May 2009 (5-6 mg/L reduced to 0.5-0.6 mg/L). Other metals have also shown substantial reductions in the same time frame: Antimony ~80% removal (0.0025 mg/L reduced to 0.0005 mg/L), arsenic ~97% reduction (0.068 mg/L reduced to 0.0015 mg/L), cadmium ~60% reduction (0.015 mg/L reduced to 0.005), cobalt ~99% reduction (0.026 mg/L reduced to 0.00015 mg/L), iron ~97% reduction (1.75 mg/L reduced to 0.032 mg/L), manganese ~98% reduction (18 mg/L reduced to 0.25 mg/L), and nickel ~80% reduction (0.2 mg/L reduced to 0.04). While zinc is the primary constituent of concern, the reduction of these other constituents will have beneficial effects in the reduction of toxicity where elevated metals have a combined toxicity more than any one metal alone.

Conservative elements show less than 10% change during passage through the bioreactor, including calcium, magnesium, silica, sodium and strontium, showing that dilution is not a significant factor causing metal removal in the reactor.

FIGURE 1. GALKENO 900 BIOREACTOR LOCATION

2. BIOREACTOR OPERATIONS

The bioreactor construction occurred in the fall 2008. The following timeline outlines the major events associated with construction and startup:

- July-August 2008: pond construction and lining (see Figures 13 and 14)
- September 2008: pond filling with placement of sand lining layer and placement of rock from placer operation (see Figures 15-17)
- October 2008: pond filling with water began October 4.
- October 2008: 200 lbs sucrose added October 10-11.
- October 2008: 110 gallons methanol and 4 lbs dried milk solids added October 16
- October 2008: covering bioreactor with geotextile and several feet soil cover.
- October 2008-present: occasional "top up" of mine water from Galkeno 900 adit discharge to maintain full conditions in bioreactor in range of 1 m^3/day
- January 2009: 110 gallons methanol added January 23
- January 2009: determination of leakage rate from bioreactor: 1.09 m^3/day
- February 2009: tank overflow and loss of ~135 m^3 water from bioreactor through tank overflow
- May 2009: began adding methanol at a rate of 1 liter per day.

2.1. OPERATIONAL DISCUSSION

The exact volume of the reactor has not yet been determined independently, but the dimensions of the reactor are approximately 100 feet x 90 feet and the depth of the water in the reactor is approximately 10 feet. With an estimated porosity of 0.35, the liquid volume is estimated to be 31,500 ft^3, or approximately 235,000 gallons (890 $m^{3)}$.

The volume and residence time of the reactor will be evaluated by injecting a soluble tracer and observing the elution rate and concentration profile. This test is planned for summer 2009.

The slow leakage rate from the reactor requires periodic refilling of the tank located between the adit discharge and the bioreactor. The leakage rate is slow enough to not affect the reactor operation, as it represents approximately 0.8% per week. Ultimately the residence time in the reactor after growth has reached a maximum is designed to be in the range of 1 week.

An upset condition occurred in the bioreactor in February 2009 resulting in the loss of 135 m^3 of bioreactor solution. The loss of 135 m^3 represented a significant loss of the flowing volume in the reactor, approximately 15% of the total volume. The upset condition was a result of a frozen anti-siphon valve. This upset condition provides valuable information for design of full scale systems in the future. Refilling the reactor with new water appeared to delay onset of sulfate reducing conditions (see discussion of bioreactor performance below).

3. BIOREACTOR PERFORMANCE

The operation of the bioreactor with respect to water chemistry changes is summarized in Table 1 (dissolved parameters), and Appendix 1, which contains all of the field data.

3.1. GENERAL PARAMETERS

The pH of the reactor did not substantially change through the operational period, with the inflow and outflow the reactor in the same range as the pH of the adit drainage. There may be a slight pH increase by passage of adit water through the bioreactor as the carbon source conversion to create alkalinity will have a small pH effect.

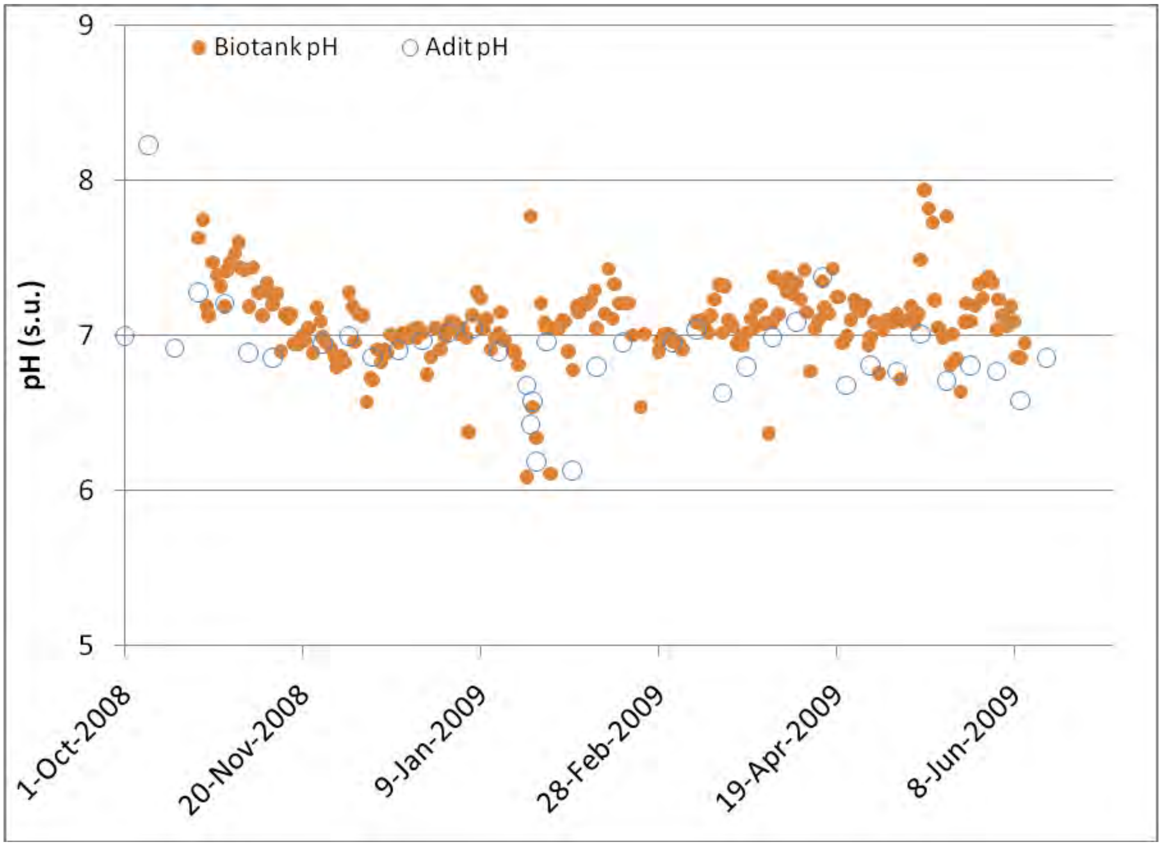


FIGURE 2. COMPARISON OF GALKENO 900 ADIT PH AND BIOREACTOR PH.

Other general parameters that have been tracked at the bioreactor include water temperature and conductivity. The conductivity measurements are not significantly different between the bioreactor and the adit discharge. The water temperature of the adit and the bioreactor shows a substantially different profile, where the bioreactor shows water temperatures to be affected by ambient air temperatures to a greater extent than the adit drainage water temperature. It is important to note that the majority of the growth phase of the bioreactor has been while the water temperature was less than 1°C, a temperature range where psychrophilic (cold-loving) microbes would be expected to be selected.

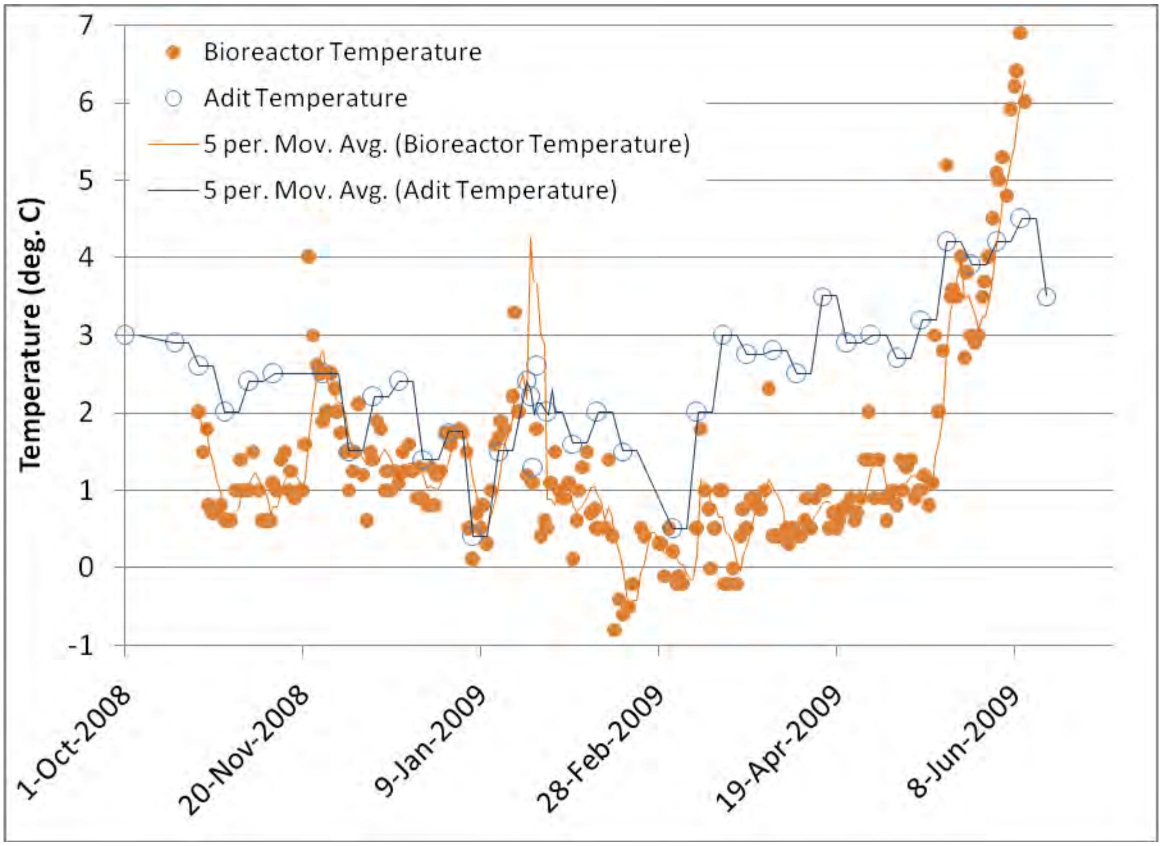


FIGURE 3. COMPARISON OF GALKENO 900 ADIT DISCHARGE WATER TEMPERATURE AND BIOREACTOR WATER TEMPERATURE.

3.2. DISSOLVED METALS

The primary metal being tracked at the Galkeno 900 bioreactor is zinc. However, other metals will contribute to the toxicity of the water, and hence the water chemistry of all dissolved metals have been evaluated. Since suspended solids are very low (due to the settling provided by the existing installed adit plug) the total metals concentrations are the essentially the same as the dissolved metals concentrations. Key metals are discussed below:

3.2.1. Zinc

The concentrations of zinc in the fill water were initially lower than the adit water used to fill the bioreactor. This can be attributed to the dilution of rainwater and snowmelt during construction and initial filling prior to covering the reactor. There may also be a minor component of attenuation of zinc by sorption onto the freshly saturated rock surfaces. However, within a few weeks, and continuing for the first 2 months thereafter, the concentration of zinc in the bioreactor was equivalent to the adit discharge.

Beginning in late January 2009, concentrations of zinc began to fall. This corresponded to development of a biological "organic-sulfide" type odor in the transfer tank. Other metals concentration began to decrease in this same timeframe, perhaps indicative of multiple mechanisms of removal (see Section 4 for further discussion of metals removal mechanisms). By mid-February, zinc removal was over 60% and this distinctive odor was often noted. The loss of bioreactor water due to icing of the antisiphon valve and the subsequent filling with adit water led to an increase in zinc concentrations for approximately 1 month, until late March. Since that time until early may there was a steady decline of zinc concentrations at a rate of approximately 0.1 mg/L per day. This steady rate is consistent with a direct or indirect biological-growth based mechanism for zinc removal, such as microbial sulfate reduction.

Figures 4 and 5 illustrate the zinc removal using onsite (total metals) and offsite laboratory data (dissolved metals), respectively. There is good agreement with the two data sets. There is also good correspondence between the standpipe sampling location and the transfer tank (Figure 5).

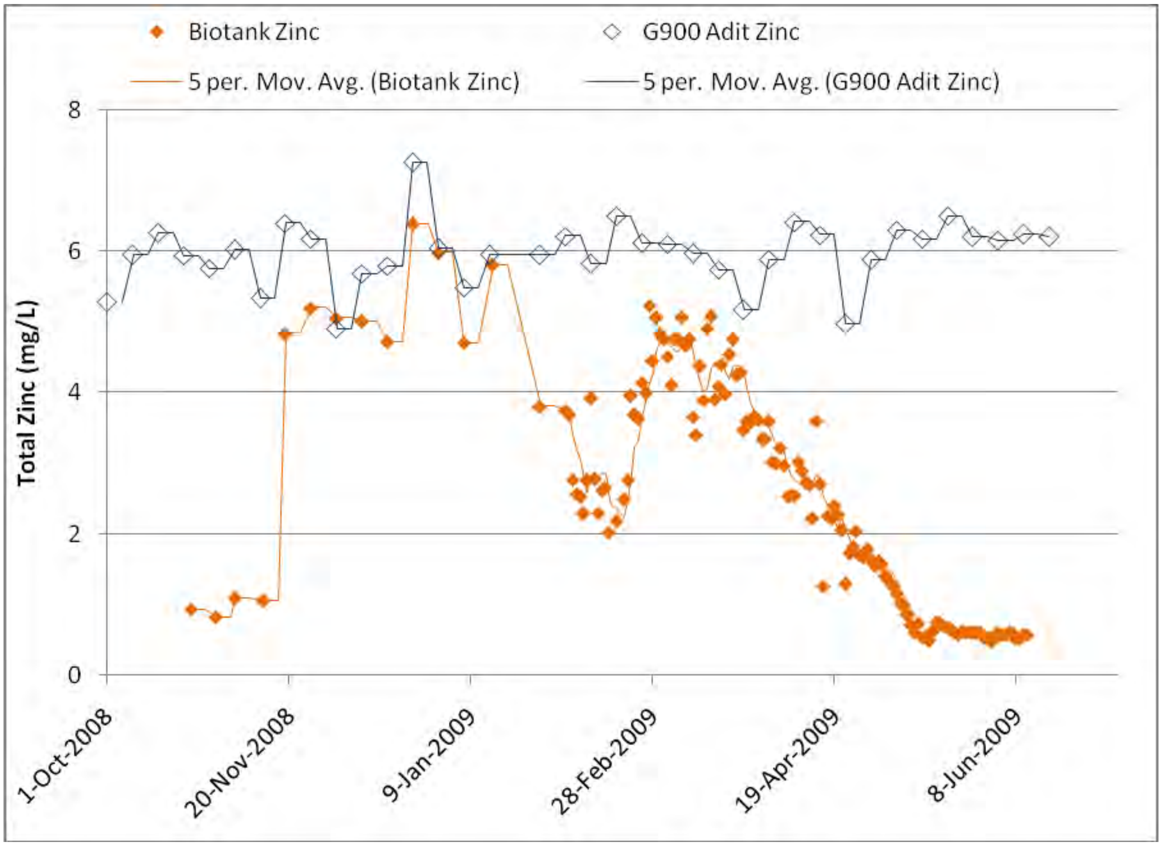


FIGURE 4. ZINC REMOVAL IN THE GALKENO 900 BIOREACTOR USING DAILY SAMPLES FROM ON SITE LAB.

Since early May 2009, the concentrations of zinc have remained constant, ranging from 0.4-0.7 mg/L. The removal of zinc in the bioreactor will be evaluated at different flow rates and as a function of organic substrate loading rates in the next year of operation.

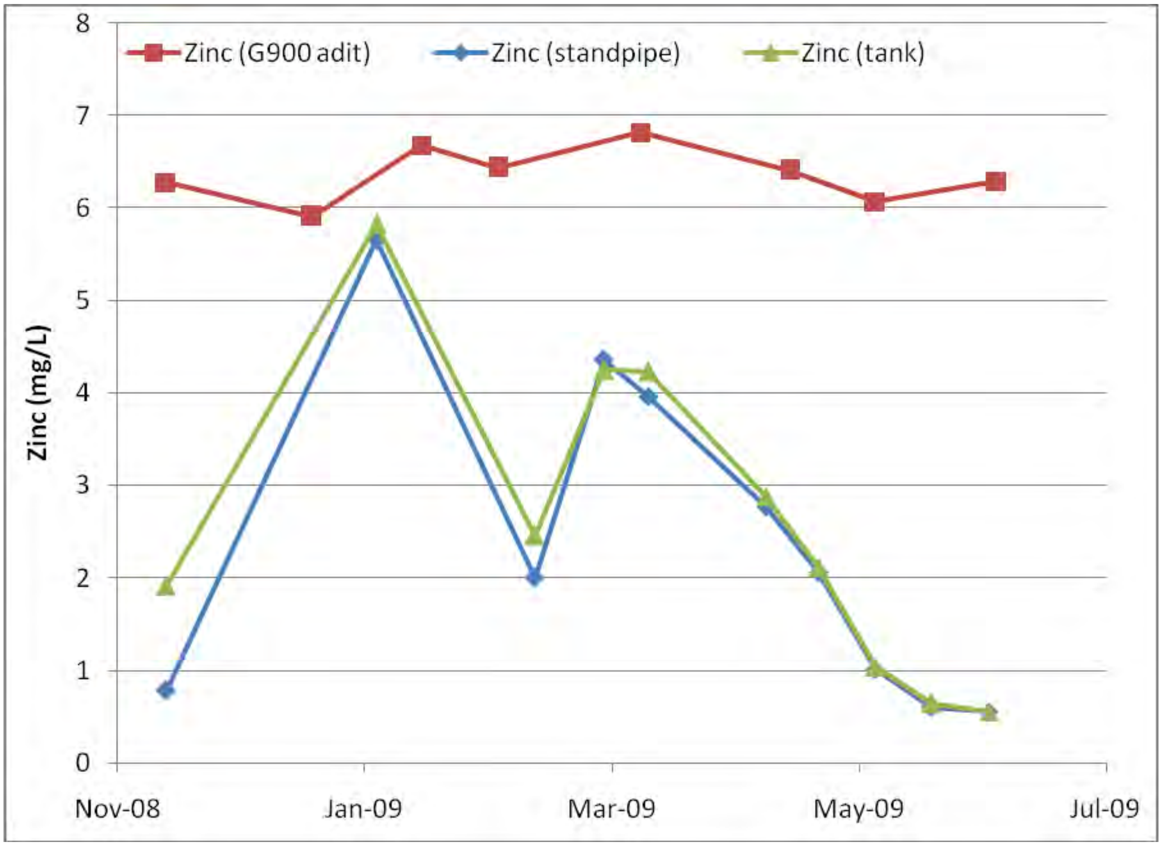


FIGURE 5. DISSOLVED ZINC REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.2. Antimony

Antimony concentrations declined approximately 80% during the test (0.0025 mg/L reduced to 0.0005 mg/L average of last 2 months) (Figure 6). Antimony removal in an organic carbon-rich reducing system is typically attributed to an antimony sulfide phase, or by sorption to iron or manganese oxides, carbonates, or sulfides that are stable in reducing conditions.

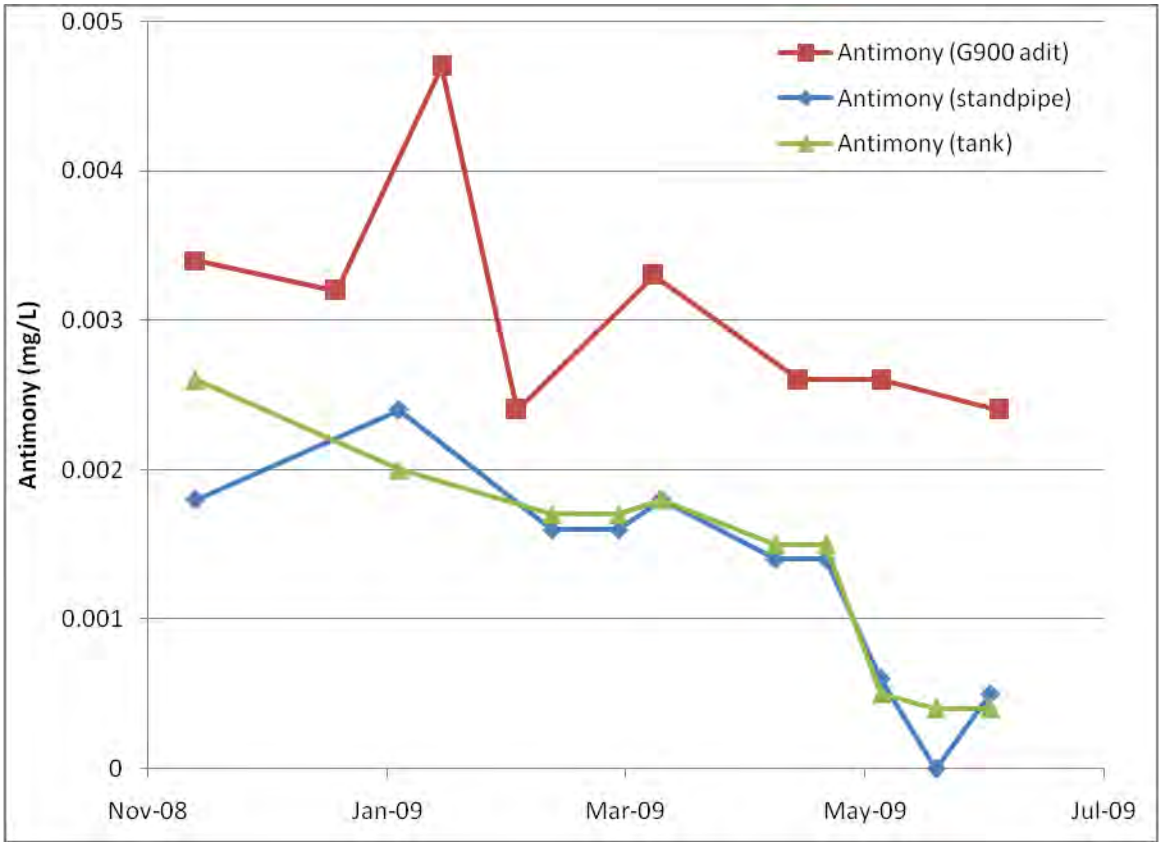


FIGURE 6. ANTIMONY REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.3. Arsenic

Arsenic concentrations declined approximately 97% (0.068 mg/L reduced to 0.0015 mg/L average of last 2 months) during passage through the bioreactor (Figure 7). Arsenic removal was substantial from the start, but improved in time, and during the last two months has consistently been between 0.002 and 0.001 mg/L. This graph points to two removal mechanisms, one likely sorptive during initial operational phase, and another precipitation or sorption mechanism that is stronger during the onset of sulfate reducing conditions.

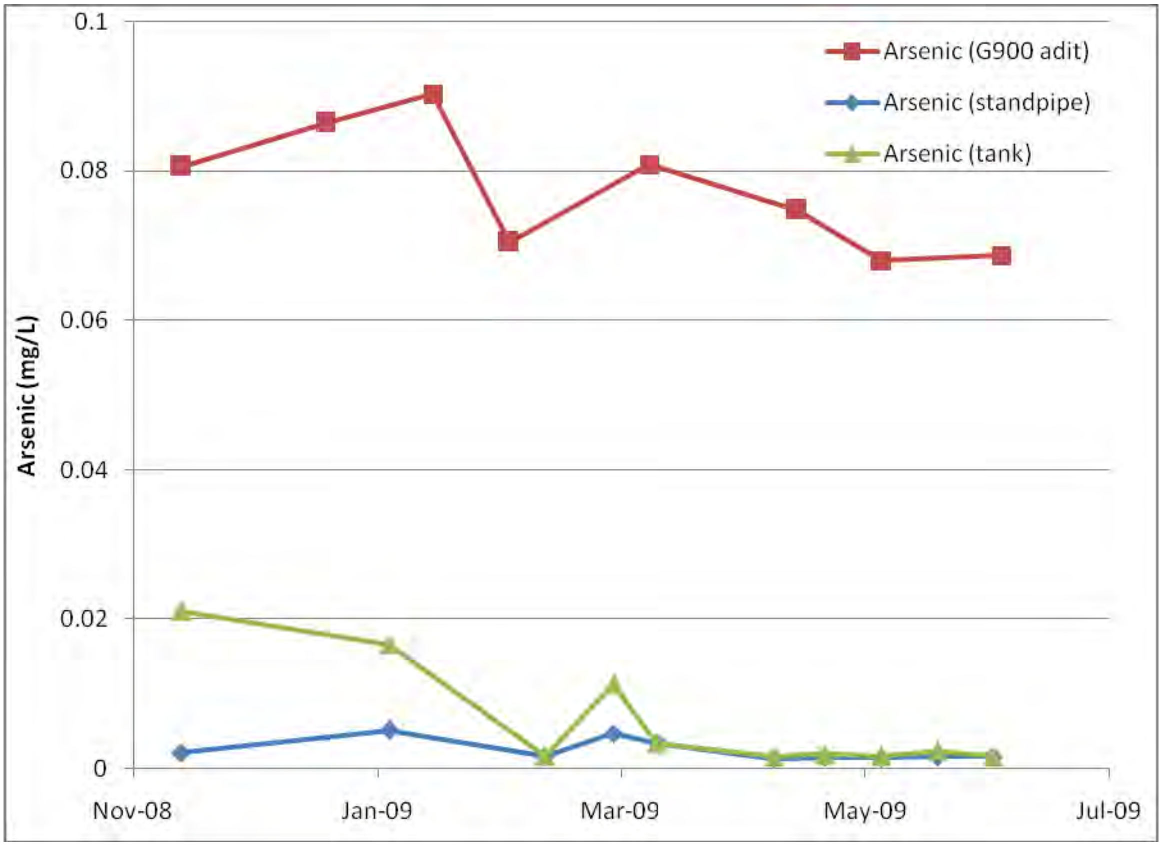


FIGURE 7. ARSENIC REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.4. Cadmium

Cadmium concentrations declined approximately 60% (0.0015 mg/L reduced to 0.0005 mg/L average of last 2 months) during passage through the bioreactor (Figure 8). It is important to note that the rock used to construct the bioreactor appears to be a minor source of cadmium, evidenced by slightly higher cadmium concentrations in the bioreactor than the drainage from the Galkeno 900 adit. Thus the last few samples represent over 80% decrease from the baseline concentrations.

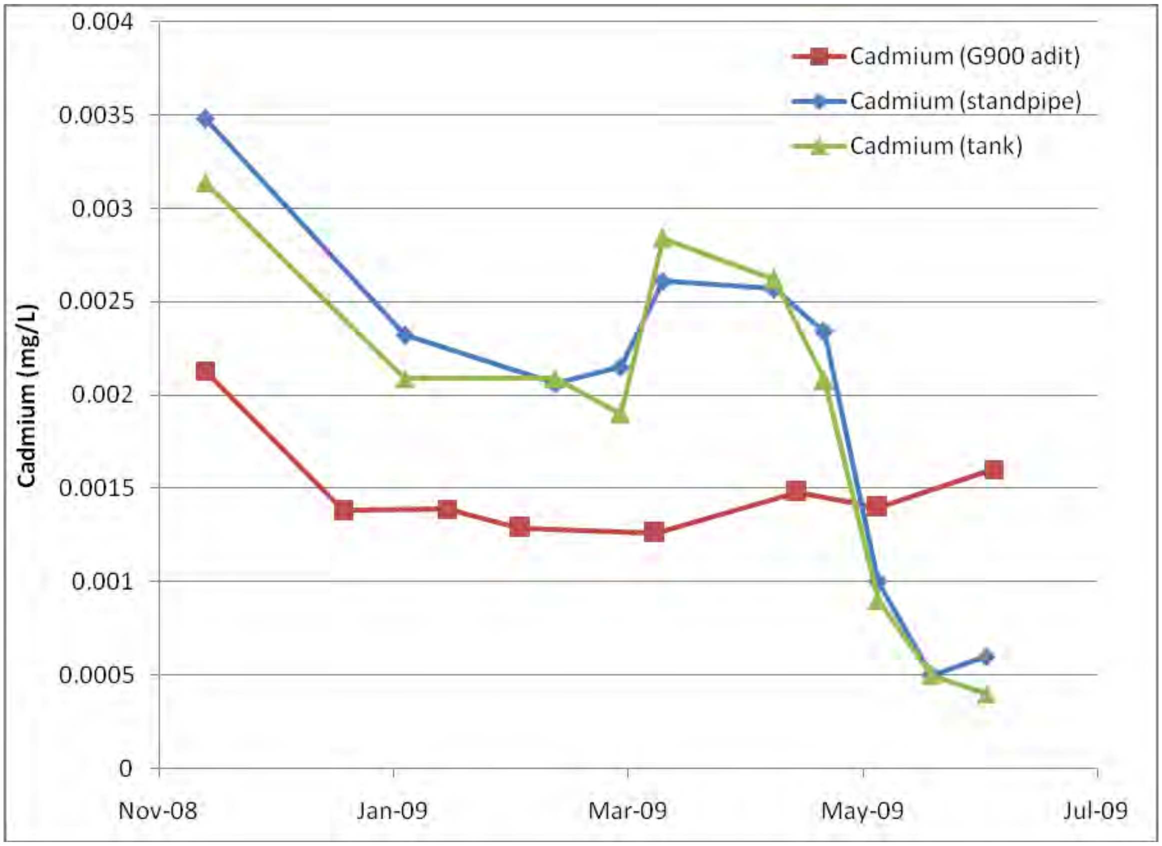


FIGURE 8. CADMIUM REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.5. Cobalt

Cobalt concentrations declined approximately 99% (0.026 mg/L reduced to 0.00015 mg/L average of last 2 months) during passage through the bioreactor (Figure 9). Similar to other metals, cobalt removal coincides with formation of biological activity and sulfate reduction.

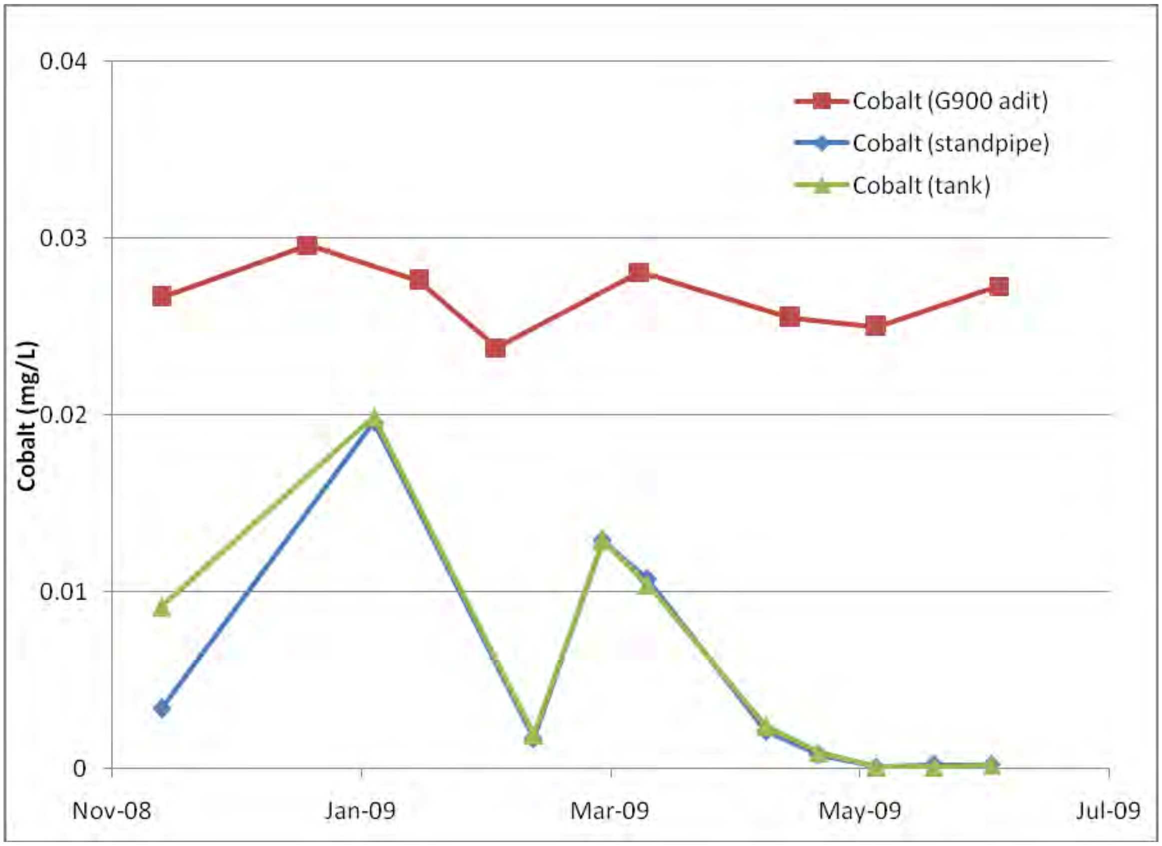


FIGURE 9. COBALT REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.6. Iron

Iron concentrations declined approximately 97% reduction (1.75 mg/L reduced to 0.032 mg/L average of last 2 months) during passage through the bioreactor (Figure 10). Similar to arsenic, iron appears to be removed by two mechanisms, one operational immediately in the bioreactor, which implies sorption on the substrate rock or precipitation as an oxide. During the formation of stronger reducing conditions in the last two months, iron removal has continued, but more to a greater extent than in the initial phases of operation.

Iron removal in the bioreactor has important effects for other metals. Iron oxides have good sorption capacity for trace metals. Iron sulfides in their initial amorphous precipitate form (operationally called "acid volatile sulfides" or AVS) provide a sink for sulfide that is a source for preferential reaction with other metals that form more insoluble sulfides than AVS. As such, it provides an important insurance phase during operation of the bioreactor, that if the bioreactor runs out of organic carbon due to imperfect supply, the AVS pool provides continued metals removal capacity, and helps maintain reducing conditions within the bioreactor. The iron in the bioreactor will be the subject of additional study after the test bioreactor is complete.

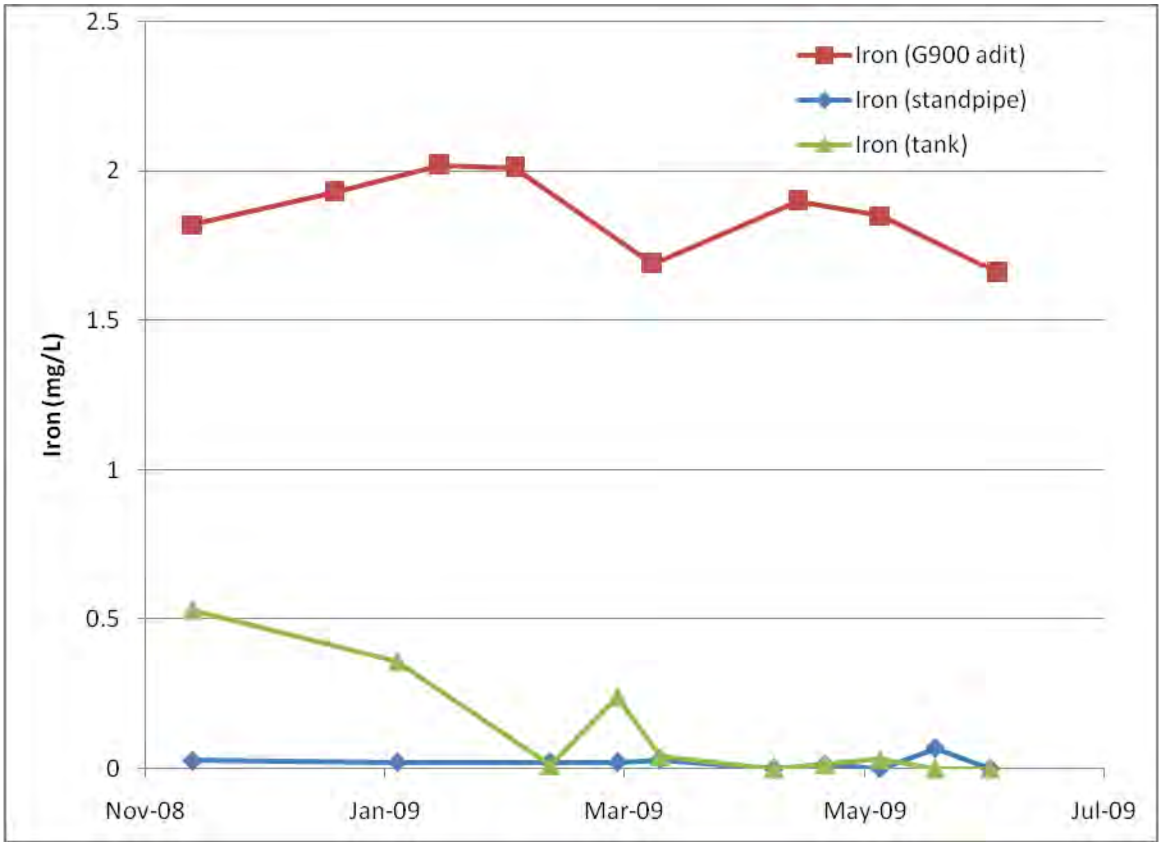


FIGURE 10. IRON REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.7. Manganese

Manganese concentrations declined approximately 98% reduction (18 mg/L reduced to 0.25 mg/L average of last 2 months) during passage through the bioreactor (Figure 11). Interestingly, manganese removal appears to coincide with the formation of biological activity, including sulfate reduction. It is often thought that manganese will be soluble in reducing conditions, such as are being generated in the bioreactor, because manganese sulfides do not rapidly form. As a consequence, manganese sinks in the bioreactor are considered to be more likely carbonates than oxides. The fact that the March data point was the same for the adit discharge and the two bioreactor locations, when the bioreactor was at its most oxidized form due to the siphoning of some of the reactor out and refilling with adit water, indicates that it is not an oxide form that is removing the manganese, but that some secondary effect of sulfate reduction, perhaps formation of bicarbonate, is responsible for the enhanced removal of manganese under reducing conditions.

Similar to iron, manganese removal in the bioreactor has important effects for other metals. Manganese carbonates and oxides have good sorption capacity for trace metals. These manganese minerals will sorb trace metals such as zinc without releasing them if the pH becomes mildly acidic, making them a more permanent sink than even iron forms. Manganese precipitates may play a significant role in the removal of metals in the bioreactor. This will be studied further after the reactor operations are complete.

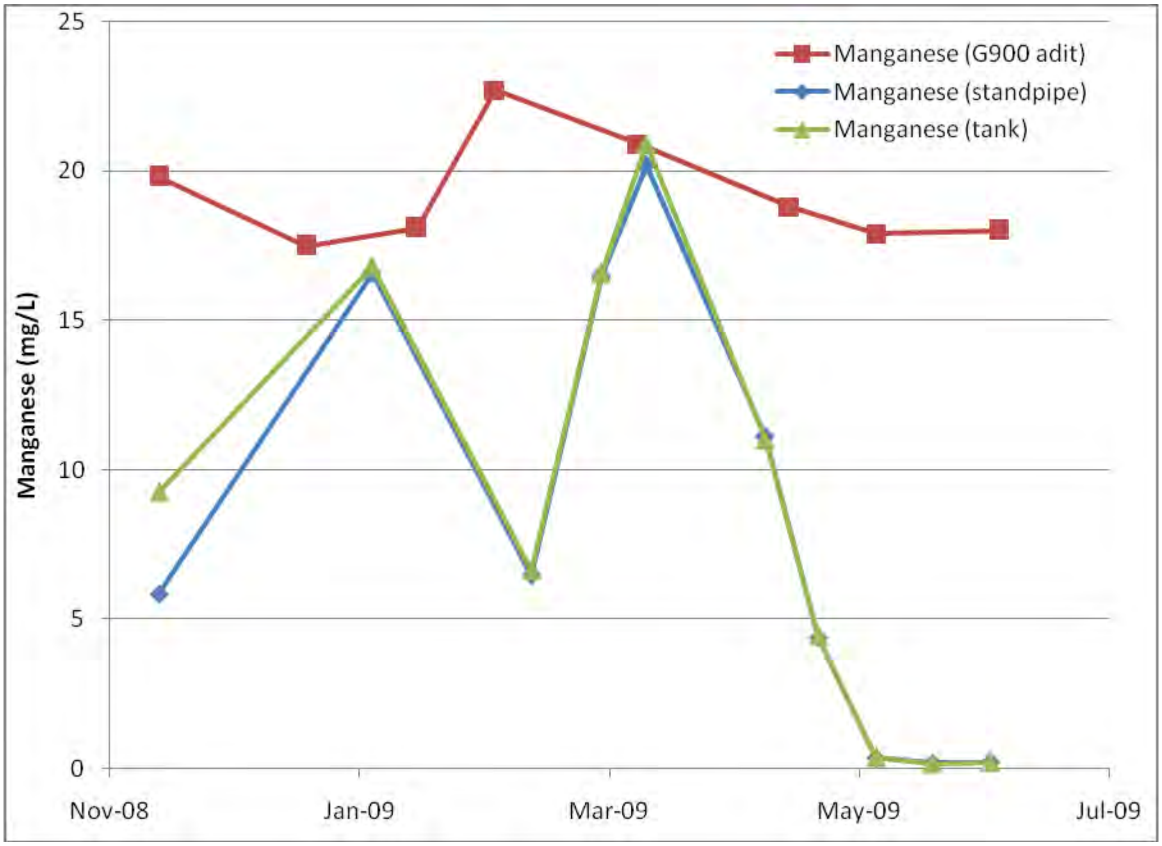


FIGURE 11. MANGANESE REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.8. Nickel

Nickel concentrations declined approximately 80% (0.2 mg/L reduced to 0.04 average of last 2 months) during passage through the bioreactor (Figure 12).

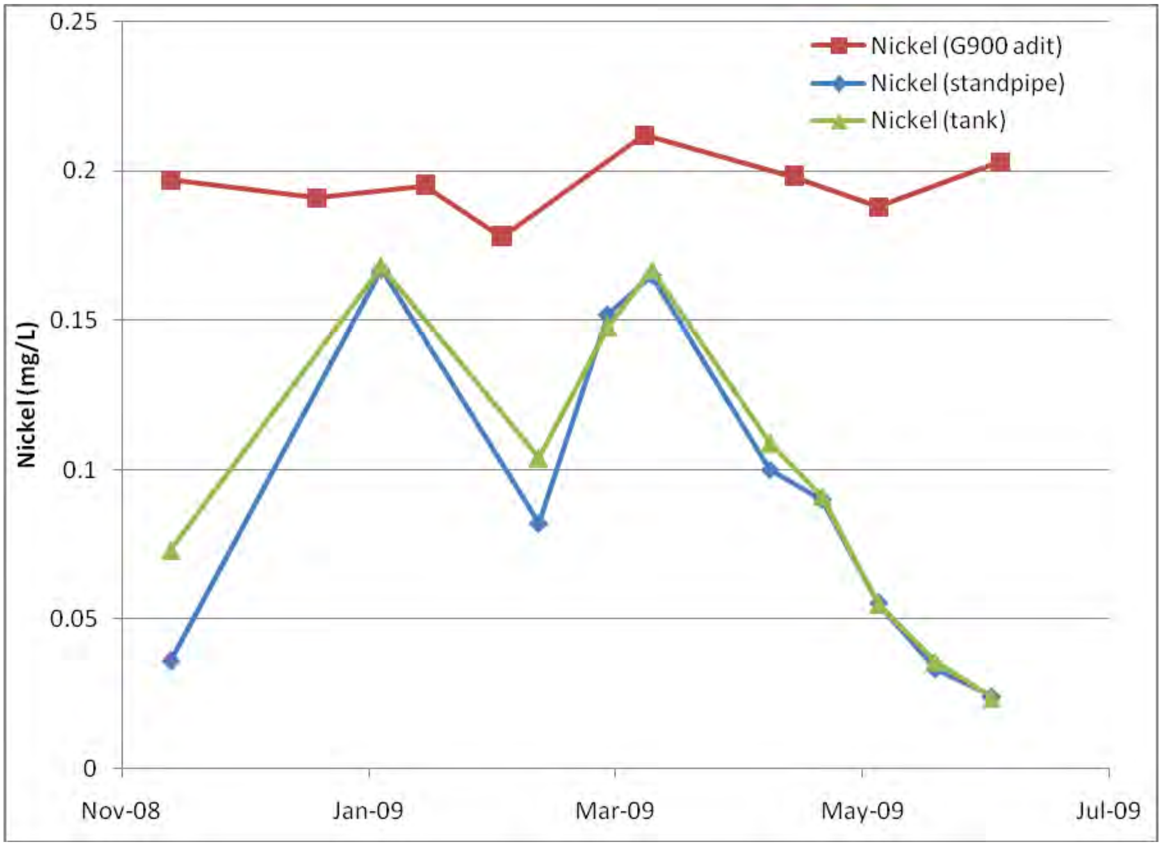


FIGURE 12. NICKEL REMOVAL IN THE GALKENO 900 BIOREACTOR, MONTHLY SAMPLES FROM OFFSITE COMMERCIAL LAB.

3.2.9. Major Cations

Conservative elements show less than 10% change during passage through the bioreactor, including calcium, magnesium, silica, sodium and strontium. These data (Table 1) indicate that dilution is not a significant factor causing metal removal in the reactor in the last few months. The minor amount of calcium removal may indicate its participation in a carbonate precipitation phase in the reactor.

4. METALS REMOVAL MECHANISMS

The formation of metal precipitates in bioreactors has been extensively studied. One "reversible" mechanism often attributed to removal of metals is sorption to organic matter. Because only coarse rock was used as a solid substrate, this mechanism can be dismissed as relevant for the bioreactor performance.

Two classes of metals removal can be broadly described from this preliminary data. In general, metals that showed substantial removal throughout the test include arsenic and iron. Other metals showed initial reduction beginning in January-February when reducing conditions began to be observed in the bioreactor, then removal efficiency was reversed during the siphoning incident, and then the best efficiency was achieved in the last two months when sulfate reducing conditions became apparent in the reactor. Metals in this latter category include zinc, manganese, and trace metals antimony, cadmium, cobalt, and nickel.

Because the products of the sulfate reduction reaction include both sulfide and bicarbonate alkalinity, it is possible that one product or the other is a primary reactant in the precipitation of these metals. Metals that readily form very insoluble sulfides include antimony, arsenic, cadmium, cobalt, iron, nickel, and zinc. Thus it is at least a likely candidate removal mechanism for these metals. As noted in the discussion of both iron and manganese results, the oxides, carbonates, and sulfides formed with these metals are themselves efficient at sorptive removal of trace metals. However, the sulfide removal mechanism is a preferred mechanism when both mechanisms are present because sulfide forms stronger complexes and more insoluble precipitates.

Now that the bioreactor has achieved some level of metal removal capacity, several tests will be undertaken to enhance our understanding of how the bioreactor performance can be maximized. In these tests the results may also help us understand the mechanisms of metal removal even better.

The planned tests for the 2009-2010 work plan will include the following:

- Dye tracer study, which will help evaluate the current residence time in the bioreactor, the amount of short circuiting or dead zones in the bioreactor, and the reactive volume in the reactor.
- Increased dosing of the organic carbon substrate into the reactor until residual organic carbon levels (TOC) in the reactor discharge is over 10 mg/L, or until 2 mg/L residual sulfide is in the reactor discharge. This will determine the theoretical minimum metals concentrations that can be achieve in the reactor. This increased loading rate of substrate will also help maximize the microbiological activity for the step test.
- A step test, where the adit discharge addition to the bioreactor is increased in 2 month increments until metals removal is not effective.
- Metals removal as a function of water temperature will be continuously assessed, as will the bioreactor physical performance during the wintertime months.

These tests will be largely completed in the 2009-2010 work year.

Some scientific papers that may help explain some of the metals removal mechanisms in the bioreactor include the following:

- Stahl and James (1990) “Zinc Sorption by Manganese-Oxide-Coated Sand as a Function of pH” (Soil Science Society of America Journal, vol 55, pgs 1291-1294) evaluates sorption of zinc to manganese oxides coating sand particles. Key findings that relate to Keno include the observation that at low pH, the zinc was primarily in an exchangeable form, but at higher pH, the zinc was primarily in a non-exchangeable form. The mechanisms proposed to account for the nonexchangeable retention of Zn at pH greater than 7 (which is typical for the bioreactor) on oxide-coated sand surfaces were hydrolysis of the Zn followed by chemisorption to the oxide surface. This is a very stable form of storage of zinc, not readily reversible.
- Negra et al, 2005 “Soil Manganese Oxides and Trace Metals: Competitive Sorption and Microfocused Synchrotron X-ray Fluorescence Mapping (Soil Science Society of America Journal, vol 69, pgs 353-361). Manganese oxides have been found to specifically adsorb weakly hydrated cations, commonly in the order of preference Pb > Cu > Mn > Co > Zn > Ni, and their sorption is still strong even in acidic conditions. In neutral pH conditions associated with the bioreactor, the sorption to manganese oxides and their conversion to stable manganese oxide nodules is a possible permanent sink for trace metals.
- Podda et al, 2000, titled “Heavy Metal Coprecipitation with Hydrozincite [$Zn_5(CO_3)_2(OH)_6$] from Mine Waters Caused by Photosynthetic Microorganisms” (Applied and Environmental Microbiology, vol 66, pgs 5092–5098) describes the significance of hydrozincite in attenuating zinc and other heavy metals in a stream environment, where 92% zinc removal was observed in a particular stream reach, and hydrozincite was documented as the key precipitate accounting for this significant attenuation. The inputs of alkalinity from natural and photosynthetic sources substantially enhanced the process; in a similar way the bioreactor producing alkalinity may make this attenuation mechanism significant in the bioreactor.
- Labrenz et al (2000) “Formation of Sphalerite (ZnS) Deposits in Natural Biofilms of Sulfate-Reducing Bacteria” (Science, vol 290, pgs 1744-1747) showed that an accumulation of zinc as a sphalerite mineral (ZnS) in biofilms can cause zinc attenuation from liquid to solid phase by a factor of 10^6. Where organic carbon is readily available, such as in the bioreactor, and sulfate is readily available, sulfate reduction as a mechanism for zinc precipitation in the bioreactor is a likely mechanism.

Based on these references, the precipitates in the bioreactor are likely to be stable as long as they remain undisturbed. The stability of metal-oxide associated zinc, both for iron oxides and manganese oxides, is also good at neutral to alkaline pH which will be associated with pore waters associated with the bioreactor. The zinc sulfide formation in the bioreactor and the precipitation of carbonate minerals associated with the zinc sulfide will enhance its permanence. The permanence of the zinc and other trace metals precipitates will be specifically assessed at the completion of the bioreactor operation.

5. BIOREACTOR CONSTRUCTION PHOTOS

FIGURE 13. SHOWS LINER AND INITIAL LOADING OF COARSE STREAMBED (PLACER) ROCK INTO THE LINED REACTOR.

FIGURE 14. SHOWS LINER AND INITIAL LOADING OF COARSE STREAMBED (PLACER) ROCK INTO THE LINED REACTOR.

FIGURE 15. PLACEMENT OF ROCK IN REACTOR. NOTE LINER BAFFLE ON THE LEFT, DRAINPIPE IN THE CENTER BOTTOM.

FIGURE 16. PLACEMENT OF ROCK WITHIN BIOREACTOR. NOTE SAMPLING STANDPIPE IN CENTER OF PICTURE.

FIGURE 17. GEOTEXTILE PLACEMENT PRIOR TO COVER MATERIAL PLACEMENT.

TABLE 1. DISSOLVED CONSTITUENT CONCENTRATIONS FOR FIRST 8 MONTHS BIOREACTOR OPERATION.

Station Name	Sample Date	Al-D mg/L	As-D mg/L	Sb-D mg/L	Ba-D mg/L	Cd-D mg/L	Ca-D mg/L	C-TOC mg/L	Co-D mg/L	Hard-D mgCaCO3/L	Fe-D mg/L	Li-D mg/L	Mg-D mg/L	Mn-D mg/L	Ni-D mg/L	P-D mg/L	K-D mg/L	Si-D mg/L	Na-D mg/L	Sr-D mg/L	S-D mg/L	SO4-D mg/L	U-D mg/L	Zn-D mg/L	Sulphide mg/L
KV-31	11/13/2008	0.022	0.0806	0.0034	0.007	0.00213	359		0.02666	1040	1.82	0.053	36	19.8	0.197	<0.01	0.6	3.54	1.6	0.466			0.0084	6.28	
KV-31	12/19/2008	0.015	0.0864	0.0032	0.009	0.00138	398		0.0296	1120	1.93	0.069	31.9	17.5	0.191		0.6	3.75	1.6	0.449	324		0.0095	5.91	
KV-31	1/15/2009	0.01	0.0903	0.0047	0.008	0.00139	413		0.0276	1020	2.02	0.067	33.1	18.1	0.195		0.7	3.9	2.8	0.467	331		0.0099	6.68	
KV-31	2/3/2009	<0.005	0.0705	0.0024	0.007	0.00129	369		0.0238	1060	2.01	0.054	34.4	22.7	0.178	<0.01	0.8	3.39	1.6	0.487	369		0.0089	6.44	
KV-31	3/10/2009	<0.005	0.0809	0.0033	0.008	0.00126	328		0.0281	959	1.69	0.054	33.8	20.9	0.212	<0.01	0.6	3.39	1.5	0.494	284		0.009	6.82	
KV-31	4/16/2009	0.006	0.0748	0.0026	0.008	0.00148	437		0.0255	1240	1.9	0.06	37.7	18.8	0.198	<0.01	0.73	4.35	1.87	0.463	380		0.0095	6.41	
KV-31	5/7/2009	0.005	0.068	0.0026	0.0084	0.0014	422		0.025	1210	1.85	0.057	39	17.9	0.188		<1	4.11	2	0.453	365		0.00937	6.07	
KV-31	6/6/2009	0.014	0.0687	0.0024	0.0079	0.0016	418		0.0273	1210	1.66	0.057	39	18	0.203		<1	4.28	2	0.449	371		0.00938	6.29	
Bio-pipe	11/13/2008	0.006	0.0021	0.0018	0.041	0.00348	349	108	0.0034	1050	0.026	0.03	44.1	5.85	0.036	<0.01	1.6	3.79	2.7	0.493		844	0.0152	0.78	<0.005
Bio-pipe	1/4/2009	0.01	0.0051	0.0024	0.017	0.00232	408	1.1	0.0196	1200	0.02	0.061	33.1	16.6	0.167	<0.05	0.8	3.84	1.8	0.484	329	1460	0.0104	5.65	<0.005
Bio-pipe	2/12/2009	<0.005	0.0016	0.0016	0.015	0.00206	414	240	0.0017	1200	0.02	0.042	41.4	6.47	0.082	<0.01	0.8	3.55	1.8	0.438	319	989	0.0087	2	<0.005
Bio-pipe	3/1/2009	<0.005	0.0047	0.0016	0.014	0.00215	413	35.9	0.0129	1200	0.02	0.053	41.1	16.5	0.152	<0.01	0.8	3.81	1.7	0.461	308	925	0.009	4.36	<0.005
Bio-pipe	3/12/2009	<0.005	0.0034	0.0018	0.02	0.00261	346	7.8	0.0107	1020	0.03	0.048	37.8	20.2	0.165	<0.01	0.8	3.56	1.6	0.519	298	977	0.0119	3.96	<0.005
Bio-pipe	4/10/2009	<0.005	0.0013	0.0014	0.017	0.00257	408	2.5	0.00214	1200	<0.01	0.042	45.2	11.1	0.1	<0.01	1.1	4.37	2.1	0.449	323	152	0.0103	2.77	<0.005
Bio-pipe	4/23/2009	0.005	0.0015	0.0014	0.019	0.00234	413	2.4	0.0008	1190	0.014	0.047	39.3	4.39	0.09	<0.01	0.95	4.35	1.85	0.459	354	840	0.0109	2.06	0.007
Bio-pipe	5/7/2009	<0.004	0.0014	0.0006	0.0183	0.001	408	2	0.0001	1190	<0.02	0.043	40	0.358	0.0553		<1	4.19	2	0.444	353	940	0.011	1.01	0.005
Bio-pipe	5/21/2009	<0.004	0.0016	<0.0004	0.0165	0.0005	383	2.4	0.0002	1110	0.067	0.037	37	0.178	0.0333		<1	4.2	2	0.425	328	970	0.0114	0.597	<0.005
Bio-pipe	6/4/2009	0.006	0.0016	0.0005	0.0216	0.0006	402	3.1	0.0002	1180	<0.02	0.042	42	0.212	0.0241		1	4.42	2	0.471	348	930	0.0127	0.553	0.006
Bio-tank	11/13/2008	0.007	0.0211	0.0026	0.032	0.00314	355	77.6	0.00916	1060	0.53	0.04	42.4	9.26	0.073	<0.01	1.3	3.78	2.4	0.511		890	0.014	1.909	<0.005
Bio-tank	1/4/2009	<0.005	0.0166	0.002	0.016	0.00209	411	<0.5	0.0199	1150	0.36	0.061	33.3	16.8	0.168	<0.05	0.8	3.85	1.8	0.483	331	1470	0.0105	5.83	<0.005
Bio-tank	2/12/2009	<0.005	0.0017	0.0017	0.016	0.00209	429	242	0.00192	1250	0.01	0.042	43.1	6.64	0.104	<0.01	0.8	3.75	1.8	0.48	327	908	0.0102	2.46	<0.005
Bio-tank	3/1/2009	<0.005	0.0113	0.0017	0.012	0.0019	411	36.1	0.0129	1190	0.24	0.048	40.7	16.6	0.148	0.02	0.8	3.66	1.7	0.45	306	894	0.0095	4.25	<0.005
Bio-tank	3/12/2009	<0.005	0.0034	0.0018	0.018	0.00284	367	8.1	0.0104	1080	0.04	0.05	39.9	20.9	0.167	<0.01	0.9	3.73	1.7	0.52	342	960	0.0114	4.23	<0.005
Bio-tank	4/10/2009	<0.005	0.0016	0.0015	0.016	0.00262	376	1	0.0024	1100	<0.01	0.047	40.6	11	0.109	0.01	1	3.9	1.8	0.435	268	156	0.0103	2.88	<0.005
Bio-tank	4/23/2009	0.002	0.0019	0.0015	0.017	0.00208	414	1.9	0.0009	1200	0.015	0.046	39.7	4.45	0.091	<0.01	0.95	4.33	1.85	0.452	355	860	0.0108	2.12	<0.005
Bio-tank	5/7/2009	0.009	0.0017	0.0005	0.0164	0.0009	407	1.7	0.0001	1180	0.032	0.042	40	0.374	0.0551		<1	4.14	2	0.439	351	1000	0.011	1.04	0.007
Bio-tank	5/21/2009	<0.004	0.0024	0.0004	0.0158	0.0005	396	3.1	0.0001	1150	<0.02	0.037	38	0.152	0.0357		<1	3.87	2	0.434	341	1100	0.0117	0.639	0.006
Bio-tank	6/4/2009	<0.004	0.0016	0.0004	0.0172	0.0004	390	3.4	0.0002	1140	<0.02	0.038	41	0.207	0.0238		<1	4.67	2	0.426	342	940	0.0115	0.55	0.008
			As-D	Sb-D	Ba-D	Cd-D	Ca-D		Co-D	Hard-D	Fe-D	Li-D	Mg-D	Mn-D	Ni-D			Si-D	Na-D	Sr-D	S-D			Zn-D	
Average G900 Adit (May-June)			0.06835	0.0025	0.00815	0.0015	420		0.02615	1210	1.755	0.057	39	17.95	0.1955			4.195	2	0.451	368			6.18	
Average Standpipe (May-June)			0.00153	0.00055	0.0188	0.0007	397.667		0.00017	1160	0.067	0.04067	39.6667	0.24933	0.03757			4.27	2	0.44667	343			0.72	
Average Biotank (May-June)			0.0019	0.00043	0.01647	0.0006	397.667		0.00013	1156.67	0.032	0.039	39.6667	0.24433	0.0382			4.22667	2	0.433	344.667			0.743	
Percent Reduction in Standpipe			97.76	78.00	(130.7)	53.33	5.32		99.36	4.13	96.18	28.65	(1.71)	98.61	80.78			(1.79)	-	0.96	6.79			88.35	
Percent Reduction in Tank			97.22	82.67	(102.0)	60.00	5.32		99.49	4.41	98.18	31.58	(1.71)	98.64	80.46			(0.75)	-	3.99	6.34			87.98	

ALEXCO

Alexco Keno Hill Mining Corp
1150-200 Granville Street
Vancouver BC V6C 1S4

Thursday March 18th, 2010

Letter to Yukon Water Board

Regarding: Water Use Licence Application QZ09-092

Thank you for meeting with us on Monday March 15th to discuss our Water License Application for the Bellekeno Mine.

As we discussed, the construction of the mine and mill is progressing well, and we are now able to move forward on the Keno City bypass road construction so that future mine traffic can avoid disruption of Keno City. An essential component of the bypass road will be the construction of a new bridge crossing over Lightning Creek, which we had originally included in our Bellekeno Mine Water Use Licence (application QZ09-092).

However since our discussion on Monday, we have decided to apply for a separate Miscellaneous Water Licence for the bridge alone. Accordingly we wish to withdraw the request to construct a bridge over Lightning Creek from Water Licence application QZ09-092.

Our application for the miscellaneous Type B licence will follow this request for withdrawal.

Thank you,
Alexco Keno Hill Mine Corp

Robert L. McIntyre, R.E.T.
Vice President, Business Development

ALEXCO

Alexco Keno Hill Mining Corp
1150-200 Granville Street
Vancouver BC V6C 1S4

April 6th, 2010

Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, Yukon   Y1A 3V1

Attention: Ms. Joelle Janes, Licencing Officer

Dear Ms. Janes:

Re: Bellekeno Mine Water Licence Application QZ09-092,
Response to Review for Adequacy and Supplemental Information

We herewith provide our responses to follow up questions presented in your March 9th, 2010 letter regarding our application QZ09-092.

Documents that we are including as components of our responses are submitted as attachments to the response.

We trust that these supplemental responses satisfy the requirements for Water Licence applications as set out in Section 5 of the *Yukon Waters Act*.

Should you have any questions, please contact our office at 867-668-6463.

Sincerely,
Alexco Keno Hill Mining Corp

Robert L. McIntyre, R.E.T.
Vice President, Business Development
Alexco Keno Hill Mining Corp

cc. external D. Buyck, NNDFN
cc. internal C.Nauman, B.Thrall, T.Hall, D.Whittle, Alexco Resource Corp.
E. Allen, T. Lunday, Access Consulting Group

Attachments:

- *Attachment A: Letters of reliance on third party technical reports, EBA and Access Consulting Group;*
- *Attachment B: Bellekeno 625 water treatment system minor modifications;*
- *Attachment C: Bellekeno Non-AML WRDA preliminary design letter;*
- *Attachment D: 2009 Mine wall testing plan results*

4. *Please identify any overlapping water uses, waste deposits, and activities that are being requested in this application and are already authorized under existing water licences QZ06-074 and QZ07-078.*

   The identified overlapping uses in your response only include direct water uses from Flat Creek for camp use. I was looking for a list of all water uses, deposits of waste, infrastructure and activities being applied for that would overlap with QZ06-074 and QZ07-078. Examples of such activities include the operation of the existing wastewater treatment system and settling ponds at the Bellekeno 625 adit, deposit of waste in the form of treated wastewater discharge from the settling ponds at Bellekeno 625, etc.

   - Please confirm and identify all existing water use activities, infrastructure and deposits of waste being applied for that overlap with existing licences QZ06-074 and QZ07-078.

Please see Table 1 below for a summary of all overlapping water use activities, infrastructure and deposits of waste between QZ06-074, QZ07-078, and QZ09-092. Where water use numbers are presented in a more recent licence, total use includes (is not in addition to) use in previous licences (e.g., total water use at Flat Creek camp after issuance of QZ09-092 will not exceed 42.75 m3/day).

Table 1 Summary of Overlapping Water Uses, Deposits of Waste, and Infrastructure

	Flat Creek			Bellekeno Mine		
Licence	Water Use	Deposit of Waste	Infrastructure	Water Use	Deposit of Waste	Infrastructure
QZ06-074	"Obtain a maximum combined quantity of 90 cubic metres of water per day from Flat Creek and Bellekeno 600 adit, Silver King 100 adit, Galkeno 300 adit, Galkeno 900 adit and Valley Tailings Area for the purpose of water treatment"	Deposit waste to Flat Creek drainage authorized without mention of volume authorized	Flat Creek Camp, water intake and treatment infrastructure, septic system	"Obtain a maximum combined quantity of 90 cubic metres of water per day from Flat Creek and Bellekeno 600 adit, Silver King 100 adit, Galkeno 300 adit, Galkeno 900 adit and Valley Tailings Area for the purpose of water treatment"	• Deposit waste to Lightning Creek authorized without mention of volume authorized • Sludge resulting from water treatment deposited as per District Wide Sludge Management Plan in Valley Tailings Area and Sime Pits	• Bellekeno 625 Treatment Plant • Valley Tailings Area and Sime Pits
QZ07-078	29 m3/day from Flat Creek and camp well	Deposit waste to ground in the form of camp wastewater that has been treated in a septic system; no volume specified	Flat Creek Camp, water intake and treatment infrastructure, septic system	71 m3/day from Thunder Gulch and Lightning Creek, 864 m3/day from Bellekeno Mine	• Deposit waste to Thunder Gulch and Lightning Creek in the form of treated wastewater authorized, no volume specified • Sludge resulting from water treatment deposited as per District Wide Sludge Management Plan in Valley Tailings Area and Sime Pits	• Bellekeno 625 Treatment Plant • Valley Tailings Area and Sime Pits
QZ09-092 (draft)	42.75 m3/day requested from Flat Creek and camp well	Deposit waste to ground in the form of camp wastewater that has been treated in a septic system	Flat Creek Camp, water intake and treatment infrastructure, septic system	245.5 m3/day from Thunder Gulch, Lightning Creek, and treated wastewater from the Bellekeno 625 and underground waters from the Bellekeno Mine	• Deposit waste to Thunder Gulch and Lightning Creek in the form of treated wastewater authorized, no volume specified • Sludge resulting from water treatment post closure will be deposited as per District Wide Sludge Management Plan in Valley Tailings Area and Sime Pits with care taken that liabilities are kept separate from other district wide sludge.	• Bellekeno 625 Treatment Plant • Valley Tailings Area and Sime Pits

6. *The technical memo included in the Construction Site Plan -Appendix J (1.4.10) contains a disclaimer that states: "This report and its contents are intended for the sole use of Alexco and their agents…" Furthermore, Environmental Conditions Report - Appendix H (exhibit 1.3.6.8) contains the following: "This report was prepared for the exclusive use of Elsa Reclamation and Development Company…"*
   While the Board received a number of authorizations from your consultants, the letters for the reports in the above noted exhibits from Access Consulting and EBA remain outstanding.

   Please see authorizations from Access Consulting Group and EBA as Attachment A.

9. *Segregation of responsibility for pre-existing and new environmental liabilities, both terrestrial and aquatic, need to be explicitly identified for the proposed Bellekeno project so that the Board clearly understands which liabilities are the legal responsibility of Alexco.*

   Please provide a concise summary of:

   a) *the pre-existing environmental liabilities prior to Alexco's development of the Bellekeno project;*

      The reference SRK 2007 report only presents figures delineating terrestrial liabilities.

      1) Please supply narrative delineating aquatic liabilities associated with the Bellekeno mine and the Flame and Moth open pit site.

      Water related liabilities associated with the Flame and Moth pit site will be borne by Alexco once a production unit has been declared as per the Subsidiary Agreement with government of Canada.

   b) *the post-closure environmental liabilities associated with the development of the Bellekeno project; and*

      It appears that the response is missing a list of post closure liabilities that should follow the first sentence.

      1) Please provide, to the extent predicted at this time, the expected liabilities following closure of the mine, not just to-date liabilities.

      Future liabilities generated as a result of the Bellekeno development will be documented as development progresses. Bellekeno mine environmental impacts are mitigated through the Preliminary Decommissioning and Reclamation Plan (PDRP) (exhibit 1.4.5).

   c) *the assignment of the liabilities (legal responsibility) identified in a and b post-closure.*

While the response provided can be understood from the perspective of terrestrial liabilities, it does not clearly identify the responsibility for aquatic liabilities post closure of the Bellekeno mine.

1) Please explicitly identify the responsibility for mine discharges from the Bellekeno mine after mining is completed.

Alexco will retain responsibility for mine discharges from the Bellekeno mine after mining is completed.

2) It is noted that the submitted Closure costing seems to imply that post closure mine discharges "may be" retained by Canada; therefore, this needs to be clarified and any limitations associated with Canada's liability should be defined.

In accordance with the terms and conditions of the 2006 Subsidiary Agreement, pre-development terrestrial liabilities (noted in [a], above) will be the responsibility of the Government of Canada (for example, existing waste rock dumps at Bellekeno 625). Post-closure liabilities generated beyond those which were documented in the 2007 Baseline Assessment (those noted in [b], above) will be the responsibility of Alexco.

10. *Page 6-75 of the Main Application Report indicates that "Liabilities resulting from sludge produced by the Bellekeno mine and mill operations will be kept separate from sludge resulting from other site treatment operations to the satisfaction of the appropriate government agency". Please clarify how sludge liabilities will be kept separate.*

The response provided adequately addresses the issue during the operational phase of the project. The fate, however, of treatment sludge from either the mill site or the mine site after the dry stack tailings facility is closed and no more tailings are deposited in either the DSTF or in the mine is not provided.

1) Please provide information on treatment sludge that may be created after the DSTF and the mine are no longer available for co-disposal with tailings.

Sludge produced from the Bellekeno Mine and Flame and Moth mill site after closure of the DSTF will be disposed of as per the District Wide Sludge Management Plan, with care taken that liability for this sludge and other district wide sludge are kept separate.

2) Furthermore, please provide a rationale for inclusion of the District Wide Sludge Management Plan in this application, as it is not clear why it is included in the application. If requested, this plan can be removed from the register.

See response to 1) above.

15. *Environmental Conditions Report -Appendix G (exhibit 1.3.6.7) presents the methodology for developing background (baseline) water quality data for the mining district. Please comment on the rationale for combining water quality data from KV-1 and KV-37 instead of developing a separate background water quality for South McQuesten River and for*

Lightning Creek/ Duncan Creek watersheds. Please advise if sufficient data is currently available to provide specific background levels for the 2 watersheds.

1) Please verify who is responsible for the presented opinion in your response, the qualifications of those individuals, and any analysis that was used to support the opinion.

   Cynthia Russel, B.Sc., President, Minnow Environmental. Ms. Russel has 25 years of experience in aquatic ecosystem science.

16. *Please review most current data for KV-37 and comment on whether or not it supports the background water quality developed for the district using data up to 2007, as done by Minnow in the Environmental Conditions Report –Appendix G (exhibit 1.3.6.7).*

    1) Please verify who is responsible for the presented opinion in your response, the qualifications of those individuals, and any analysis that was used to support the opinion.

       Cynthia Russel, B.Sc., President, Minnow Environmental. Ms. Russel has 25 years of experience in aquatic ecosystem science.

17. *Page 6 of exhibit 1.3.6.7 discusses the validity of selecting KV-1 as a reference station and discusses the additional collection of additional information at KV-72. Furthermore, the report suggests that a comparative assessment be conducted of the data used in KV-1 and the additional data collected in KV-72 be conducted.*

    Please provide an update on the status of KV-1 and KV-72 with respect to which is to be utilized for background water quality for South McQuesten River.

    Based on the response it is understood that both KV-01 and KV-72 will require monitoring as part of a Type A Licence issued for this undertaking.

    1) Please update the monitoring plan to include monitoring of KV-72

    Please see Table 7-2 Revision 2 which has been updated to include KV-72.

Table 7-2 Revision 2 Proposed Monitoring Program Summary Within the Area of the Mill and Mine

Monitoring Station	Easting	Northing	Description	Internal Lab								External Lab										EEM Program		
				Inspect	Flow	pH	Temp.	Cond.	Total Zinc	Ammonia	Turbidity	Total ICP Metals	Dissolved ICP Metals	Ammonia	Phosphorous	Dissolved Organic Carbon (DOC)	Hardness	pH	Cond.	TSS	LT50	Sediment	Benthic	Sub-Lethal Toxicity
Proposed Monitoring under new Type A Water Licence Application																								
KV-1	4742790	7092790	South McQuesten River u/s Christal Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-2	472076	7090036	South McQuesten River @ Pumphouse		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-6	483909	7088242	Christal Creek at Keno Highway		Q	Q	Q	Q				M	M		M	M	M	M	M	M		BA	BA	
KV-7	478657	7092413	Christal Creek at Hanson Road		M	M	M	M				M	M		M	M	M	M	M	M				
KV-8	465836	7088410	Christal Creek @ Mouth		Q	Q	Q	Q				M	M		M	M	M	M	M	M				
KV-37*	490315	7087776	Lightning Creek u/s Hope Gulch		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-38	488193	7087341	Lightning Creek u/s Thunder Gulch		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q		A		
KV-39	490252	7087783	Hope Gulch u/s Lightning Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-40	488982	7087503	Charity Gulch u/s Lightning Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-41	485429	7086764	Lightning Creek u/s bridge at Keno City		Q	Q	Q	Q				M	M		M	M	M	M	M	M		A		
KV-42	487363	7087062	Bellekeno 625 Adit		C	W	W	W	W	W	W	M	M	M	M	M	M	M	M	M				
KV-43	487318	7087147	Bellekeno 625 Treatment Pond Decant	D	D	D	D	D	D	D	D	W	W	W	W	W	W	W	W	W	M	A		SA
KV-44	487361	7087195	Bellekeno 625 Seep			Ms	Ms	Ms	Ms				Q	Q	Q	Q		Q	Q	Q	Q			
KV-45	485101	7087288	Onek Adit		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-50*	483575	7086897	Christal Creek u/s Hinton Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-51	483600	7087010	Christal Creek d/s Hinton Creek		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-52	483756	7087869	Mackeno Creek		M	M	M	M				M	M		M	M	M	M	M	M				
KV-65	487464	7086873	Thunder Gulch Upstream of Bellekeno		Q	Q	Q	Q				M	M	M	M	M	M	M	M	M				
KV-72	482492	7104476	South McQuesten River at McQuesten Lake		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-75	487594	7086161	Bellekeno East Pond Decant	*Pond has been reclamated*								*Pond has been reclamated*												
KV-76	487414	7087118	Thunder Gulch d/s of Bellekeno 625 adit			Q	Q	Q	Q				M	M	M	M	M	M	M	M	M			
KV-77	487742	7086013	Thunder Gulch upstream of Bellekeno East		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-78	487126	7087052	Bellekeno Waste Rock Storage Facility			Ms	Ms	Ms				Q	Q		Q	Q	Q	Q	Q	Q				
KV-79	483796	7087919	Christal Creek d/s MacKeno Tailings		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-80	483790	7087869	Christal Lake u/s Mackeno Tailings		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				
KV-36	483787	7086750	Bellekeno Mill Pond Discharge	D	D	D	D	D	D	D	D	W	W	W	W	W	W	W	W	W	M	A		SA
KV-81	483548	7086423	Lightning Creek, South of Mill Site		Q	Q	Q	Q				Q	Q		Q	Q	Q	Q	Q	Q				

Codes:

C = Continuous
D = Daily
W = Weekly
M = Monthly
Ms = Monthly (May - Oct)
Q = Quarterly
A = Annually
SA = Semi Annually
BA = Bi Annually - every 2 years
* = Background
**To Be Determined

ICP Metals include: Aluminum, Antimony, Arsenic, Barium, Beryllium, Bismuth, Boron, Cadmium, Calcium, Chromium Cobalt, Copper, Iron, Lead, Lithium, Magnesium, Manganese, Molybdenum, Nickel, Potassium, Selenium Silicon, Silver, Sodium, Strontium, Sulfur, Thallium, Tin, Titanium, Uranium, Vanadium, Zinc and Zirconium

18. *Please confirm whether water quality or quantity data exists for Duncan Creek. If the data exists, please provide this information for inclusion in the application.*

    In the event that Duncan Creek is considered to be the receiving environment for the Bellekeno mine, monitoring of this creek would be required.

    1) As an information item only, you may want to consider adding a Duncan Creek monitoring station to the site monitoring program.

21. *Please provide the rationale for not including monitoring stations KV-49 and KV-50 in the list of proposed monitoring stations listed in table 7-2 of the Main Application Report.*

    KV-49 (Hinton Creek) receives the treated discharge of Galkeno 300 and is therefore not upstream of mine influences. It is believed that monitoring of these two stations is justifiable to account for mine influences (Hinton Creek) and to provide background inflows into Christal Creek upstream of mine influences (KV-50).

    1) As an information item only, please reconsider adding KV-49 and KV-50 to the proposed water quality-monitoring network.

22. *The Water Quality Assessment Report (exhibit 1.3.6.7) prepared by Minnow Environmental Inc. included 10 recommendations regarding future modifications to the environmental monitoring program. The recommendations are presented below:*

    c) *The laboratory responsible for water quality analyses should be instructed to conduct total phosphorus analysis using the standard colourimetric method and a reasonable number of samples should be split and sent to a second laboratory for confirmation of total phosphorus concentrations;*

       Phosphorus has not been identified as a parameter to be monitored in any water quality stations in this application.

       1) Please add Phosphorus as a parameter to all of the proposed water quality stations or provide a rationale for the selective testing for this parameter at specific stations.

    d) *Dissolved organic carbon (DOC) should be added to the routine monitoring parameter list as it is a known modifier of zinc toxicity and is currently not included in the monitoring program. Stations to be monitored for DOC should include KV1, KV37, KV39, KV41, KV6, KV16, KV29, KV30, KV7, KV8, KV21, KV47, KV9, KV-4 and KV5. In addition, DOC should be included in the parameter list at any new reference stations.*

       DOC has not been identified as a parameter to be monitored in any water quality stations in this application.

       1) Please add DOC as a parameter to all of the proposed water quality stations or provide a rationale for the selective testing for this parameter at specific stations.

Dissolved organic carbon has been added as a parameter for testing at all proposed water quality stations (see revised table 7-2). Further review and analysis of parameters is currently underway and may in the near future, through development of an LTMP, lead to modifications in the location or frequency of monitoring. However, at this point and for the purposes of this application, DOC has been included in the proposed monitoring program.

g) *More frequent monitoring (5 to 8 samples/year) should be undertaken for analysis of aluminum, arsenic, chromium, copper, cyanide (WAD and total), manganese, mercury, nitrite, selenium and silver, particularly in the tributaries, Christal Creek (KV6, KV16, KV29, and KV30), Lightning Creek (KV39 and KV40), Flat Creek (KV47), and No Cash Creek (KV21). The increased monitoring frequency should span the duration of a year in order to evaluate these parameters as possible COCs;*

You have indicated that you disagree with your consultant’s recommendation to increase the frequency of sampling at the indicated stations as required to evaluate these parameters as possible COC’s; however, no evidence has been put forward to support this position.

1) Please provide evidence that refutes the need to complete the recommended sampling and analysis identified by Minnow.

At this stage in time, Alexco is not in a position to provide evidence to confirm or refute the recommendation made by Minnow. As such, this application will include sampling frequency to be increased to 5 samples/year for the all of the above recommended stations which are monitored on a less frequent basis and are included in the proposed monitoring program of this application. This includes stations KV-39 and KV-40. Sampling of these stations will include any parameters listed above which are not currently monitored. This sampling program will be carried out for the recommended duration of one year.

h) *Background benchmarks should be re-developed for all substances having a guideline once an adequate reference database has been developed with consistently low MDLs and including data for a greater number of reference stations;*

The referenced response to Question #15 does not appear to indicate a sampling frequency or a period of time to continue that frequency for the referenced stations. Moreover, the response does not indicate whether the dataset that exists currently has been accounted for in the two year time frame for monthly sampling that is suggested as required to allow for the redevelopment of background benchmarks.

1) Please identify the reference stations that will be sampled monthly and when this sampling rate will be or was initiated.

Additional reference stations representative of non-mine influenced conditions are in the process of being selected as a part of the LTMP being developed for the district wide closure plan. It is understood that this information may be relevant during interventions and every effort is being made to ensure this information is available in the event that it is needed for consultation.

2) Please provide some analysis that identifies the number of sampling events required to allow for the re-development of background benchmarks. This analysis should encompass the currently available dataset that includes data acquired after your consultant completed the original analysis.

An analysis of this nature is currently being carried out by Minnow and will be addressed in the LTMP designed for the Keno Hill property for district-wide closure. This analysis will include all data in the currently available dataset. It is understood that this information may be relevant during interventions and every effort is being made to ensure this information is available in the event that it is needed for consultation.

23. *The analysis completed in the Water Quality Assessment Report (exhibit 1.3.6.7) relied upon water quality data current to either spring 2007 or summer 2007 (depending upon the station). In some cases parameter analysis was limited to use of data available only between the above dates and July 2004. Given recommendation (h) above, please advise if the currently available data still supports the completed analysis.*

Please verify who is responsible for the presented opinion in this response, the qualifications of those individuals, and any analysis that was used to support the opinion.

Cynthia Russel, B.Sc., President, Minnow Environmental. Ms. Russel has 25 years of experience in aquatic ecosystem science.

24. *The submitted Aquatic Resources Assessment Report (exhibit 1.3.6.10) prepared by Minnow Environmental Inc. included 8 recommendations regarding future modifications to the environmental monitoring program. The recommendations are presented below:*

a) *Expand on the habitat characterization by Sparling (2006), presented in Table 2.1, to ensure consistent information is available among areas where benthic and fish communities are typically assessed.*

I was unable to find any reference to the 2009 fisheries study referenced in your response. Exhibit 1.3.6.8 presents the results of only 2008 studies.

1) Please clarify if fisheries studies were completed in 2009 and if so submit the results of those studies as part of this application.

The work conducted in 2008 and 2009 by Access Consulting Group with respect to fisheries was an investigation to assess fisheries habitat at tributaries that may be impacted by the access road. This work, although sufficient to determine the absence of fish habitat, was not extensive enough to warrant a full report.

With respect to the recommendation by Minnow to expand on the habitat characterization by Sparling (2006), additional work is under consideration. The extent of this work is currently being determined by ACG in conjunction with Minnow consultants.

b) *Review monitoring station locations to ensure that each station provides unique information relative to source loads.*

I was unable to find any reference to the August 2009 Minnow work referenced in your response. Please submit.

At this time the requested report is in the process of being prepared. It is understood that this information may be relevant during interventions and every effort is being made to ensure this information is available in the event that it is needed for consultation. This report's purpose is to provide input into the design of the long term monitoring program being developed for the district wide closure plan.

c) *Analyze particle size and chemistry of whole sediment samples collected in reference and mine-exposed areas to determine if metal concentrations, particularly arsenic, are high enough to potentially affected biota.*

I was unable to find any reference to the August 2009 Minnow work referenced in your response. Please submit.

At this time the requested report is in the process of being prepared. It is understood that this information may be relevant during interventions and every effort is being made to ensure this information is available in the event that it is needed for consultation. This report's purpose is to provide input into the design of the long term monitoring program being developed for the district wide closure plan.

d) *Evaluate the sample collection methods and the sampling design that have been used in past assessments of benthic community health to identify opportunities for improvement. For example, changes to the sampling design are recommended to allow for statistical comparison of conditions in mine-exposed versus reference areas and thus allow for quantification of changes over time. Specific design options should be developed and evaluated as part of the long term monitoring design.*

I was unable to find any reference to the August 2009 Minnow work referenced in your response. Please submit.

At this time the requested report is in the process of being prepared. It is understood that this information may be relevant during interventions and every effort is being made to ensure this information is available in the event that it is needed for consultation. This report's purpose is to provide input into the design of the long term monitoring program being developed for the district wide closure plan.

e) *Once the long-term monitoring program is established, standard operating procedures (SOPs) should be developed.*

If the Minnow SOPs were to identify less rigorous protocols than those that may be included in any licence issued for this undertaking, then an amendment to adopt those protocols may be required. As such it would be advantageous for the SOPs to be submitted and evaluated as part of this application.

1) Please advise when it is expected that these SOPs will be available for review.

Standard Operating Procedures are being developed concurrently with the district-wide closure plan. When the long-term monitoring program for district-wide closure is finalized, so too will SOPs associated with the monitoring activities that will be carried out at the Keno Hill property.

Alexco understands that more rigorous protocols may be required by the terms of this licence than will be proposed in a final long-term monitoring program.

f) Evaluate sites that could serve as additional reference areas in future surveys to enhance evaluation of mine-exposed areas through improved understanding of reference conditions and variability.

I was unable to find any reference to the August 2009 Minnow work referenced in your response. Please submit.

At this time the requested report is in the process of being prepared. It is understood that this information may be relevant during interventions and every effort is being made to ensure this information is available in the event that it is needed for consultation. This report's purpose is to provide input into the design of the long term monitoring program being developed for the district wide closure plan.

g) Consider replacing potentially impacted KV-1 with the new reference area KV-72 by conducting a comparative assessment of the two stations when more data at KV-72 are available.

Please refer to follow-up question 17.

h) Collect more detailed fish health data during fisheries assessments and also measure major organ weights (e.g., gonads, livers) and fish age for any specimens that are sacrificed for tissue analysis.

I was unable to find any reference to the 2009 fisheries study referenced in your response. Exhibit 1.3.6.8 presents the results of only 2008 studies.

1) Please clarify if fisheries studies were completed in 2009 and if so submit the results of those studies as part of this application.

With respect to the recommendation by Minnow to expand the collection of fish health data, the additional work is under consideration. The full list of data that shall be collected during fisheries assessments is currently being determined by ACG in conjunction with Minnow consultants. With respect to the Minnow report recommendation to conduct additional fish studies, additional work will be conducted every other year in accordance with water use licence QZ07-074.

The work 2009 by Access Consulting Group with respect to fisheries was an investigation to assess fisheries habitat at tributaries that may be impacted by the access road. This investigation was sufficient to determine the absence of fish habitat. The 2009 investigation did not pertain to the Minnow Report recommendation to collect additional fish health data.

25. *Please provide the predicted water quality of the following inputs that report to the mill site treatment pond:*

   a) *mill water discharge;*

   Please provide an expanded Table 2-13 to include all parameters identified in the CCME guidelines for the protection of aquatic life. If the testing did not account for all of these parameters then it should be indicated that the concentration of the parameter is unknown.

   Table 2-13 (Tailings Water Assay) was run on a limited number of elements. Another standard environmental waste characterization test (TCLP) was conducted on LC1 tailings. These results may also be relevant for predicting water quality for some inputs to the mill site treatment pond, and were reported in Table 2-14 of the Main Application Report. Table 2-14 included some additional metals indentified in the CCME guidelines for the protection of aquatic life (e.g. Se, Hg). An expanded Table 2-14 (revision 1) is provided here which contain all metals identified in the CCME guidelines for the protection of aquatic life:

Table 2-14 Revision 1

Elements	Units	Sample ID	
		Leachate Dry Sample	Leachate Wet Sample
SO4	mg/L	19.1	16.4
Al	µg/L	45	62
Sb	µg/L	5.2	4.3
As	µg/L	6.0	4.0
Cd	µg/L	150.2	144.8
Cr	µg/L	<0.5	<0.5
Cu	µg/L	2968.6	2977.9
Fe	µg/L	65	199
Pb	µg/L	10004.7	10554.7
Hg	µg/L	<0.1	<0.1
Mo	µg/L	<0.1	<0.1
Ni	µg/L	71.8	71.1
Se	µg/L	<0.5	<0.5
Ag	µg/L	<0.05	<0.05
Tl	µg/L	0.1	0.1
Zn	µg/L	34,254	34,162

26. *Table 6-7 of the Main Application Report provides proposed effluent quality discharge standards. Please complete the table by proposing criteria for Ammonia Nitrogen, Cadmium and Silver; or explain why effluent discharge standards for these parameters were not included.*

    The provided response addressed the initial intent of question 26. As a follow up, please provide an expanded Table 6-7 to cover all established CCME parameters for protection of aquatic life or provide a rationale for not including any such parameters in an expanded Effluent Discharge Standard.

    We do not believe that CCME standards are appropriately compared to end of pipe discharge standards.

Please see attached Table 6-7 Revision 2.

27. *Please provide the predicted water quality that will be released to the environment. The predicted parameters should include those which are proposed in the effluent quality*

standards, as well as, the contaminants of concern identified in the Environmental Conditions Report –Appendix G (exhibit 1.3.6.7).

The provided response addressed the initial intent of question 27. As a follow up,

1) Please provide similar information for an expanded list of parameters that captures all established CCME parameters for protection of aquatic life or provide a rationale for not including any such parameters.

   We do not believe that CCME standards are appropriately compared to end of pipe discharge standards.

2) Please provide further details regarding proposed modifications to the Bellekeno 625 treatment plant.

Please see Attachment B, detailing planned minor modifications for the Bellekeno 625 water treatment system submitted under QZ07-078.

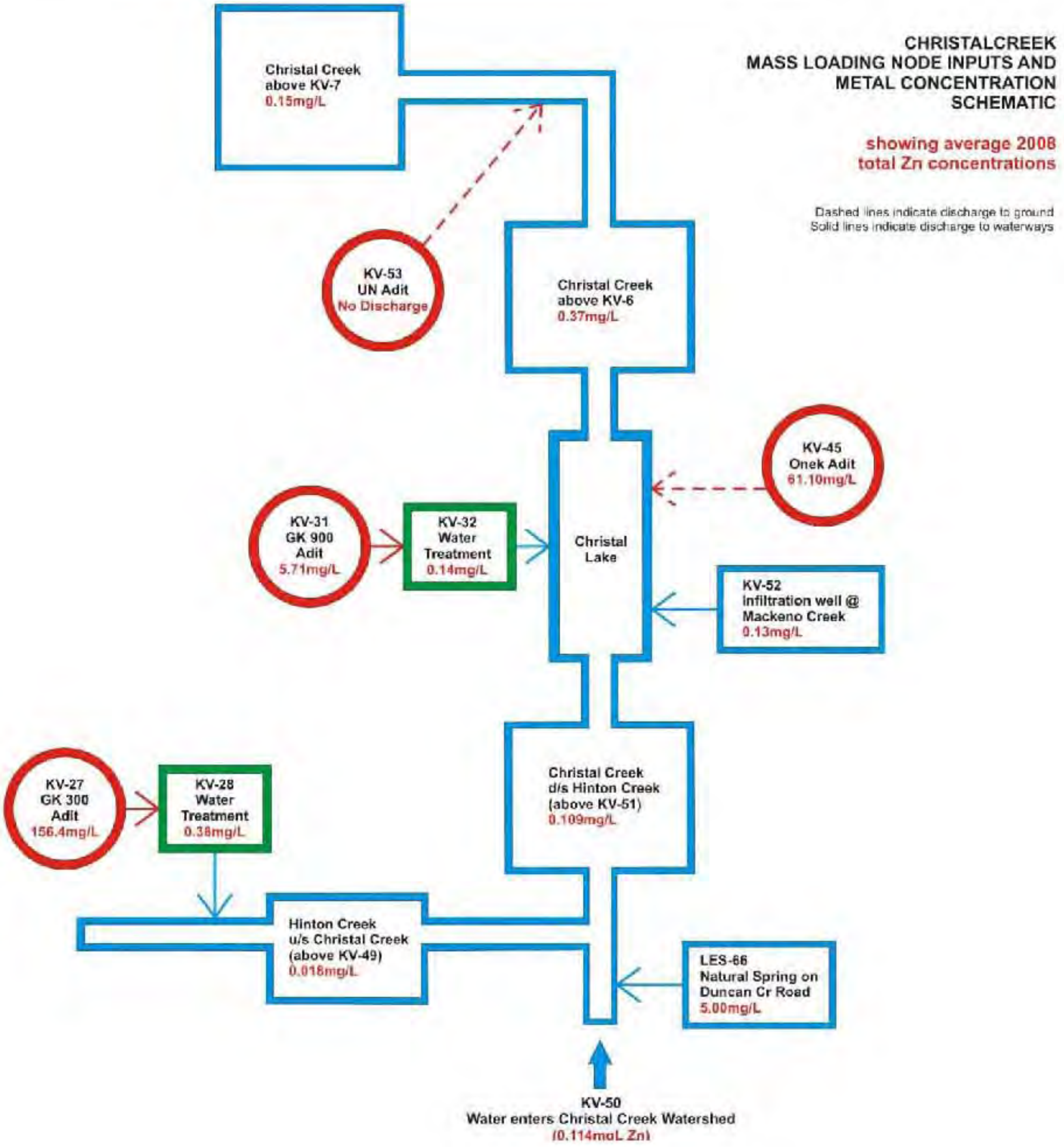
29. *Please reference all relevant monitoring stations for node inputs for figure 3-4 on page 3-19 of the Main Application Report (see figure 3-3 as an example).*

It is my understanding that KV-37 (Lightning Creek u/s of Hope Gulch) is shown where it is believed KV-49 is actually located. It is unclear if KV-52 (which is not shown on the revised figure) is the infiltration well at Mackeno Creek or if the infiltration well is some other monitoring station. There is no indicated monitoring station for the natural spring on the Duncan Lake road; however it is understood to be LES-66 (for the time being) and should be reflected as such.

1) Please review the erroneous or missing station references indicated in the above comments and make revisions as appropriate to the revised figure.

Please see Figure 3-4 revision 2 below.

Figure 3-4 Revision 2   Current Christal Creek Mass Loading Note Inputs and Metal Loading Schematic Showing Average 2008 Dissolved Zn Concentrations



30. Please refer to section 3 of the Main Application Report. Table 3-5 on page 3-21 does not appear to be the table referenced on page 3-20. Please identify where the table referenced on page 3-20 (table 3-5) is located.

The Zinc load for Onek presented on page 3-20 of the application (718 kg in 2008) disagrees with the value shown in Table 5 of Exhibit 1.3.9 (597.73 kg).

1) Please confirm if Table 5 is correct and current.

The total zinc load for the Onek adit in 2008 was 718Kg, while the dissolved zinc load at the Onek adit was 597.73Kg.

31. Please provide the referenced document "SRK 2009" described on Page 5-21 of the Main Application Report.

The response references Exhibit 1.3.6.4 (SRK Geotechnical Closure Studies) but appears to believe that this exhibit is SRK's "Geochemical Closure Studies".

1) Please confirm that Exhibit 1.3.6.4 presents the correct report that is referenced on page 5-21 of the application.

We acknowledge that the reference we previously supplied as Exhibit 1.3.6.4 is not the same as the document referred to on page 5-21 of the application. The correct reference for the document mentioned on page 5-21 is Geochemical Studies Keno Hill Silver District (2009), written by SRK consulting.

33. Please provide the daily internal testing results and weekly external testing results for adit water quality during the drawdown of the Bellekeno mine pool in 2009.

1) Please clarify if the internal analysis flow data is daily average data or instantaneous data from a single daily flow measurement.

Flow measurements provided are instantaneous data from a single flow measurement.

2) Please clarify the relationship between the daily internal laboratory results and the weekly external laboratory results (i.e. are they testing of duplicate samples or un-related sampling events from the same calendar date).

Three weeks in a month, the samples are duplicate samples taken at the same time and sent to the internal Atomic Absorption machine and the external laboratory. Once a month the samples taken are unrelated sampling events from the same calendar date. Unrelated events typically occur in either the second week or during the second sampling event of each month.

3) Have you conducted any analysis to draw comparisons between the internal results and external results – if so please provide that analysis.

Yes, such an analysis has been conducted. The results of this analysis for zinc are presented in tables 2a and 2b and figures 1a and 1b (see below). The tables contain the analytical results reported by the on-site lab compared against results received from duplicate samples sent to an external lab. The figures show correlation analysis of these results.

Figure 1a shows all data, while figure 1b is zoomed in to better display results at levels of zinc <1.5mg/L (the level below which most results are reported). The correlation analysis presented in the graphs shows a high degree of correlation between internal testing results and results tested externally by the lab. The coefficient of determination shows an excellent goodness of fit (0.92). These results imply that internal testing conducted at the site is reliable.

The unaccounted for variability in results may result from differences in the testing method, handling of the sample bottles during sampling or transport, contamination at some stage in the sampling procedure, or a combination of these or other factors.

Table 2a

KV-42: Bellekeno 625 Adit Discharge

	External Total Zinc	Internal Total Zinc
Sample Date	mg/L	mg/L
28-Dec-2008	7.79	7.691
4-Jan-2009	7.66	6.58
9-Jan-2009	8.49	8.412
3-Feb-2009	5.85	4.26
12-Feb-2009	4.01	5.904
20-Feb-2009	4.19	5.01
1-Mar-2009	2.86	3.14
19-Mar-2009	2.03	-
29-Mar-2009	1.91	-
10-Apr-2009	0.934	0.955
23-Apr-2009	0.693	-
30-Apr-2009	0.974	0.953
7-May-2009	0.147	0.848
14-May-2009	1.24	1.1
21-May-2009	1.17	1.35
28-May-2009	0.858	0.87
4-Jun-2009	1.53	1.221
11-Jun-2009	1.16	0.8
18-Jun-2009	0.311	0.34
25-Jun-2009	0.444	0.626
2-Jul-2009	0.407	0.439
10-Jul-2009	0.841	0.55
16-Jul-2009	0.612	0.69
24-Jul-2009	0.755	0.87
30-Jul-2009	0.79	0.832
6-Aug-2009	0.822	0.85
13-Aug-2009	0.772	0.69
20-Aug-2009	0.723	0.736
27-Aug-2009	0.751	0.755
3-Sep-2009	0.77	0.79
10-Sep-2009	0.903	0.94
18-Sep-2009	0.989	0.88

Table 2b

KV-43: Bellekeno 625 Treated Decant Water

	External Total Zinc	Internal Total Zinc
Sample Date	mg/L	mg/L
28-Dec-2008	0.282	0.333
4-Jan-2009	0.258	0.171
9-Jan-2009	0.074	0.264
12-Feb-2009	0.368	0.435
20-Feb-2009	0.16	0.2304
1-Mar-2009	0.801	0.666
19-Mar-2009	0.203	-
29-Mar-2009	0.424	-
2-Apr-2009	0.368	-
10-Apr-2009	0.271	0.401
23-Apr-2009	0.18	-
30-Apr-2009	0.138	0.284
7-May-2009	0.556	0.293
14-May-2009	0.387	0.42
21-May-2009	0.335	0.39
28-May-2009	0.254	0.235
4-Jun-2009	0.095	0.143
11-Jun-2009	0.336	0.39
18-Jun-2009	0.135	0.15
25-Jun-2009	0.452	0.313
2-Jul-2009	0.256	0.329
10-Jul-2009	0.457	0.4
16-Jul-2009	0.242	0.16
24-Jul-2009	0.076	0.083
30-Jul-2009	0.046	0.054
6-Aug-2009	0.051	0.03
13-Aug-2009	0.035	0.02
20-Aug-2009	0.032	0.003
27-Aug-2009	0.019	0.01
3-Sep-2009	0.02	0.01
10-Sep-2009	0.017	0.01
18-Sep-2009	0.013	0.01

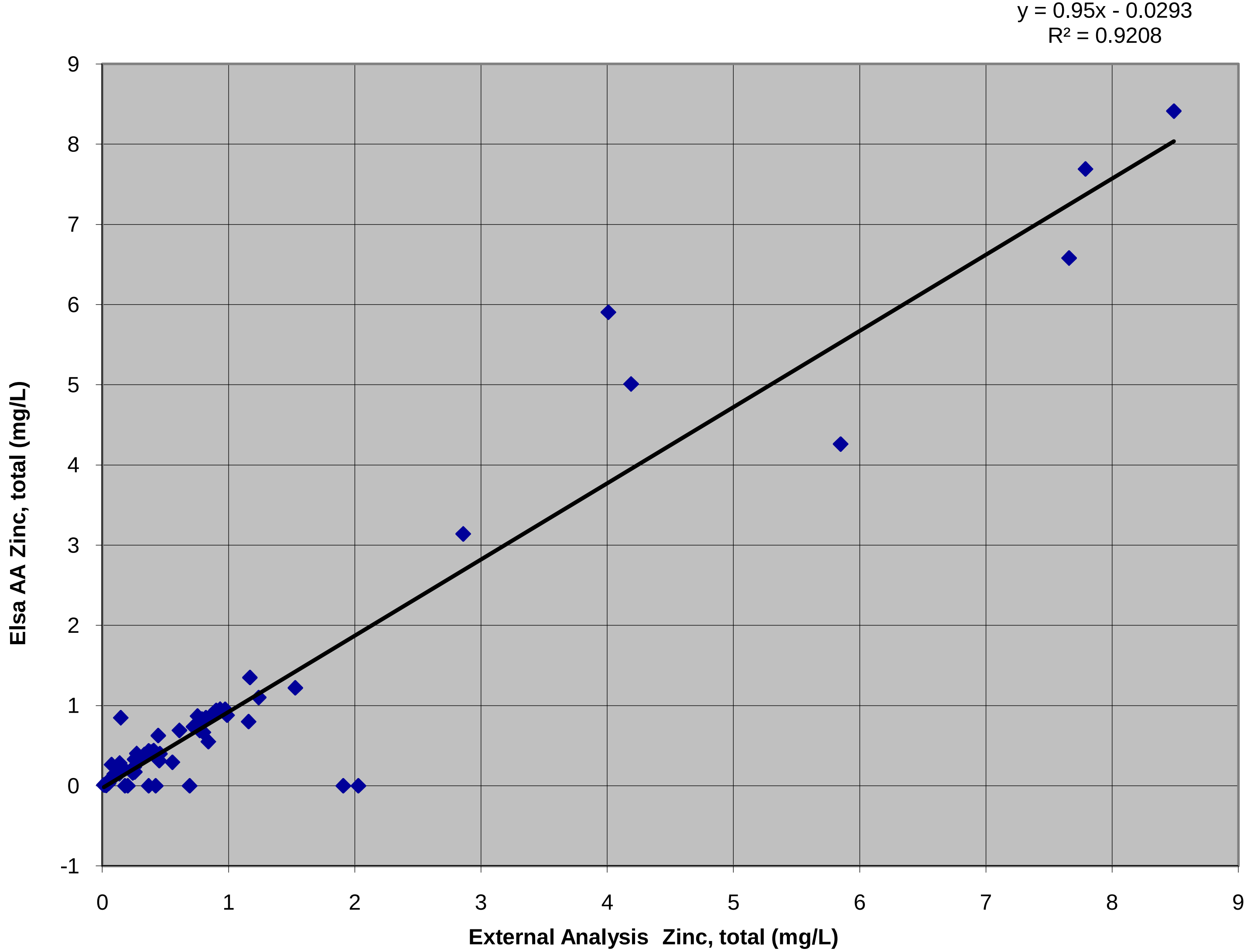


Figure 1a: Zinc Results, Correlation Analysis
External Analysis (X) vs. Elsa AA (Y)

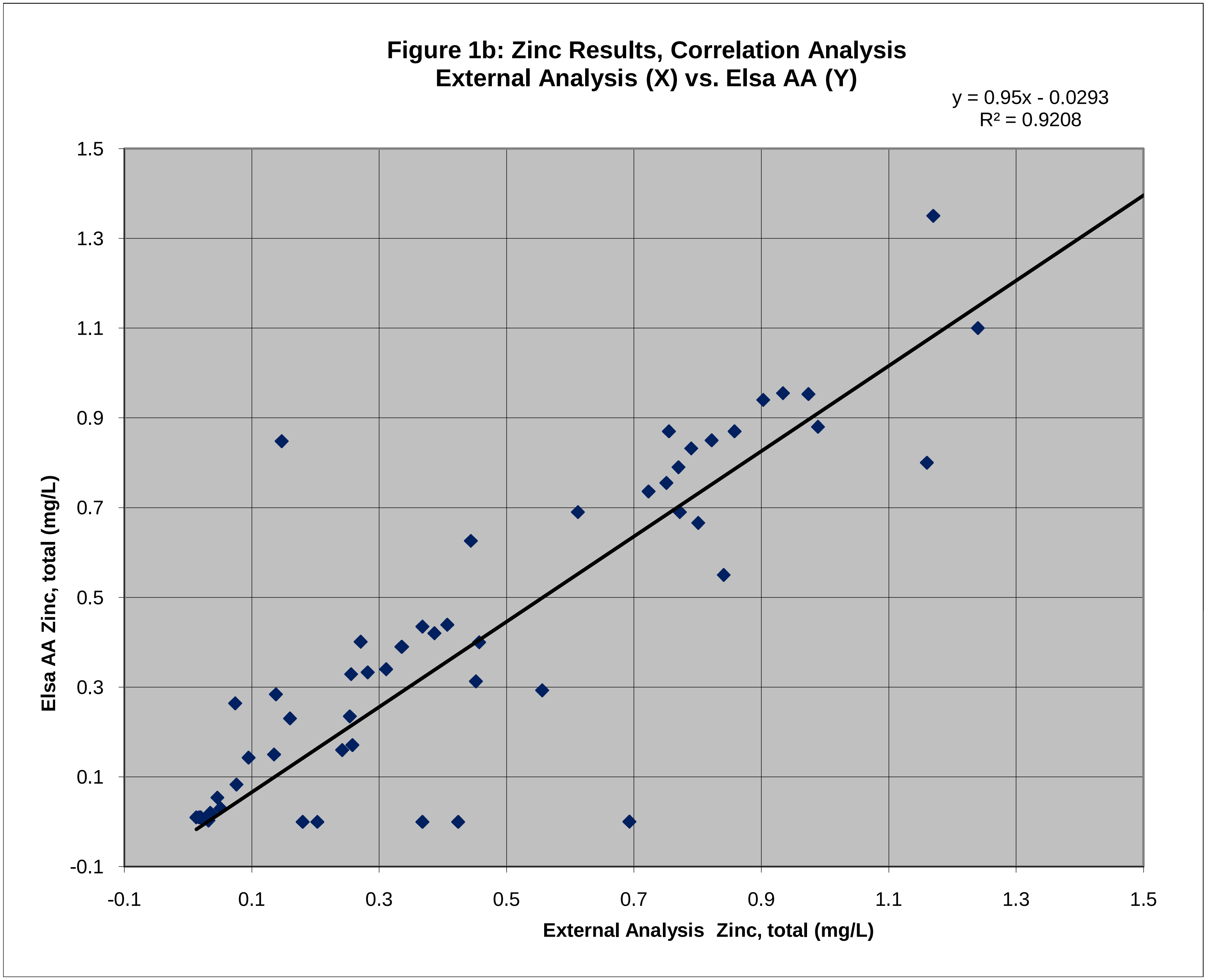


Figure 1b: Zinc Results, Correlation Analysis
External Analysis (X) vs. Elsa AA (Y)
y = 0.95x - 0.0293
R² = 0.9208
Elsa AA Zinc, total (mg/L)
1.5
1.3
1.1
0.9
0.7
0.5
0.3
0.1
-0.1
-0.1
0.1
0.3
0.5
0.7
0.9
1.1
1.3
1.5
External Analysis Zinc, total (mg/L)

35. *The freshet runoff assessment Main Application Report -Appendix L (exhibit 1.3.12) utilizes frequency analysis of stream gauge records for northern gauged basins with areas ranging from 13.7 km2 to 7,250 km2 to make predictions for potential runoff amounts from the mill site and dry stack tailings facility which has an area of 0.06 km2 and for the Lightning Creek basin above KV-41 which has an area of 59.1 km2. While this methodology seems reasonable for Lightning Creek (given it is a stream and the catchment is of reasonable size), it seems an unusual application for the very small mill catchment area.*

    Please provide comment as to whether the applied methodology is expected to produce a conservative estimate of runoff for the mill catchment and provide justification for not utilizing climatic records (precipitation inputs) and estimates of site runoff parameters to provide a runoff estimate for the mill catchment.

    It is noted that the responses provided have identified the pond storage requirement as being for a 10 day event as opposed to the 30 day event indicated in this response. It is further noted that the 10 day period used in other responses does not represent even the most critical 10 days of the cumulative runoff assessment submitted (i.e. the 10 day period with greatest inflows).

    Please provide additional details regarding the sizing of the mill pond. Also, please provide additional evidence that the runoff volumes for the mill and DSTF are based on appropriately conservative methodology.

    Additional details regarding sizing of the mill pond are presented in the response to question 46. As discussed in the response to question 46, sizing of the mill pond is based upon the Freshet Runoff Assessment prepared by Pete McCreath of Clearwater Consultants Ltd (see exhibit 1.3.12). The methodology used to model freshet flows and cumulative runoff volumes is presented within that memorandum.

Additional discussion of the Hydrological Update

36. *Please refer to the site hydrology update presented in the Environmental Conditions Report – Appendix A (exhibit 1.3.6.1):*

    a) The report utilized continuous water level data available for stations KV-7, KV-9, andKV-41 up to 2007. Please clarify if continuous water level data was collected for these sites in 2008 and 2009. If so please indicate if the data validates the findings of the Site Hydrology Update.

    b) The report indicated that some additional work was required to complete calculations for station KV-9. Please clarify if this work has been completed.

       It is expected that the 1996 results will be subject to verification through the consideration of all available flow data acquired since that regional analysis was completed. No evidence was provided to support the opinion provided in the response.

1) Please supply the requested flow data as part of the application and provide a review of the latest data by a qualified hydrologist or engineering hydrologist. This will provide assurance that the 1996 regional analysis results are still considered to be appropriate for this site.

The results of the Hydrological Update and Assessment carried out in 2008 are reliable based on the inclusion of the data provided at that time for the purposes of that study. Figure 12 of the Hydrological Update shows the validation of the regional relationship between MAR and elevation. The results of this validation show the considerable predictive power of the regression line. Estimated MAR at each of the three gauging stations is almost exactly predicted by the original relationship developed for the 1996 UKHM Closure Plan. For station KV-9 (Flat Creek), the range of estimates of MAR are given based on the exclusion of the missing freshet data. Even given the error as a result of the missing data, correlation between the 1996 study and real data at KV-9 is very high.

It is the opinion in of Pete McCreath (P.Eng) of Clearwater Consultants Ltd. that the results of the 2008 Hydrological Update study are reliable in general for the purposes of this application.

c) The report recommended that a quality assurance and quality control program be implemented for the mine site water quantity measurements. Please clarify if such a program has been developed and/or is incorporated into this application.

The identified program has the potential to impact the monitoring terms and conditions that would be included in any licence issued for this undertaking. As such it would be advantageous for the QA/QC program to be submitted and evaluated as part of this application.

1) Please advise when it is expected that the QA/QC program will be available for review.

The QA/QC program referred to in our original response is still in the process of being developed. Alexco understands that the terms and conditions of the licence may differ from the QA/QC program developed in conjunction with our consultants, and as a result more rigorous conditions may be applied.

d) Please provide referenced sections of the 1996 Site Characterization Report that present the original hydrology development.

An important aspect of the 1996 work was the review and evaluation of point source runoff from existing weather stations available at that time. Since the 1996 work the consultant has reviewed additional stream flow data, however it does that appear that a review to update the point source runoff estimates was conducted.

1) Please provide an update on climatic inputs used in the 1996 study to verify the point source runoff estimates that to a significant extent fix the proposed runoff estimates for the project site.

The mass loading model uses site-specific runoff data collected from routine daily measurements made at point sources of contamination. We use site-specific runoff data collected from routine daily measurements as these data are significantly more reliable than the estimations made during the 1996 Site Characterization.

37. *The Bellekeno mine water balance is shown to be based on mine water inflows recorded in 2008, which is considered to be the most conservative available data. Given that the mine development will entail significant expansion of the underground workings, please explain why the mine inflows are not expected to increase over the course of the mine life. Please provide an assessment of expected maximum mine water inflows that will be expected during the operational life of the Bellekeno mine.*

The response does not provide any evidence to support its conclusions. The response infers that mine flows will increase but does not establish an estimate of those flows.

1) Please submit at least a conceptual level hydro-geological assessment of projected mine water inflows over the mine life and at closure. The study should be completed by a qualified hydro-geologist.

The following discussion of the hydro-geology of the Bellekeno mine has been prepared by Richard Lippoth, M.Sc. (Geology), CPG who has been a senior geologist for Alexco Resource Corp. working on a variety projects in the Keno Hill District including Bellekeno Mine Development since 2006. Dick also has at least twenty years of experience which has included underground exploration and development projects ranging from deep mines (Coeur d'Alene district, Idaho) to sites involving significant ground water problems (Tintic district, Utah). While not a career hydrologist, he has been involved in the installation of ground water monitoring wells (Yampa coal field, Colorado) and wells for dewatering in advance of shaft sinking (Tintic, Utah).

> The quartzites and schists exposed in the Bellekeno Mine have very low permeability and are not an important conduit for groundwater. Where water has been observed entering the underground mine workings it is always in close association with some geologic structure such as the 48 Vein itself or possible low angle fault zones. Historic records document relatively large amounts of water issuing from the Bellekeno 48 Vein when first opened by drifting in the 1980's, but the flows diminished rapidly suggesting that the vein was acting as a limited reservoir having a very slow rate of recharge. Driving of the new East Decline by Alexco in 2008 disclosed no flowing groundwater. In 2009, concurrent with de-watering of the historic underground workings, the vein was tested by 133 underground diamond drillholes spaced approximately 25 metres apart. Some of the holes in the lower workings did encounter water in the vein, but the flows were modest and have since diminished noticeably

confirming the limited nature of the reservoir. Over the last six months the rate of water flow into the Bellekeno workings has steadily decreased to less than 3 litres/second (Figure 2).

The wider geologic picture produced by surface geological mapping in 2009 suggests little likelihood of additional major structures (veins or faults) being crosscut by proposed new mine workings at Bellekeno. If anything, it appears that Bellekeno is somewhat unique in having few crosscutting faults or branching veins. This is not to say that additional water inflows will not occur, but it is unlikely that they will amount to more than a few litres per second and many sources will decrease in volume rapidly over time as the small structural reservoirs are drawn down. There will of course be some seasonal variation in ground water movement, but here again this will produce modest and temporary increases in the mine water discharge.

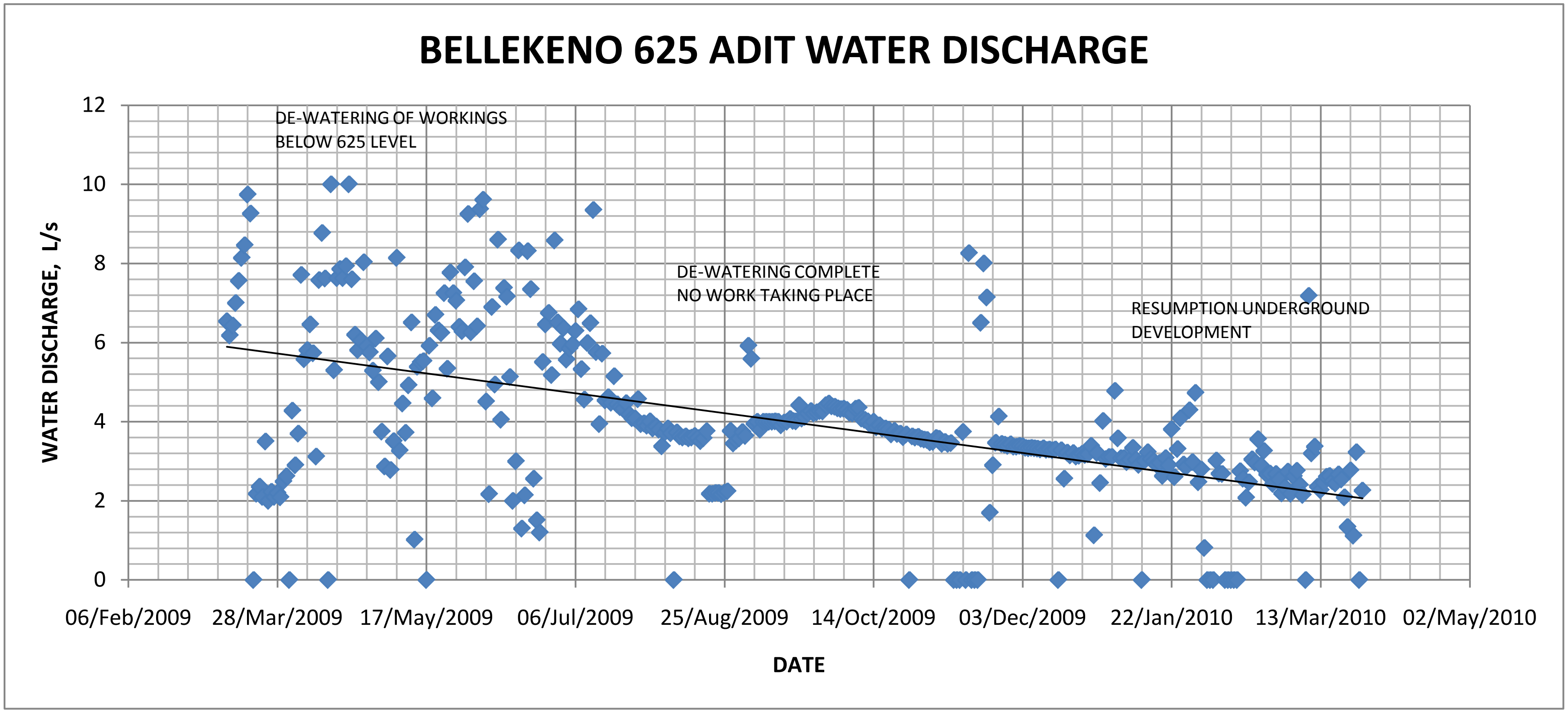
For additional context Alexco engineers and production personnel have summarized some statistics on the extent of the Bellekeno mine workings, planned development and proposed measures to mitigate any additional groundwater inflows as follows:

The Bellekeno Mine contains approximately 8 levels and over 5.6km of underground workings excluding stoping for a lateral extent of approximately 1500m and a vertical extent of approximately 350m of development with no significant occurrences of water either in the vertical or horizontal dimension

Compared with the existing extent of the Bellekeno Mine, total planned new development will expand the extent of these workings by approximately 60%. As a crude (and conservative) approximation, consider the assumption of a linear relationship between workings extent and water inflow to mine workings. Should this be the case, mine water inflows would increase from current levels of 2-3 L/s up to approximately 3.5 - 4.5 L/s.

Finally, cover hole drilling prior to significant linear development advance will provide strategic hydrologic information prior to opening up new underground workings. An additional safeguard is the previously mentioned contingency of treatment system modifications which will be put in place if needed to additional treatment in the unlikely event of hitting a hidden, hydraulically conductive structure.

Figure 2


BELLEKENO 625 ADIT WATER DISCHARGE
WATER DISCHARGE, L/s
12
10
8
6
4
2
0
06/Feb/2009
28/Mar/2009
17/May/2009
06/Jul/2009
25/Aug/2009
14/Oct/2009
03/Dec/2009
22/Jan/2010
13/Mar/2010
02/May/2010
DATE
DE-WATERING OF WORKINGS
BELOW 625 LEVEL
DE-WATERING COMPLETE
NO WORK TAKING PLACE
RESUMPTION UNDERGROUND
DEVELOPMENT

40. *Page 6-4 of the Main Application Report indicates that the mill has no systematic discharge other than septic water; however, the mill water balance in table 6-5 indicates a discharge stream of 6.18 m3/day for years 1-2 and 0.53 m3/day for years 3-5. Please clarify the mill water discharge stream.*

    The response provided resolves the issue of mill discharges to treatment. It is, however suggested that inclusion of negative water out to treatment would be more appropriately shown as positive water in (for make-up of process water). It is also uncertain why the process recycle in and out do not balance in either the 250 TPD or 400 TPD scenarios.

    1) Please consider showing a Process Water make up item in “water in” portion of the water balance table and eliminate the negative discharge stream in the water out.

    Please see Table 6-5 Revision 2 presented in the response to question 45.

    2) Please provide an explanation of the different in process recycle water quantities and comment on reason for changes in water contained in filtered tailings and concentrate.

    Over the course of the adequacy review, ongoing optimization of the mill process equipment and engineering work has resulted in minor changes to equipment selection including gland water seal requirements for pumps, filter press and thickener equipment sizing. This optimization process is the reason for changes in process recycle water quantities and water contained in filtered tailings and concentrate.

41. *Table 6-5 of the Main Application Report also indicates that the estimated daily runoff from the dry stack tailings facility is 26.1 m3/day. Please explain the basis of that estimate.*

    It is noted that the mean annual precipitation for the mill site is based on the 1996 dataset and therefore excludes a significant amount of data (1997-2009) that should be available to confirm that the mean annual precipitation estimates are reasonable. It is also noted that two different area estimates have been provided for the mill site and DSTF (62,700 m^2 and 58,300 m^2). A review of the EBA report does not allow for the runoff area to be determined; therefore it is assumed that some other work has been completed to delineate and measure the runoff area and this work has not been submitted.

    1) Please provide a detailed site water balance for the mill pond and figures that delineate and confirm contributing areas for runoff reporting to the mill pond for the case where the contributing area is the greatest in the mine life cycle.

    Figure 1 of Appendix L contained in Volume 3 of the Main Application Report (Exhibit 1.3.12) gives the maximum estimate of the surface area of the catchment for the mill site at the greatest contributing area during the mine life cycle (year 4). An updated water balance (Table 6-5 revision 2) is provided in the response to question 45 below.

    2) Please provide a preliminary design report for the water management infrastructure at the mill site and dry stack tailings facility.

Preliminary design for water management infrastructure including upper diversion berms, lower collection berms and pond are shown within the EBA Report Dry –stacked Tailings Facility Preliminary Engineering Design and Management Plan (Exhibit 1.8.3). In the normal course of engineering design, updates to the preliminary design will be made including addition of an overflow spillway for storm events, and grading of the mill site pad to be directed to the treatment pond.

Subsequent final design work will confirm these preliminary results, and will result in similar or more conservative results than the existing preliminary work presented to the Board with respect water management and pond sizing.

42. *Please indicate the number of flow measurements utilized to develop the average flow rates listed in table 6-3 of the Main Application Report.*

1) The number of load measures used in the load calculations should be identified such that the level of uncertainty associated with the results can be qualified.

See Table 3 below which summarizes the number of measurements taken for each sampling location used in the mass balance and load calculations.

Table 3

Number of Water Quality Measurements Taken at Stations used in the Mass Loading Model

	KV-1	KV-2	KV-4	KV-5	KV-6	KV-7	KV-9	KV-12	KV-13	KV-14	KV-17	KV-18	KV-19
	South McQuesten River u/s Christal Creek	South McQuesten River @ Pumphouse	South McQuesten River d/s Flat Creek	South McQuesten River 9 km downstream Flat Creek	Christal Creek @ Keno Highway	Christal Creek @ Hanson Road	Flat Creek u/s South McQuesten River	Valley Tailings Pond #3 Decant	Silver King Adit	Silver King Treatment Pond #2 Decant	Husky South West Adit	Bermingham Adit	Ruby Adit
2006	12	6	4	6	12	12	5	5	7	8	2	2	2
2007	11	2	3	3	12	11	3	15	16	16	2	2	2
2008	10	4	4	4	9	12	8	7	12	12	4	3	3

	KV-20	KV-21	KV-27	KV-28	KV-31	KV-32	KV-45	KV-47	KV-53	KV-55	KV-57	KV-58	KV-59
	No Cash 500 Adit	No Cash Creek @ Keno Highway*	Galkeno 300 Adit	Galkeno 300 Treatment Pond Decant	Galkeno 900 Adit	Galkeno 900 Treatment Pond Decant	Onek Adit	Porcupine Diversion Ditch	UN Adit*	Sandy Creek at Silver Trail Highway*	Haldane Creek at South McQuesten Road*	Seepage at toe of #3 dam**	Galena Creek at mouth (just upstream of Flat Creek*
2006	1	-	12	10	6	7	3	3	-	-	-	-	-
2007	2	2	16	16	17	17	2	2	2	2	2	2	2
2008	4	9	12	15	11	13	4	4	-	3	4	-	3

*in years where no measurements were taken, data from years immediately prior to and after were used

**where no seep data exists, it is assumed no seepage occurred in that year

2) The dry stacking tailings facility runoff values in Table 6-3 should be updated to be consistent with other references in the application.

Please see Table 6-3 revision 1 below:

Table 6-3 Revision 1 Christal Lake Inflows and Potential Mill Freshwater Makeup Sources

Input Node	Christal Creek at KV-51	Christal Creek at KV-6	Galkeno 900 (KV-31)	DSTF Runoff
Average Flow (m^3/day)	484	4,069	299	34.3

44. Please indicate the basis for the maximum daily mill water use of 58.64m3/day that is described on page 6-23 of Main Application Report.

1) Please clarify the water use as being 85.5 m3/day or a 25% contingency on the projected 64.8 m3/day water use described in the updated water balance of Table 6-5.

We can confirm that the requested water use of 85.5m3/day at the mill site includes a 25% contingency on 64.8 m3/day.

2) Please confirm if the mill site water balance has accounted for dust control water use in the pre-mill crushing circuit.

Water for dust control is not a planned systematic water use, but may be necessary as a contingency. This additional use, should it be required, will fall within the 25% contingency requested (see previous).

45. Please clarify the description of mill water discharge described on page 6-29 of the Main Application Report. It does not appear to identify the mill water discharges listed in table 6-5.

It is noted that section 6.1.6.2 indicates pore water seepage from compacted tailings as being negligible; however, supplied EBA preliminary design report indicates pore water seepage as 10% of pore water.

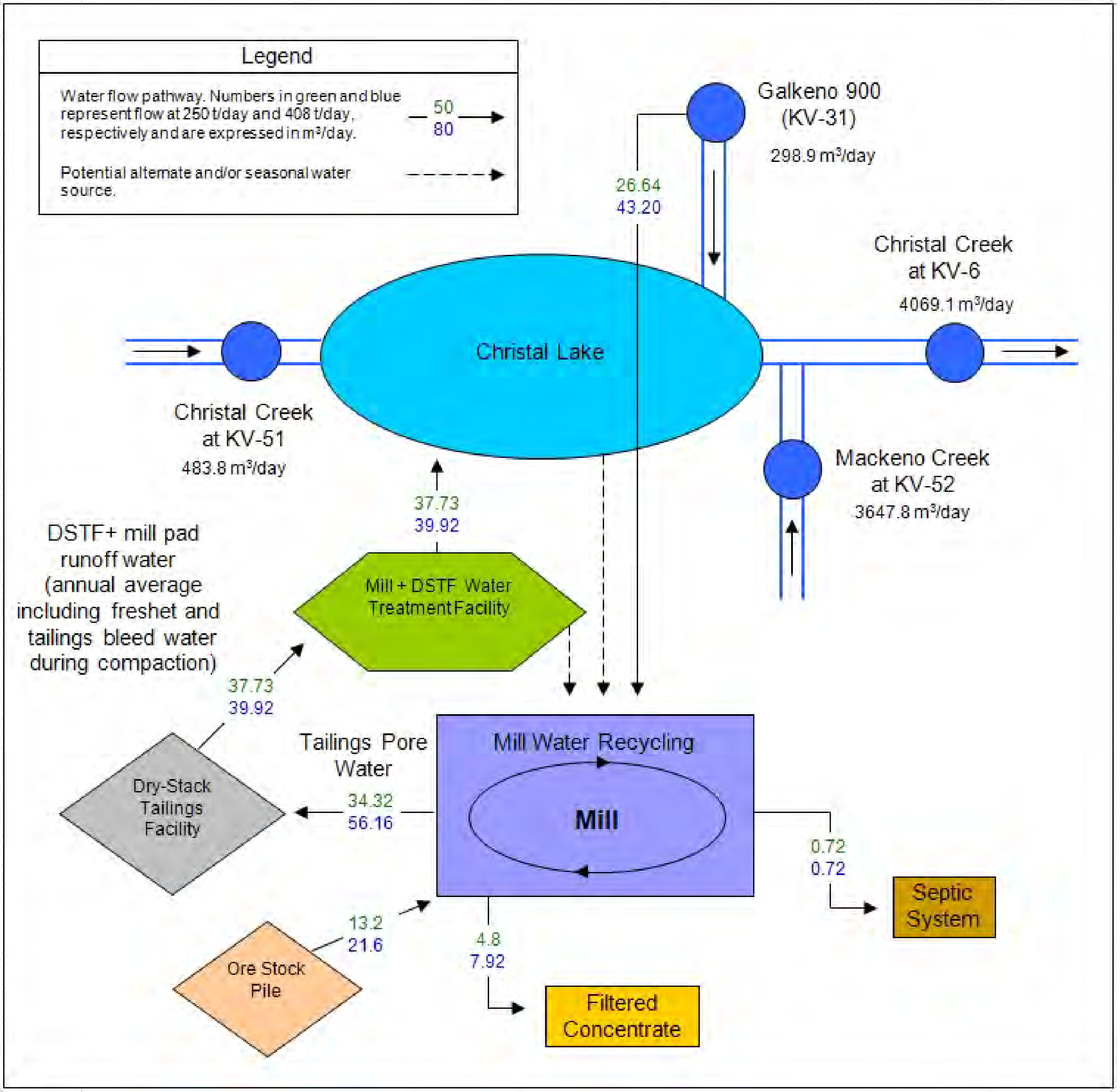
1) Please clarify whether the 10% bleed water from the placed and compacted tailings is included in the site water balance prepared for the mill site and dry stack tailings facility.

The component from the predicted 10% bleed water is now included in the figures and tables (see below Table 6-5 revision 2, and Figure 6-3, Revision 2).

Table 6-5 Revision 2

PROCESS DESCRIPTION	**250t/day (m^3/day)**	**408t/day (m^3/day)**
Fresh Water to Gland Seals	15.36	15.36
Fresh Water for Reagent Mixing	5.52	9.12
General Plant Use (sanitation)	0.72	0.72
Water in Fresh Ore	13.2	21.6
Make up Water	5.04	18
TOTAL WATER IN	39.84	64.8
Water to Sewage	0.72	0.72
Water Leaving Plant in Filtered Concentrate	4.8	7.92
Water Leaving Plant in Filtered Tailings	34.32	56.16
TOTAL WATER OUT	39.84	64.8
DSTF seepage (during compaction)	3.43	5.62
Mill Pad + DSTF Runoff	34.3	34.3
Total Water Treated/Discharged to Christal Lake	37.73	39.92

Figure 6-3 Revision 2



46. Please provide a more detailed water balance for the proposed mill pond ensuring that site freshet flows, mill water discharges, mill intakes, and treatment discharges are shown and the impact of these on the pond volume is described.

The provided response does not supply the desired detailed water balance for the mill pond, and does not allow for the pond sizing to be critically evaluated. The referenced section 6.1.5.5 is inconsistent with the provided response both in terms of the identified pond size (10,000 m^3 in application, 2,500 m^3 in response), retention time (30 days in application and

10 days in response), and design criteria (1:100 runoff in application, 1:200 in response). It is also noted that section 6.1.5.5 indicates that a preliminary design of "surface water management infrastructure" is being supplied by EBA; however the included EBA report supplied in the responses presents assumptions for pond sizing not a design of that sizing. The EBA report also does not provide preliminary design information for the various water conveyance and control structures that will be used to manage surface and groundwater at the site.

1) Please provide a water balance for the mill pond that confirms the currently proposed sizing is adequate.

Sizing of the Flame and Moth Mill Site collection and treatment pond at 2500m^3 was done according to standard industry practice and in consultation with Pete McCreath (P.Eng) of Clearwater Consultants Ltd. at this stage of the preliminary engineering design process. The basic method used was to compare modeled peak storm events for a chosen return period with treatment plant capacity flow rates over the peak period of the event. Freshet event cumulative runoff volumes for a variety of return periods were calculated by Clearwater Consultants for the supplied Flame and Moth mill site area (see Figure 7 of Memorandum CCL-UKHM-2 presented as Exhibit 1.3.12). The resulting curves were compared with design treatment plant capacity in order to generate an approximate pond size necessary to accommodate the "1:200 year best" event.

Peak flow and cumulative runoff volume in the modeled events occurred between days 15 and 20 during which approximately 3,750 m^3 (750m^3/day) of water was shed from the site and reported to the treatment pond. Treatment system capacity will be sized to be able to handle 10L/s (864 m^3/day). Assuming 100% treatment capacity, during the peak 5 day flow period, the system will be able to treat and discharge all water without any accumulation in the pond. Should the system break down completely during the peak five days of the 1:200 event, the pond will provide approximately 3.33 days of capacity before overtopping.

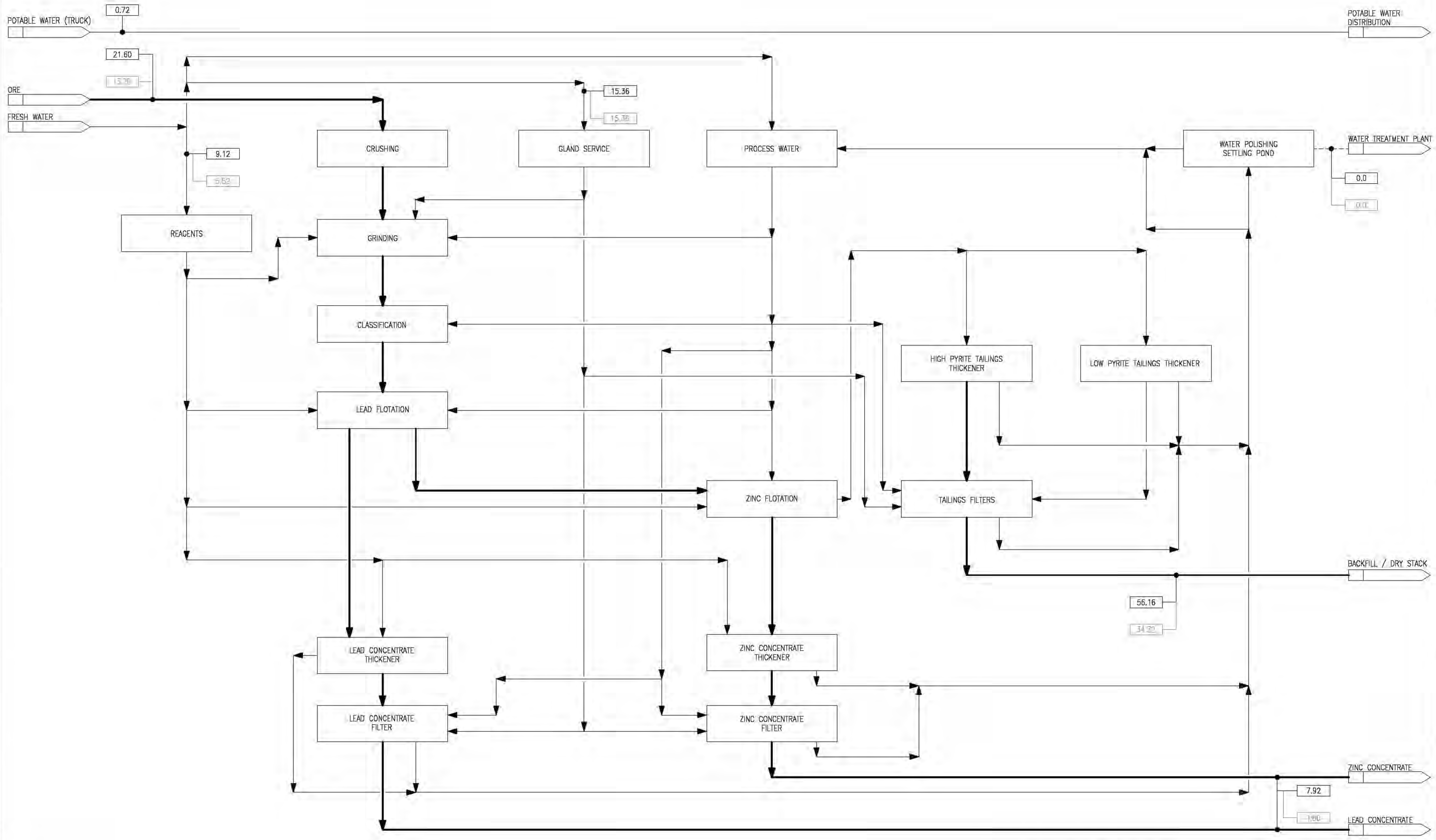
It should be noted that this pond sizing exercise does not include any mill freshwater makeup from the treatment pond (this may be up to 64.8 m3/day, see Table 6-5, revision 2) which would result in less accumulation/discharge.

47. *Please refer to the Construction Site Plan -Appendix A (exhibit 1.4.1). Please clarify that the Water Balance Process Flowsheet (drawing A00-09-012) is a correct representation of the mill water balance described elsewhere in the application or revise the drawing to be consistent with presented water balance.*

The response provided appears to state that drawing A00-09-012 dated March 25, 2009 in Exhibit 1.4.1 is consistent with the application. If this drawing was consistent with the application then it no longer appears to be consistent with the revised water balance information provided as a result of the "recently" completed final engineering design work.

Please supply a replacement drawing that reflects the current mill water balance; ensuring consistency with the final water balance submitted at the end of the adequacy review.

Please see revised updated water balance process flowsheet A00-09-014 which replaces drawing A00-09-012, submitted in Appendix A of Exhibit 1.4.1.



PROGRESS PRINT

WATER SOLUTIONS: 408T/D
WATER SOLUTIONS: 250T/D

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DWG. NO.	REFERENCE DRAWINGS

REV. No.	ISSUE No.	DESCRIPTION	DATE	BY
C	1	ISSUED FOR CLIENT APPROVAL	29JAN10	CC
B	1	ISSUED FOR INFORMATION	09JUL09	AKF
A	1	ISSUED FOR CLIENT REVIEW	21MAY09	CC

CLIENT | PROJ.MAN. | PROJ.ENG. | PROCESS | ELECTR. | INSTR. | PIPING | MECH. | STRUCT. | SERVICES | ARCH. | LAYOUT

SECTION:	PROCESS	
SCALE:	NONE	DATE
DESIGN BY:	RA	25MAR09
DRAWN BY:	PH	25MAR09
CHECK. BY:		
APP. BY:		

YUKON TERRITORY

ALEXCO

WARDROP Engineering Inc.

TITLE

BELLEKENO PROJECT (EP)

PERMITTING WATER BALANCE
PROCESS FLOWSHEET
408 tpd / 250 tpd

FILENAME	PROJECT NUMBER	DRAWING NUMBER	REV.
A0009014.DWG	09539602.00	A00-09-014	C

13:22
10/01/29

U:\A-G\ALEXCO RESOURCE CORP - 5396\09539602.00 - BELLEKENO PROJECT (EP)\09-PROCESS\PFD\A0009012.DWG

56. *On page 5-7 of the Main Application Report -Appendix K (exhibit 1.3.11), you indicate that the ethanol-based, gravel infiltration gallery bioreactor will be employed for decommissioning of the Bellekeno 625 for 5 years; citing the success of the Galkeno 900 pilot project. Furthermore, it is suggested that this technology may also be employed immediately down slope of the drystack tailings facility. Please provide information supporting the stated success of Galkeno 900 bioreactor pilot project. Also, please provide the rationale as to why this passive treatment is only expected to be required for 5 years at Bellekeno 625.*

    The information provided in the response and the associated attachments are helpful in providing evidence of bioreactor treatment and operation in the Keno environment. It is noted, however, that the Galkeno reactor is a pilot program that has not yet completed its operational testing. Detailed reporting that has been submitted is limited to only the recirculation and limited discharge phases of the pilot project.

    The response provided suggests that once the bioreactor is no longer actively managed (i.e. supplied with organic carbon) a secondary process will occur to passively continue treatment (i.e. the oxidation of iron sulfide).

    1) Please submit the most recent data from the Galkeno 900 bioreactor treatment site.

    The data can be found below in Table 4 below.

Table 4 Summary of Data From Galkeno 900 Bioreactor Treatment Site

	Aluminum, dissolved	Arsenic, dissolved	Antimony, dissolved	Barium, dissolved	Cadmium, dissolved	Calcium, dissolved	Carbon, Total Organic	Cobalt, dissolved	Hardness calculated from dissolved metal scan	Iron, dissolved	Lithium, dissolved	Magnesium, dissolved	Manganese, dissolved	Nickel, dissolved	Phosphorus, dissolved (not colourmetric)	Potassium, dissolved	Silicon, dissolved	Sodium, dissolved	Strontium, dissolved	Sulphur, Dissolved	Sulphate, Dissolved	Uranium, dissolved	Zinc, dissolved	Sulphide
	mg/L	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**	**mg/L**
Galkeno 900 Adit Discharge																								
13-Nov-2008	0.022	0.0806	0.0034	0.007	0.00213	359		0.02666	1040	1.82	0.053	36		0.197	<0.01	0.6	3.54	1.6	0.466			0.0084	6.28	
19-Dec-2008	0.015	0.0864	0.0032	0.009	0.00138	398		0.0296	1120	1.93	0.069	31.9	17.5	0.191		0.6	3.75	1.6	0.449	324		0.0095	5.91	
15-Jan-2009	0.01	0.0903	0.0047	0.008	0.00139	413		0.0276	1020	2.02	0.067	33.1	18.1	0.195		0.7	3.9	2.8	0.467	331		0.0099	6.68	
3-Feb-2009	<0.005	0.0705	0.0024	0.007	0.00129	369		0.0238	1060	2.01	0.054	34.4	22.7	0.178	<0.01	0.8	3.39	1.6	0.487	369		0.0089	6.44	
10-Mar-2009	<0.005	0.0809	0.0033	0.008	0.00126	328		0.0281	959	1.69	0.054	33.8	20.9	0.212	<0.01	0.6	3.39	1.5	0.494	284		0.009	6.82	
16-Apr-2009	0.006	0.0748	0.0026	0.008	0.00148	437		0.0255	1240	1.9	0.06	37.7	18.8	0.198	<0.01	0.73	4.35	1.87	0.463	380		0.0095	6.41	
7-May-2009	0.005	0.068	0.0026	0.0084	0.0014	422		0.025	1210	1.85	0.057	39	17.9	0.188		<1	4.11	2	0.453	365		0.00937	6.07	
6-Jun-2009	0.014	0.0687	0.0024	0.0079	0.0016	418		0.0273	1210	1.66	0.057	39	18	0.203		<1	4.28	2	0.449	371		0.00938	6.29	
8-Jul-2009	<0.01	0.0628	0.0026	0.008	0.0015	391		0.0254	1130	1.72	0.058	38	16.5	0.183		<1	3.35	2	0.481	322		0.0105	5.93	
18-Aug-2009	<0.01	0.0641	0.0026	0.007	0.0014	417		0.0265	1200	1.39	0.059	39	17.6	0.197		<1	3.53	2	0.447	354	930	0.0121	6.05	
11-Sep-2009	<0.01	0.064	0.0025	0.008	0.0014	443		0.0252	1270	1.84	0.056	41	17.9	0.194		<1	4.24	2	0.454	356	910	0.0102	6.05	
9-Oct-2009	<0.01	0.0679	0.0027	0.008	0.0014	407		0.0252	1180	1.96	0.057	39	17.5	0.183		<1	3.93	2	0.485	353	930	0.0102	4.97	
12-Nov-2009	<0.01	0.0508	0.0022	0.007	0.0014	425		0.0264	1220	0.624	0.06	38	17.6	0.195		<1	4.08	2	0.453	397	960	0.0092	5.9	
2-Dec-2009	0.016	0.0702	0.0026	0.008	0.0016	448		0.0285	1300	2	0.058	43	19	0.211		<1	4.77	2	0.47	393	950	0.0101	6.22	
12-Jan-2010	<0.01	0.0589	0.0025	0.008	0.0015	427		0.0234	1220	1.57	0.055	38	17.7	0.183		<1	4.18	2	0.459	349	940	0.0099	5.9	
11-Feb-2010	0.031	0.0586	0.0023	0.007	0.0013	418		0.0246	1200	1.74	0.054	38	16.5	0.188		<1	4.08	2	0.417	363	960	0.0097	5.77	
8-Mar-2010	<0.01	0.0549	0.0023	0.007	0.0015	421	<0.5	0.0261	1210	1.36	0.055	38	17.3	0.202		<1	3.93	2	0.456	339	1000	0.0099	6.15	
23-Mar-2010	<0.01	0.0597	0.0022	0.008	0.0016	427	<0.5	0.0231	1200	1.52	0.06	34	17.2	0.17		<1	3.93	1	0.453	364	940	0.0098	5.56	
Galkeno 900 Bioreactor Standpipe																								
13-Nov-2008	1.55	0.0179	0.0019	0.076	0.0044	349	108	0.00599	1050	0.026	0.033	44.1	6.52	0.051	<0.01	1.6	3.79	2.7	0.551		844	0.0171	1.05	<0.005
4-Jan-2009	0.01	0.0051	0.0024	0.017	0.00232	408	1.1	0.0196		0.02	0.061	33.1	16.6	0.167		0.8	3.84	1.8	0.484	329	1460	0.0104	5.65	<0.005
12-Feb-2009	<0.005	0.0016	0.0016	0.015	0.00206	414	240	0.0017	1200	0.02	0.042	41.4	6.47	0.082	<0.01	0.8	3.55	1.8	0.438	319	989	0.0087	2	<0.005
1-Mar-2009	<0.005	0.0047	0.0016	0.014	0.00215	413	35.9	0.0129	1200	0.02	0.053	41.1	16.5	0.152	<0.01	0.8	3.81	1.7	0.461	308	925	0.009	4.36	<0.005
12-Mar-2009	<0.005	0.0034	0.0018	0.02	0.00261	346	7.8	0.0107	1020	0.03	0.048	37.8	20.2	0.165	<0.01	0.8	3.56	1.6	0.519	298	977	0.0119	3.96	<0.005
10-Apr-2009	<0.005	0.0013	0.0014	0.017	0.00257	408	2.5	0.00214	1200	<0.01	0.042	45.2	11.1	0.1	<0.01	1.1	4.37	2.1	0.449	323	152	0.0103	2.77	<0.005
23-Apr-2009	0.005	0.0015	0.0014	0.019	0.00234	413	2.4	0.0008	1190	0.014	0.047	39.3	4.39	0.09	<0.01	0.95	4.35	1.85	0.459	354	840	0.0109	2.06	0.007
7-May-2009	<0.004	0.0014	0.0006	0.0183	0.001	408	2	0.0001	1190	<0.02	0.043	40	0.358	0.0553		<1	4.19	2	0.444	353	940	0.011	1.01	0.005
21-May-2009	<0.004	0.0016	<0.0004	0.0165	0.0005	383	2.4	0.0002	1110	0.067	0.037	37	0.178	0.0333		<1	4.2	2	0.425	328	970	0.0114	0.597	<0.005
4-Jun-2009	0.006	0.0016	0.0005	0.0216	0.0006	402	3.1	0.0002	1180	<0.02	0.042	42	0.212	0.0241		1	4.42	2	0.471	348	930	0.0127	0.553	0.006
18-Jun-2009	<0.01	0.0016	0.0005	0.02	0.0005	395	2.1	<0.0005	1160	<0.02	0.037	41	0.208	0.019		1	4.68	2	0.435	341	920	0.0116	0.537	<0.005
2-Jul-2009	<0.01	0.0018	0.0007	0.021	0.0007	406	1.9	<0.0005	1190	<0.02	0.038	42	0.196	0.018		1	4.67	2	0.445	359	870	0.0124	0.533	<0.005
16-Jul-2009	<0.01	0.0017	0.0007	0.021	0.0006	387	18.9	<0.0005	1110	<0.02	0.038	35	0.337	0.015		1	4.85	3	0.467	309	900	0.0116	0.578	0.008
30-Jul-2009	<0.01	0.0033	0.002	0.033	0.0033	399	17.5	0.0239	1160	0.028	0.039	40	26.1	0.066		1	4.33	2	0.459	335	850	0.0154	1.04	0.012
13-Aug-2009	<0.01	0.0301	0.0006	0.051	<0.0001	401	12.3	0.0745	1180	0.042	0.03	42	55.6	0.07		<1	4.87	2	0.468	329	870	0.0219	0.266	0.014
27-Aug-2009	<0.01	0.0655	<0.0005	0.047	<0.0001	404	17.3	0.0206	1180	17.9	0.031	43	37.9	0.013		<1	6.7	2	0.462	318	850	0.0127	<0.01	0.033
10-Sep-2009	<0.01	0.0944	<0.0005	0.047	<0.0001	403	15.8	0.0043	1180	6.97	0.027	43	32.2	0.003		<1	9.26	2	0.475	221	580	0.0095	<0.01	0.012
24-Sep-2009	<0.01	0.128	<0.0005	0.045	<0.0001	363	10.1	0.0018	1080	1.66	0.028	42	25.9	0.002		<1	9.43	2	0.491	180	440	0.011	<0.01	0.109
9-Oct-2009	<0.01	0.0173	<0.0005	0.044	<0.0001	346	17.2	0.0029	1040	0.08	0.031	43	22.2	0.012		<1	8.99	2	0.437	167	410	0.0139	0.043	
20-Oct-2009	<0.01	0.142	<0.0005	0.054	<0.0001	374	7	0.0071	1110	17	0.028	43	23.4	0.005		<1	7.37	2	0.447	224	560	0.012	<0.01	0.086
5-Nov-2009	<0.01	0.0295	<0.0005	0.044	<0.0001	411	9.4	0.0139	1200	13.8	0.044	42	22.6	0.02		<1	5.79	2	0.445	341	720	0.0106	0.022	0.078
16-Nov-2009	<0.01	0.0144	<0.0005	0.035	<0.0001	405	1.5	0.0139	1170	9.91	0.052	39	19	0.016		<1	4.73	2	0.458	370	820	0.0087	0.026	0.133
30-Nov-2009	<0.01	0.0009	<0.0005	0.027	<0.0001	423	6.5	0.013	1220	<0.02	0.053	40	18.8	0.025		<1	4.65	2	0.452	349	880	0.0053	<0.01	0.16
14-Dec-2009	<0.01	0.0037	<0.0005	0.028	<0.0001	471	5.2	0.0087	1350	6.45	0.06	43	19.5	0.018		<1	4.85	2	0.5	391	970	0.0083	0.026	0.3
28-Dec-2009	<0.01	0.0053	<0.0005	0.019	<0.0001	420	3.9	0.0135	1210	4.56	0.056	38	17.1	0.067		<1	4.7	2	0.45	354	940	0.008	0.238	0.202
11-Jan-2010	<0.01	0.0055	<0.0005	0.022	<0.0001	415	1.6	0.0127	1190	4.87	0.056	37	17.8	0.052		<1	4.27	2	0.447	335	1000	0.0094	0.036	0.138
25-Jan-2010	<0.01	0.0031	<0.0005	0.019	<0.0001	423	3.2	0.0146	1210	2.53	0.057	37	17.6	0.087		<1	4.07	2	0.451	353	950	0.0085	0.039	0.273
9-Feb-2010	<0.01	0.0082	0.0015	0.014	<0.0001	398	0.6	0.0299	1130	0.451	0.057	34	16.8	0.21		<1	3.65	1	0.459	315	920	0.0105	4.14	0.011
8-Mar-2010	<0.01	0.0067	0.0018	0.011	0.0005	415	0.7	0.0255	1190	0.385	0.054	37	17.1	0.19		<1	3.93	2	0.432	340	930	0.0099	5.03	0.006
23-Mar-2010	<0.01	0.006	0.0015	0.014	0.0007	431	2.1	0.0205	1210	0.477	0.057	34	16.5	0.149		<1	4.01	1	0.46	366	920	0.0097	4.38	0.011
Galkeno 900 Bioreactor Return Line																								
20-Oct-2009	0.016	0.0447	<0.0005	0.05	<0.0001	428	3.8	0.007	1240	13.1	0.047	40	20.8	0.006		<1	5.4	2	0.462	337	800	0.0081	0.018	0.216
5-Nov-2009	<0.01	0.0327	<0.0005	0.042	<0.0001	423	10.7	0.006	1220	16.3	0.049	41	20.8	0.001		<1	5.89	2	0.446	354	860	0.0061	<0.01	0.091
16-Nov-2009	<0.01	0.0383	<0.0005	0.04	<0.0001	422	2.1	0.0059	1220	15	0.051	40	20.3	0.001		<1	5.5	2	0.458	368	780	0.0062	<0.01	0.108
30-Nov-2009	<0.01	0.0053	<0.0005	0.036	<0.0001	420	10.5	0.0055	1210	<0.02	0.05	40	19.9	0.002		<1	5.15	2	0.452	341	870	0.0044	<0.01	0.099
14-Dec-2009	<0.01	0.0202	<0.0005	0.035	<0.0001	417	9.3	0.0038	1200	10.7	0.05	38	19.5	0.002		<1	5.31	2	0.455	334	880	0.0056	0.013	0.104
28-Dec-2009	<0.01	0.0105	<0.0005	0.03	<0.0001	451	2	0.0058	1290	7.39	0.059	40	18.6	0.009		<1	5.55	2	0.474	369	920	0.0067	0.07	0.34
11-Jan-2010	<0.01	0.0104	<0.0005	0.029	<0.0001	431	1.1	0.007	1240	7.16	0.056	39	18.8	0.007		<1	4.56	2	0.451	349	990	0.0088	0.032	0.76
25-Jan-2010	<0.01	0.0075	<0.0005	0.028	<0.0001	430	1.3	0.0063	1230	6.18	0.057	37	18.1	0.011		<1	4.74	2	0.468	344	820	0.0077	0.048	0.218
8-Mar-2010	<0.01	0.0027	<0.0005	0.02	0.0001	403	0.7	0.0192	1150	1.84	0.055	36	17.6	0.095		<1	4.26	2	0.438	327	1000	0.0089	1.28	0.143
23-Mar-2010	<0.01	0.0034	0.0007	0.02	0.0003	428	3.9	0.0187	1210	3.33	0.055	34	18	0.098		<1	4.45	1	0.456	373	930	0.0098	1.88	0.099
Galkeno 900 Bioreactor Tank																								
13-Nov-2008	0.036	0.028	0.0016	0.034	0.00343	355	77.6	0.0108	1060	0.53	0.04	42.4	10.6	0.092	<0.01	1.3	3.78	2.4	0.552		890	0.0155	2.28	<0.005
4-Jan-2009	<0.005	0.0166	0.002	0.016	0.00209	411	<0.5	0.0199		0.36	0.061	33.3	16.8	0.168		0.8	3.85	1.8	0.483	331	1470	0.0105	5.83	<0.005
12-Feb-2009	<0.005	0.0017	0.0017	0.016	0.00209	429	242	0.00192	1250	0.01	0.042	43.1	6.64	0.104	<0.01	0.8	3.75	1.8	0.48	327	908	0.0102	2.46	<0.005
1-Mar-2009	<0.005	0.0113	0.0017	0.012	0.0019	411	36.1	0.0129	1190	0.24	0.048	40.7	16.6	0.148	0.02	0.8	3.66	1.7	0.45	306	894	0.0095	4.25	<0.005
12-Mar-2009	<0.005	0.0034	0.0018	0.018	0.00284	367	8.1	0.0104	1080	0.04	0.05	39.9	20.9	0.167	<0.01	0.9	3.73	1.7	0.52	342	960	0.0114	4.23	<0.005
10-Apr-2009	<0.005	0.0016	0.0015	0.016	0.00262	376	1	0.0024	1100	<0.01	0.047	40.6	11	0.109	0.01	1	3.9	1.8	0.435	268	156	0.0103	2.88	<0.005
23-Apr-2009	0.002	0.0019	0.0015	0.017	0.00208	414	1.9	0.0009	1200	0.015	0.046	39.7	4.45	0.091	<0.01	0.95	4.33	1.85	0.452	355	860	0.0108	2.12	<0.005
7-May-2009	0.009	0.0017	0.0005	0.0164	0.0009	407	1.7	0.0001	1180	0.032	0.042	40	0.374	0.0551		<1	4.14	2	0.439	351	1000	0.011	1.04	0.007
21-May-2009	<0.004	0.0024	0.0004	0.0158	0.0005	396	3.1	0.0001	1150	<0.02	0.037	38	0.152	0.0357		<1	3.87	2	0.434	341	1100	0.0117	0.639	0.006
4-Jun-2009	<0.004	0.0016	0.0004	0.0172	0.0004	390	3.4	0.0002	1140	<0.02	0.038	41	0.207	0.0238		<1	4.67	2	0.426	342	940	0.0115	0.55	0.008
18-Jun-2009	<0.01	0.0018	0.0006	0.019	0.0004	394	2.9	<0.0005	1160	<0.02	0.038	42	0.226	0.019		1	4.72	2	0.431	336	880	0.0115	0.542	<0.005
2-Jul-2009	<0.01	0.0022	0.0007	0.02	0.0004	389	3.5	<0.0005	1140	0.02	0.038	41	0.236	0.019		1	4.84	2	0.443	352	920	0.0123	0.532	<0.005
16-Jul-2009	<0.01	0.0018	0.0006	0.021	0.0006	391	22.5	<0.0005	1120	<0.02	0.038	36	0.428	0.017		1	4.8	2	0.468	313	900	0.0116	0.604	0.008
30-Jul-2009	<0.01	0.0058	0.002	0.034	0.0026	403	19.8	0.0273	1170	0.039	0.04	41	26.5	0.068		1	4.45	2	0.455	337	850	0.0155	1.11	0.018
13-Aug-2009	<0.01	0.0339	0.0005	0.051	<0.0001	403	17.1	0.0731	1180	0.184	0.03	42	56.1	0.066		<1	4.97	2	0.466	328	840	0.0218	0.22	0.011
27-Aug-2009	<0.01	0.067	<0.0005	0.045	<0.0001	414	34.4	0.0136	1210	18.9	0.031	43	40.1	0.004		<1	7	2	0.468	317	850	0.0114	<0.01	0.077
10-Sep-2009	<0.01	0.088	<0.0005	0.045	<0.0001	413	21.7	0.0033	1210	6.01	0.027	44	33.6	<0.001		<1	9.24	2	0.483	231	640	0.0093	<0.01	0.015
24-Sep-2009	<0.01	0.14	<0.0005	0.045	<0.0001	374	14.3	0.0014	1110	1.74	0.028	42	27.2	0.001		<1	9.88	2	0.491	192	440	0.011	<0.01	0.122
9-Oct-2009	<0.01	0.0143	0.0008	0.049	<0.0001	343	12.3	0.0051	1030	0.168	0.028	43	21.4	0.018		<1	9.3	2	0.434	152	410	0.018	<0.01	
9-Feb-2010	<0.01	0.0081	<0.0005	0.025	<0.0001	386	1.2	0.0251	1100	4.95	0.058	33	16.7	0.131		<1	3.95	1	0.472	299	870	0.0122	0.476	0.081

2) Please provide evidence of the passive treatment mechanism suggested for the bioreactor system proposed for the Bellekeno 625 adit.

   Rather than a single mechanism, an outcome of treated effluent which meets discharge standards at the Bellekeno Mine will be achieved by three mechanisms. These are:

   - Mine pool treatment which has been demonstrated at other sites to be effective at reducing zinc by over 90%
   - A bioreactor system which is currently being demonstrated at Galkeno 900
   - Passive/sorption of metals unto sulphide/oxide phases within the bioreactor which well documented to be the mechanisms at work the natural environment.

3) Please ensure that Table 5-6 in Exhibit 1.3 is current and consistent with the preliminary design report provided for the dry stack tailings facility and currently understood net precipitation which may be revised to account for data accrued since net precipitation was estimated in 1996.

Table 5-6, which was used to estimate zinc loading was based on an earlier (and 12% larger) DSTF design. Recalculation of Table 5-6 based on the DSTF footprint and designs presented in the EBA preliminary design report presented in Exhibit 1.3 will result in lower zinc loadings. For the purposes of the mass loading model, these footprints are sufficiently close that the loading number with the new DSTF footprint would be similar (though slightly smaller).

57. *It is understood that modifications to the water treatment process at Bellekeno 625 were required due to high suspended solids loads during advanced exploration and development at the mine site in 2008/2009. Please provide the most current data and a review of the operational performance of the Bellekeno treatment plant during advanced exploration including performance both during dewatering and post dewatering.*

As previously requested in regards to Question #27, please provide details regarding the necessary (or already implemented) modifications to the Bellekeno 625 treatment plant required to meet proposed effluent discharge standards during mine operations.

Proposed modifications to the Bellekeno 625 treatment plant were submitted to the Board on March 15th under QZ07-078 (see Attachment B).

59. *Mine water inflows into Bellekeno are known to have a seasonal increase during the freshet period. Please identify the expected peak inflow and resulting peak adit outflow (which includes mine development water returns) and comment on the treatment plant's capacity to treat this peak inflow amount during operations, or provide alternative strategy for managing seasonal peak water inflows. Please ensure your response accounts for any predicted changes to mine water inflows resulting from expansion of the underground workings during operations.*

Please provide the rationale for increasing the treatment plant capacity to 30 L/s, and provide details on the proposed modifications to the treatment plant to accommodate the increased treatment rate.

The optional contingency to allow treatment of 30L/sec is planned for the unlikely event of hitting a hidden, hydraulically conductive structure.

Proposed modifications to the Bellekeno 625 treatment plant were submitted to the Board on March 15th under QZ07-078 (see Attachment B). While the currently proposed water treatment system modifications have been sized for a 10L/s capacity, these modifications (filtration and recirculation systems) can easily be modularized to provide 30L/s capacity. The increase in treatment capacity to 30L/s will be implemented should the need arise.

63. *Please provide preliminary details regarding the proposed water treatment plant for the Flame and Moth Mill and the ground based discharge system for the treated effluent.*

It is unclear where a spillway would discharge storm flows down gradient of the seepage pond and where such flows would then report to. For the proposed ground diffuser it is noted that no geotechnical information has been provided to show that this diffusion rate is sustainable, for example if the ground is frozen. Moreover, there is no preliminary design for this discharge system. It is noted that the 0.5 L/s diffuser appears to be insufficient to manage the freshet volumes for even the best estimate (i.e. least conservative) 10 year scenario.

The response references a 1:100 year storm event; however, the response to Question #46 indicated that the pond sizing was based on a 200 year 10 day event. It is not clear if these two pieces of infrastructure have been designed to the same standard.

1) Please provide preliminary designs for the mill pond including its discharge infrastructure that is understood to include a ground diffuser system and spillway.

As a correction to the January 19 response to this question we would like to clarify that the clarifier will be sized at 10L/s to be able to handle the 1:200 year freshet event and will be consistent with the rationale for pond sizing and treatment rates as discussed in the response to question 46.

While the normal discharge flows from the mill site pond are expected to be < 0.5 L/s, pond sizing was designed to accommodate the 1:200 year event, requiring a treatment capacity flow rate of 10 L/s. As a correction to the January 19 response to this question, we would like to clarify that energy dissipater/diffuser will be sized at 10L/s in order to be able to handle the peak flows of the 1:200 year event.

2) As with previous recommendations, please also provide a detailed water balance to ensure that the pond sizing is appropriate.

Please see the response to question 46.

3) Please provide the estimated water quality that will be discharged to the environment from the mill pond.

Water quality of discharge from the mill pond will meet effluent discharge criteria as determined by this license.

Because the mill site treatment pond will not deal with mine adit flows as other locations in the district, water reporting to the treatment pond will be comprised primarily of meteoric runoff water (a small proportion of this water may be influenced by ore stockpile). Additionally, a minor contribution (up to 5.6 m^3/day) of potentially more metal rich bleed water released during compaction of the DSTF will report to the treatment pond and be diluted by meteoric runoff.

In general, we expect water inflows the mill site water treatment pond to contain lower total metals than other adit flow treatment sites around the district (e.g. Bellekeno 625, Galkeno 900) and we are confident that our water treatment system will be able to meet effluent discharge criteria as determined by the license. For context, the proposed system is modeled after the water treatment system at Galkeno 300, which successfully treats flows up to 100 L/s with zinc concentrations in excess of 100mg/L.

64. Please clarify the expected sludge volume that will be produced during operations and closure water treatment at the Bellekeno mine and at the mill site.

The response is limited to sludge produced during operations and should be expanded to comment on sludge production during closure operations. It is noted that closure of the mill site will add an additional waste stream as the mill process water would require treatment and be expected to add to the sludge volume. Based on other provided responses it is now understood that sludge produced during operations would be filtered at the mill and mixed with tails for disposal both at the DSTF and underground in the mine stopes. With this understanding the sludge volumes during operations are recognized as being a minor waste stream.

During closure when tailings are no longer being produced it is unclear how sludge would be disposed of; hence the information on its mass and volume is still necessary.

(1) Please identify sludge mass and volume that will be created during the closure phase of the mine life cycle and indicate the fate of this waste product.

Less than 100 m^3 of sludge will be produced during the closure phase of the mine life cycle. The fate of this waste will be determined by the District Wide Sludge Management Plan, with care taken that liability for this sludge and other district wide sludge are kept separate (see also the response to question 10).

(2) The response may need to be revised if there are changes to the mine water balance that show discharges in excess of the 10 L/s used in the development of sludge volume estimate.

Discharges are not expected to exceed 10L/s especially in light of the fact that during this closure period, the mine will return to steady state.

65. *Please clarify where sludge produced during operations and closure at the Bellekeno mine and the Flame and Moth mill site will be disposed of.*

The response clarifies the fate of sludge developed during operations but does not address the fate of sludge (if any) created during closure operations when the DSTF is no longer available for disposition.

1) Please clarify how sludge will be managed during the closure phase of the project.

The fate of sludge during the closure period will be determined by the District Wide Sludge Management Plan, with care taken that liability for this sludge and other district wide sludge are kept separate (see also the response to question 10).

67. *Please clarify the status of the May 2009 (District) Sludge Management Plan submitted as Appendix N of the Main Application Report (exhibit 1.3.14). The Sludge Management Plan suggests that the Sime pit will be developed to provide significant extra storage for sludge.*

If it is correctly understood that sludge from the Bellekeno project will not be disposed of at the existing district wide sludge disposal sites, then the purpose of the sludge management plan in this application is not understood.

1) Please reconsider the inclusion of the District Wide Sludge Management Plan in this application. If you feel it should be considered during this application please provide a rationale for its consideration.

Sludge produced from the Bellekeno Mine and Flame and Moth mill site after closure of the DSTF will be disposed of as per the District Wide Sludge Management Plan, with care taken that liability for this sludge and other district wide sludge are kept separate.

68. *a) If you are requesting that the Board consider an expanded septic field, please provide a map of the area delineating the existing septic field and the proposed expanded septic field; provide the distance to the nearest water body, and the type and permeability of soils;*

The response does not address the distance to the nearest water body and the nature of the soils in the area of the proposed septic field.

1) Please provide the distance to the nearest water body, and the type and permeability of soils.

Permeability is assumed to be similar to that encountered in the existing drain field (between 5 and 10 mpi, N. Jacobsen, P. Eng). Permeability and sizing will be confirmed with final design. Distance from the proposed septic field to the nearest water body (Flat Creek) is 106 m.

73. *Please clarify whether the static water level in the Keno well has been confirmed through field measurements.*

The static water level is a key piece of information to support (or not) the conceptual model and its conclusions.

1) Please consider providing a field measurement of Keno City water wells static level as part of this application.

   Although we were unable to obtain a measurement from the Fire Hall Keno City municipal water well, during the field component of the groundwater monitoring program well installation, we did obtain one static water level measurement from a private resident's well in Keno City. This measurement in conjunction with findings from the other recently installed groundwater monitoring wells confirmed that groundwater gradients flow away from Keno City with respect to the Mill Site.

74. c) Please provide schematic figures of the mass balance model elements.

The schematic Figure 5 is very useful in understanding the mass loading model for Christal Creek drainage. A similar figure for Lightning Creek was not provided in this response; however, it is expected that Figure 5-1 in Exhibit 1.3 is a complete depiction of the mass balance model schematic for Lightning Creek.

1) Please confirm that Figure 5.1 of Exhibit 1.3 is the complete and current schematic for the mass balance model of Lightning Creek watershed.

We can confirm that this is the case.

e) For presented results from the mass balance, please indicate the number of flow measurements utilized in calculations of loads (when applicable).

The level of uncertainty in the mass balance model can be significantly influenced by the level of uncertainty in the volume of flow the model assumes. Therefore, the information in Table 4 is important and should be provided in any reporting of the model results.

1) As information only, it is recommended that you are prepared to identify the influence of flow uncertainty in the results of mass balance model.

77. Page 2-8 of the Main Application Report indicates that the conceptual design report for the Waste Rock Disposal Area is presented in Appendix C. It also indicates that a conceptual tailings and waste rock management plan report is presented in Appendix D. Appendix C contains a generic design for a lined containment facility and Appendix D presents a small number of borehole logs from geotechnical drilling. Please clarify where the conceptual design report is located. If this report has not been provided as part of the application, please do so.

This question was originally put forward to see if the missing conceptual design report for the rock dumps could be considered as meeting the test for a preliminary design. Based on the response provided, a preliminary design for its waste rock storage area(s) has not yet delivered to the Board.

1) Please provide a preliminary design for its proposed waste rock disposal area.

Please see Attachment C for the preliminary design report for the waste rock disposal area.

78. *On page 6-30 of the Main Application Report, reference is made to the temporary potentially AML waste rock storage facilities at Bellekeno 625. Based on my understanding of the project, the temporary potentially AML waste rock storage facilities are to be constructed near the Bellekeno East decline on top of the final bench of the WRDA.*

    Please confirm the location(s) of the temporary potentially AML waste rock storage facility. If the storage area is indeed on top of the final bench of the WRDA, how will potential AML waste rock be stored in advance of construction of these facilities? When will the facilities be constructed in the mine life cycle?

    As indicated in the response to question 12, the supposition that another location (not addressed in this application) can be picked in the future for permanent P-AML storage is problematic.

    Based on the provided response it is unclear whether the application correctly represents the plan to manage potentially AML waste rock from the Bellekeno mine. It is noted that the conservative estimate of potentially AML waste rock is 26,050 tonnes per year which would total 78,150 tonnes in three years. Therefore, unless this estimate is revised, sufficient space is required at the temporary site and underground for this mass of P-AML rock. Even if this space is available it is unclear that the proposed placement methodology for the waste rock storage area at Bellekeno 625 would allow for development of permanent disposal cells as indicated in Figure 2.1 of Exhibit 1.3 starting in year four of mining operations.

    1) Please provide additional definition to the plan for disposal of both P-AML and non AML waste rock such that the plans can be clearly understood by the Board and third parties. If permanent P-AML storage is required to handle the waste rock, please provide a preliminary design drawing for the storage facility.

    Please see Table 5 below, which is provided as clarification for the Board as to the fate and handling of all materials (including P-AML rock) produced by the Bellekeno Mine project.

Table 5 Bellekeno Mine Materials Handling Balance

Material Stream	Total Estimated Tonnage (metric tonnes, rounded to the nearest 1000 tonnes)	Fate/Storage Location	Storage Capacity [Requirement] (metric tonnes)
1. Total Excavated Tonnage (100%)	**1,037,000**	-	-
A. Total Development Rock (48%)	**500,000**[A]	-	-
i. Potentially-AML Development Rock (26%)	130,000	100% to U/G (underground) backfill	355,000[B]
ii. Non-AML Development Rock (74%)	367,000	11% for general site construction material	[40,000]
		89%Non-AML WRDA (surface)	360,000 [C]
B. Total Ore (52%)	**537,000**[D]	-	-
i. Concentrate to Smelter (22.2%)	119,000	Permanently removed from site	N/A
ii. Total Tailings (77.8%)	418,000	-	-
a. High Sulphur Tailings (22.9%)	96,000	100% to U/G backfill	355,000[B]
b. Low Sulphur Tailings (77.1%)	322,000	40% to U/G backfill	355,000[B]
		60% to DSTF	209,430[E]

A. Refer to Table 2-1, Main Application Report

B. Assuming 90% utilization, available U/G storage capacity over LOM is anticipated to be approximately 355,000 tonnes. Total utilization of U/G space with a combination of backfill composed of High Sulphur tailings, P-AML Waste Rock and Low Sulfur tailings is 355,000 tonnes. Priority for U/G backfill will be as follows:
  1. High Sulphur Tailings
  2. P-AML Waste Rock
  3. Low Sulphur Tailings

C. Calculated as indicated on Figure 2-2, Main Application Report using a bulk density of 1.8 tonnes/m^3

D. Refer to Table 2-3, Main Application Report

E. Calculated from Table 6 of Preliminary Engineering Design and Management Plan Dry Stacked Tailings Facility, Bellekeno Mine Mill Site, Yukon (Exhibit 1.8.3), assuming bulk tailings density of 1.7 tonnes/m^3

80. *Page 6-67 of the Main Application Report indicated that the chip samples were still being analyzed. Please advise when the results of the mine wall testing will be available.*

    Please provide an update of the status of the 2009 mine wall testing report. It is felt that the inclusion of these results, along with a discussion is an important for this application. Please provide if available.

    The mine wall testing results for 2009 were submitted as Appendix G of the Annual Report for water licence QZ07-078. For ease of reference, they are presented here as Attachment D

81. *Please provide a Preliminary Design Report to replace the Conceptual Design Report presented in the Main Application Report -Appendix G (exhibit 1.3.7).*

    The EBA report presents some information that is inconsistent with the current application. In particular the DSTF designed by EBA is shown to be used for 45 months of tailings production and placement whereas the application indicated five years (60 months of mining). The EBA report presents a design for permanent storage of 123,220 m3 of tailings at the facility and indicates this represents 60% of the total tailings production. The remaining 40% is indicated as being placed underground in the Bellekeno mine. The application indicates that 50% of the tailings will be placed underground (and 50% at the DSTF). Also Table 5-6 on Page 5-28 of Exhibit 1.3 shows total tailings placed at the DSTF as being 139,552 m3 over five years. Therefore, it appears that either the mining plan has changed to that reflected in the EBA report or the DSTF will not accommodate the planned volume of tailings production. In either case the inconsistency needs to be resolved.

    The EBA report does not develop preliminary designs of the water management features of the mill site and dry stack tailings facility. Conceptual layouts and designs are presented in the report without validation. In regards to the geotechnical design of the DSTF, it is noted that ice rich permafrost conditions are shown to be a controlling factor in the stability of the facility. In particular the critical case appears to be for relatively rapid thawing of an ice rich zone of foundation soils that underlies much of the proposed facility.

    For such a case EBA has assumed that excess pore pressures would develop but it is understood that these pressures are mitigated to some degree through an assumption that some drainage would occur via a drainage layer placed over the soils. It is noted that the report indicates that the drainage layer would be placed over surficial organic soils (included those identified as peat); therefore, its value in draining the thawing soils is questionable. It is also noted that predicted strains in the thawed zone are as much as 2.1 m. When potential differential strains are considered it is possible that the ability of the relatively thin drainage layer (0.5 m) to locally drain the thawing foundation soils could be impacted further.

    Finally it is observed that the preliminary design is based on very limited geotechnical data underlying the actually DSTF location. In particular, there is no information from the steep slope underlying as much as two thirds of the facility.

    1) Please confirm the current mine plan is either reflected correctly in the EBA report or that additional tailings storage is being proposed.

Current mine plans do not require additional tailings storage in the DSTF beyond the design presented in the EBA report (Exhibit 1.8.3). This is demonstrated in the Bellekeno mine materials handling balance table presented in the response to question 78.

2) Please confirm that the proposed tailings stream for placement underground at the Bellekeno mine is now 40% of the total tailings volume not 50% as currently shown in the application.

   The proposed tailings streams are shown in the Bellekeno mine materials handling balance table presented in the response to question 78. In this balance, 100% of high sulphur tailings (22.9% of total tailings) and 40% of low sulphur tailings (77.1% of total) are slated for underground backfill. The sum of these two numbers (total tailings for underground backfill) is approximately 54%, leaving 46% of total tailings to be deposited in the DSTF.

3) Please provide a sensitivity analysis of the stability of the Dry Stack Tailings facility to ascertain the impact of larger excess pore pressures in the thawing ice rich zone. This could simulate either higher ice contents than projected based on the minimal site work or impeded drainage. Impeded drainage could be the result of either the overlying organic layers that will be left in place or localized disruption of the thin drainage blanket due to large differential strains that could develop during the thawing process.

   Preliminary design for the DSTF with an engineer’s seal has been provided to the Board for review. We are confident that this design is sufficient for the preliminary design level of information required. Ice related geotechnical issues will continue to be incorporated into engineering design work as the project proceeds through to construction.

4) Please comment on the expected performance of the 0.5 m thick drainage blanket as it is subjected to the large thaw consolidation strains predicted for this slope.

   Materials selected for the drainage blanket will ensure that performance is maintained during any thaw consolidation.

5) Please comment on the need or not for additional geotechnical data to confirm the preliminary design provided with this application.

   Final design may require further geotechnical investigation.

85. *Pages 6-68 and 6-72 of the Main Application Report indicate that the portion of tailings to be placed underground will “most likely” be placed as a paste backfill. Please confirm if underground tailings will or will not be stored as a paste product underground.*

   1) Please provide additional details regarding the proposed processing, handling and disposal of tailings and waste rock in the Bellekeno mine.

      Underground backfill will be conducted by conventional cemented rock fill (CRF), which will be a mixture of P-AML rock and tailings (high sulphur and low sulphur) with an average of 2-3% cement.

For additional details on mass balance, including priority given for underground backfill material, please see the Bellekeno mine materials handling balance table presented in the response to question 78.

2) Please identify if the revision in backfill methodology impacts the water balance and water use previously developed for placement of paste backfill at the Bellekeno mine.

Because both paste fill and CRF require water (some of which is permanently consumed in the Ca-silicate hydration reaction) the use of CRF for backfill will not materially affect the Bellekeno mine water balance.

87. *Please indicate when the predicted static level for the mine will be determined and describe the plan for pyrite tailings placement prior to that determination.*

It was hoped that the response would identify when a hydrogeological assessment of the mine plan with respect to potential mine water inflows would be completed and that study would identify the expected static water level that could be different than that known before the additional mine development.

As elsewhere stated in this letter, it is recommended that a conceptual hydrogeologic assessment be provided. It is expected that the issue identified above would also be expected to be addressed in such a study.

This question is addressed in the response to question 37.

89. *Please clarify the proportion of new mine workings and stopes that will be filled with tailings and/or waste rock materials.*

In regards to the 90% amount indicated for backfill of new stopes, is this less than 100% simply as a result of the logistic feasibility of the operation or is there some other reason limiting the filling operations to 90%?

We can confirm that the figure of 90% backfill is an estimate based on logistic feasibility.

90. *Please indicate the volume of stopes and development workings that will be excavated above the 625 level (i.e. above the historical flooding level of the Bellekeno mine).*

The response references a development plan that provides information such as the anticipated volume of excavation by level that is located in the application. Such information would be useful in understanding the propose mine development.

1) Please identify if the development plan is currently part of the application documents and if so identify where it resides.

The development plans is not part of the application. If there are questions raised by interveners pertaining to the development plan, we would be prepared to submit portions with proprietary economic information redacted.

2) If the Development plan is not currently part of the application, please consider submitting the plan for inclusion in the register.

91. *Clause 11 of the decision document describes the requirement for baseline data to be collected from a site at Christal Creek. In looking at the YESAA Evaluation Report, it appears as though a new monitoring station along Christal Creek is required. Please advise if this new monitoring station has been identified, and if baseline characterization of this new monitoring station has begun.*

    Information previously provided identifies KV-52 as being the natural spring into Christal Lake at the old Mackeno pumphouse and KV-50 as being Christal Creek upstream of Hinton Creek.

    1) Please verify and confirm the correct new monitoring station required by Clause 11.

In our previous response to this question (January 19) we incorrectly identified the new monitoring site in upper Christal Creek as KV-52. We can confirm that the new monitoring site which will be upstream of the effluent discharge point is KV-50 (please see revised Table 7-2 in the response to question 21).

ALEXCO KENO HILL MINING CORP.

TYPE A WATER LICENCE APPLICATION

QZ09-092

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Attachment A

Prepared by:

www.accessconsulting.ca

ACCESS
CONSULTING GROUP

March 29, 2010

Yukon Water Board
Suite 106
419 Range Road
Whitehorse, YT
Y1A 3V1

Attention: Ms. Joelle Janes, Licencing Officer

Dear Ms. Janes:

Re: Reliance on Technical Reports, for Mine Licensing, Bellekeno Project, Yukon

I acknowledge that the Environmental Conditions Report and all other reports prepared by Access Consulting Group may be used and relied upon by the Yukon Water Board, and the federal and territorial regulatory agencies responsible for review of such reports in support of licensing of the Bellekeno Project.

Respectfully,

David Petkovich B.Sc.
Senior Environmental Manager
Access Consulting Group

CREATING AND DELIVERING BETTER SOLUTIONS

www.eba.ca

January 5, 2010 EBA File: W14101178.003

Mr. Robert L. McIntyre, R.E.T.
Vice President, Corporate Affairs and Communications
Suite 1150, 200 Granville St.,
Vancouver, BC V6C 1S4

Attention: Mr. Robert McIntyre

Subject: Reliance on Technical Reports
Mill and Mine Development, Bellekeno Mine, Yukon

Dear Mr. McIntyre

EBA Engineering Consultants Ltd. (EBA) acknowledges that the Issued for Use reports dated between August 2008 and the present prepared for Alexco Resource Corp with regard to the Mill and Mine Development, Bellekeno Mine Project and in support of their "Water Use License" application submitted to the Yukon Water Board may be relied upon by the Yukon Water Board, and the federal and territorial regulatory agencies responsible for review of such reports.

If there is a need for clarification, the contact within EBA for the work is Mr. Christopher Dixon.

Sincerely,
EBA Engineering Consultants Ltd.

C. J. Dixon

J Richard Trimble

Christopher J. Dixon, P.Eng.
Geotechnical Engineer, Yukon Region
Direct Line: 867.668.2071 x241
cdixon@eba.ca

J. Richard Trimble, M.Sc. (Eng.), P.Eng.
Principal Consultant, Office Manager
Direct Line: 867.668.2071 x222
rtrimble@eba.ca

Ltr Alexco Resources .doc

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

ALEXCO KENO HILL MINING CORP.

TYPE A WATER LICENCE APPLICATION

QZ09-092

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Attachment B

Prepared by:

www.accessconsulting.ca

March 15th, 2010

Carola Sheu
Manager - Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, YT Y1A 3V1

License Number: QZ07-078
Subject: Proposed Bellekeno 625 Water Treatment System Minor Modifications

Dear Carola Sheu,

Alexco Resource (“Alexco”) is operating a water treatment facility at the Bellekeno 625 mine site which is located within our Keno Hill property. This mine requires continual dewatering, with flows typically ranging between 3.0 to 3.5 liters per second (lps), less than 2 mg/l zinc and a minimal amount of treatment, typically limited to lime slurry addition and a small amount of iron. In the last year, the system has successfully treated the constituents in the mine discharge, with the occasional exception of Total Suspended Solids (TSS) related to underground exploration drilling

To maintain compliance consistently as the mine advances into the production phase, Alexco believes some minor modification to the current system is needed. Pursuant to Clause 51 in WUL QZ07-078, this letter serves as a 10 day advance notice to undergo minor modifications to the Bellekeno water treatment facility. The proposed modifications are considered minor modifications as they do not change the source or receiving water, the structural integrity, function, intention or impoundment of structures of the original design. The original design concept is the same whereby water from the Bellekeno 625 adit is treated using simple lime addition for precipitation of zinc. The construction superintendent for this modification is Peter Johnson (867-995-311). A construction schedule is attached.

In order to capture and document these modifications, Alexco has created an attached document called the Bellekeno 625 Water Treatment System. This document includes general and specific site location information, average recent adit discharge water chemistry data, an overall process flow diagram, and supporting engineering calculations. Please refer to this document as needed.

In addition, Alexco has retained Randy Clarkson, a Professional Engineer registered in the Yukon to review the overall layout, equipment selection, and pumping calculations. After providing Mr. Clarkson with all requested information, he provided a stamped report, which is attached, that included an overview of the system as well as his own calculations certifying that this proposed modification meets rigorous design requirements.

The Bellekeno 625 Water Treatment System is comprised of the following:

- Water is dewatered from the mine and flows by gravity into a rapid mix tank. There the water is agitated and mixed with lime slurry from a lime slurry tank.
- Water flows from the rapid mix tank into pond 1, which provides residence time for the water to calm and for larger particles to settle out. As the larger particles settle, they collect on the bottom of pond 1 as sludge.
- Water is then decanted from pond 1 and flows into pond 2, which is a larger pond that allows additional settling time. Alexco has divided pond 2 into three sections by extending geo-fabric across the pond which limits the travel of larger particles and aids in settling.
- Water is then decanted from pond 2 and flows down an HDPE lined trench into a decant box before final release into the Lightning Creek drainage system.

Based on the treatment performance during previous underground drilling activiitesadditional modifications are required to enhance the suspended solids removal. These minor modifications are:

1. Addition of a filtration system to collect TSS after the ponds settling, prior to release to the environment
2. Addition of a water re-cycling system from Pond 2 to the rapid mix tank, which allows for better sludge settling by providing an additional control point for when treatment is insufficient in the first pass into the ponds. This system will only operate as needed when TSS is high in the settling ponds.

Filtration System: To implement the filtration system, Alexco plans to modify the existing Bellekeno 625 Water Treatment setup as follows:

- An electric 5 hp BJM Submersible Pump (Model J37H) will be added to the downstream edge of pond 2. From the pump curve, this pump will provide sufficient flow and pressure to a Multi-Media Filter (MMF).
- A Yardney Multi-Media Filter (Model MM-2460-3A) will be installed within a 40 foot sea container positioned near the furthest downstream edge of pond 2. This multimedia filter contains three pods or cylinders which are filled with four layers of filtration media. Starting at the top of the cylinder and going down, the media layers are:
    - 0.75 mm Anthracite: ~ 18” thick
    - 0.35mm Garnet: ~ 18” thick
    - 1.45mm Garnet: ~ 6” thick
    - ½” x ¾” Crushed Rock: ~ 6” thick
- The MMF should drastically reduce TSS content as the water is filtered to a particle size of between 5 and 10 microns. Under normal flow conditions, the pressure drop between the influent and the effluent on the MMF is 5 psi, but as particles are collected this pressure difference increases. As the particles accumulate, the pressure difference will eventually reach 12 psi which triggers a cleaning or back wash cycle.
- During this cycle, a valve at the effluent closes and another valve near the top of the back washed cylinder opens. This action reverses the flow of water through one of the

cylinders, thereby fluidizing the media and releasing the particulates which are then returned to the rapid mix tank.

- The flow path during back wash is identified on page 5 of the water treatment document and identified with the markings “Back-wash Discharge”. Each cylinder is back washed for roughly 4 minutes, totaling 12 minutes for the entire back wash cycle.
- During normal operation, flow through the MMF will be measured in a flow meter and controlled by a throttling valve, both being located within the 40’ sea container.
- Once water passes through the throttling valve, it will be released into an existing decant box, which releases water into the Lighting Creek drainage.
- In the event that the submersible pump malfunctions, the existing HDPE lined trench acts as an overflow, allowing water to short-circuit the MMF and flow directly to the decant box.

Re-Circulation System: To implement re-circulation, Alexco plans to modify the existing Bellekeno 625 Water Treatment setup as follows:

- An electric submersible pump will be added to the downstream edge of pond 2. This system will flow at an estimated 50 to 60 gpm and the selected pump will provide sufficient flow and pressure to transport the water through a 2” ID HDPE pipe to the rapid mix tank.
- The flow in this system will be controlled by a throttling valve immediately downstream of the pump.
- The flow within the re-circulation line will be injected back into the rapid mix tank where the water will again pass through ponds 1 and 2 before release or re-circulation.
- Alexco believes this re-circulation loop will allow additional residence time and opportunity for treatment so that particles will settle out in either pond 1 or 2.
- This system will only be implemented as needed.

If you have any questions regarding this minor modification, please feel free to contact me.

Sincerely,

Eric J. Lancaster

Eric J. Lancaster
Project Manager
T. 303-862-3929
Alexco Resource U.S. Corp
Englewood, Colorado USA

cc: Brad Thrall, Chief Operating Officer (Alexco), President - ERDC
Jim Harrington, President of Environmental Services - Alexco
Joe Harrington, Vice President of Tech. and Strategic Dev. - Alexco
Scott Keesey, Environmental Manager - Access Consulting Group/ERDC
Kurt Neunherz, Environmental Scientist - Access Consulting Group/ERDC
Matthew Jenner, Inspector - YG Water Resources
Kriss Sarson, Senior Project Manager – INAC

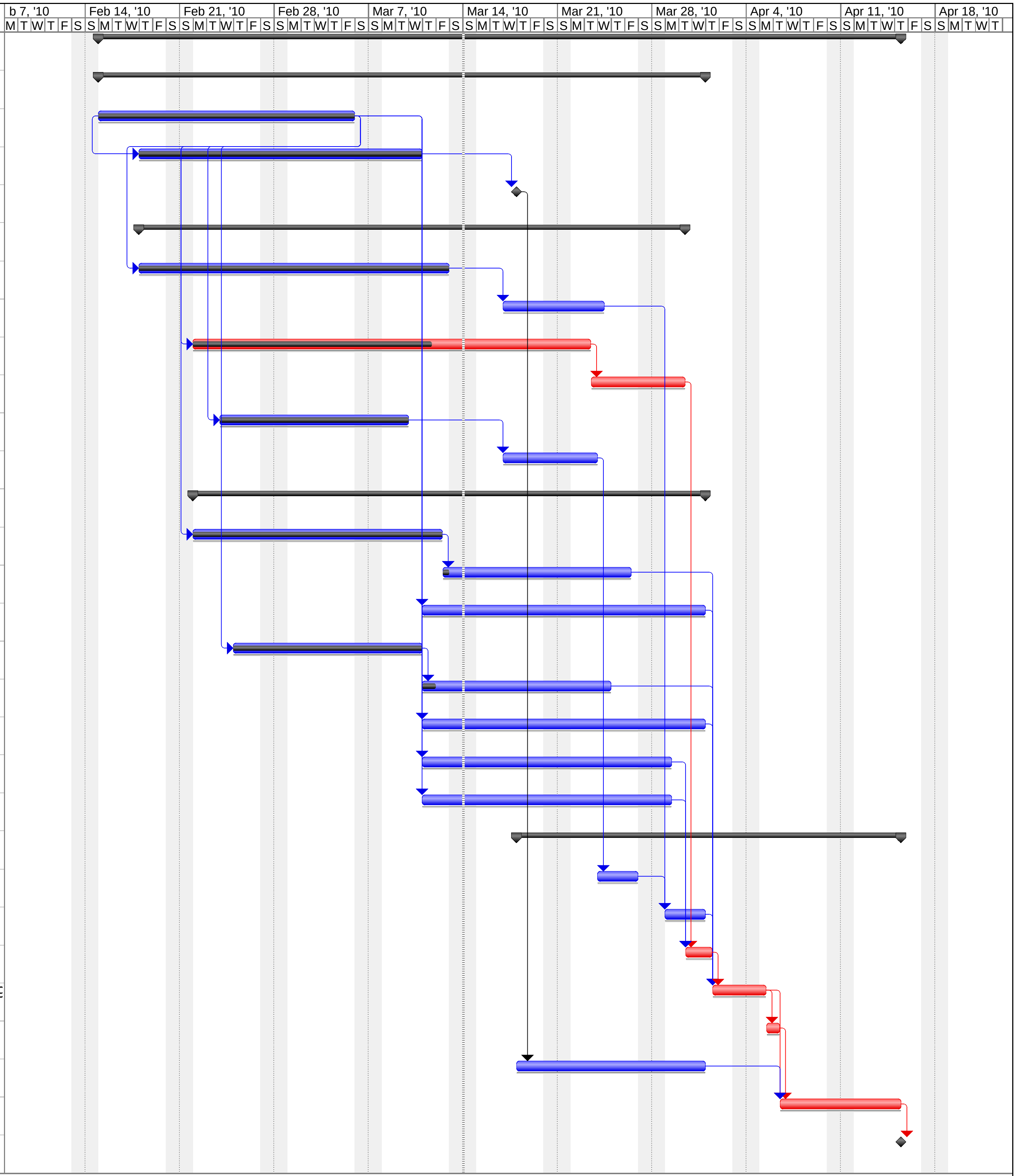
Attachments:

- Bellekeno 625 Minor Modification Construction Schedule
- Bellekeno 625 Water Treatment System Rev. A
- Alexco Bellekeno 625 Proposed Modifications – Randy Clarkson Report

References:

- BJM Pumps: www.bjmpumps.com (pump curves and additional information)
- Sea Metrics: www.seametrics.com
- Yardney Filter Systems: www.yardneyfilters.com (flow curves and additional information)
- Mechanical Engineering Reference Manual by M. Lindeburge, P.E. (Head loss estimations and turbulent flow equations)

ID	ℹ	Task Name	Duration	% Complete	Start	Finish	Predecessors
1		**Alexco: Bellekeno 625 Treatment Schedule**	**43.5 days**	**44%**	**Mon 2/15/10**	**Thu 4/15/10**	
2		**Design and Approvals**	**33 days**	**50%**	**Mon 2/15/10**	**Wed 3/31/10**	
3	✓	Internal reviews, feedback, & updates	15 days	100%	Mon 2/15/10	Fri 3/5/10	
4	✓	Review and P. Eng. Signature (Randy Clarkson)	15 days	100%	Thu 2/18/10	Wed 3/10/10	3SS+3 days
5		Send to Yukon Water Board	0 days	0%	Wed 3/17/10	Wed 3/17/10	4FS+5 days
6		**Place PO's for more expensive, longer lead-time items**	**28.5 days**	**64%**	**Thu 2/18/10**	**Tue 3/30/10**	
7	✓	Yardney MMF	3.4 wks	100%	Thu 2/18/10	Fri 3/12/10	3FS-12 days
8		Yardney MMF - Shipping ($6,400 w/ dedicated shipping)	1.1 wks	0%	Wed 3/17/10	Wed 3/24/10	7FS+2 days
9		BJM Submersible Pump	4.3 wks	65%	Mon 2/22/10	Tue 3/23/10	3FS-10 days
10		BJM Submersible Pump - Shipping	1 wk	0%	Tue 3/23/10	Tue 3/30/10	9
11	✓	40' Sea Container (w/ modifications of mandoor & vents)	2 wks	100%	Wed 2/24/10	Tue 3/9/10	3FS-8 days
12		40' Sea Container (Peter Johnson to fill w/ lime & ship)	1 wk	0%	Wed 3/17/10	Tue 3/23/10	11FS+5 days
13		**Place PO's for all additional items**	**28 days**	**26%**	**Mon 2/22/10**	**Wed 3/31/10**	
14	✓	Sea Metrics Flow Meters	2.9 wks	100%	Mon 2/22/10	Fri 3/12/10	3FS-10 days
15		Sea Metrics Flow Meter - Shipping International Ground	10 days	5%	Fri 3/12/10	Fri 3/26/10	14
16		2" & 3" Diameter Piping	3 wks	0%	Thu 3/11/10	Wed 3/31/10	3FS+3 days
17	✓	3" Flanged Ball Valve	2 wks	100%	Thu 2/25/10	Wed 3/10/10	3FS-7 days
18		3" Flanged Ball Valve - Shipping	10 days	10%	Thu 3/11/10	Wed 3/24/10	17
19		Misc. Items (Heat Trace, Insulation, Fittings, Flanges, etc.)	3 wks	0%	Thu 3/11/10	Wed 3/31/10	3FS+3 days
20		Pump for Re-Circulation Loop	2.5 wks	0%	Thu 3/11/10	Mon 3/29/10	3FS+3 days
21		Create Walkway in Pond 2 for Submersible Pumps	2.5 wks	0%	Thu 3/11/10	Mon 3/29/10	3FS+3 days
22		**Bellekeno 625 System Set-up**	**20.5 days**	**0%**	**Thu 3/18/10**	**Thu 4/15/10**	
23		Position 40' Sea Container - cut holes for piping	3 days	0%	Wed 3/24/10	Fri 3/26/10	12
24		Assemble Yardney MMF inside of 40' Sea Container	3 days	0%	Mon 3/29/10	Wed 3/31/10	23,8
25		Position and stabilize Submersible Pump, Control Box, & Float Switches	2 days	0%	Tue 3/30/10	Thu 4/1/10	10,20,21
26		Assemble 2" & 3" diameter HDPE between pump, MMF, & Rapid Mix Tank	2 days	0%	Thu 4/1/10	Mon 4/5/10	25,24,15,16,18,1
27		Heat Trace all lines, winterize system for below 0°C temperatures	1 day	0%	Mon 4/5/10	Tue 4/6/10	26
28		10 Lead-Time for the Yukon Government via Modification Document	10 days	0%	Thu 3/18/10	Wed 3/31/10	5
29		Start-up and System check	7 days	0%	Tue 4/6/10	Thu 4/15/10	26,27,28
30		**Bellekeno 625 Water Treatment System Installed and Operating**	**0 days**	**0%**	**Thu 4/15/10**	**Thu 4/15/10**	**29**



Bellekeno 625 Water Treatment Sched
Date: Sun 3/14/10

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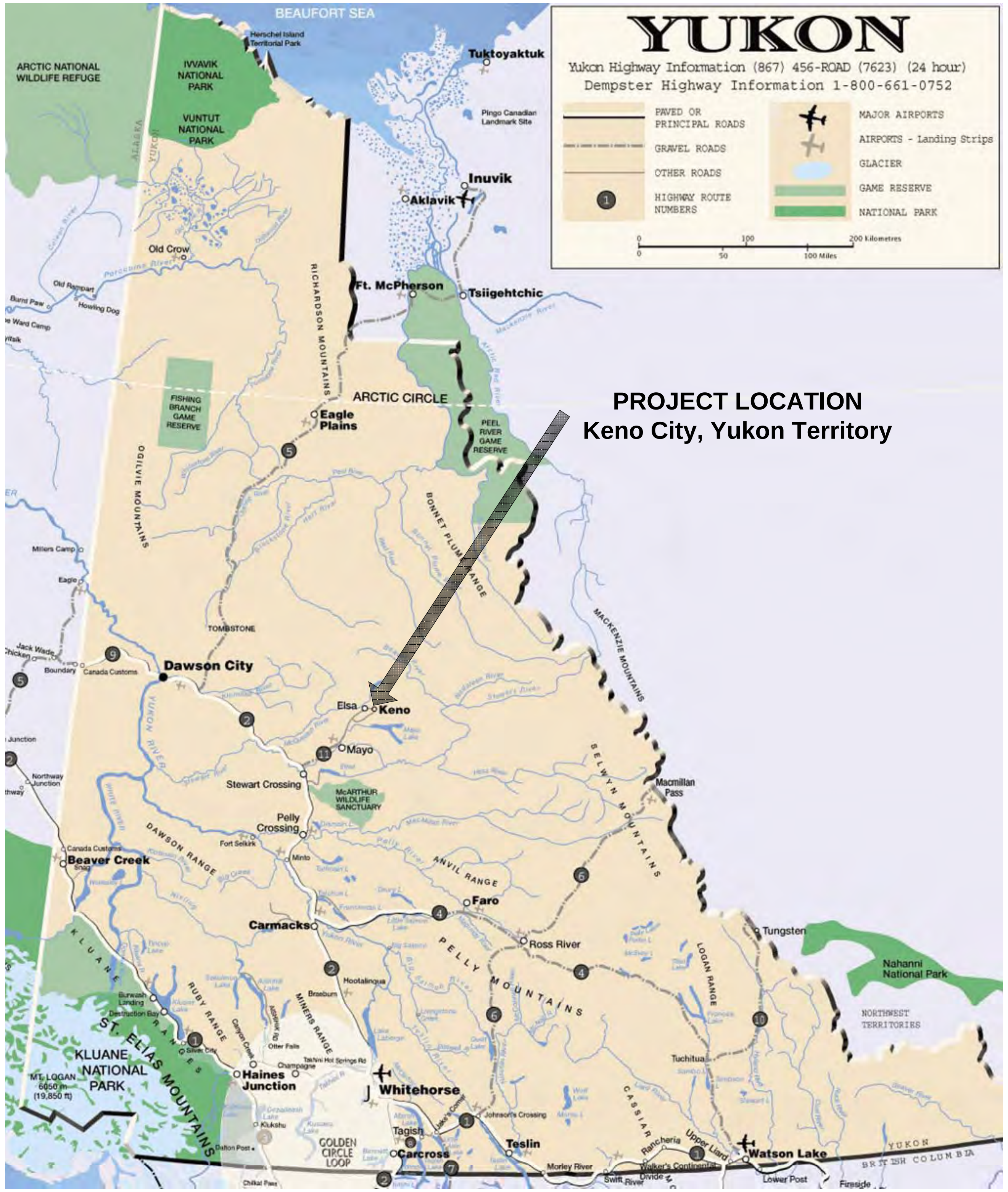
REV.	DESCRIPTION	DATE	BY
A	INITIAL RELEASE	3/08/10	EJL



LOCATION MAP

SCALE: NONE

DRAWING CONFIDENTIAL: This drawing and all information contained thereon is and shall remain the property of Alexco as an instrument of professional service. This information shall not be used in whole or in part without the full knowledge and prior written consent of Alexco.

DESCRIPTION
COVER SHEET

ALEXCO

Alexco Resource US Corp
88 Inverness Circle East, Suite N - 102
Englewood, CO 80112
Main Office: 303.862.3929
www.alexcoresource.com

Scope:
Design of a water treatment system which collects water from the furthest end of the Bellekeno 625 settling ponds, transfers it to a Multi-Media Filter, a Nitrification tower, and then discharges it into Lighting Creek at or below standards.

BELLEKENO 625
Water Treatment System

Alexco Resource US Corp
Water Transfer System Designer: Eric Lancaster, PE - Project Manager
Reviewer: Jim Harrington - VP Engineering

Rev. Date
3/08/10

NOT TO SCALE

SIZE	FSCM NO	DWG NO	REV
B		2010-01	A

SCALE N/A
SHEET 1

REV.	SHEET	DATE	BY
A	2	3/08/10	EJL

LIST OF DRAWINGS

DISCIPLINE	SHEET NO.	TITLE	REVISION NO. & DATE
GENERAL	1	COVER SHEET	
	2	LIST OF DRAWINGS	
CHEMICAL	3	WATER COLLECTION	
	4	WATER SPECIFICATIONS	
MECHANICAL	5	PROCESS FLOW SHEET	Rev. A (3/8/10)
	6	PIPING AND INSTRUMENTATION LEGEND	ALL DRAWINGS
	7	BELLEKENO LAYOUT PLAN	
	8	MMF REGULAR FLOW CALCULATIONS	
	9	MMF BACKWASH CALCULATIONS	
	10	RE-CIRCULATION CALCULATIONS	
REFERENCES	11	APPENDICIES / DATASHEETS	

DESCRIPTION
LIST OF DRAWINGS

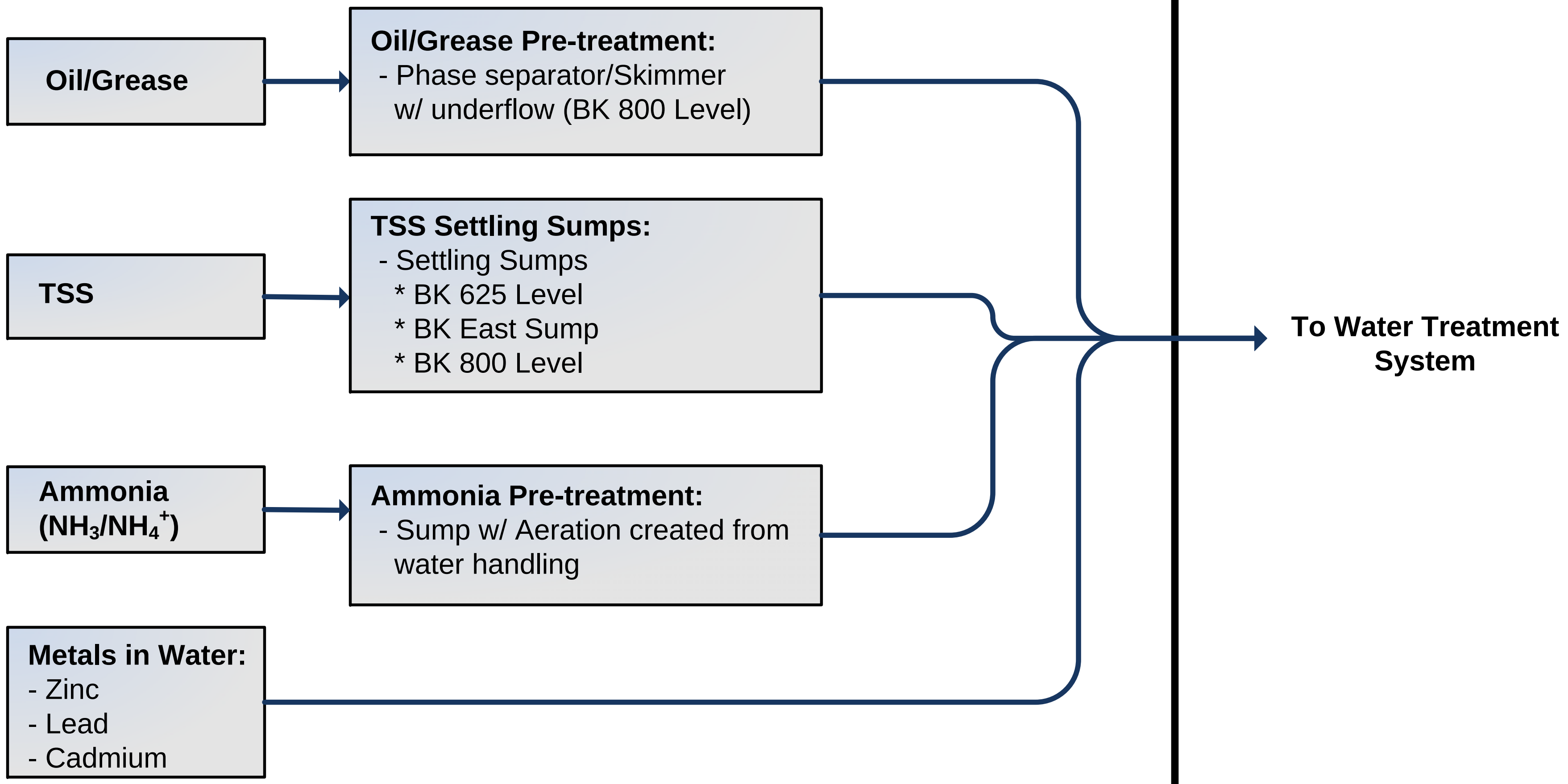
REV.	SHEET	DATE	BY
A	3	3/08/10	EJL

BELLEKENO 625

Underground – Pre-Treatment

Above ground

What is collected within the mine: (See Next page for water Specs)
- Background $H_2$0 (low metals and TSS)
- Vein $H_2$0 (High metals + TSS)
- Ammonia
- Oil and Grease



Oil/Grease

Oil/Grease Pre-treatment:
- Phase separator/Skimmer w/ underflow (BK 800 Level)

TSS

TSS Settling Sumps:
- Settling Sumps
  * BK 625 Level
  * BK East Sump
  * BK 800 Level

Ammonia (NH_3/NH_4^+)

Ammonia Pre-treatment:
- Sump w/ Aeration created from water handling

Metals in Water:
- Zinc
- Lead
- Cadmium

To Water Treatment System

DESCRIPTION
WATER COLLECTION

REV.	SHEET	DATE	BY
A	4	3/08/10	EJL

Bellekeno 625

Water Specifications

What is collected within the mine:

Data collected between May & Nov, 2009

Oil/Grease
Diesel

TSS

Ammonia
(NH_4^+)

Metals:
- Zinc
- Lead
- Cadmium
- Iron
- Manganese
- Aluminum
- Xanthate

	AUTHORIZED LIMITS OF DELETERIOUS SUBSTANCES				
		MMER			Water License
Item #	Deleterious Substance	Maximum Authorized Monthly Mean Concentration	Maximum Authorized Concentration in a Composite Sample	Maximum Authorized Concentration in a Grab Sample	Maximum Authorized Concentration in a Grab Sample
1	Arsenic	0.50 mg/L	0.75 mg/L	1.00 mg/L	0.50 mg/L
2	Copper	0.30 mg/L	0.45 mg/L	0.60 mg/L	0.30 mg/L
3	Cyanide	1.00 mg/L	1.50 mg/L	2.00 mg/L	*
4	Lead	0.20 mg/L	0.30 mg/L	0.40 mg/L	0.20 mg/L
5	Nickel	0.50 mg/L	0.75 mg/L	1.00 mg/L	0.50 mg/L
6	Zinc	0.50 mg/L	0.75 mg/L	1.00 mg/L	0.50 mg/L
7	Total Suspended Solids	15.00 mg/L	22.50 mg/L	30.00 mg/L	25 mg/L
8	Radium 226	0.37 Bq/L	0.74 Bq/L	1.11 Bq/L	*
9	PH	*	*	*	6.0 - 9.5 pH Units
10	Ammonia (NH_3/NH_4^+)	*	*	*	5.0 mg/L
11	Silver	*	*	*	0.1 mg/L
12	Cadmium	*	*	*	0.05 mg/L

* Not Listed

No Treatment Planned: Monitored
- Arsenic
- Copper
- Nickel
- Radium
- Mercury
- Iron
- Manganese
- Aluminum

Average Flow Rate

3.0-3.5 L/sec

No Treatment Planned: Not Monitored
- Cyanide

Maximum Flow Rate (Limited by Pump Curve)

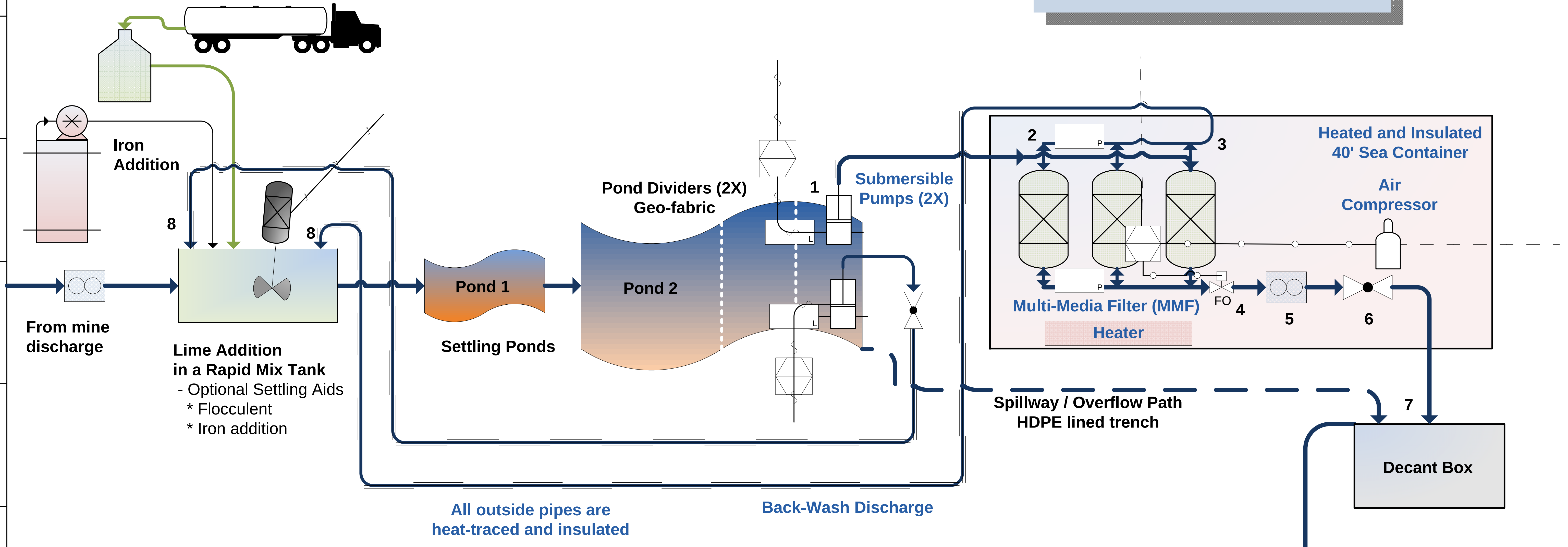
10.0 L/sec

DESCRIPTION
WATER SPECIFICATIONS

REV.	SHEET	DATE	BY
A	5	3/08/10	EJL

BELLEKENO 625
Treatment Flow Sheet

Black Lettering = Existing Water Treatment
Blue Lettering = Proposed Modification



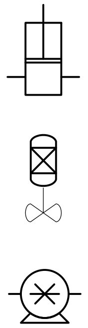
Connection List

Connection #	Equipment	Part Number	Interface	Material	Description
1	BJM Submersible Pump	J37H	2" NPT-Male	Cast Iron	Verticle discharge, need conversion to 3" pipe as well as steel to HDPE
2	MMF - Influent	MM 2460-3A	3" 150# Flange	Cast Iron	Influent interface w/ MMF - requires 3" gasket and 4 bolts/nuts
3	MMF - Backwash	MM 2460-3A	2" NPT - Male	Cast Iron	Backwash interface w/ MMF - NPT to 2" HDPE line for return to mix tank
4	MMF - Effluent	MM 2460-3A	3" 150# Flange	Cast Iron	Effluent interface w/ MMF - requires 3" gasket and 4 bolts/nuts
5	Sea Metrics Flow Meter	WTP-101-300-18	3" 150# Flange	PVC	Interface w/ Flow Meter - requires 3" gasket and 4 bolts/nuts
6	3" Flanged Ball Valve	3700	3" 150# Flange	Steel	3" teflon coated ball valve - American Valve
7	Open Pipe	NA	Decant Box - Open Tank	HDPE	Release into Decant Box
8	Open Pipe	NA	Open Tank	HDPE	Release into Mix Tank - Fluid will pass back through the system

DESCRIPTION
PROCESS FLOW SHEET

REV.	SHEET	DATE	BY
A	6	3/08/10	EJL

PRIME MOVERS FOR MOTOR DRIVEN EQUIPMENT

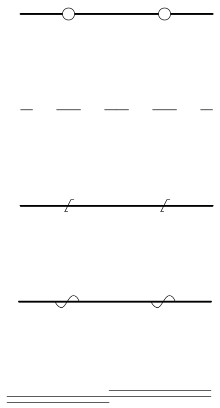


SUBMERSIBLE PUMP

AGITATOR OR MIXER

METERING PUMP

INSTRUMENT LINE SYMBOLS



PNEUMATIC LINE

120V A/C 1-PHASE

240V A/C 1-PHASE

575V A/C 3-PHASE

HEAT TRACE / INSULATION

PIPE LINE DESIGNATIONS

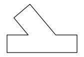
= IRON ADDITION TUBE

= 2" HDPE

= 3" HDPE

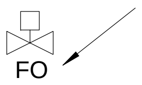
= LIME SLURRY

PIPING ACCESSORIES AND DETAILS



45° IPS Fab Lateral

SYMBOLS FOR VALVE ACTION IN THE EVENT OF ACTUATOR POWER FAILURE



SYMBOL LOCATED BY VALVE – USED ONLY WHERE NECESSARY TO INCREASE UNDERSTANDING OF THE SYSTEM.

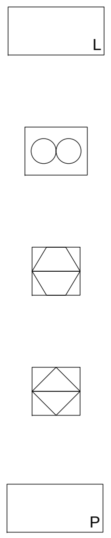
FO = FAIL OPEN

FC = FAIL CLOSED

FL = FAIL LOCKED

FI = FAIL INDETERMINATE (LAST POSITION)

INSTRUMENTATION



LEVEL SENSOR/
FLOAT SWITCH

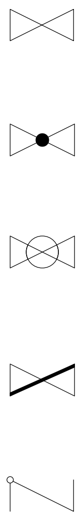
FLOW METER

CONTROL PANEL

PROGRAMMABLE
LOGIC CONTROLLER

PRESSURE GAUGE

VALVE SYMBOLS



GATE

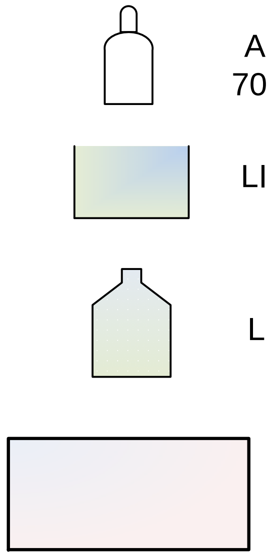
GLOBE

BALL

BUTTERFLY

CHECK

ADDITIONAL COMPONENTS



AIR COMPRESSOR
70 psig @ 2 CFM min.

LIME MIX TANK

LIME SLURRY STORAGE TANK

INSULATED 40' SEA CONTAINER

DESCRIPTION
PIPING & INSTRUMENTATION LEGEND

REV.	SHEET	DATE	BY
A	7	3/08/10	EJL

Black Lettering = Existing Water Treatment
Blue Lettering = Proposed Modification

DIMENSIONS:

POND 1: 50' x 50'
POND 2: 60' x 200'
ELEVATION GAIN BETWEEN PUMP AND MMF INFLUENT: ~10'
DISTANCE BETWEEN PUMP AND MMF INFLUENT: ~50'
ELEVATION GAIN BETWEEN PUMP AND RAPID MIX TANK: ~15'
DISTANCE BETWEEN PUMP AND RAPID MIX TANK: ~300'

Aerial photograph obtained from
Geodesy Remote Sensing Inc., Calgary Alberta.
Imagery acquired September 13 and14 2006.

N

metres
0 10 20 40 60

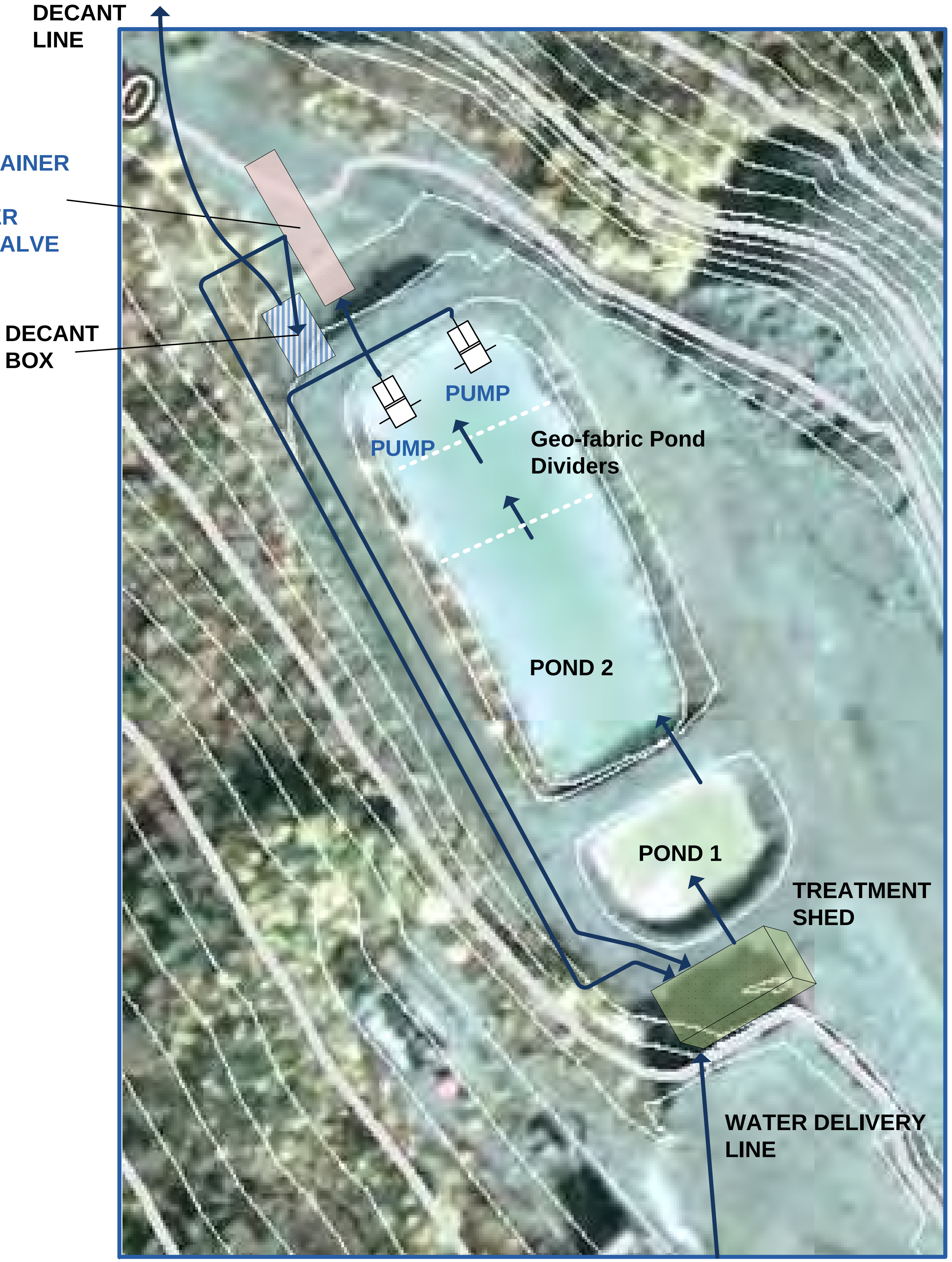
ContoursMinor
Contour_wt_elevation

ALEXCO
ACCESS CONSULTING GROUP

BELLEKENO MINE PROJECT
TYPE A WATER LICENSE APPLICATION
FIGURE 2-1
MINE SITE LAYOUT

Drawn By: MD	August 2009	Verified by: RM

D:\Project\AllProjects\ALEX-05-01\Bellekeno\GIS\mxd\
WUL MLU Applications\WUL Aug 09\Fig2 1 MineSite.mxd



DESCRIPTION
BELLEKENO LAYOUT PLAN

REV.	SHEET	DATE	BY
A	8	3/08/10	EJL

Bellekeno 625 System Flow Rates w/ 3" Piping

AVERAGE FLOW RATES IN GREEN OF BETWEEN 3.0 TO 3.5 LPS

MAXIMUM FLOW (10.0 lps) IN RED THROUGH CLEAN MEDIA IN MMF (SEE PUMP CURVE – APPENDIX)

MAXIMUM FLOW (9.0 lps) IN RED THROUGH DIRTY MEDIA IN MMF

Bellekeno Mine In-flow		Head Loss due to design features (ft)			
Flow Rate (lps) Bellekeno Mine	**Flow Rate (gpm) Bellekeno Mine**	**Friction Head Loss (ft)**	**3" Piping Velocity (ft/sec)**	**Total Dynamic Head Loss (ft) - Clean Filter**	**Total Dynamic Head Loss (ft) - Dirty Filter**
2.0	31.70	0.18	1.44	45.35	61.48
2.5	39.63	0.28	1.80	45.45	61.58
3.0	47.55	0.39	2.16	45.56	61.69
3.5	55.48	0.52	2.52	45.69	61.82
4.0	63.40	0.66	2.88	45.84	61.96
4.5	71.33	0.83	3.24	46.00	62.13
5.0	79.25	1.00	3.60	46.18	62.30
5.5	87.18	1.20	3.96	46.37	62.50
6.0	95.10	1.41	4.32	46.58	62.71
6.5	103.03	1.63	4.68	46.80	62.93
7.0	110.95	1.87	5.04	47.04	63.17
7.5	118.88	2.13	5.40	47.30	63.43
8.0	126.80	2.40	5.76	47.57	63.70
8.5	134.73	2.68	6.12	47.86	63.98
9.0	142.65	2.98	6.48	48.16	64.28
9.5	150.58	3.30	6.84	48.47	64.60
10.0	158.50	3.63	7.20	48.80	64.93
10.5	166.43	3.97	7.56	49.14	65.27
11.0	174.35	4.33	7.92	49.50	65.63
11.5	182.28	4.70	8.28	49.87	66.00
12.0	190.20	5.09	8.64	50.26	66.38
12.5	198.13	5.48	9.00	50.66	66.78
13.0	206.05	5.90	9.36	51.07	67.20

Additional Variables/Inputs

	3" HDPE		
Elevation Gain (ft)	10		
Distance from pump to MMF or Lime Tank (ft)	50		
Inside Diameter of HDPE (in)	3		
Hazen-Williams Constant	130		
Minimum Filter Losses (psi)	5	Equiv (ft)	11.5
Maximum Filter Losses (psi)	12	Equiv (ft)	27.6

Head Loss from Valves, Sweeps, & fittings

Description	**Qnty (3" Line)**		**Head Loss (ft)/ea.**	**Head Loss Total (ft)**
45° Sweep	1		2.6	2.6
90° Sweep	5		3.4	17
Gate Valve (Open)	1		2.8	2.8
Ball Valve (Open)	1		1	1
Turbine Flow Meter	1		0.25	0.25
Total Feature Losses (ft)				**23.65**

DESCRIPTION
MMF REGULAR FLOW CALCS

REV.	SHEET	DATE	BY
A	9	3/08/10	EJL

Bellekeno 625 System Flow Rates w/ 2" Piping

Bellekeno Mine In-flow		Head Loss due to design features (ft)			
Flow Rate (lps) Bellekeno Mine	Flow Rate (gpm) Bellekeno Mine	Friction Head Loss (ft)	2" Piping Velocity (ft/sec)	Total Dynamic Head Loss (ft) - Clean Filter	Total Dynamic Head Loss (ft) - Dirty Filter
2.0	31.70	7.94	3.24	53.27	69.39
2.5	39.63	12.01	4.05	57.33	73.46
3.0	47.55	16.83	4.86	62.16	78.28
3.5	55.48	22.40	5.67	67.72	83.85
4.0	63.40	28.68	6.48	74.00	90.13
4.5	71.33	35.67	7.29	80.99	97.12
5.0	79.25	43.36	8.10	88.68	104.81
5.5	87.18	51.73	8.91	97.05	113.18
6.0	95.10	60.77	9.72	106.09	122.22
6.5	103.03	70.48	10.53	115.81	131.93
7.0	110.95	80.85	11.34	126.17	142.30
7.5	118.88	91.87	12.15	137.19	153.32
8.0	126.80	103.54	12.96	148.86	164.99
8.5	134.73	115.84	13.77	161.16	177.29
9.0	142.65	128.78	14.58	174.10	190.23
9.5	150.58	142.34	15.39	187.66	203.79
10.0	158.50	156.52	16.20	201.84	217.97
10.5	166.43	171.33	17.00	216.65	232.78
11.0	174.35	186.74	17.81	232.06	248.19
11.5	182.28	202.76	18.62	248.09	264.21
12.0	190.20	219.39	19.43	264.71	280.84
12.5	198.13	236.62	20.24	281.94	298.07
13.0	206.05	254.45	21.05	299.77	315.90

AVERAGE FLOW RATES IN GREEN OF BETWEEN 3.0 TO 3.5 LPS

MAXIMUM FLOW (5.0 lps) IN RED THROUGH CLEAN MEDIA IN MMF

MAXIMUM FLOW (4.5 lps) IN RED THROUGH DIRTY MEDIA IN MMF

Additional Variables/Inputs

	2" HDPE		
Elevation Gain (ft)	15		
Distance from pump to MMF or Lime Tank (ft)	300		
Inside Diameter of HDPE (in)	2		
Hazen-Williams Constant	130		
Minimum Filter Losses (psi)	5	Equiv (ft)	11.5
Maximum Filter Losses (psi)	12	Equiv (ft)	27.6

Head Loss from Valves, Sweeps, & fittings

Description	Qnty (2" Line)		Head Loss (ft)/ea.	Head Loss Total (ft)
90° Sweep	6		2.7	16.2
Gate Valve (Open)	1		2.6	2.6
Total Feature Losses (ft)				**18.8**

DESCRIPTION
MMF BACKWASH CALCS

REV.	SHEET	DATE	BY
A	10	3/08/10	EJL

Bellekeno 625 System Flow Rates w/ 2" Piping

Bellekeno Mine In-flow		Head Loss due to design features (ft)		
Flow Rate (lps) Re-circulation	**Flow Rate (gpm) Re-circulation**	**Friction Head Loss (ft)**	**2" Piping Velocity (ft/sec)**	**Total Dynamic Head Loss (ft)**
2.0	31.70	7.94	3.24	40.14
2.5	39.63	12.01	4.05	44.21
3.0	47.55	16.83	4.86	49.03
3.5	55.48	22.40	5.67	54.60
4.0	63.40	28.68	6.48	60.88
4.5	71.33	35.67	7.29	67.87
5.0	79.25	43.36	8.10	75.56
5.5	87.18	51.73	8.91	83.93
6.0	95.10	60.77	9.72	92.97
6.5	103.03	70.48	10.53	102.68
7.0	110.95	80.85	11.34	113.05
7.5	118.88	91.87	12.15	124.07
8.0	126.80	103.54	12.96	135.74
8.5	134.73	115.84	13.77	148.04
9.0	142.65	128.78	14.58	160.98
9.5	150.58	142.34	15.39	174.54
10.0	158.50	156.52	16.20	188.72
10.5	166.43	171.33	17.00	203.53
11.0	174.35	186.74	17.81	218.94
11.5	182.28	202.76	18.62	234.96
12.0	190.20	219.39	19.43	251.59
12.5	198.13	236.62	20.24	268.82
13.0	206.05	254.45	21.05	286.65

Additional Variables/Inputs			
	2" HDPE		
Elevation Gain (ft)	15		
Distance from pump to MMF or Lime Tank (ft)	300		
Inside Diameter of HDPE (in)	2		
Hazen-Williams Constant	130		

Head Loss from Valves, Sweeps, & fittings				
Description	**Qnty (2" Line)**		**Head Loss (ft)/ea.**	**Head Loss Total (ft)**
90° Sweep	6		2.7	16.2
Ball Valve (Open)	1		1	1
Total Feature Losses (ft)				**17.2**

Bellekeno 625 System Flow Rates w/ 3" Piping

Bellekeno Mine In-flow		Head Loss due to design features (ft)		
Flow Rate (lps) Re-circulation	**Flow Rate (gpm) Re-circulation**	**Friction Head Loss (ft)**	**3" Piping Velocity (ft/sec)**	**Total Dynamic Head Loss (ft)**
2.0	31.70	1.10	1.44	37.50
2.5	39.63	1.67	1.80	38.07
3.0	47.55	2.34	2.16	38.74
3.5	55.48	3.11	2.52	39.51
4.0	63.40	3.99	2.88	40.39
4.5	71.33	4.96	3.24	41.36
5.0	79.25	6.03	3.60	42.43
5.5	87.18	7.19	3.96	43.59
6.0	95.10	8.45	4.32	44.85
6.5	103.03	9.80	4.68	46.20
7.0	110.95	11.24	5.04	47.64
7.5	118.88	12.78	5.40	49.18
8.0	126.80	14.40	5.76	50.80
8.5	134.73	16.11	6.12	52.51
9.0	142.65	17.91	6.48	54.31
9.5	150.58	19.79	6.84	56.19
10.0	158.50	21.77	7.20	58.17
10.5	166.43	23.83	7.56	60.23
11.0	174.35	25.97	7.92	62.37
11.5	182.28	28.20	8.28	64.60
12.0	190.20	30.51	8.64	66.91
12.5	198.13	32.91	9.00	69.31
13.0	206.05	35.39	9.36	71.79

Additional Variables/Inputs			
	3" HDPE		
Elevation Gain (ft)	15		
Distance from pump to MMF or Lime Tank (ft)	300		
Inside Diameter of HDPE (in)	3		
Hazen-Williams Constant	130		

Head Loss from Valves, Sweeps, & fittings				
Description	**Qnty (3" Line)**		**Head Loss (ft)/ea.**	**Head Loss Total (ft)**
90° Sweep	6		3.4	20.4
Ball Valve (Open)	1		1	1
Total Feature Losses (ft)				**21.4**

DESCRIPTION
RE-CIRCULATION CALCS

REV.	SHEET	DATE	BY
A	11	3/08/10	EJL

APPENDICIES / DATASHEETS

DESCRIPTION
APPENDICIES / DATASHEETS

REMOVAL OF SUSPENDED SOLIDS DOWN TO 5 MICRONS AND BELOW

MODEL	SERVICE FLOW RATES		MEDIA	TOTAL FILT. SQ. FT.	BACK- WASH	IN/ OUT	MAX PSI	DIMENSIONS		
	NORMAL GPM	PEAK GPM						L	W	H
MM-2460-1A	16-47	63	12.0	3.15	47	2"	100	3'1"	2'4"	8'0"
MM-2460-2A	32-95	126	24.0	6.30	47	3"	100	4'5"	2'4"	8'6"
MM-2460-3A	48-142	189	36.0	9.45	47	3"	100	6'9"	2'4"	8'6"
MM-3060-1A	25-74	98	20.0	4.91	74	3"	100	4'8"	2'9"	8'6"
MM-3060-2A	50-147	196	40.0	9.82	74	4"	100	5'5"	2'9"	8'8"
MM-3060-3A	75-221	294	60.0	14.73	74	4"	100	8'3"	2'9"	8'8"
MM-3660-1A	35-107	142	28.5	7.10	107	3"	100	4'8"	3'3"	8'10"
MM-3660-2A	70-213	284	57.0	14.20	107	4"	100	6'5"	3'3"	9'3"
MM-3660-3A	105-320	426	85.5	21.30	107	4"	100	9'9"	3'3"	9'3"
MM-4860-1A	63-189	252	51.5	12.60	189	4"	80	5'7"	4'3"	9'10"
MM-4860-2A	126-378	504	103.0	25.20	189	6"	80	8'5"	4'3"	10'2"
MM-4860-3A	189-567	756	154.5	37.80	189	6"	80	12'9"	4'3"	10'2"
MM-4860-4A	252-756	1008	206.0	50.40	189	8"	80	17'1"	4'9"	10'4"
MM-4860-5A	315-945	1260	257.0	63.00	189	10"	80	22'2"	4'9"	10'8"
MM-4860-6A	378-1134	1512	309.0	75.60	189	10"	80	26'6"	4'9"	10'8"
MM-5460-1A	80-239	318	65.5	15.91	239	4"	80	5'10"	4'9"	10'10"
MM-5460-2A	160-477	636	131.0	31.82	239	6"	80	9'4"	4'9"	10'8"
MM-5460-3A	240-716	954	196.5	47.73	239	6"	80	14'2"	4'9"	10'8"
MM-5460-4A	320-955	1272	262.0	63.64	239	8"	80	19'9"	4'9"	10'10"
MM-5460-5A	400-1193	1590	327.5	79.55	239	10"	80	24'7"	4'9"	10'8"
MM-5460-6A	480-1432	1908	393.0	95.46	239	10"	80	29'5"	4'9"	10'8"

STANDARD SYSTEMS INCLUDE:

- FILTERED WATER BACKWASH ON MULTI-TANK SYSTEMS
- ALL INTERIOR SURFACES FUSION EPOXY COATED WITH 3M SCOTCHKOTE® 134 FUSION BONDED EPOXY
- ADVANCED SOLID STATE AUTOMATION WITH ELAPSED TIMER AND DIFFERENTIAL PRESSURE CONTROL
- SKID MOUNTED ON STRUCTURAL STEEL SKID
- LIQUID FILLED STAINLESS STEEL PRESSURE GAUGES
- FLANGED IN /OUT STANDARD (GROOVED - OPTIONAL)
- AUTOMATIC DIAPHRAGM OPERATED NON-CORROSIVE FUSION EPOXY LINED CAST IRON VALVES, STAINLESS TRIM, REPLACEABLE POLYURETHANE VALVE SEALS
- SYSTEMS PROVIDED WITH INTERCONNECTING PIPING
- REMOVABLE TYPE 304 STAINLESS STEEL UNDERDRAIN STANDARD
- ASME CODE STAMPED AVAILABLE - *CONSULT FACTORY*
- FILTRATION MEDIA IS INCLUDED IN THE SYSTEM "PACKAGE"

MORE INFO

Homepage | About Yardney . Product Applications | . Products A to Z | Contact Yardney

MM 2460-3AS
HEIGHT RESTRICTION

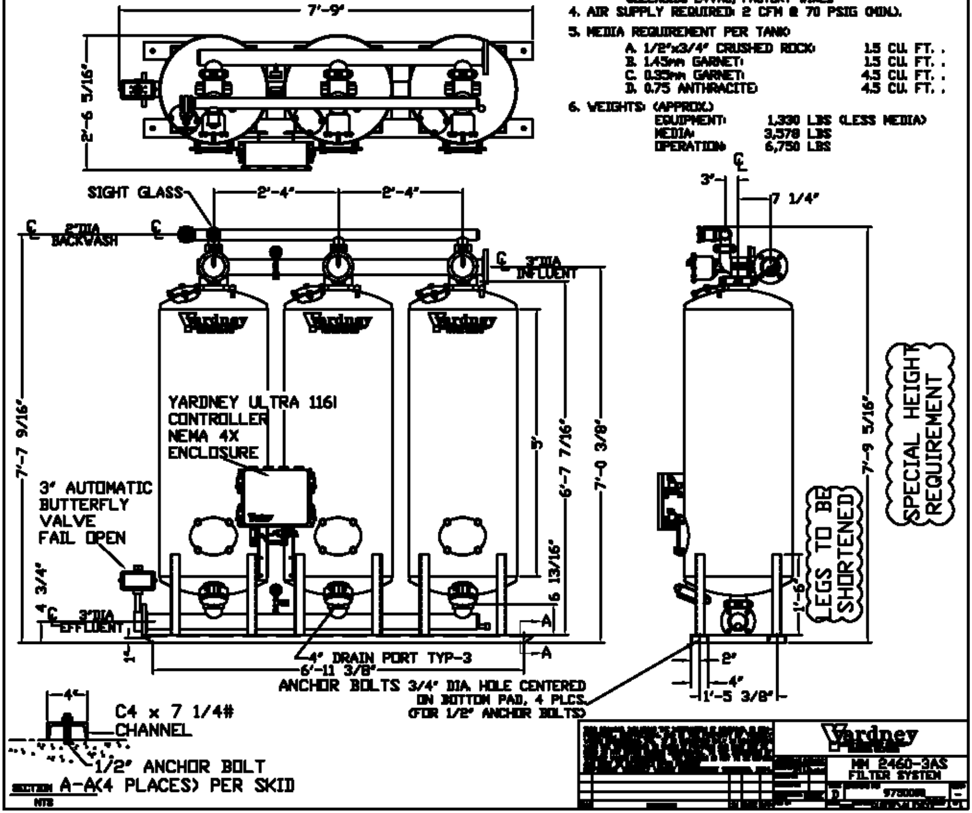
NOTES:

1. FLOW RATE DESIGN: 48-142 GPM; MAX TO 189 GPM
2. MAXIMUM WORKING PRESSURE: 100 PSI.
3. ELECTRICAL REQUIREMENTS:
   CONTROLLER 120V;
   SOLENOIDS 24VAC; FACTORY WIRED
4. AIR SUPPLY REQUIRED: 2 CFM @ 70 PSIG (MIN).
5. MEDIA REQUIREMENT PER TANK:

A. 1/2"x3/4" CRUSHED ROCK:	1.5 CU. FT. .
B. 1.45mm GARNET:	1.5 CU. FT. .
C. 0.35mm GARNET:	4.5 CU. FT. .
D. 0.75 ANTHRACITE:	4.5 CU. FT. .

6. WEIGHTS: (APPROX.)

EQUIPMENT:	1,330 LBS (LESS MEDIA)
MEDIA:	3,578 LBS
OPERATION:	6,750 LBS

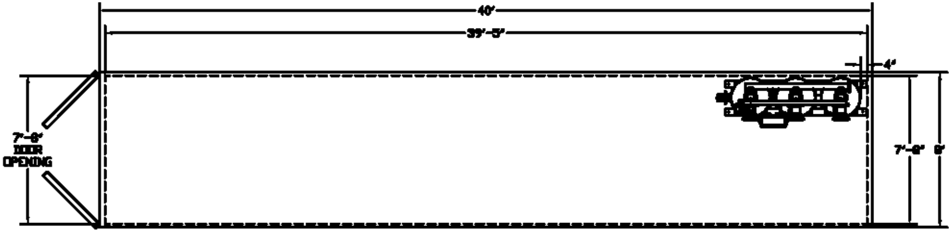


Yardney

MM 2460-3AS
FILTER SYSTEM

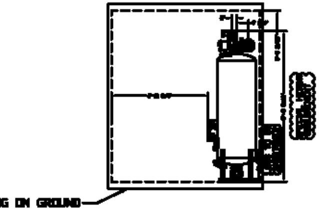
D

MODEL MM 2460-3AS
IN HC CONTAINER 8' X 40'



TOP VIEW

SIDE VIEW



END VIEW

Yardney

HC CONTAINER 8'X40'
WITH 2460-3 SYSTEM

SYSTEM LAYOUT

NONE

1 OF 1

Visit our website: www.bjmpumps.com

3/20/2009
0812
Supersedes
0811

TECHNICAL DATA
MODEL J37H
BJM SUBMERSIBLE PUMP - CAST IRON

GENERAL DATA

MAX. FLOW: GPM (L/min)	192 GPM (726 L/min)
MAX. HEAD: ft (m)	113' (34.4 m)
MAX. SUBMERSION DEPTH: ft (m)	200' (61 m) or limited to length of power cord
PUMP TYPE	SUMP, SIDE DISCHARGE
MINIMUM SUBMERSION DEPTH: in(mm)	12" (305 mm)
SOLID SIZE: in (mm)	3/8" (9.5 mm)
STRAINER OPENING	0.375" (9.5 mm) diameter
IMPELLER DIAMETER: in (mm)	5.8" (147 mm)
DISCHARGE SIZE	2" NPT-MALE
PUMP WEIGHT, without cable: lbs (kg)	97 lbs (44.1 kg)
SHIPPING WEIGHT: lbs (kg)	105 lbs (47.7 kg)

CONSTRUCTION / MATERIAL DATA

MECHANICAL SEAL - UPPER	CARBON/CERAMIC
MECHANICAL SEAL - LOWER	SILICON CARBIDE/SILICON CARBIDE
MOTOR CASING	304 SS
PUMP VOLUTE	CAST IRON
IMPELLER- MULTI VANE	CAST IRON
STRAINER	STEEL
LIPSEAL & O-RINGS	BUNA-N
ROTOR SHAFT	304 SS
EXTERNAL HARDWARE	304 SS
QTY. OIL IN SEAL CHAMBER	10.8 U.S. FL. OZ. (320 C.C.)
QTY. OIL IN MOTOR STATOR	No oil in motor stator (After ser# 41316). 16.9 U.S. FL. OZ. (500 C.C.) (Before ser# 41316).
BALL BEARING: PERM. LUBE. UPPER	6304
BALL BEARING: PERM. LUBE. LOWER	6305

ELECTRICAL / MOTOR DATA

MOTOR: TYPE, RATING HP	SUBMERSIBLE, 5 (CONTINUOUS DUTY[3])			
MOTOR RPM	3450			
MOTOR INSULATION CLASS	F			
MOTOR SERVICE FACTOR	1.1			
VOLTAGE[1] - 3 PH, 60 Hz	208V option	230V	460V	575V option
CURRENT F.L.A.	14.7	14	7	5.5
LOCKED ROTOR CURRENT (LRA)	86.5	85	43	38
MOTOR PROTECTION	THERMAL & AMP. OVERLOAD			
POWER CORD: GAGE; LENGTH	A.W.G. 12/4; 33' (10 m), STOW			
MAXIMUM LIQUID TEMPERATURE	104°F (40°C)			
SEAL LEAK DETECTOR[2] (OPTIONAL)	Seal Minder®; MOISTURE SENSING PROBE			

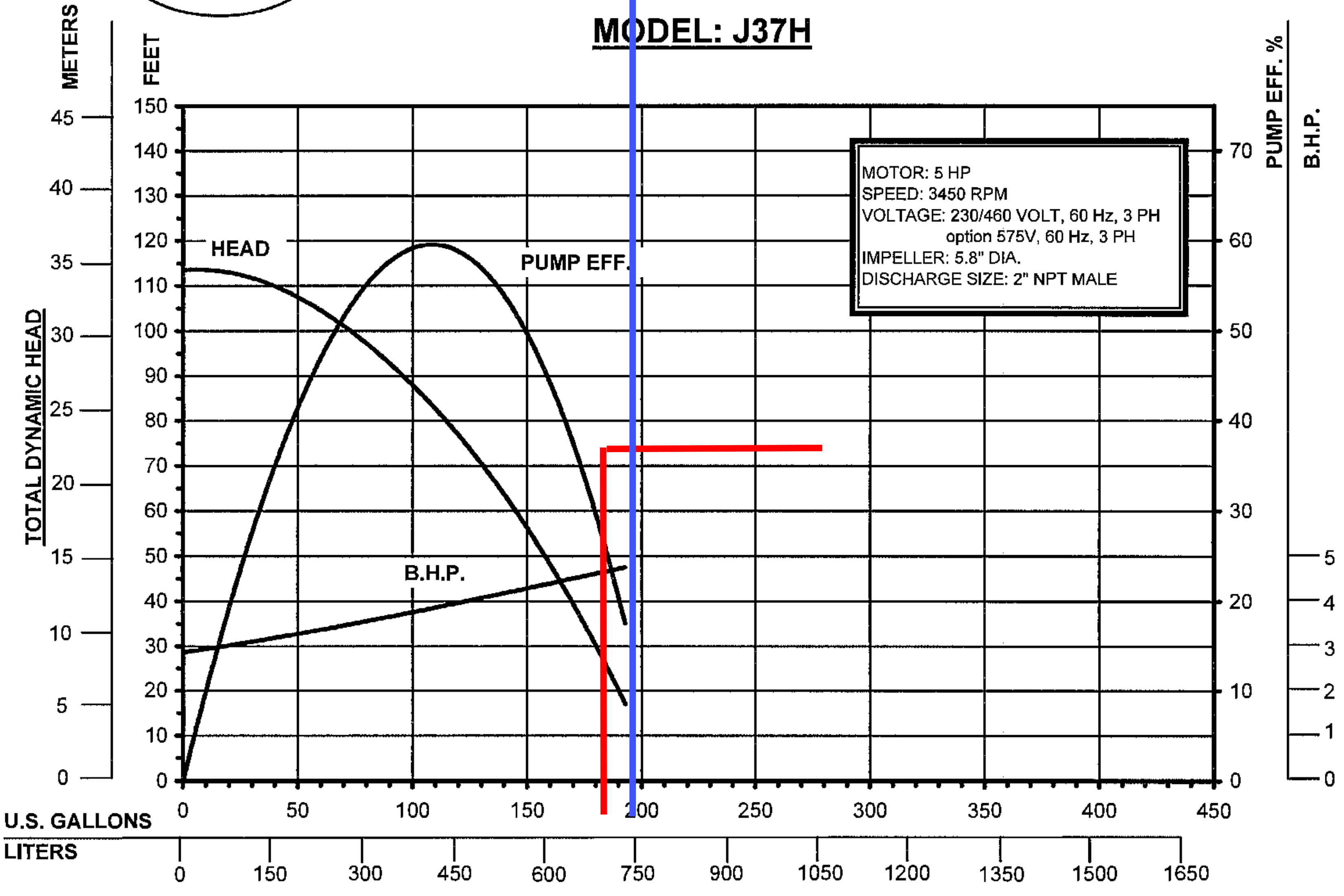
1- Available in other voltages (and in 50 Hz).
2- Requires a seal fail circuit in control panel for warning signal.
3 - Continuous duty motor – see minimum submersion depth at General Data table above.

123 Spencer Plain Road
Old Saybrook, CT. 06475, USA
(860)399-5937 - (877) BJM-PUMP - Fax: (860)399-7784

REFER TO REVERSE SIDE FOR PUMP PERFORMANCE CURVES
SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE
Seal Minder is a registered trademark of BJM Pumps, LLC. All rights reserved.

BJM PUMPS

MODEL: J37H



MOTOR: 5 HP
SPEED: 3450 RPM
VOLTAGE: 230/460 VOLT, 60 Hz, 3 PH
option 575V, 60 Hz, 3 PH
IMPELLER: 5.8" DIA.
DISCHARGE SIZE: 2" NPT MALE

2/17/2006 supersedes priors

FLOW RATE PER MINUTE

SPECIFICATIONS SUBJECT TO CHANGE WITHOUT NOTICE

THREE PHASE CONTROL PANEL

Standard Features:

- Nema 4X Enclosure with Hinged Door and Lockable Hasp
- Motor Circuit Manual Starter/Protector with Adjustable Overload Protection
- Terminal Blocks and Ground Lugs as required
- Alarm Light and Electronic Alarm Horn with Silence Switch
- Alarm Test Push Button
- Multitap Transformer
- U.L.508 Listed
- Backpanel and Inner Door
- Incoming Power Block
- Heavy Duty IEC Rated Contactors
- Pump Run Lights
- Float Indicators
- Alternator (Duplex Panels Only)
- Hand-Off-Auto Push buttons (HOA)
- Control and Alarm Circuit Fuses

Simplex has: 3 mechanical Float Switches with 20' cable

Duplex has: 4 Mechanical Float Switches with 20' cable

See page 9 for High Temperature Floats

Ship Weight: Approx. 30 lbs

SIMPLEX PUMP CONTROL SYSTEM - THREE PHASE

Overall Dimensions for Simplex and Duplex 14.5" x 12" x 7.5"

P/N	FLA	PUMP MODEL
AP31AH	1-1.6	all: 08/460V
AP31BH	1.6-2.5	all: 12/460V
AP31CH	2.5-4	all: 08/230V all: 15/ 460V
AP31DH	4-6.3	all: 12/230V all: 22/460V
AP31FH	6-10	all: 15/230V all: 22/230V all: 37/460V
AP31GH	9-14	all: 55/460V
AP31HH	13-18	all: 37/230V all: 75/460V
AP31AS	17-23	all: 55/230V all: 110/460V
AP31BS	23-32	all: 75/230V note 230V 3 phase only
AP31CS	25-40	all: 150/460V all 220/460
AP31DS	30-40	all: 110/230V note 230V 3 phase only

DUPLEX ALTERNATING PUMP CONTROL SYSTEM - THREE PHASE

Overall Dimensions for Simplex and Duplex 14.5" x 12" x 7.5"

P/N	FLA	PUMP MODEL
AP32AH	1-1.6	all: 08/460V
AP32BH	1.6-2.5	all: 12/460V
AP32CH	2.5-4	all: 08/230V all: 15/ 460V
AP32DH	4-6.3	all: 12/230V all: 22/460V
AP32FH	6-10	all: 15/230V all: 22/230V all: 37/460V
AP32GH	9-14	all: 55/460V
AP32HH	13-18	all: 37/230V all: 75/460V all: 110/460V
AP32AS	17-23	all: 55/230V
AP32BS	23-32	all: 75/230V
AP32CS	25-40	all: 150/460V all: 220/460
AP32DS	30-40	all: 110/230V note 230V 3 phase only

Custom Panels Available - Contact BJM

NEW ERA Engineering Corporation
Placer Mining and Small Hydro Specialists
71 Fireweed Drive, Whitehorse, Yukon, Canada Y1A 5T8, 867-668-3978 fax 668-4528

March 11, 2010

Eric Lancaster
Alexco Resource US Corp
88 Inverness Circle East, Suite N-102
Englewood, Colorado, U.S.A.
CO 80112

Dear Mr. Lancaster:

RE: Proposed Bellekeno 625 Treatment System Modifications

I have reviewed the proposed Bellekeno 625 Treatment System Modifications and completed pump and pipe flow calculations for the two new proposed pumps: the sludge pond #2 overflow to the filtering system; and the submersible pump for the recycle/return line from pond #2 back to the rapid mix tank (see attached flow chart and site plan).

From conversations with Eric Lancaster (Alexco) and Mark Herndon (Yardney Filter Systems) and from a review of a draft report provided by Eric Lancaster and manufacturers' data I understand the following.

a) Effluent from the Bellekeno 625 adit flows at an average flow of 3 to 3.5 l/s and contains metals and other substances as specified in the attached Alexco report (Water Specifications table) including relatively high levels of total suspended solids occasionally (when there is drilling and other activity is going on in the Bellekeno mine).

b) Mine water presently flows by gravity through a flow meter to a rapid mix tank where lime slurry, iron, and flocculent is added and agitated/aerated. The lime treatment system lowers levels of zinc, lead, and other metals in the effluent.

c) This treated effluent flows to a small (~15 m by 15 m, 50 by 50 feet) settling pond and then to a larger (~20 m by 60 m, 60 by 200 feet) settling pond #2 and then to a decant box for discharge to Lightning Creek drainage;

In order to alleviate some concerns about high levels of suspended solids in the effluent, it is proposed:

a) To install a BJM model J37H submersible pump in pond #2 and pump the effluent to a Yardney model MM 2460-3A multi media filtering system to remove more of the suspended solids prior to release to the decant box. and

b) To install a second pump and piping to recycle/return treated effluent back from the end of pond #2 to the rapid mix tank to allow for additional treatment of the effluent as necessary at a flow of about 5 l/s (80 USgpm).

The Yardney automatic multi-media filters have a 76 mm (3 inch) flanged inlet and outlet for the filtered effluent. The filter back wash system is automatic and occurs when either a time interval or pressure differential 8 m (~12 psi) across the filter media is reached. During backwash, a valve on the effluent discharge closes and redirects filtered water from the bottom of the other two cylinders through the bottom of the back washed filter. At the top of the back washed filter, another valve redirects the backwashed filter effluent through a 51 mm (2 inch) pipe back to the rapid mix tank. Each of the three cylinders back washes in turn and then the system returns to normal filtering operation. The automatic valves are operated with compressed air. The pressure drop across the cleaned filters is approximately 4 m (5 psi). Therefore the flow through the filters will drop slightly as the filters become clogged at a pressure drop of about 8 m (12 psi). The rated flow for the system is 3 to 9 l/s (48 to 142 USgpm). It takes approximately 12 minutes to backwash the three filter cylinders.

Mine Effluent Flow from Settling Pond #2 to Yardney Filter System

Hydraulic Data

Max Net Head m	3	m	pond to filters	
Inlet Head	-	m	Submersible	
Max Net Head m	-	m	filters back to rapid mix tank	
Effluent Pipe Diameter HDPE	76	mm	3.0	inch
Effluent Pipe Area m2	0.0046	m2		
Effluent Pipe length m	15	m	50	ft
Return Pipe Diameter HDPE	51	mm	2.0	inch
Return Pipe Area m2	0.0020	m2		
Return Pipe length m	91	m	300	ft
Hazen/Williams Friction Coefficient			130	
Minimum Filter Losses	3.5	m	5	psi
Maximum Filter Losses	8.4	m	12	psi

Table 1 - Pump from Pond #2 to Filtration System (3" HDPE)

Effluent Flow		Velocity	Pipe	Velocity	Fit & Filter Loss		Net	Gross Head	
gpm	l/s	m/s	Loss m	Head m	min m	Max m	Head m	min	Max
					3.7				
30	1.9	0.42	0.1	0.01	3.5	8.4	3.0	6.6	11
40	2.5	0.55	0.1	0.02	3.6	8.5	3.0	6.6	12
50	3.2	0.69	0.1	0.02	3.6	8.5	3.0	6.7	12
60	3.8	0.83	0.2	0.04	3.6	8.5	3.0	6.8	12
70	4.4	0.97	0.2	0.05	3.7	8.6	3.0	6.9	12
80	5.0	1.11	0.3	0.06	3.7	8.6	3.0	7.0	12
90	5.7	1.25	0.4	0.08	3.8	8.7	3.0	7.2	12
100	6.3	1.38	0.5	0.10	3.9	8.8	3.0	7.3	12
110	6.9	1.52	0.6	0.12	3.9	8.8	3.0	7.5	12
120	7.6	1.66	0.7	0.14	4.0	8.9	3.0	7.7	13
130	8.2	1.80	0.8	0.16	4.1	9.0	3.0	7.9	13
140	8.8	1.94	0.9	0.19	4.2	9.1	3.0	8.1	13
160	10.1	2.21	1.1	0.25	4.4	9.3	3.0	8.6	13
180	11.4	2.49	1.4	0.32	4.7	9.6	3.0	9.1	14
200	12.6	2.77	1.7	0.39	4.9	9.9	3.0	9.7	15

Notes: Fittings = 5 @ 90 degrees (5*0.3), Y (0.2), 2 @gate valves (2*0.15 open), Seametrics flow meter (1.65), ball valve (0.05 open)
Seametrics Flow meter is a turbine type meter with 4 psi loss at 500 gpm in 3 inch pipe = 1.65 velocity head loss
Globe valves have coefficients of (10), therefore the last valve is assumed to be a ball valve
assumes BJH model J37H pump
assumes HDPE pipe in good condition
assumes fluid with same density and viscosity as water

Minimum gross head and maximum flows would occur immediately after all filters were flushed at 11 l/s (180 USgpm) at 9 m head.
Maximum gross head and minimum flows would occur immediately before all filters were due to be flushed 9 l/s (140 USgpm) at 13 m head (18 psi).

The selected pump would be operating at the very low end of its efficiency curve.
These flows would have to be throttled down with the ball valve to remain below the recommended 3 to 9 l/s (48 to 142 USgpm) flow through filters.
These flows would reduce over time due to wear and lining of pipe with calcium.
This is the flow and pressure estimate for filtered effluent.

Table 2 - Filtration Flush System to Rapid Mix Tank (2" HDPE)

Effluent	Flow	Velocity	Pipe	Velocity	Ftt & Filter Loss		Net	Gross Head	
gpm	l/s	m/s	Loss m	Head m	min m	Max m	Head m	min	max
					1.95				
30	1.9	0.93	2	0.04	10	20	0	12	22
40	2.5	1.25	4	0.08	10	20	0	14	24
50	3.2	1.56	6	0.12	10	20	0	16	26
60	3.8	1.87	8	0.18	11	20	0	19	28
70	4.4	2.18	11	0.24	11	21	0	21	31
80	5.0	2.49	14	0.32	11	21	0	25	35
90	5.7	2.80	17	0.40	11	21	0	28	38
100	6.3	3.11	20	0.49	12	22	0	32	42
110	6.9	3.42	24	0.60	12	22	0	37	46
120	7.6	3.74	29	0.71	13	22	0	41	51
130	8.2	4.05	33	0.83	13	23	0	46	56
140	8.8	4.36	38	0.97	13	23	0	52	61

Notes: Filter Flush Return Line would have all the fittings and filter losses of the effluent treatment system as well as the return losses of 6 @ 90 degree (6*0.3) and gate valve (0.15) & pipe.
assumes BJH model J37H pump
assumes HDPE pipe in good condition
assumes no net gain in head from filters to rapid mix tank
assumes fluid with same density and viscosity as water

Minimum gross head and maximum flush return would occur briefly when two flushed filters were flushing an almost clean third filter at the end of flushing cycle.
Maximum flow of 5 l/s (80 USgpm) at 25 m head.

Maximum gross head and minimum flush return would occur briefly at the very start of flushing when two full filters were flushing a full third filter.

Minimum flow of 4.4 l/s (70 USgpm) at 31 m head (44 psi).
This is within the suggested backwash flow of 3 l/s (47 USgpm)
The selected pump would be operating a high levels of efficiency.

This is the flow of back flushed water from filters not the flow estimate for filtered effluent.
The filtered flow through both remaining filters is used to flush the remaining single filter.
There should be adequate flushing volume for each filter.
It takes about 12 minutes to flush all three filters; effluent storage would be required for the backwash period.

Bellekeno 625 Level
Recycled flow from Settling Pond #2 back to Rapid Mix Tank

Hydraulic Data				
Max Net Head m	3	m		
HDPE Pipe length m	91	m	300	ft
Inlet Head	-	m	Submersible	
Pipe Diameter mm HDPE	51	mm	2.0	inch
Pipe Area m2	0.002	m2		
Hazen/Williams Friction Coefficient	130			

Table 3 - Recycled flow from Settling Pond #2 back to Rapid Mix Tank (2" HDPE)

Effluent gpm	Flow l/s	Velocity m/s	Pipe Loss m	Velocity Head m	Fitting Loss m 1.85	Net Head m	Gross Head m
30	1.9	0.93	2.2	0.04	0.1	3	5
40	2.5	1.25	3.8	0.08	0.1	3	7
50	3.2	1.56	5.7	0.12	0.2	3	9
60	3.8	1.87	7.9	0.18	0.3	3	11
70	4.4	2.18	10.6	0.24	0.4	3	14
80	5.0	2.49	13.5	0.32	0.6	3	17
90	5.7	2.80	16.8	0.40	0.7	3	21
100	6.3	3.11	20.4	0.49	0.9	3	24
110	6.9	3.42	24.4	0.60	1.1	3	28
120	7.6	3.74	28.6	0.71	1.3	3	33
130	8.2	4.05	33.2	0.83	1.5	3	38
140	8.8	4.36	38.1	0.97	1.8	3	43

Notes: Fittings = 6 @ 90 degrees (6*0.3) and ball valve open (0.05)
Globe valves have coefficients of (10), the last valve is assumed to be a ball valve
assumes HDPE pipe in good condition
assumes fluid with same density and viscosity as water

Flow could be increased substantially and power reduced with larger pipe size.
Flows would reduce in time with wear and lining of pipe with calcium.

A flow of 5 l/s (80 USgpm) would have a resulting friction loss of 17 m with the 51 mm (2 inch) pipe.

Bellekeno 625 Level
Recycled flow from Settling Pond #2 back to Rapid Mix Tank - larger pipe

Max Net Head m	3	m		
HDPE Pipe length m	91	m	0	ft
Inlet Head	-	m	Submersible	
Pipe Diameter mm HDPE	76	mm	3.0	inch
Pipe Area m2	0.0046	m2		
Hazen/Williams Friction Coefficient			130	

Table 3 - Recycled flow from Settling Pond #2 back to Rapid Mix Tank (3" HDPE)

Effluent Flow		Velocity	Pipe	Velocity	Fitting	Net	Gross
gpm	l/s	m/s	Loss m	Head m	Loss m	Head m	Head m
					1.85		
30	1.9	0.42	0.3	0.01	0.0	3	3
40	2.5	0.55	0.5	0.02	0.0	3	4
50	3.2	0.69	0.8	0.02	0.0	3	4
60	3.8	0.83	1.1	0.04	0.1	3	4
70	4.4	0.97	1.5	0.05	0.1	3	5
80	5.0	1.11	1.9	0.06	0.1	3	5
90	5.7	1.25	2.3	0.08	0.1	3	5
100	6.3	1.38	2.8	0.10	0.2	3	6
110	6.9	1.52	3.4	0.12	0.2	3	7
120	7.6	1.66	4.0	0.14	0.3	3	7
130	8.2	1.80	4.6	0.16	0.3	3	8
140	8.8	1.94	5.3	0.19	0.4	3	9
150	9.5	2.08	6.0	0.22	0.4	3	9
160	10.1	2.21	6.8	0.25	0.5	3	10
170	10.7	2.35	7.6	0.28	0.5	3	11
180	11.4	2.49	8.4	0.32	0.6	3	12

Notes: Fittings = 6 @ 90 degrees (6*0.3) and ball valve open (0.05)
Globe valves have coefficients of (10), the last valve is assumed to be a ball valve.
assumes HDPE pipe in good condition
assumes fluid with same density and viscosity as water

Flows would reduce in time with wear and lining of pipe with calcium.
This is probably more flow than required for back flushing.

A flow of 5 l/s (80 USgpm) would have a resulting friction loss of 5 m with the 76 mm (3 inch) pipe.

Conclusions

This is a fairly complex hydraulic circuit with limited hydraulic data for some of its components and inherent cyclic and long term variations in flow. It appears that the selected submersible pumps (BJM model J37H) would be adequate to pump about 9 to 11 l/s (140 to 180 USgpm) through the three Yardney multi-media filters (MM 2460-3A) to filter suspended solids from the Bellekeno 625 mine effluent (table 1). This is near the maximum recommended flows for the filter (3- 9 l/s, 48-142 USgpm) but the flow could be throttled down using the ball valve at the end of the system.

The variance in flows is due to increased pressure 4 to 8 m (5 to 12 psi) as the media in the filters become plugged. The BJM pump would be operating at the low end of its efficiency range during normal filtering operations. These flow rates would be lower over time due to wear and tear on the system and the build up of calcium on the pipes. The filters cycle on and into flush cycle therefore a greater throughput than the average 3-3.5 l/s would be required. Therefore it is prudent to have this excess capacity.

When the Yardney filter system is back flushing, the flows back to the rapid mix tanks should range from about 4 to 5 l/s (70-80 USgpm) using a 51 mm (2 inch) HDPE return line (table 2). This is slightly higher than the recommended 3l/s (47 USgpm) but these flows also could be throttled down using a ball valve. These flow rates would be lower over time with wear and tear on the system and the build up of calcium on the pipes. Therefore it is prudent to have this excess capacity. The selected pump would be operating a high efficiency during back flushing operations. Backwashing is expected to take about 12 minutes according to the manufacturer. There should be adequate storage in the pond system to store any discharge of effluent from the mine while the filters are backwashing.

The selected flow meter (Sea Metrics WTP-101-300-18) is a turbine meter and may plug up with calcium in the short term. Depending on costs it may be prudent to use an external flow meter such as an ultrasonic or Doppler flow meter to improve meter reliability and service life. In this case, the meter may have to be located upstream of the filters where there would be sufficient suspended solids. I have assumed flow coefficients for ball valves as those for globe valves tend to quite high.

The pump chosen to pump effluent back from settling pond #2 to the rapid mix tank at a rate of 5 l/s (80 USgpm) would have to overcome 17 m of friction head loss in 51 mm (2 inch) pipe, or 5 m of friction loss if 76 mm (3 inch) pipe was used (table 3).

Settling pond #2 should retain a gravity overflow in the event of prolonged power or equipment failure. The pond system should have sufficient capacity to store the mine effluent for at least 12 minute backwashing period without discharge. Prior to cleaning out the solids, the effluent levels in the pond should be lowered as much as possible to allow time for the settlement of the fine solids which were resuspended.

Regards,

Randy Clarkson P.Eng.

PROFESSIONAL
YUKON
RANDY CLARKSON
TERRITORY
ENGINEER

References:

BJM Pumps– Pump data from website – www.bjmpumps.com

Herndon Mark, March 5, 2101, Personal Communication regarding the operation of Yardney Filter Systems

Lancaster, Eric, March 4, 2010, Personal Communication regarding proposed system.

Lancaster, Eric, March 2010, Alexco Resources US Corp Draft Report – “Bellekeno 625 Water Treatment System”

Sea Metrics – product information of the WTP turbine flow meters www.seametrics.com

Yardney Filter Systems – Filter system data from website www.yardneyfilters.com

Attachments:

Excel Spreadsheet with detailed calculations

Alexco Resources US Corp Report – “Bellekeno 625 Water Treatment System”

ALEXCO KENO HILL MINING CORP.

TYPE A WATER LICENCE APPLICATION

QZ09-092

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Attachment C

Prepared by:

ACCESS
CONSULTING GROUP

www.accessconsulting.ca

CREATING AND DELIVERING BETTER SOLUTIONS

www.eba.ca

April 1, 2010 EBA File: W14101178.003

Alexco Resource Corp.
#3-151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Attention: Mr. Rob McIntyre, Vice President

Subject: Response to Water Board Questions – Bellekeno Waste Rock Dump

1.0 INTRODUCTION

In a meeting held on March 25, 2010 between Alexco Resource Corp. (Alexco) and EBA Engineering Consultants Ltd. (EBA), two concerns raised by the Waster Board specific to the Water License application were discussed. Alexco requested EBA provide further information with regard to the following:

- Bellekeno Waste Rock Dump stability, and,
- The Typical Waste Containment Facility Design.

The concerns related to whether or not any preliminary design work had been completed for the dumps, and furthermore whether a typical Waste Containment Facility could be constructed on top of the waste rock dump, per preliminary plans submitted by Alexco.

2.0 TYPICAL WASTE CONTAINMENT FACILITY DESIGN

EBA completed the design of the Typical Waste Containment Facility as part of the "Typical Waste Containment Facility Design, Keno Hill Silver District, YT Construction Specifications" dated July 2008. The original construction specifications have been attached to this letter and are available in hard copy upon request. The intent is that although this is a generic design, a site specific geotechnical evaluation would be completed at each location proposed for construction, and the design/construction details modified according to site conditions.

It is EBA's opinion that a "Typical Waste Containment Facility" could be constructed on top of the Bellekeno Waste Rock Dump, as it would be a balanced cut and fill construction, adequately set back from the crest of the dump, and specifically designed for this location.

This was always the intent when the generic design was prepared – construction would not occur until a site specific design was completed by EBA, including the collection of site specific geotechnical data.

3.0 WASTE ROCK DUMP STABILITY

EBA completed the conceptual design, stability calculations, potential risks and mitigations, and closure plans for the Non-AML Waste Rock Disposal Area at the Bellekeno site in a letter report entitled "Conceptual Tailings and Waste Rock Management Plans, Bellekeno Project near Keno City, Yukon" dated December 12, 2008.

The section relevant to the stability of the waste rock dump stability (Section 3.0) is copied below and full copies of the original report are available upon request:

3.1 NON-AML WASTE ROCK DISPOSAL AREA

Alexco is proposing to dispose of non-AML waste rock at the Bellekeno site. This section summarizes the geotechnical data collected, design assumptions, conceptual design, stability calculations, potential risks and mitigations, and closure plans for the Non-AML Waste Rock Disposal Area (WRDA) at the Bellekeno site.

3.2 GEOTECHNICAL AND GROUND TEMPERATURE DATA COLLECTED

Five boreholes were drilled, logged and sampled, and one thermistor cable was installed on October 30, 2008, using an air rotary drill rig. A site plan showing the location of the boreholes and thermistor is attached, followed by the borehole logs. The data indicates that subsurface conditions are primarily unfrozen glacial till, however, as this is a north-facing slope and the area has been somewhat disturbed, preliminary modelling was completed assuming that permafrost existed in the slope, and that the failure mechanism would be shearing along the frozen/unfrozen soil boundary. Additional data will need to be collected along the proposed toe of the dump, prior to the detailed design stage.

3.3 NON-AML WASTE ROCK DISPOSAL AREA ASSUMPTIONS

Alexco provided the following assumptions to EBA for use in design of the WRDA:

Total volume of waste rock to be generated: 500,000 dry metric tons (dmt);

Volume of non-AML waste rock will be 75% of the total;

Placed density of the waste rock will be 1800 kg/m3;

Waste Rock used in construction of DSTF can be subtracted from total to be stored; and

Total volume to be stored is 200,000 m3.

EBA's design assumptions are as follows:

An internal friction angle of 36 degrees for waste rock;

The waste rock is cohesionless;

Foundation soils for the waste rock storage facility are permafrost sand and gravel with a bulk unit weight of 2140 kg/m3;

Foundation soils have an undrained shear strength of 10 kPa with an internal friction angle of 28 degrees;

Active layer of the permafrost is 1 m thick and the groundwater surface is 0.5 m above the permafrost boundary, simulating early summer ground conditions;

Shear failure will not occur through the permafrost, but along the frozen/unfrozen boundary; and

The design seismic event was selected to be 1:500 year return period, as recommended in Mined Rock and Overburden Piles Investigation and Design Manual (BC Mine Waste Rock Pile Research Committee, 1991).

3.4 NON-AML WASTE ROCK DISPOSAL FACILITY CONCEPTUAL DESIGN

The waste rock will be hauled from the Bellekeno adit directly to the WRDA. The WRDA will be constructed as a wrap around dump, so the lower benches will be constructed first. The lowest bench will follow the existing road alignment and have a slope to the existing ground surface of 2.5H:1V. The waste rock will be dumped in 10 m benches and allowed to fall to the bench below it at the natural angle of repose of the rock. The stability of the pile was checked using Geostudio 2007 – SlopeW module. The factors of safety calculated for the waste WRDA and the guidelines set forth by the BC Mine Waste Rock Pile Research Committee (1991) are summarized in Table 3. The WRDA will not need re-contouring at closure as the long-term stability of the pile should meet the guidelines. Waste rock piles in the area have been standing at the natural angle of repose without significant stability problems for over 30 years.

TABLE 3: WRDA SLOPE STABILITY FACTOR OF SAFETY SUMMARY

Stability Condition	Factor of Safety	
	Suggested Minimum	Calculated for WRDA
Stability of Surface		
Short Term (during construction)	1.0	1.1
Long-Term (reclamation – abandonment)	1.1	1.1
Deep-Seated Stability		
Short Term (static)	1.1 – 1.3	1.7
Long-Term (static)	1.3	1.7
Pseudo-Static	1.0	1.2

3.5 NON-AML WASTE ROCK DISPOSAL AREA RISKS AND MITIGATIONS

The risks and associated mitigations of the Non-AML WRDA are summarized in Table 4.

TABLE 4: NON-AML WRDA RISK AND MITIGATION SUMMARY

Risk	Design Constraint	Mitigation	Discussion
Deep seated slope failure	Minimum FS = 1.3 (static); 1.0 (pseudo-static 1:500 year event)	Waste rock pile is designed to the applicable guidelines.	Probability of exceedance of the design seismic event is 10% in 50 years.
Surface slope failure	Minimum FS = 1.1 (static)	Waste rock pile is designed to the applicable guidelines.	Surface failures can be repaired without major effort.
Sediment transport	Setback distance of 30 m from water bodies	Pile location minimizes sediment from being transported into adjacent streams.	Sediment picked up by surface runoff can filter out in natural vegetation in the area prior to discharging into receiving water bodies.
Toe liquefaction	Consider liquefaction during preliminary design	The foundation soils not susceptible to liquefaction in frozen state.	Review of liquefaction potential will be conducted for unfrozen soils in detailed design.
Snow and ice buried during pile construction	Operational issue	Operational procedures will be developed to minimize this.	Buried snow and ice can affect the stability and capacity of the facility.
Contaminated waste rock	Operational issue	Waste rock containing contaminants will not be placed in waste rock pile.	Contaminated rock will be placed in the previously constructed contaminated waste rock facility.

3.6 NON-AML WASTE ROCK DISPOSAL AREA CLOSURE

No additional re-contouring will be required at closure for the WRDA. However, the condition of the permafrost beneath the WRDA should be monitored throughout operation and at least 10 years past closure. The requirement for ground temperature monitoring should be reviewed 10 years after closure. An annual geotechnical inspection should be conducted on the WRDA for at least 5 years after closure. The requirement for an annual geotechnical inspection should be reviewed 5 years after closure.

A toe buttress may be required along the alluvial terrace below the toe of the WRDA in the area currently being placer mined. This is necessary to improve the overall stability of the embankment in the event of an earthquake, or other seismic event. Adequate backfilling or re-contouring by the placer miner may alleviate this concern, but this should be re-examined at detailed design and at closure.

4.0 CLOSURE

We trust this letter meets your present requirements. Should you have any questions or comments, please contact the undersigned.

Yours truly,
EBA Engineering Consultants Ltd.

RICHARD TRIMBLE
April 1/10

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Geotechnical Engineer, Yukon Region
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jpigage@eba.ca

J. Richard Trimble, FEC, P.Eng.
Principal Consultant, Yukon Region
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PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date April 1/10
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

GEOTECHNICAL REPORT – GENERAL CONDITIONS

This report incorporates and is subject to these "General Conditions".

1.0 USE OF REPORT AND OWNERSHIP

This geotechnical report pertains to a specific site, a specific development and a specific scope of work. It is not applicable to any other sites nor should it be relied upon for types of development other than that to which it refers. Any variation from the site or development would necessitate a supplementary geotechnical assessment.

This report and the recommendations contained in it are intended for the sole use of EBA's Client. EBA does not accept any responsibility for the accuracy of any of the data, the analyses or the recommendations contained or referenced in the report when the report is used or relied upon by any party other than EBA's Client unless otherwise authorized in writing by EBA. Any unauthorized use of the report is at the sole risk of the user.

This report is subject to copyright and shall not be reproduced either wholly or in part without the prior, written permission of EBA. Additional copies of the report, if required, may be obtained upon request.

2.0 ALTERNATE REPORT FORMAT

Where EBA submits both electronic file and hard copy versions of reports, drawings and other project-related documents and deliverables (collectively termed EBA's instruments of professional service), only the signed and/or sealed versions shall be considered final and legally binding. The original signed and/or sealed version archived by EBA shall be deemed to be the original for the Project.

Both electronic file and hard copy versions of EBA's instruments of professional service shall not, under any circumstances, no matter who owns or uses them, be altered by any party except EBA. EBA's instruments of professional service will be used only and exactly as submitted by EBA.

Electronic files submitted by EBA have been prepared and submitted using specific software and hardware systems. EBA makes no representation about the compatibility of these files with the Client's current or future software and hardware systems.

3.0 ENVIRONMENTAL AND REGULATORY ISSUES

Unless stipulated in the report, EBA has not been retained to investigate, address or consider and has not investigated, addressed or considered any environmental or regulatory issues associated with development on the subject site.

4.0 NATURE AND EXACTNESS OF SOIL AND ROCK DESCRIPTIONS

Classification and identification of soils and rocks are based upon commonly accepted systems and methods employed in professional geotechnical practice. This report contains descriptions of the systems and methods used. Where deviations from the system or method prevail, they are specifically mentioned.

Classification and identification of geological units are judgmental in nature as to both type and condition. EBA does not warrant conditions represented herein as exact, but infers accuracy only to the extent that is common in practice.

Where subsurface conditions encountered during development are different from those described in this report, qualified geotechnical personnel should revisit the site and review recommendations in light of the actual conditions encountered.

5.0 LOGS OF TESTHOLES

The testhole logs are a compilation of conditions and classification of soils and rocks as obtained from field observations and laboratory testing of selected samples. Soil and rock zones have been interpreted. Change from one geological zone to the other, indicated on the logs as a distinct line, can be, in fact, transitional. The extent of transition is interpretive. Any circumstance which requires precise definition of soil or rock zone transition elevations may require further investigation and review.

6.0 STRATIGRAPHIC AND GEOLOGICAL INFORMATION

The stratigraphic and geological information indicated on drawings contained in this report are inferred from logs of test holes and/or soil/rock exposures. Stratigraphy is known only at the locations of the test hole or exposure. Actual geology and stratigraphy between test holes and/or exposures may vary from that shown on these drawings. Natural variations in geological conditions are inherent and are a function of the historic environment. EBA does not represent the conditions illustrated as exact but recognizes that variations will exist. Where knowledge of more precise locations of geological units is necessary, additional investigation and review may be necessary.

7.0 SURFACE WATER AND GROUNDWATER CONDITIONS

Surface and groundwater conditions mentioned in this report are those observed at the times recorded in the report. These conditions vary with geological detail between observation sites; annual, seasonal and special meteorologic conditions; and with development activity. Interpretation of water conditions from observations and records is judgemental and constitutes an evaluation of circumstances as influenced by geology, meteorology and development activity. Deviations from these observations may occur during the course of development activities.

8.0 PROTECTION OF EXPOSED GROUND

Excavation and construction operations expose geological materials to climatic elements (freeze/thaw, wet/dry) and/or mechanical disturbance which can cause severe deterioration. Unless otherwise specifically indicated in this report, the walls and floors of excavations must be protected from the elements, particularly moisture, desiccation, frost action and construction traffic.

9.0 SUPPORT OF ADJACENT GROUND AND STRUCTURES

Unless otherwise specifically advised, support of ground and structures adjacent to the anticipated construction and preservation of adjacent ground and structures from the adverse impact of construction activity is required.

10.0 INFLUENCE OF CONSTRUCTION ACTIVITY

There is a direct correlation between construction activity and structural performance of adjacent buildings and other installations. The influence of all anticipated construction activities should be considered by the contractor, owner, architect and prime engineer in consultation with a geotechnical engineer when the final design and construction techniques are known.

11.0 OBSERVATIONS DURING CONSTRUCTION

Because of the nature of geological deposits, the judgmental nature of geotechnical engineering, as well as the potential of adverse circumstances arising from construction activity, observations during site preparation, excavation and construction should be carried out by a geotechnical engineer. These observations may then serve as the basis for confirmation and/or alteration of geotechnical recommendations or design guidelines presented herein.

12.0 DRAINAGE SYSTEMS

Where temporary or permanent drainage systems are installed within or around a structure, the systems which will be installed must protect the structure from loss of ground due to internal erosion and must be designed so as to assure continued performance of the drains. Specific design detail of such systems should be developed or reviewed by the geotechnical engineer. Unless otherwise specified, it is a condition of this report that effective temporary and permanent drainage systems are required and that they must be considered in relation to project purpose and function.

13.0 BEARING CAPACITY

Design bearing capacities, loads and allowable stresses quoted in this report relate to a specific soil or rock type and condition. Construction activity and environmental circumstances can materially change the condition of soil or rock. The elevation at which a soil or rock type occurs is variable. It is a requirement of this report that structural elements be founded in and/or upon geological materials of the type and in the condition assumed. Sufficient observations should be made by qualified geotechnical personnel during construction to assure that the soil and/or rock conditions assumed in this report in fact exist at the site.

14.0 SAMPLES

EBA will retain all soil and rock samples for 30 days after this report is issued. Further storage or transfer of samples can be made at the Client's expense upon written request, otherwise samples will be discarded.

LEGEND:

⊕ – BOREHOLE LOCATION

0 50
Scale: 1: 1 500 (metres)

CLIENT

ALEXCO

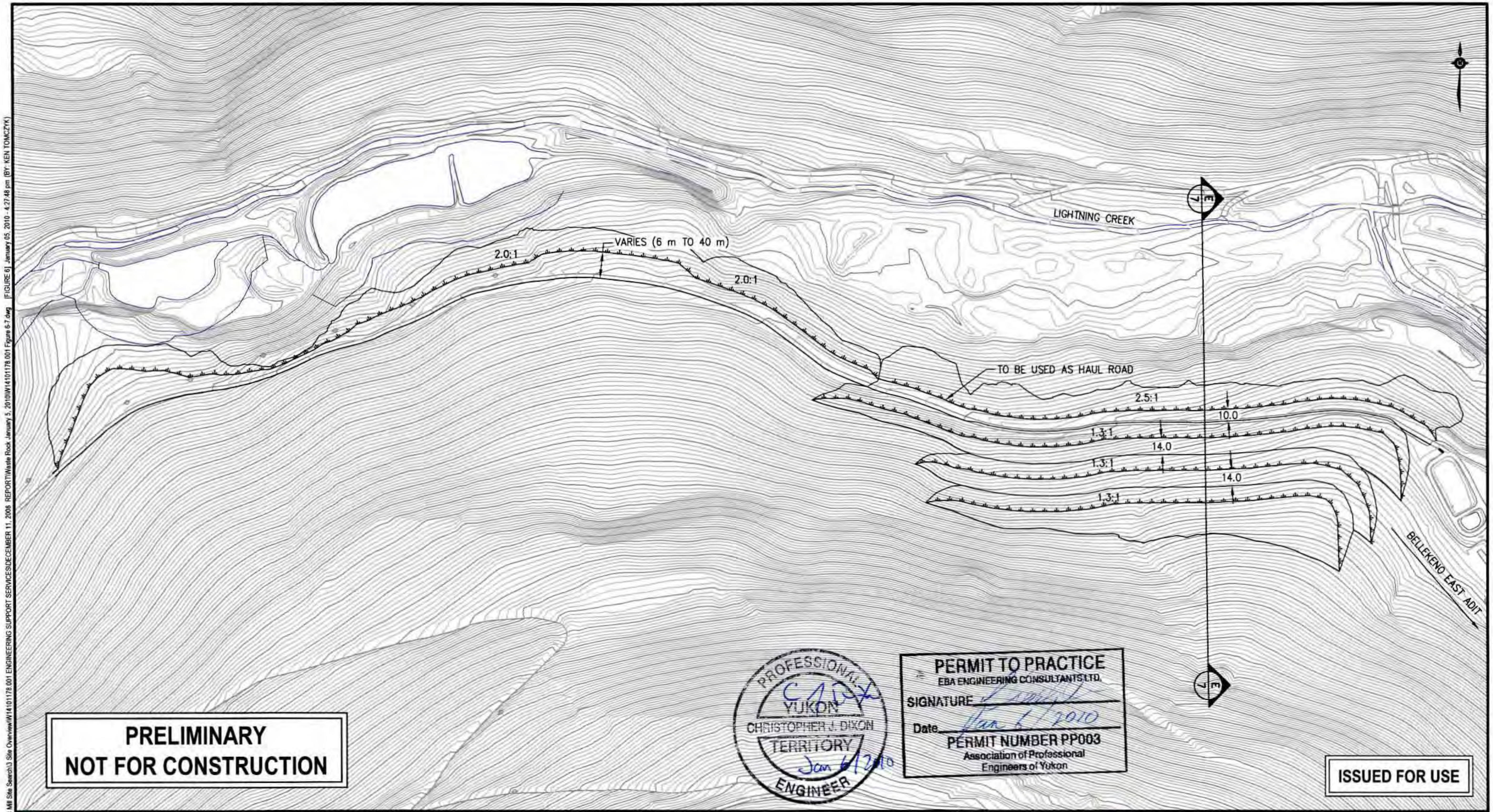
EBA Engineering Consultants Ltd.

GEOTECHNICAL EVALUATION - POTENTIAL MILL SITES
BELLEKENO PROJECT, YUKON

BELLEKENO BOREHOLE LOCATION PLAN

PROJECT NO.	DWN	CKD	REV	
W14101178	KJT	JTP	0	**Figure 4**
OFFICE	DATE			
EBA-WHSE	DECEMBER 4, 2008			

G:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178 GEOTECHNICAL EVALUATION\W14101178 Figure 1,2,3,4.dwg [FIGURE 4] December 08, 2008 - 5:20:26 pm (BY: KEN TOMCZYK)



PRELIMINARY
NOT FOR CONSTRUCTION

CHRISTOPHER J. DIXON
Jan 6/2010

PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date Jan 6/2010
PERMIT NUMBER PP003
Association of Professional Engineers of Yukon

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WASTE ROCK VOLUME = 200,000 m³

NOTE:
BASE PLAN PROVIDED BY
ALEXCO RESOURCE CANADA CORP.

0 100
Scale: 1: 3,000 (metres)

THIS DRAWING IS TO BE READ ONLY IN CONJUNCTION WITH REPORT "CONCEPTUAL TAILINGS AND WASTE ROCK MANAGEMENT PLANS - BELLEKENO PROJECT NEAR KENO CITY, YUKON" DATED DECEMBER 12, 2008

CLIENT
ALEXCO

EBA Engineering Consultants Ltd.

ENGINEERING SUPPORT SERVICES
BELLEKENO MINE PROJECT, YUKON

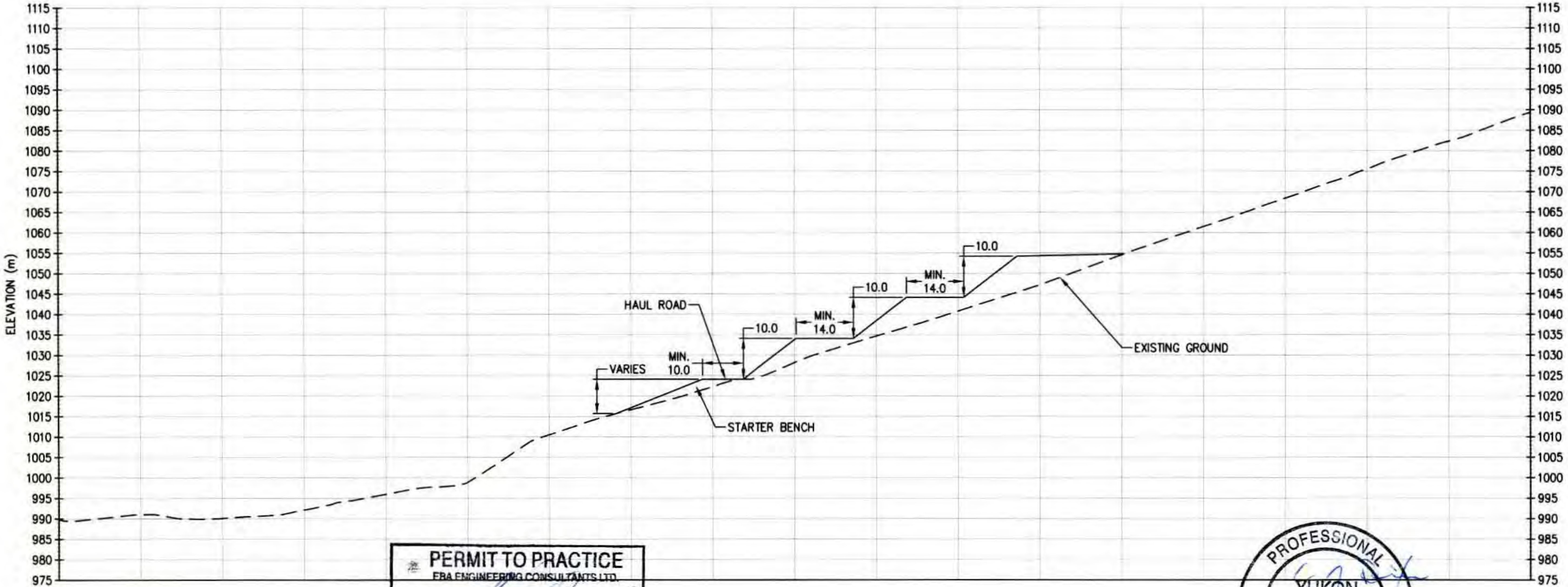
WASTE ROCK DISPOSAL AREA
PLAN

PROJECT NO	DWN	CKD	REV
W14101178.001	KJT	CJD	2
OFFICE EBA-WHSE	DATE January 5, 2010		

Figure 6

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.001 ENGINEERING SUPPORT SERVICES\DECEMBER 11, 2008 REPORT\Waste Rock January 5, 2010\W14101178.001 Figure 6-7.dwg [FIGURE 6] January 05, 2010 - 4:27:48 pm (BY: KEN TOMCZYK)

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.001 ENGINEERING SUPPORT SERVICES\DECEMBER 11, 2008 REPORT\Waste Rock January 5, 2010\W14101178.001 Figure 6-7.dwg [FIGURE 7] January 05, 2010 - 4:28:48 pm (BY: KEN TOMCZYK)



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NOT FOR CONSTRUCTION

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SIGNATURE
Date Jan 6 /2010
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

E/6 WASTE ROCK PILE PROFILE
SCALE 1:1,000

0 50
Scale: 1: 1,000 (metres)

CHRISTOPHER J. DIXON
Jan 6 2010

ISSUED FOR USE

NOTE
1. ALL UNITS IN METRES UNLESS OTHERWISE NOTED
2. BASE PLAN PROVIDED BY ALEXCO RESOURCE CANADA CORP.

THIS DRAWING IS TO BE READ ONLY IN CONJUNCTION WITH REPORT "CONCEPTUAL TAILINGS AND WASTE ROCK MANAGEMENT PLANS - BELLEKENO PROJECT NEAR KENO CITY, YUKON" DATED DECEMBER 12, 2008

CLIENT
ALEXCO

EBA Engineering
Consultants Ltd.

ENGINEERING SUPPORT SERVICES
BELLEKENO MINE PROJECT, YUKON

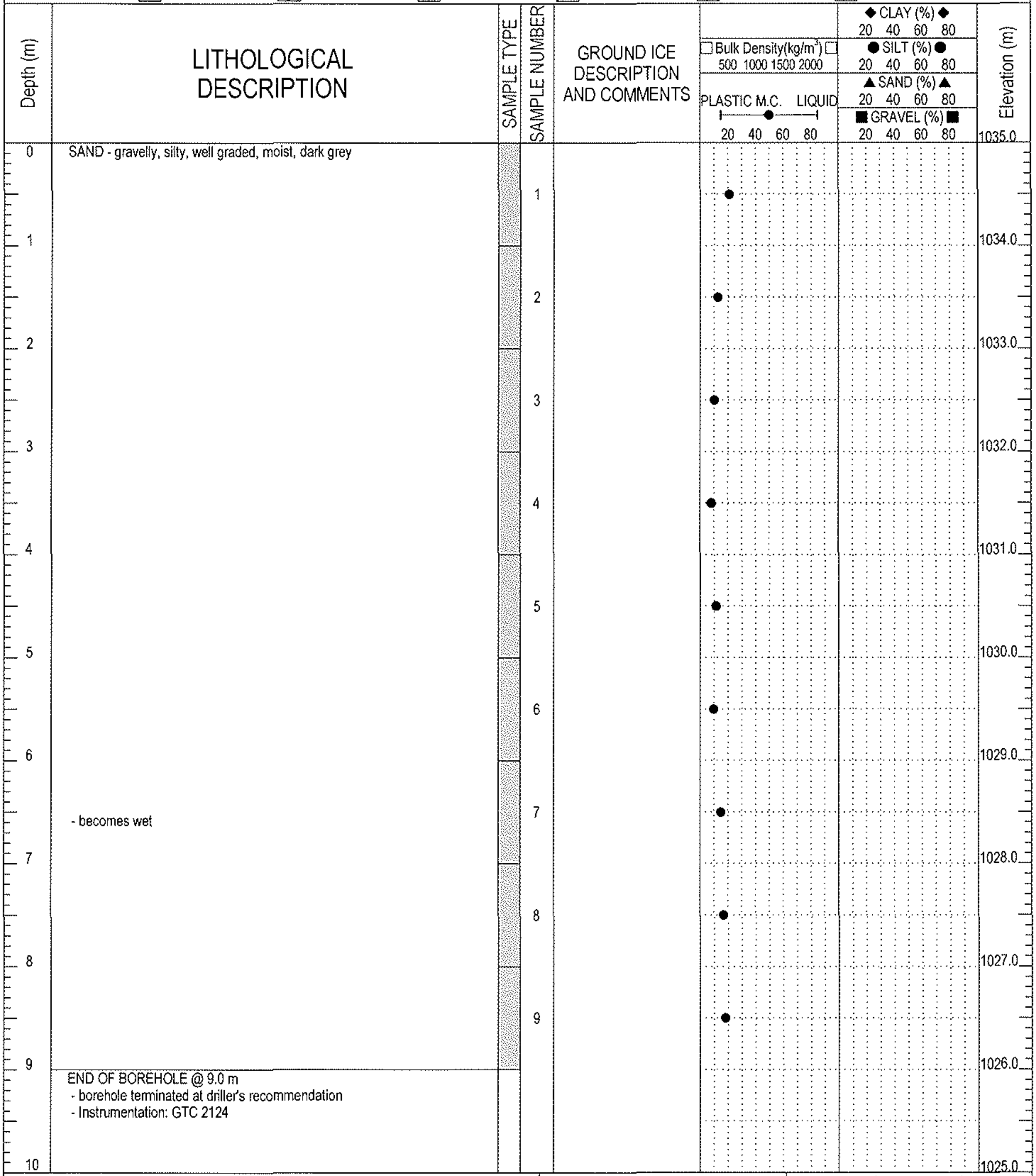
WASTE ROCK DISPOSAL AREA
PROFILE

PROJECT NO	DWN	CKD	REV	
W14101178.001	KJT	CJD	2	**Figure 7**
OFFICE	DATE			
EBA-WHSE	January 5, 2010			

Geotechnical Evaluation-Potential Mill Sites	Client: Alexco Resource Canada Corp.	BOREHOLE NO: W14101178-BH11
Bellekeno	Drill Type: 345 Hydraulic Reed Drill (air rotary)	PROJECT NO: W14101178
Keno City, YT	7087115N; 487269E; Zone 8	ELEVATION: 1035m

SAMPLE TYPE ▨ GRAB SAMPLE ◪ NO RECOVERY ☒ BULK ☰ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND



SAND - gravelly, silty, well graded, moist, dark grey

- becomes wet

END OF BOREHOLE @ 9.0 m
- borehole terminated at driller's recommendation
- Instrumentation: GTC 2124

EBA Engineering Consultants Ltd.	LOGGED BY: JTP	COMPLETION DEPTH: 9m
	REVIEWED BY: CJD	COMPLETE: 10/30/2008
	DRAWING NO: Figure 4	Page 1 of 1

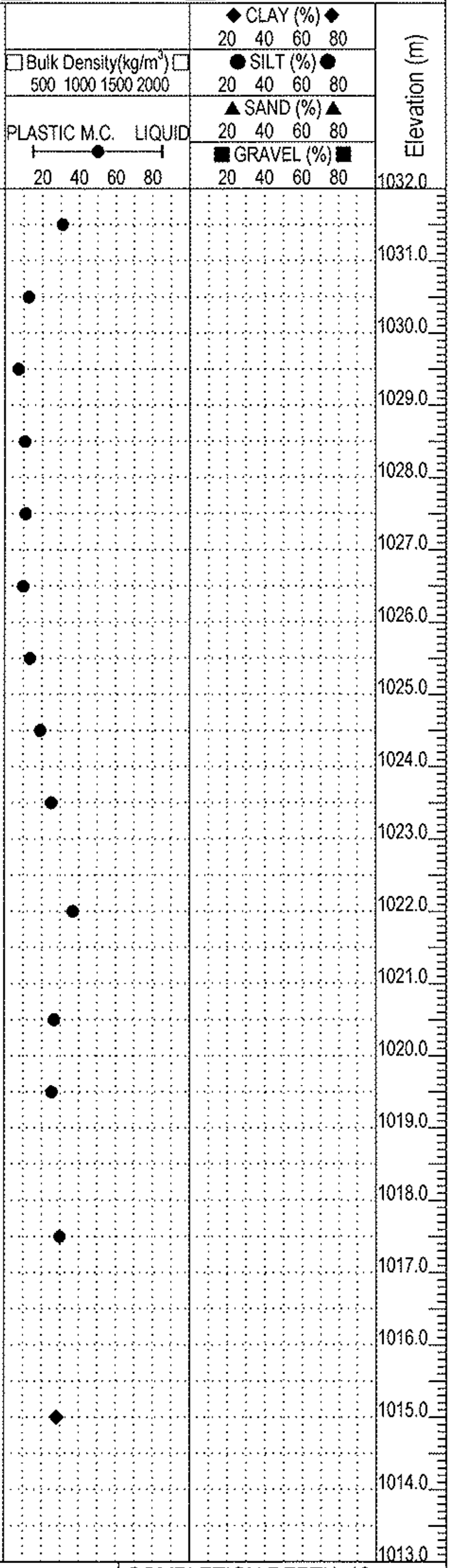
MGP W14101178.GPJ EBA.GDT 08/12/08

Geotechnical Evaluation-Potential Mill Sites	Client: Alexco Resource Canada Corp.	BOREHOLE NO: W14101178-BH12
Bellekeno	Drill Type: 345 Hydraulic Reed Drill (air rotary)	PROJECT NO: W14101178
Keno City, YT	7087131N; 487262E; Zone 8	ELEVATION: 1032m

SAMPLE TYPE ▨ GRAB SAMPLE ◪ NO RECOVERY ☒ BULK ▤ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS
0	SAND - some silt, trace gravel, wet, dark grey, organic inclusions	▨	1	
1	SAND - silty, damp, dark grey	▨	2	
		▨	3	
		▨	4	
		▨	5	
		▨	6	
	- becomes moist	▨	7	
		▨	8	
	- becomes wet	▨	9	
		▨	10	
		▨	11	
		▨	12	
		▨	13	
		▨	14	
18	END OF BOREHOLE @ 18 m - borehole terminated at driller's recommendation			



EBA Engineering Consultants Ltd.	LOGGED BY: JTP	COMPLETION DEPTH: 18m
	REVIEWED BY: CJD	COMPLETE: 10/30/2008
	DRAWING NO: Figure 4	Page 1 of 1

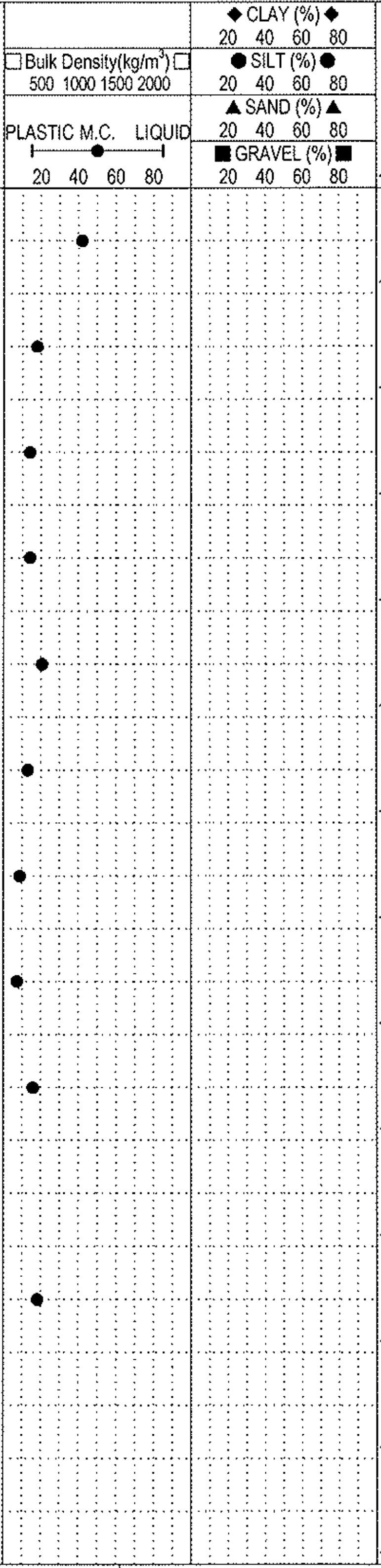
MGP W14101178.GPJ EBA.GDT 08/12/08

Geotechnical Evaluation-Potential Mill Sites	Client: Alexco Resource Canada Corp.	BOREHOLE NO: W14101178-BH13
Bellekeno	Drill Type: 345 Hydraulic Reed Drill (air rotary)	PROJECT NO: W14101178
Keno City, YT	7087134N; 487153E; Zone 8	ELEVATION: 1028m

SAMPLE TYPE ▨ GRAB SAMPLE ◪ NO RECOVERY ☒ BULK ▤ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	Elevation (m)
0	SAND - some gravel, trace silt, wet, dark grey, organic inclusions	▨			1028.0
			1		
1	SAND - silty, trace gravel, moist, dark grey	▨			1027.0
			2		
2		▨			1026.0
			3		
3		▨			1025.0
			4		
4		▨			1024.0
			5		
5		▨			1023.0
			6		
6		▨			1022.0
			7		
7		▨			1021.0
			8		
8		▨			1020.0
	- becomes wet		9		
9		▨			1019.0
10					1018.0
			10		
11					1017.0
12	END OF BOREHOLE @ 12 m - borehole terminated at driller's recommendation				1016.0
13					1015.0



LOGGED BY: JTP	COMPLETION DEPTH: 12m
REVIEWED BY: CJD	COMPLETE: 10/30/2008
DRAWING NO: Figure 4	Page 1 of 1

EBA Engineering Consultants Ltd.

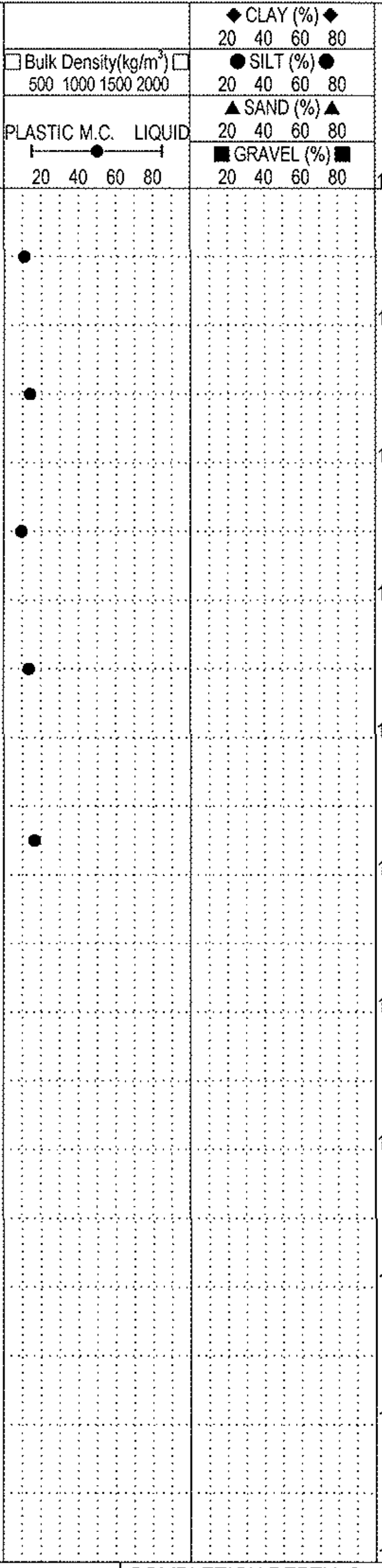
MGP W14101178.GPJ EBA.GDT 08/12/08

Geotechnical Evaluation-Potential Mill Sites	Client: Alexco Resource Canada Corp.	BOREHOLE NO: W14101178-BH14
Bellekeno	Drill Type: 345 Hydraulic Reed Drill (air rotary)	PROJECT NO: W14101178
Keno City, YT	7087135N; 487041E; Zone 8	ELEVATION: 1020m

SAMPLE TYPE ▨ GRAB SAMPLE ◪ NO RECOVERY ☒ BULK ☰ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▨ BENTONITE ⁘ PEA GRAVEL ▥ SLOUGH ⁘ GROUT ▧ DRILL CUTTINGS ⁘ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	Elevation (m)
0	SAND - some gravel, trace silt, moist, black, organic inclusions	▨	1		1020.0
1	SAND - silty, moist, dark grey	▨	2		1019.0
2		▨	3		1018.0
3		▨	4		1017.0
4		▨	5		1016.0
5	- becomes wet				1015.0
6	END OF BOREHOLE @ 6.0 m - borehole terminated at driller's recommendation				1014.0
7					1013.0
8					1012.0
9					1011.0
10					1010.0



EBA Engineering Consultants Ltd.	LOGGED BY: JTP	COMPLETION DEPTH: 6m
	REVIEWED BY: CJD	COMPLETE: 10/30/2008
	DRAWING NO: Figure 4	Page 1 of 1

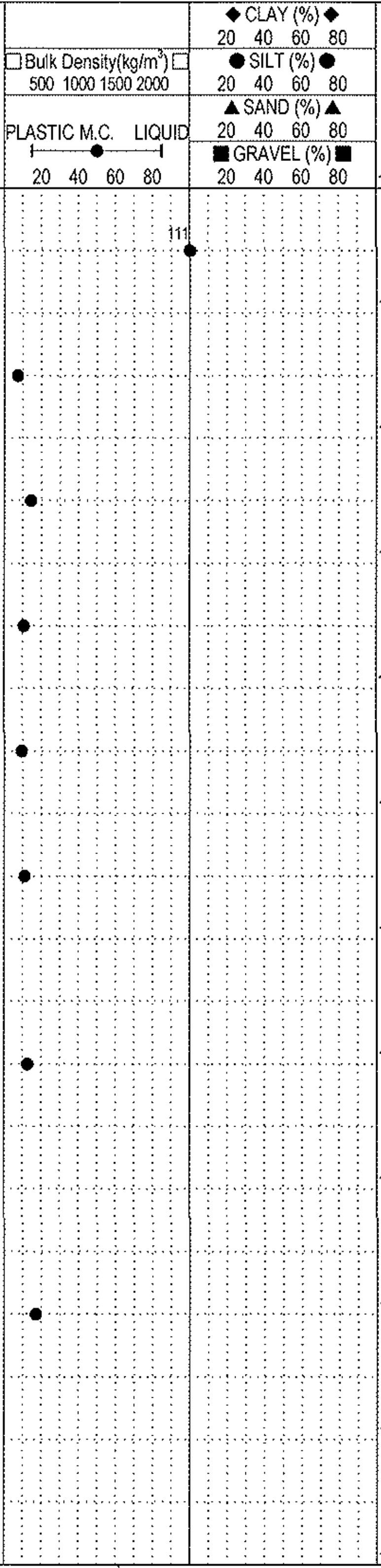
MGP W14101178.GPJ EBA.GDT 08/12/08

Geotechnical Evaluation-Potential Mill Sites	Client: Alexco Resource Canada Corp.	BOREHOLE NO: W14101178-BH15
Bellekeno	Drill Type: 345 Hydraulic Reed Drill (air rotary)	PROJECT NO: W14101178
Keno City, YT	7087139N; 487204E; Zone 8	ELEVATION: 1031m

SAMPLE TYPE ▨ GRAB SAMPLE ▨ NO RECOVERY ☒ BULK ▤ CRREL CORE ▥ SHELBY TUBE ▮ GRAB CORE

BACKFILL TYPE ▨ BENTONITE ▨ PEA GRAVEL ▥ SLOUGH ▨ GROUT ▧ DRILL CUTTINGS ▨ SAND

Depth (m)	LITHOLOGICAL DESCRIPTION	SAMPLE TYPE	SAMPLE NUMBER	GROUND ICE DESCRIPTION AND COMMENTS	Elevation (m)
0	ORGANICS	▨	1		1031.0
1	SAND - some silt, trace gravel, moist, dark grey	▨	2		1030.0
2		▨	3		1029.0
3	- becomes silty	▨	4		1028.0
4		▨	5		1027.0
5		▨	6		1026.0
6					1025.0
7		▨	7		1024.0
8	- becomes wet				1023.0
9		▨	8		1022.0
10	END OF BOREHOLE @ 10 m - borehole terminated at driller's recommendation				1021.0
11					1020.0



LOGGED BY: JTP	COMPLETION DEPTH: 10m
REVIEWED BY: CJD	COMPLETE: 10/30/2008
DRAWING NO: Figure 4	Page 1 of 1

EBA Engineering Consultants Ltd.

MGP W14101178.GPJ EBA.GDT 08/12/08

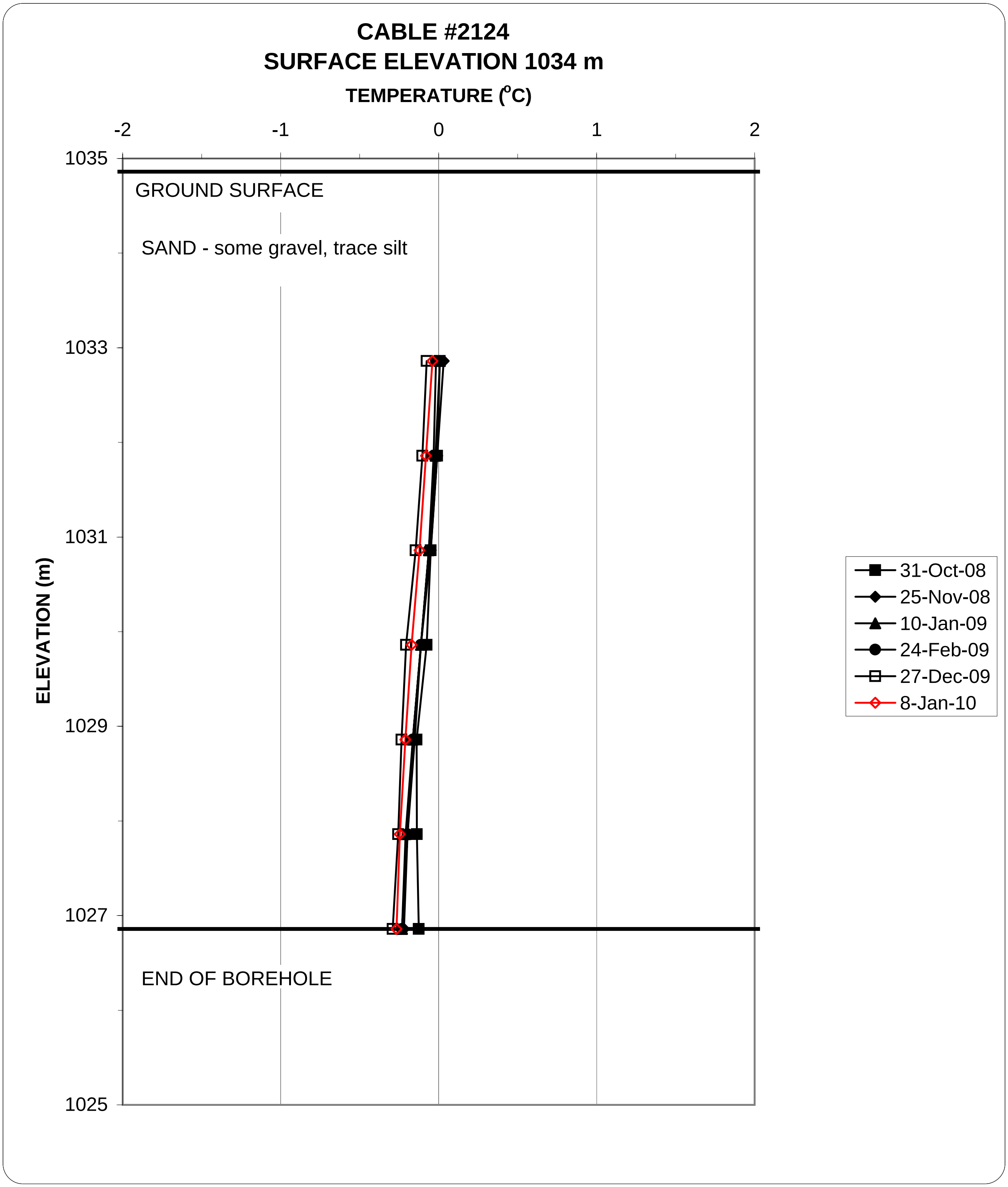


Figure 5
Ground Temperature Profile
Proposed Keno Mill Sites
Borehole #11 - BelleKeno

Alexco Resource Canada Corp.

TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT
CONSTRUCTION SPECIFICATIONS
ISSUED FOR USE

W14101142

July 2008

EBA Engineering Consultants Ltd.
p. 867.668.3068 • f. 867.668.4349
Calcite Business Centre • Unit 6, 151 Industrial Road • Whitehorse, Yukon Y1A 2V3 • CANADA

TABLE OF CONTENTS

APPENDICES

Section 1001

DEFINITIONS

DEFINITIONS

1.0 General

.1 Definitions of terms used throughout the Construction Specifications are presented in this Section.

2.0 Definitions

Construction Drawings:	the drawings, as issued for construction, of the Typical Waste Containment Facility Design.
Construction Specifications:	this document.
Contract:	the legal and binding agreement between the Contractor and Alexco Resource Corp. regarding construction of the Waste Containment Facility.
Contractor:	the general contractor responsible for constructing the Waste Containment Facility.
Engineer:	the Professional Geotechnical Engineer registered in the Yukon who is associated with the construction process.
Owner:	Alexco Resource Corp.
Site:	the area in which construction of the Waste Containment Facility or related activity is occurring.
Unsuitable:	not meeting the requirements stated herein or not receiving the Engineer's approval.
Facility:	all components of the Waste Containment Facility.

END OF SECTION

Section 1002

GENERAL

GENERAL

1.0 General

.1 Alexco Resource Canada Corp. intends to construct a containment facility to store waste rock from the Bellekeno advanced underground exploration and development program. As the company advances through the Keno Hill Silver District, it is anticipated further underground exploration and development programs will require similar containment facilities. Therefore, a typical design has been developed to account for the various potential site and construction material conditions.

.2 The Facility is to be located within previously disturbed areas, all of which will be incorporated within a district wide closure plan. This district wide closure plan is required under the water license QZ06-074.

.3 Site specific conditions and Facility location have not been provided or considered. Once Facility location and site specific conditions are known, they must be reviewed by the Engineer. Furthermore, the base of the Facility must be approved by the Engineer prior to fill placement.

.4 The Facility will be lined with a suitable geomembrane. Water in the Facility will flow towards the vertical culvert and pond within the voids of the waste material.

.5 Water in the Facility will be monitored and tested on a regular basis. Based on water quality analysis, the waste water will be extracted via pump truck and discharged to the environment or treated in a designated treatment facility.

.6 Once the Facility reaches its ultimate capacity, the Facility will be capped and reclaimed.

2.0 Scope of Work

.1 The scope of work for the construction of the Facility is as follows:

a. Construct the liner subgrade and berms with Zone B material at the specified grade. This could include cut/fill operations should the foundation material be satisfactory;

b. If required, install a geotextile layer to act as separator for Zone A and Zone B materials;

c. Construct the liner bedding with Zone A material;

d. Install the liner system consisting of a suitable liner material and if required, protective geotextile layers above and below the liner, and a geocomposite reinforcing layer;

e. Place and compact cover material, Zone A material, over the liner system;

f. Install vertical culvert as specified on the Construction Drawings;

g. Place and compact the waste material;

h. Regrade the waste material and place and compact capping material;

i. Install vegetative cover.

END OF SECTION

Section 1003

FILL MATERIALS

FILL MATERIALS

1.0 General

.1 This section describes the construction material specifications for the Waste Containment Facility.

2.0 Reference Standards

.1 The most recent copy of American Society for Testing Materials, ASTM C136, Standard Test Method for Sieve Analysis of Fine and Coarse Aggregate.

3.0 Material Sources

.1 No material of any type shall be borrowed or excavated without the Owner's prior approval.

.2 Pits and quarries shall be maintained and managed in accordance with the requirements set out in the Owner's Land Use and Quarry Permits.

.3 Zone A material shall be obtained from sources approved by the Owner, provided the final product meets the requirements specified herein. Processing may be required to achieve the specified gradation.

.4 Zone B material shall be obtained from sources approved by the Owner, provided the final product meets the requirements specified herein. Processing may be required to achieve the specified gradation.

.5 The parent rock from which all fill materials are derived shall consist of sound, hard, durable material free from soft, thin, elongated or laminated particles and shall contain no unsuitable substances. The potential quarry source shall be approved by the Engineer.

.6 The quarry source for the Facility fill materials shall be inspected by the Engineer throughout material processing to ensure the product meets the requirements stated herein.

4.0 Material Specifications

.1 Zone A Material

The Zone A material shall consist of hard, durable particles, shall be free of roots, topsoil, and deleterious material and shall have a particle size distribution, as measured by ASTM C136, as presented in Table 1003.1.

TABLE 1003.1: ZONE A MATERIAL (10 MM MINUS) - PARTICLE SIZE DISTRIBUTION LIMITS

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
10	100	100
5	80	100
2	55	100
0.63	25	65
0.25	10	40
0.08	2	15

.2 Zone B Material

The Zone B material shall be free of roots, topsoil and other deleterious material and shall have a particle size distribution within the limits presented in Table 1003.2.

TABLE 1003.2: ZONE B MATERIAL (200 MM MINUS) - PARTICLE SIZE DISTRIBUTION LIMITS

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
200	100	100
100	85	100
50	65	100
25	40	100
5	20	55
2	0	20

END OF SECTION

Section 1004

FILL PLACEMENT

FILL PLACEMENT

1.0 General

.1 The fill placement methods to be used during construction of the Waste Containment Facility are described in this Section.

.2 Construction shall be performed in accordance with the best modern practice and with equipment best adapted to the work being performed. Embankment materials shall be placed so that each zone is homogeneous; free of stratifications; ice chunks, lenses or pockets; and layers of material with different texture grading not conforming to the requirements stated herein.

.3 No fill material shall be placed on any part of the foundation until it has been prepared, as specified herein. Placement of fill material shall conform to the lines, grades and elevations shown on the Construction Drawings.

.4 Embankment construction shall not proceed when the work cannot be performed in accordance with the requirements of the Construction Specifications. Any part of the embankment that has been damaged by the action of rain, snow or any other cause shall be removed and replaced with the appropriate material conforming to the requirements stated herein.

.5 Stockpiling, loading, transporting, placing, and spreading of all materials shall be carried out in such a manner to avoid segregation. Segregated materials shall be removed and replaced with the materials meeting the requirements stated herein.

.6 The Contractor shall remove all debris, vegetation or any other material not conforming to the requirements stated herein. The Contractor shall dispose of these materials in an area approved by the Owner.

2.0 Zone B Material Placement

.1 The Zone B material shall be placed to the design elevation as specified in the Construction Drawings in lifts no greater than 500 mm in uncompacted thickness.

.2 The design elevation for the top of the Zone B berm material shall be no less than 0.5 m above original ground.

.3 Moisture condition and compact using the minimum number of passes established in accordance with section 1006.4.2.

3.0 Zone A Material Placement

.1 The Zone A material shall be placed as bedding for the liner system (minimum 300 mm thick) to the design grade specified in the Construction Drawings.

.2 Subsequent to the liner installation, the Zone A material shall be placed as liner system cover material. The liner system cover material shall be placed to the minimum thickness specified in Table 1004.1 dependent on the type of liner selected.

TABLE 1004.1: RECOMMENDED MINIMUM COVER THICKNESSES

Liner Material	Minimum Required Thickness
Enviro Liner® 4040 (Without Geocomposite)	1.3 m
Enviro Liner® 4040 (With Geocomposite)	0.3 m
HDPE 60	0.3 m
PVC 40 (With Geocomposite)	0.3 m

.3 The Construction Drawings are based on the selection of Enviro Liner® 4040 with the installation of a geocomposite reinforcing material. Other design alternatives are detailed in Section 1007.

.4 Zone A material shall be placed in lifts not exceeding 300 mm in uncompacted thickness. Vehicle traffic is prohibited from maneuvering within the Facility until the cover material has reached the minimum thickness required as specified in Table 1004.1.

.5 Moisture condition and compact with using the minimum number of passes established in accordance with section 1006.4.1.

.6 Equipment with ground pressures higher than 380 kPa should not be permitted inside the Facility once the liner system has been placed. Care is required to provide the appropriate thickness of fill beneath a vehicle when placing material above the liner system to ensure it is not damaged. Traffic in the area should be restricted to low ground pressure equipment.

END OF SECTION

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Section 1005

LINER SYSTEM

LINER SYSTEM

1.0 General

.1 The product and installation specifications for the non-woven geotextile, liner systems and geocomposite materials to be used in the Waste Containment Facility are presented in this section.

.2 The liner system will be provided by the Owner and installed by the Contractor.

2.0 Reference Standards

.1 The most recent copy of the following American Society for Testing Materials standards:

a.	ASTM D638	Standard Methods for Tensile Properties of Plastics.
b.	ASTM D792	Standard Test Methods for Density and Specific Gravity (Relative Density) of Plastics by Displacement.
c.	ASTM D1004	Standard Test Methods for Initial Tear Resistance of Plastic Film and Sheeting.
d.	ASTM D1603	Standard Test Methods for Carbon Black in Olefin Plastics.
e.	ASTM D1777	Standard Test Methods for Thickness of Textile Materials.
f.	ASTM D4533	Standard Test Methods for Trapezoidal Tearing Strength of Geotextiles.
g.	ASTM D4632	Standard Test Methods for Grab Breaking Load and Elongation of Geotextile.
h.	ASTM D4751	Standard Test Methods for Determining Apparent Opening Size of a Geotextile.

i.	ASTM D4833	Standard Test Methods for Index Puncture Resistance for Geotextile, Geomembranes, and Related Products.
j.	ASTM D5199	Standard Test Methods for Measuring the Nominal Thickness of Geosynthetics.
k.	ASTM D5261	Standard Test Methods for Measuring Mass per Unit Area of Geotextiles.
l.	ASTM D5994	Standard Test Methods for Measuring Core Thickness of textured Geomembranes

.2 Federal Test Method

a. FTM Standard 101.

3.0 Materials

.1 Geotextile

a. The non-woven geotextile shall have a weight of 542 g/m^2. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.1.

TABLE 1005.1: RECOMMENDED MINIMUM GEOTEXTILE PROPERTIES

Physical Property	Minimum Average Roll Value (Weakest Principle Direction)
Thickness – Typical (ASTM D5199)	3.6 mm
Grab Tensile Strength (ASTM D4632)	1690 N
Elongation at Failure (ASTM D4632)	50 %
Trapezoidal Tear Strength (ASTM D4533)	645 N
Puncture (ASTM D4833)	1070 N
Apparent Opening Size (ASTM D4751)	150 microns
Weight – Typical (ASTM D5261)	542 g/m^2

b. Any visible damage to the shipment of geotextile shall be noted on the freight receipt and project records.

c. Storage of geotextile rolls on site shall be in a secure location that will minimize exposure to the elements, UV light and physical damage.

.2 Enviro Liner® 4040

a. The Enviro Liner® shall be 1.0 mm (40 mil) thick geomembrane or equivalent. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.2.

TABLE 1005.2: RECOMMENDED MINIMUM GEOMEMBRANE PROPERTIES

Property	Enviro Liner® 4040
Minimum Average Thickness (ASTM D5994)	1.0 mm
Relative Density (ASTM D792)	0.939
Tensile Strength at Yield (ASTM D638)	26.6 N/mm
Elongation at Yield (ASTM D638)	800 %
Tear Resistance (ASTM D1004)	98 N
Puncture Resistance (FTMS 101)	271 N
Carbon Black Content (ASTM D1603)	2.0 – 3.0 %

b. The liner material supplied under the specifications shall not have any blisters, holes, undispersed raw materials or any signs of contamination or inclusions of foreign matter. Such defects shall be repaired using techniques in accordance with manufacturer's recommendations. Excessive defects may be grounds for rejecting the entire roll of liner.

c. Storage of geomembrane rolls on site shall be in a secure location that will minimize exposure to the elements and physical damage.

d. Enviro Liner® geomembrane is suitable for secondary containment of hydrocarbons and other chemicals, and primary containment of water and water based effluents or as approved by manufacturer.

.3 HDPE Liner

a. The HDPE geomembrane shall be 1.5 mm (60 mil) thick geomembrane or equivalent. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.3.

TABLE 1005.3: RECOMMENDED MINIMUM GEOMEMBRANE PROPERTIES

Property	Textured HDPE 60
Minimum Average Thickness (ASTM D5994)	1.5 mm
Relative Density (ASTM D792)	0.94
Tensile Strength at Yield (ASTM D638)	22.0 kN/m
Elongation at Yield (ASTM D638)	12 %
Tear Resistance (ASTM D1004)	187 N
Puncture Resistance (FTMS 101)	480 N
Carbon Black Content (ASTM D1603)	2.0 – 3.0 %

b. The liner material supplied under the specifications shall not have any blisters, holes, undispersed raw materials or any signs of contamination or inclusions of foreign matter. Such defects shall be repaired using welding techniques in accordance with manufacturer's recommendations. Excessive defects may be grounds for rejecting the entire roll of liner.

c. Extrusion resin used for extrusion joining of sheets and for repairs should be HDPE from the same resin batch as the sheet resin. Physical properties must be the same as the liner sheets.

d. HDPE liner is suitable for containment of hydrocarbons and chemicals as well as water and water based effluents or as approved by manufacturer.

e. Storage of geomembrane rolls on site shall be in a secure location that will minimize exposure to the elements and physical damage.

.4 PVC Liner

a. The PVC geomembrane shall be 0.95 mm (38 mil) thick geomembrane or equivalent. The manufacturer shall, prior to shipment of materials, provide to the

Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.4.

TABLE 1005.4: RECOMMENDED MINIMUM GEOMEMBRANE PROPERTIES

Property	PVC 40
Minimum Average Thickness (ASTM D5994)	0.95 mm
Tensile Strength at Yield (ASTM D638)	17 N/mm
Elongation at Yield (ASTM D638)	430 %
Tear Resistance (ASTM D1004)	44 N

b. The liner material supplied under the specifications shall not have any blisters, holes, undispersed raw materials or any signs of contamination or inclusions of foreign matter. Such defects shall be repaired using techniques in accordance with manufacturer's recommendations. Excessive defects may be grounds for rejecting the entire roll of liner.

c. PVC liner is suitable for containment of water and water based effluents or as approved by manufacturer. It is not suitable for containment of hydrocarbons.

d. Storage of geomembrane rolls on site shall be in a secure location that will minimize exposure to the elements, UV light and physical damage.

.5 Geocomposite

a. The geocomposite reinforcing material shall be 5 mm (200 mil) thick or equivalent. The manufacturer shall, prior to shipment of materials, provide to the Engineer a signed manufacturing certification that materials to be shipped to site have test values that meet or exceed the requirements listed in Table 1005.5.

TABLE 1005.5: RECOMMENDED MINIMUM GEOCOMPOSITE PROPERTIES

Property	Geo-Comp 5
Minimum Average Thickness (ASTM D5994)	5 mm
Relative Density (ASTM D792)	0.94
Tensile Strength at Yield (ASTM D638)	79 N/cm
Puncture Resistance (FTMS 101)	489 N
Carbon Black Content (ASTM D1603)	2.0 %

b. The geocomposite material supplied under the specifications shall not have defects or any signs of contamination or inclusions of foreign matter. Excessive defects may be grounds for rejecting the entire roll of geocomposite.

4.0 Installation - Enviro Liner® 4040 Design (with Geocomposite)

.1 The liner system consists of the following layers (starting from the top layer):

- Geo-Comp 5 or equivalent geocomposite
- Enviroliner 4040 or equivalent geomembrane

.2 The liner should line the entire surface of the Facility, which includes the crest of the berms, inside slopes, and floor. The geocomposite material is only required on the floor and approach berm of the Facility.

.3 The Contractor shall ensure that the integrity of the liner system and its components are not compromised during construction. Precautions the Contractor may take to avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

.4 Any damage to the liner system and/or its components shall be repaired as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.5 The liner system shall be anchored at the top of the berm so that movement downslope does not occur during backfilling at any stage of construction.

.6 The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system. Care shall be taken to avoid making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall not be permitted.

Enviro Liner® Installation

.7 The Enviro Liner® should be deployed subsequent to the placement of Zone A bedding material.

.8 The Engineer should walk the liner to observe for any defects caused by on-site equipment and tools. Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause should be replaced or repaired with an additional piece of Enviro Liner® installed as per the manufacturer's specifications over the defective area. All patches should have rounded edges and extend a minimum of 150 mm beyond the affected area.

.9 Low ground pressure equipment should be used to deploy the liner material. No equipment shall be allowed on the liner.

Geocomposite Reinforcing Installation

.10 The geocomposite material should be deployed subsequent to the placement of the Liner.

.11 No equipment is permitted on the liner material during the placing of the geocomposite reinforcing material. The geocomposite reinforcing material must rolled out by hand and the cover material placed in accordance with Section 1004.

Material Quantities

.12 Estimated material quantities required for the lined pad are listed in Table 1005.6

TABLE 1005.6: MATERIAL QUANTITY ESTIMATES

Material	Total Area (m^2)
Enviro Liner® 4040	1900
Geo-Comp 5	905

5.0 Installation - HDPE 60 Design

.1 The liner system consists of the following layers (starting from the top layer):

- HDPE 60 mil or equivalent geomembrane

.2 The liner should line the entire surface of the Facility, which includes the crest of the berms, inside slopes, and floor.

.3 The Contractor shall ensure that the integrity of the liner system and its components are not compromised during construction. Precautions the Contractor may take to avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

.4 Any damage to the liner system and/or its components shall be repaired as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.5 The liner system shall be anchored at the top of the berm so that movement downslope does not occur during backfilling at any stage of construction.

.6 The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system. Care shall be taken to avoid making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall not be permitted.

HDPE Liner Installation

.7 The HDPE liner should be deployed subsequent to the placement of Zone A bedding material. The liner should be placed with no horizontal seams on the slopes. Tie-in seams should be located on the floor at a minimum of 1.5 m from the toe of the slopes.

.8 The liner panels shall be welded together along the full length of the seam to the top of the berm.

.9 Both the wedge and the extrusion welding equipment should be qualified by conducting trial seam tests prior to start-up each day and at approximately 4-hour intervals during seaming operations. During the trial seam, the minimum peel and shear strength criteria set by the manufacturer for the 60 mil HDPE geomembrane should be met. The industry-accepted peel and shear strengths for 60 mil HDPE geomembrane are 78 ppi (pounds/inch) and 120 ppi, respectively.

.10 The Engineer should walk the liner to observe for any defects caused by on-site equipment and tools. Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause should be replaced or repaired with an additional piece of HDPE liner extrusion welded over the defective area. All patches should have rounded edges and extend a minimum of 150 mm beyond the affected area.

.11 Low ground pressure equipment should be used to deploy the liner material. No track-wheel equipment shall be allowed on the liner. Equipment travel on the liner material should be kept to a minimum.

Material Quantities

.12 Estimated material quantities required for the lined pad are listed in Table 1005.7

TABLE 1005.7: MATERIAL QUANTITY ESTIMATES

Material	Total Area (m^2)
HDPE 60 Liner	1900

6.0 Installation - PVC 40 Design

.1 The liner system consists of the following layers (starting from the top layer):

- Geo-Comp 5 or equivalent geocomposite
- PVC 40 mil or equivalent geomembrane

.2 The liner system should line the entire surface of the Facility, which includes the crest of the berms, inside slopes, and floor. The geocomposite material is only required on the floor and approach berm of the Facility.

.3 The Contractor shall ensure that the integrity of the liner system and its components are not compromised during construction. Precautions the Contractor may take to avoid damaging the liner system may include, but will not be limited to, providing light plants in the work area to improve visibility or using pylons to mark the lift/liner system interface.

.4 Any damage to the liner system and/or its components shall be repaired as soon as possible. Fill placement shall cease immediately in an area where the integrity of the liner system has been compromised. Fill surrounding the damaged liner system may have to be excavated, without further damaging the integrity of the liner, to permit repairs to be made. Hand excavation shall be used to expose damaged portions of the liner for repair.

.5 The liner system shall be anchored at the top of the berm so that movement downslope does not occur during backfilling at any stage of construction.

.6 The Contractor shall take the necessary steps to ensure that backfilling does not induce tensile stress in the liner system. Care shall be taken to avoid making sharp turns, sudden stops or sudden starts adjacent to the liner system. Non-essential heavy equipment traffic in the immediate vicinity of the liner system shall not be permitted.

PVC Liner Installation

.7 The PVC liner should be deployed subsequent to the placement of Zone A bedding material.

.8 The Engineer should walk the liner to observe for any defects caused by on-site equipment and tools. Any liner area showing injury due to excessive scuffing, puncture, or distress from any cause should be replaced or repaired with an additional piece of PVC liner installed as per the manufacturer's specifications over the defective area. All patches should have rounded edges and extend a minimum of 150 mm beyond the affected area.

.9 Low ground pressure equipment should be used to deploy the liner material. No equipment shall be allowed on the liner.

Geocomposite Reinforcing Installation

.10 The geocomposite material should be deployed subsequent to the placement of the Liner.

.11 No equipment is permitted on the liner material during the placing of the geocomposite reinforcing material. The geocomposite reinforcing material must rolled out by hand and the cover material placed in accordance with Section 1004.

Material Quantities

.12 Estimated material quantities required for the lined pad are listed in Table 1005.8

TABLE 1005.8: MATERIAL QUANTITY ESTIMATES

Material	Total Area (m^2)
PVC 40 Liner	1900
Geo-Comp 5	905

END OF SECTION

Section 1006

QUALITY ASSURANCE

QUALITY ASSURANCE

1.0 General

.1 The quality assurance testing suggested is described in this section.

2.0 Reference Standards

.1 The most recent edition of the following American Society for Testing Materials standards:

a. ASTM C136 – Standard Test Method for Sieve Analysis of Fine and Coarse Aggregates.

b. ASTM D698 – Standard -Standard Test Methods for Laboratory Compaction Characteristics of Soil Using Standard Effort (12,400 ft-lbf/ft^3 (600 kN-m/m^3))

d. ASTM D4437 – Standard Practice for Determining the Integrity of Field Seams Used in Joining Flexible Polymeric Sheet Geomembranes.

.2 Geosynthetic Research Institute

a. GRI Test Method GM6 – Pressurized Air Channel Test for Dual Seamed Geomembranes.

3.0 Fill Particle Size Testing Requirements

.1 Zone A Material

a. Samples of the Zone A material should be evaluated from locations within the borrow source prior to construction. One sample will be evaluated every 500 m^3 placed during construction to ensure the placed gradation meets the specification stated herein. The required tests and testing frequency for the Zone A material are presented in Table 1006.1.

TABLE 1006.1: TESTING AND FREQUENCY OF ZONE A MATERIAL

Test	Test Frequency
Particle Size Analysis	One (1) test every 500 m^3 during construction.

.2 Zone B Material

a. Samples of the Zone B material will be evaluated from the foundation material within the Facility prior to construction and every 2000 m^3 placed during construction to ensure the placed gradation meets the specification stated herein. The required tests and testing frequency for the Zone B material are presented in Table 1006.2.

TABLE 1006.2: TESTING AND FREQUENCY OF ZONE B MATERIAL

Test	Test Frequency
Particle Size Analysis	One (1) location within the Facility and One (1) test every 2000 m^3 during construction.

4.0 Fill Compaction Testing Requirements

.1 Zone A Material

a. Compact each lift with a minimum of six passes using a large smooth-drum, vibratory compactor. The optimum vibratory frequency and number of passes should be determined during construction using proof-roll tests, which demonstrate optimum compaction. The Engineer should inspect the compaction effort to ensure that this effort results in a density equivalent to about 95% MDD.

.2 Zone B Material

a. Compact each lift with a minimum of six passes using a large smooth-drum, vibratory compactor. The optimum vibratory frequency and number of passes should be determined during construction using proof-roll tests, which demonstrate optimum compaction. The Engineer should inspect the compaction effort to ensure that this effort results in a density equivalent to about 98% MDD.

b. The foundation material (Zone B or subcut material) should also be compacted as specified in section 1006.4.1.

5.0 Geomembrane Testing Requirements

.1 General

a. The Contractor is responsible for obtaining mill certificates from the manufacturer and forwarding them to the Engineer.

b. If applicable, the Contractor shall record all seam parameters (i.e. time, date, operator, welding speed and temperature) on the liner.

c. If applicable, the Contractor shall be responsible for completing the vacuum box testing and pressure testing for the appropriate seams. The Contractor shall mark the test number and parameters on the liner.

d. If applicable, the Contractor shall supply and use a field tensiometer for testing liner seams for shear and peel strength.

e. The Contractor is responsible for maintaining testing records.

f. All coupons and test specimens remain the property of the Owner.

.2 Qualifying Welds

a. Qualifying seams shall be conducted on fragmented pieces of material at the following times:

- At the start of each shift of production seaming, and at 4 hour intervals during production seaming;
- When a new operator or new machine starts welding;
- When a machine is restarted after repairs;
- When welding is stopped for sixty (60) minutes or more;
- When there is a change in the ambient conditions; and
- At the discretion of the Engineer.

b. Qualifying seams shall be 1 m long, and shall be subject to shear and peel testing. The test seam shall meet the minimum requirements stated herein for seam strength, when tested on a field tensiometer. If a qualifying seam fails, the seaming procedure shall be reviewed and the test shall be repeated.

.3 Non-Destructive Testing

a. Test all wedge-welded seams over their full length using a vacuum unit or air pressure test.

- Seam intersections will also be subject to vacuum box testing, regardless of seaming method employed.
- The Contractor shall supply all apparatus and personnel for this type of test.
- The tests shall be witnessed and documented by the Engineer.

b. Clean all seams to permit proper inspection.

c. Repair any seams which fail non-destructive testing in accordance with this Specification. Repairs shall be fully documented by the Contractor.

.4 Vacuum Box Testing

a. Extrusion welded seams should be tested using either vacuum box testing or pick-testing. Vacuum box testing involves placing the extrusion weld under a vacuum. The weld is first coated with a soapy water solution and any holes in a weld would be indicated by a stream of bubbles when vacuum is applied.

b. No leaks shall be permitted while conducting vacuum box testing.

c. Pick-testing is conducted on uneven surfaces where a vacuum cannot be maintained. During pick testing, attention should be paid to the following specific items:

- The width of the weld;
- Weld bond to the underlying geomembrane;
- Joints between three panels (“T” joints);
- Defects such as bubbles created within the weld due to moisture; and
- Textured weld surfaces due to temperature fluctuation in the extrusion welder.

.5 Air Pressure Testing

a. Wedge welded seams should be air-pressure tested over their full lengths using an air pressure test. Air pressure testing involves pressurizing the air channel located between the dual tracks of the seams to a minimum pressure of 40 psi for a period of five minutes.

b. During the test, the air pressure is not allowed to drop more than 4 psi (10% allowance). Any leaks and bubbling in the seams found during the non-destructive tests must be repaired by extruding a patch of HDPE material over the defect.

c. Air pressure testing shall be carried out according to GRI Test Method GM6, Pressurized Air Channel Test for Dual Seamed Geomembranes.

.6 Destructive Testing for Production Seams

a. Cut-out coupons shall be taken at a minimum frequency of one (1) per 150 m of seam, or once per seam. Coupons shall be cut by the contractor at the location directed by the Engineer. Coupons shall generally be taken from a location that does not affect the performance of the liner. All cut-outs shall have rounded corners. Care shall be taken to ensure that no slits penetrate the parent liner.

b. All holes left by cut outs shall be patched immediately.

.7 Testing of Repairs

a. All repairs shall be tested using the Vacuum Box in accordance with test method ASTM 4437.

END OF SECTION

Section 1007

DESIGN ALTERNATIVES

DESIGN ALTERNATIVES

1.0 General

.1 This section provides design alternatives for the Facility should the fill materials available on or near site not adhere to the gradation specifications stated in Tables 1003.1 and 1003.2.

.2 Should Zone A, Zone B or both materials not meet the gradation specifications stated in Tables 1003.1 and 1003.2 then the recommended design alternatives are available in Table 1007.1.

TABLE 1007.1: RECOMMENDED DESIGN ALTERNATIVES FOR GRADATION NON-COMPLIANCE

		Zone B		
		Meets Specifications	Gradation Below Fine Limit	Gradation Above Coarse Limit
Zone A	Meets Specifications	This section does not apply	This section does not apply	See Section 1007.2
	Gradation Below Fine Limit	See Section 1007.2	See Section 1007.2	See Section 1007.2
	Gradation Above Coarse Limit	See Section 1007.3	See Section 1007.3	See Section 1007.4

2.0 Detailed Design Alternatives – Non-Compliance Criteria I

.1 If the fill materials do not comply with gradation specifications as per Table 1007.1 geotextile material is required at the interface between Zone A and Zone B materials.

.2 The geotextile material should be deployed prior to the placement of Zone A material.

.3 The geotextile should be placed with a minimum overlap of 150 mm and connected at the seam by heat bonding. If heat bonding is not available an overlap of 300 mm should be used. Horizontal seams should be kept to a minimum on the side slopes. If a horizontal seam is unavoidable, the overlap shall be capped with a 300 mm wide strip of the same geotextile and heat bonded to the underlying material.

.4 Any tears or holes made in the geotextile should be repaired by placing a patch of geotextile on the defect and held in place by heat bonding. The patch should extend at least 300 mm beyond the damage, in all directions.

3.0 Detailed Design Alternatives – Non-Compliance Criteria II

.1 If the fill materials do not comply with gradation specifications as per Table 1007.1 geotextile material is required above and below the liner system.

.2 The geotextile material should be deployed prior to the deployment of the liner system as well as subsequent to the deployment of the liner system.

.3 The geotextile should be placed with a minimum overlap of 150 mm and connected at the seam by heat bonding. If heat bonding is not available an overlap of 300 mm should be used. Horizontal seams should be kept to a minimum on the side slopes. If a horizontal seam is unavoidable, the overlap shall be capped with a 300 mm wide strip of the same geotextile and heat bonded to the underlying material.

.4 Any tears or holes made in the geotextile should be repaired by placing a patch of geotextile on the defect and held in place by heat bonding. The patch should extend at least 300 mm beyond the damage, in all directions.

4.0 Detailed Design Alternatives – Non-Compliance Criteria III

.1 If the fill materials do not comply with gradation specifications as per Table 1007.1 geotextile material is required above and below the liner system as well as at the interface between Zone A and Zone B materials.

.2 The geotextile material should be placed prior to the placing of Zone A material, prior to the deployment of the liner system as well as subsequent to the deployment of the liner system.

.3 The geotextile should be placed with a minimum overlap of 150 mm and connected at the seam by heat bonding. If heat bonding is not available an overlap of 300 mm should be used. Horizontal seams should be kept to a minimum on the side slopes. If a horizontal seam is unavoidable, the overlap shall be capped with a 300 mm wide strip of the same geotextile and heat bonded to the underlying material.

.4 Any tears or holes made in the geotextile should be repaired by placing a patch of geotextile on the defect and held in place by heat bonding. The patch should extend at least 300 mm beyond the damage, in all directions.

END OF SECTION

Section 1008

OPERATION AND MAINTENANCE

OPERATION AND MAINTENANCE

5.0 General

.1 This section provides a general guideline for the operation and maintenance of the Waste Containment Facility.

6.0 Geomembrane Lined Pad

.1 Structure Maintenance

a. This section refers to the structure as the berm, side slopes, and floor of the Facility.

b. The structure shall be inspected regularly. Attention shall be concentrated on the following:

- Eroded and/or damaged granular slope and floor surfaces and
- Exposed liner material

c. Any identified problems should be repaired immediately. The repair can be conducted by reconstructing the damaged or eroded slopes with a material of similar gradation to Zone A material. Any exposed liner material can be recovered with Zone A material; however, if the liner material is damaged, liner installation personnel shall be retained to repair the liner.

.2 Surface Water Management

a. The Facility is designed to drain all surface water to the installed vertical culvert. Each month, the water lever must be inspected, pumped and disposed of appropriately.

b. The frequency of monitoring must be increased during times of high precipitation or snow melt within the Facility.

7.0 Filling Procedure

.1 The filling procedure for the Facility is as follows:

a. Waste material is not to exceed a height of 3.0 m above the level of the top of the berm unless approved by the Engineer;

b. Waste material is not to be placed higher than relative elevation 0.5 m below the crest of the liner unless approved by the Engineer.

8.0 Closure

.1 Upon reaching capacity the Facility will be capped with material meeting the specifications outlined in Table 1008.1 or as approved by the Engineer.

TABLE 1008.1: CAPPING MATERIAL- PARTICLE SIZE DISTRIBUTION LIMITS

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
100	100	100
50	95	100
25	90	100
20	85	100
5	65	90
0.63	35	60
0.08	5	20

.2 The capping material shall have a minimum thickness of 0.5 m.

.3 The vegetative cover must be capable of self-regeneration without continuous dependence on fertilizer or re-seeding.

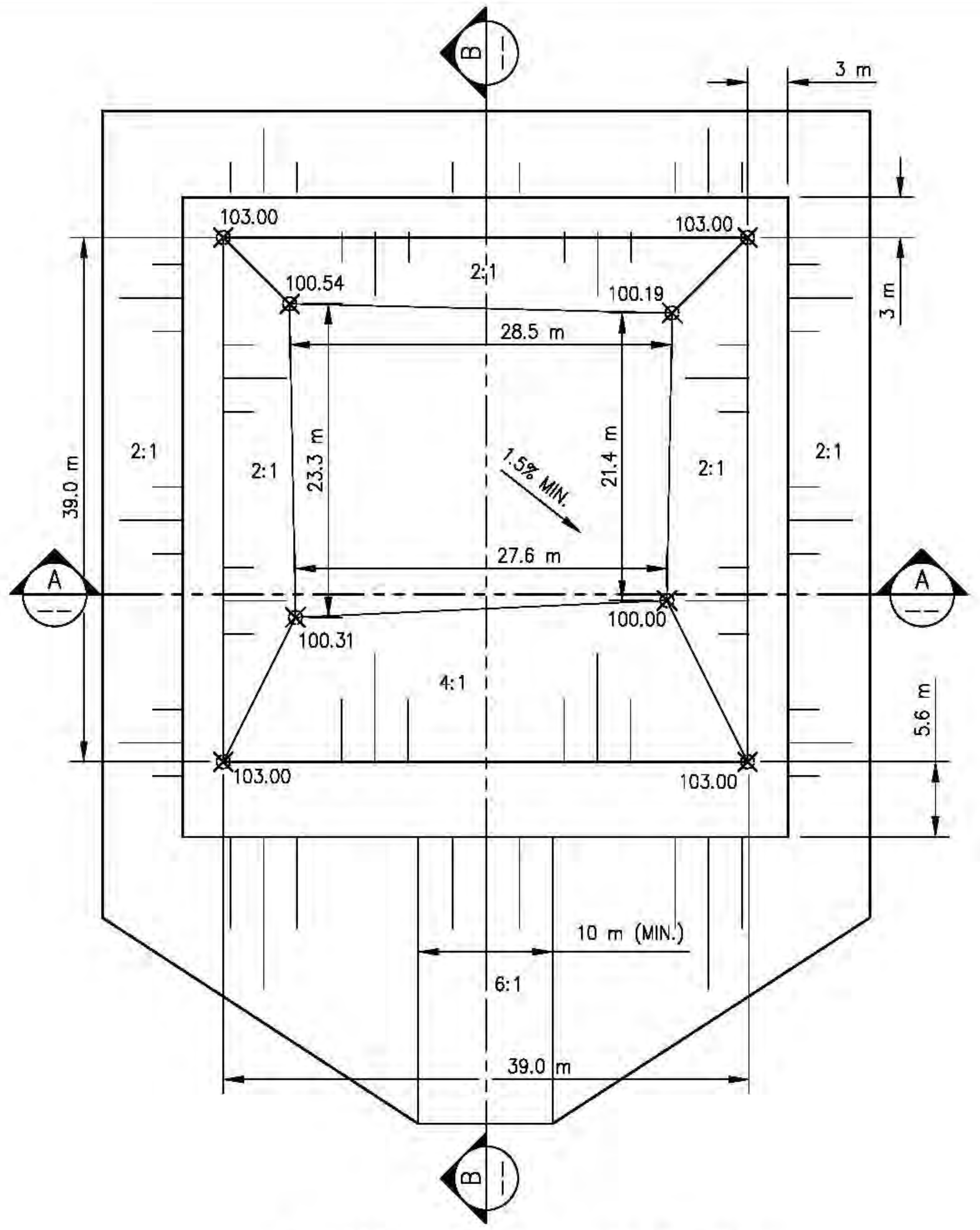
.4 The vegetative cover must have sufficient density and species diversity to stabilize the surface against the effects of long term erosion.

.5 Closure monitoring should include inspection for any ponding water. If ponded water is present capping material should be added or re-graded.

END OF SECTION

APPENDIX

APPENDIX A CONSTRUCTION DRAWINGS



PLAN – ZONE B MATERIAL

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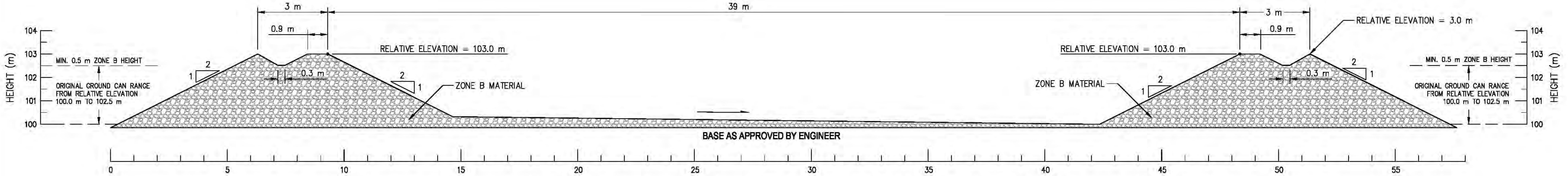

CROSS–SECTION A

SCALE: 1 : 100

CROSS–SECTION B

SCALE: 1 : 100

ISSUED FOR CONSTRUCTION

NOTES

1. CONTAINMENT FACILITY SIZED FOR 1900 m² OF GEOMEMBRANE. CONFIGURATION OF BASE AREA CAN BE MODIFIED SHOULD SITE CONDITIONS WARRANT. HOWEVER, SPECIFIED BERM CROSS-SECTION, FILL MATERIALS, LINER SYSTEM AND GENERAL DESIGN CRITERIA MUST BE ADHERED TO.
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3. ALL ELEVATIONS ON PLAN ARE FOR TOP OF ZONE B MATERIAL.

NUM	DATE	DWN	CKD	APR	DESCRIPTION

REVISIONS

NUM	DATE	APR	DESCRIPTION
B	08/0708	JPB	ISSUED FOR CONSTRUCTION
A	08/06/25	JPB	ISSUED FOR REVIEW

DRAWING STATUS

ORIGINAL
SIGNED AND SEALED

Permit: J. Richard Trimble, P.Eng.
Date: July 8, 2008

Seal: Jason Berkers, P.Eng.
Date: July 8, 2008

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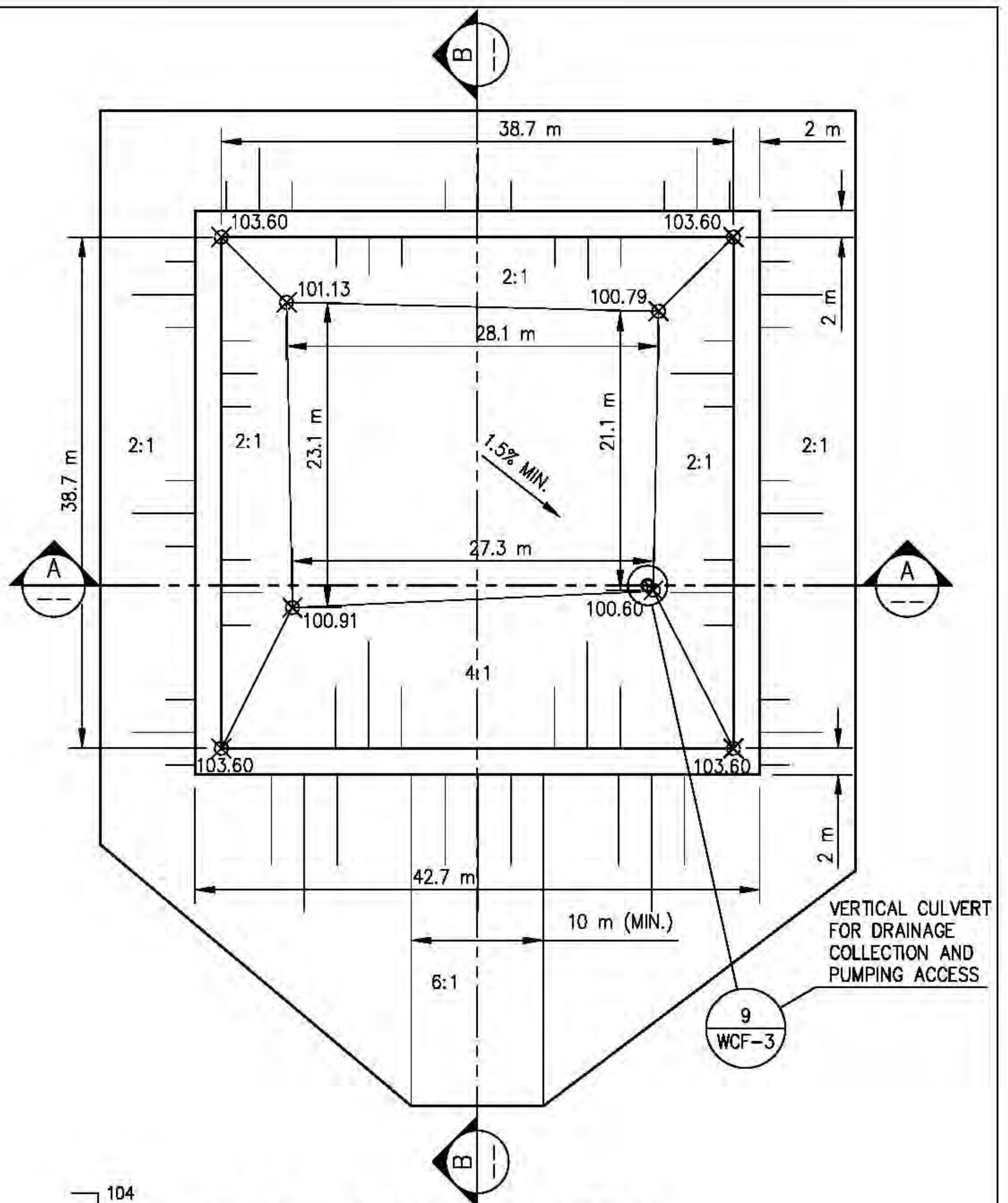
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

ZONE B MATERIAL PLAN & CROSS SECTIONS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPB	0	WCF-1
DATE:	SHEET No.	DWN	APP	STATUS	
June 25, 2008	1 of 4	KJT	JRT	B	



PLAN – ZONE A MATERIAL

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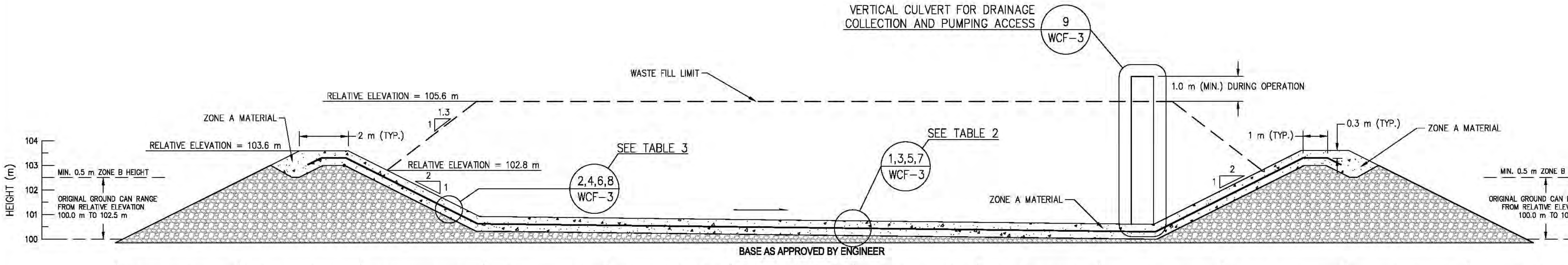

CROSS-SECTION A

SCALE: 1 : 100

CROSS-SECTION B

SCALE: 1 : 100

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TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

ZONE A MATERIAL PLAN & CROSS SECTIONS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
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DATE:	SHEET No.	DWN	APP	STATUS	
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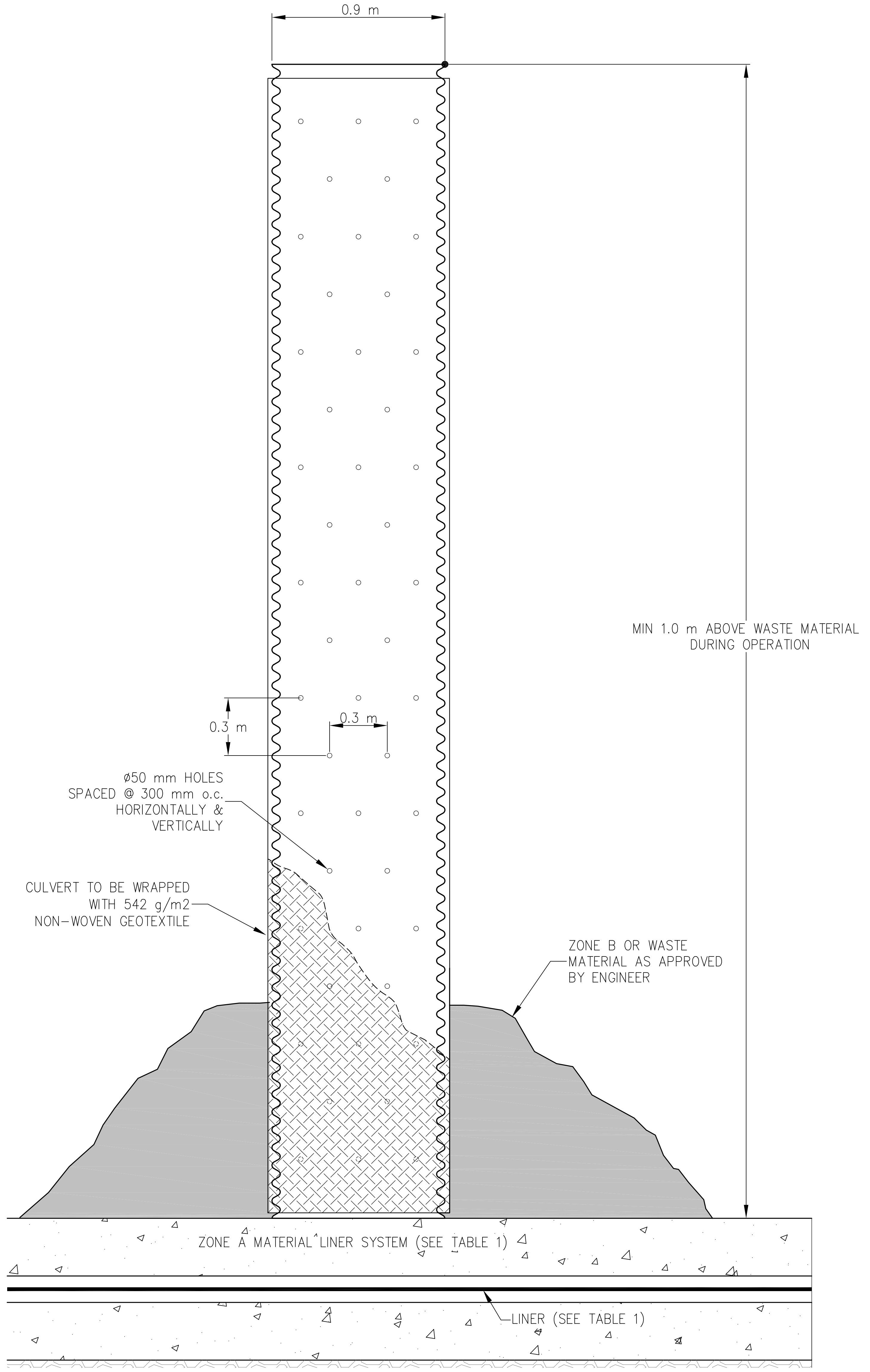


DETAIL 1 – VERTICAL CULVERT

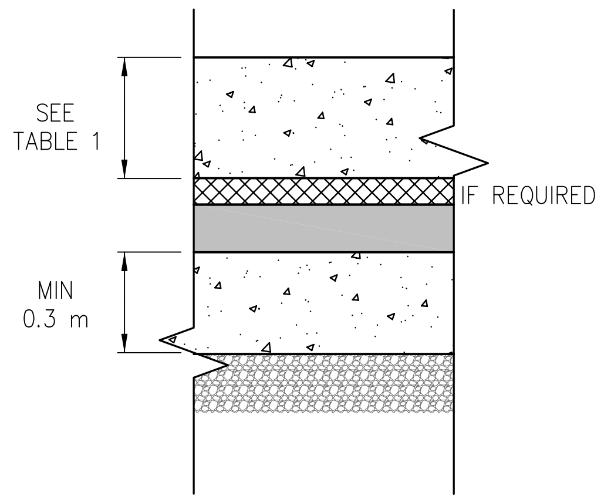
9 / WCF–1

SCALE: 1 : 20

LINER SYSTEM DETAIL KEY

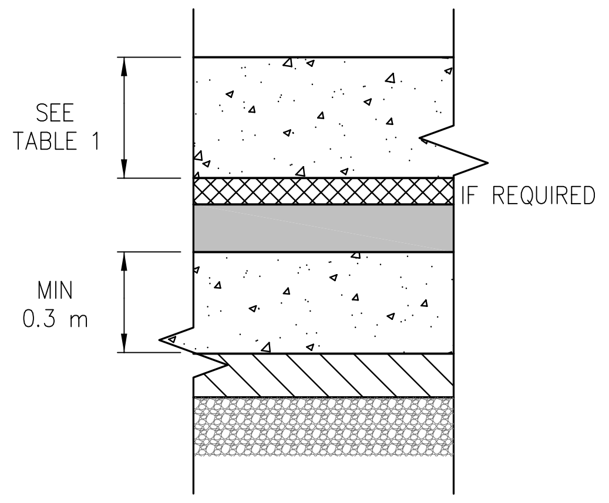
░	ZONE A MATERIAL
▩	GEOCOMPOSITE DRAIN, IF REQUIRED (SEE TABLE 1)
▨	542 g/m² NON–WOVEN GEOTEXTILE
▒	SELECTED GEOMEMBRANE
▦	ZONE B MATERIAL

LINER SYSTEM FLOOR & APPROACH BERM



1 / WCF–1 FLOOR & APPROACH

NOT TO SCALE



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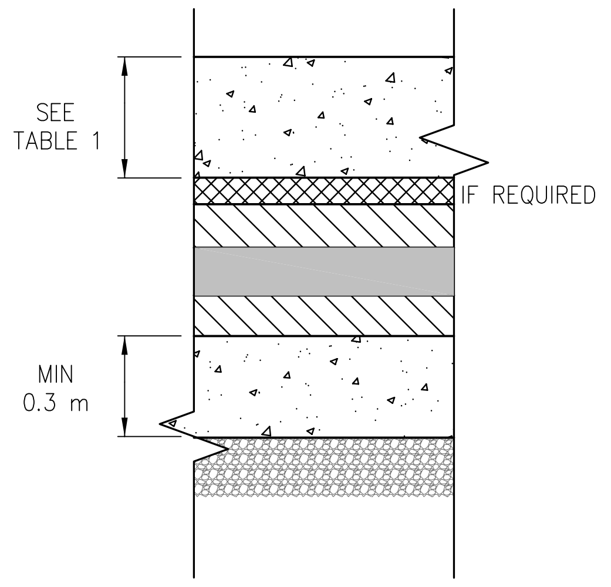

5 / WCF–1 FLOOR & APPROACH

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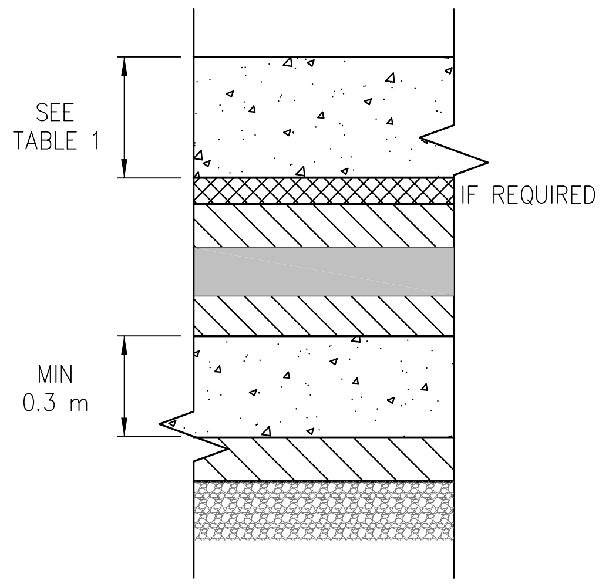
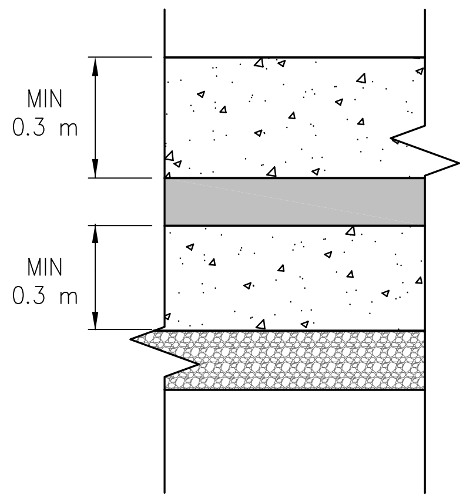


7 / WCF–1 FLOOR & APPROACH

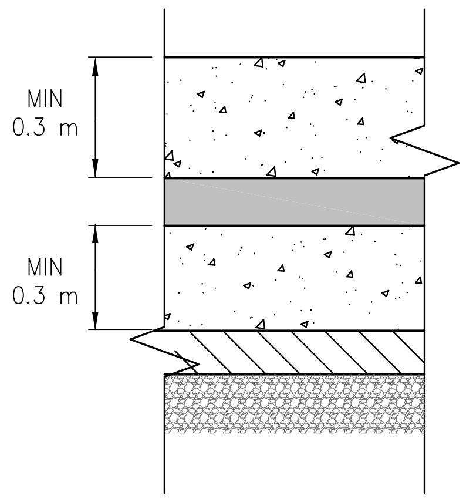
NOT TO SCALE

LINER SYSTEM BERMS



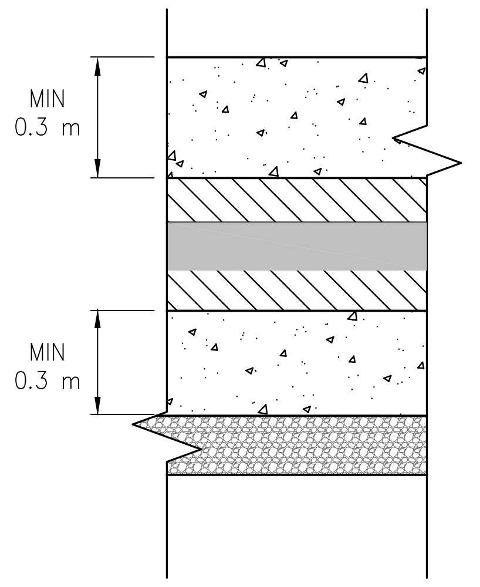
2 / WCF–1 BERM

NOT TO SCALE



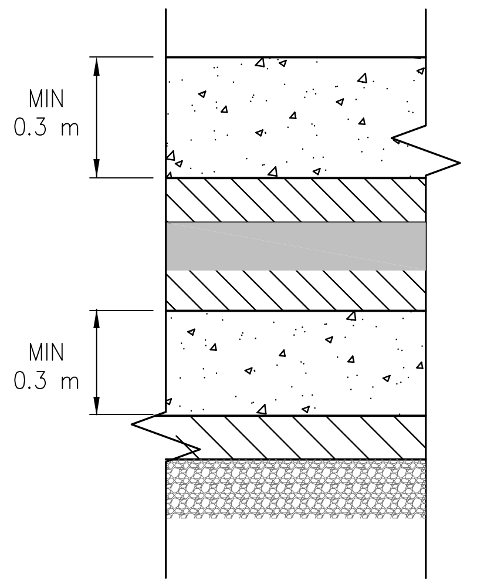
4 / WCF–1 BERM

NOT TO SCALE



6 / WCF–1 BERM

NOT TO SCALE



6 / WCF–1 BERM

NOT TO SCALE

Table 1: Recommended Minimum Cover Thicknesses

Liner Material	Drainage Composite	Minimum Required Thickness
Enviro Liner® 4040 (Without Geocomposite)	Not Required	1.3 m
Enviro Liner® 4040 (With Geocomposite)	Required	0.3 m
HDPE 60	Not Required	0.3 m
PVC 40 (With Geocomposite)	Required	0.3 m

Table 2: Liner System Floor and Approach Berm

		Zone B		
		Meets Specifications	Gradation Below Fine Limit	Gradation Above Coarse Limit
Zone A	Meets Specifications	Detail 1	Detail 1	Detail 3
	Gradation Below Fine Limit	Detail 3	Detail 3	Detail 3
	Gradation Above Coarse Limit	Detail 5	Detail 5	Detail 7

Table 3: Liner System Berm

		Zone B		
		Meets Specifications	Gradation Below Fine Limit	Gradation Above Coarse Limit
Zone A	Meets Specifications	Detail 1	Detail 1	Detail 3
	Gradation Below Fine Limit	Detail 3	Detail 3	Detail 3
	Gradation Above Coarse Limit	Detail 5	Detail 5	Detail 7

Table 4: Zone A Material (10 mm Minus) - Particle Size Distribution Limits

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
10	100	100
5	80	100
2	55	100
0.63	25	65
0.25	10	40
0.08	2	15

Table 5: Zone B Material (200 mm Minus) - Particle Size Distribution Limits

Sieve Size (mm)	% Passing Fine Limit	% Passing Coarse Limit
200	100	100
100	85	100
50	65	100
25	40	100
5	20	55
2	0	20

ISSUED FOR CONSTRUCTION

NOTES

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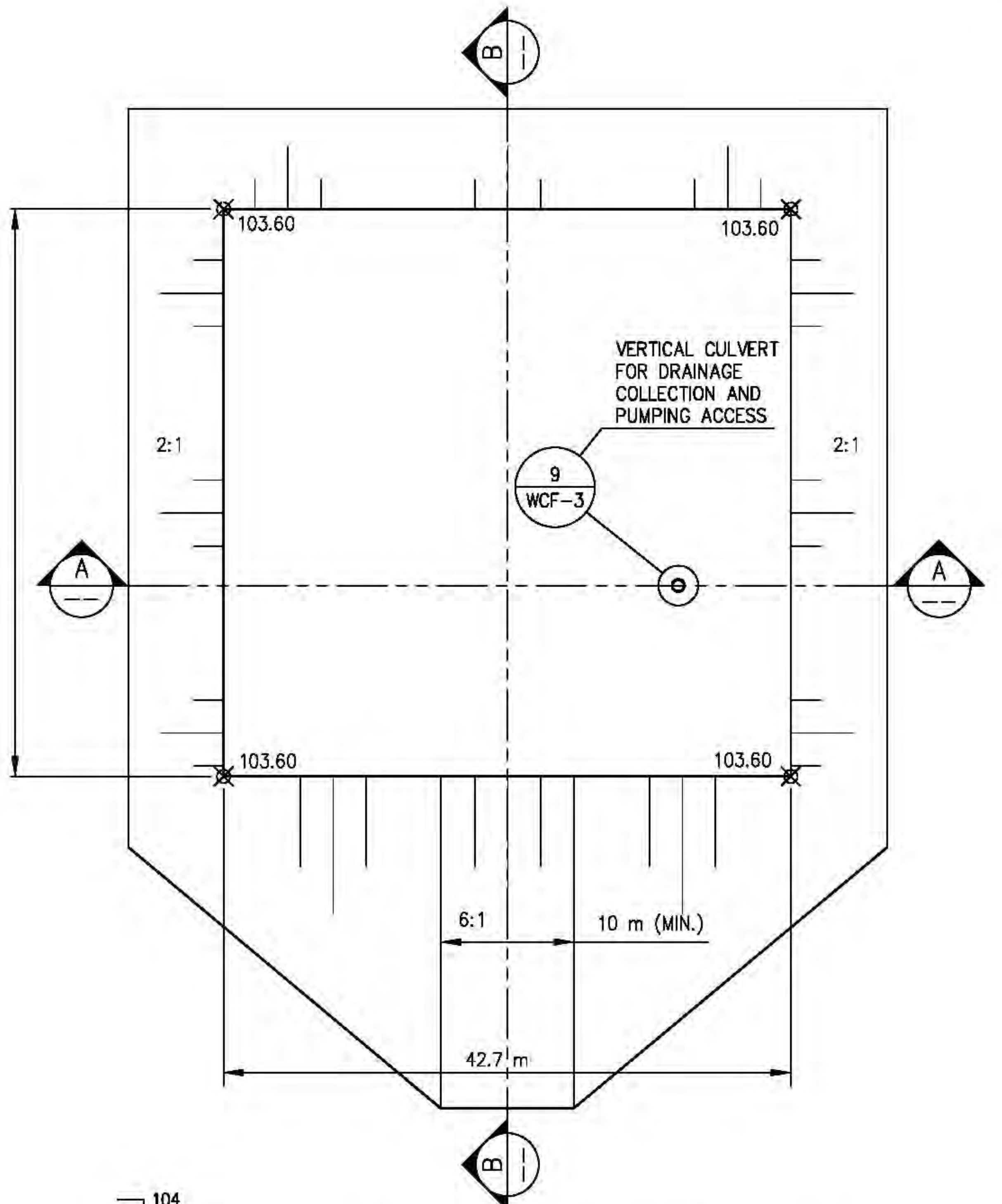
TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

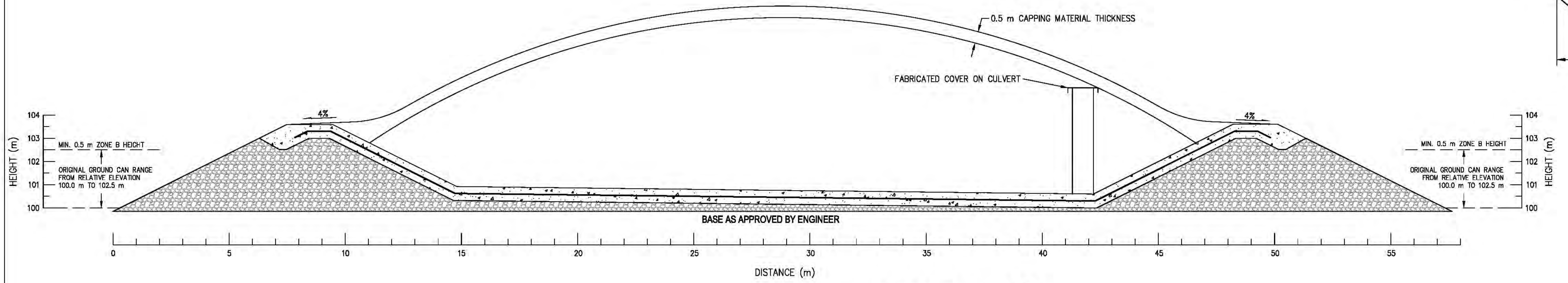
DETAILS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPB	0	WCF-3
DATE:	SHEET No.	DWN	APP	STATUS	
JUNE 25, 2008	3 of 4	KJT	JRT	B	



PLAN – FACILITY CLOSURE

SCALE: 1 : 400



CROSS–SECTION A

SCALE: 1 : 100

CROSS–SECTION B

SCALE: 1 : 100

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TYPICAL WASTE CONTAINMENT FACILITY DESIGN
KENO HILL SILVER DISTRICT, YT

FACILITY CLOSURE PLAN & CROSS SECTIONS

PROJECT No.	OFFICE	DES	CKD	REV	DRAWING
W14101142	WHSE	JTP	JPB	0	WCF-4
DATE:	SHEET No.	DWN	APP	STATUS	
June 25, 2008	4 of 4	KJT	JRT	B	

ALEXCO KENO HILL MINING CORP.

TYPE A WATER LICENCE APPLICATION

QZ09-092

BELLEKENO MINE DEVELOPMENT

KENO HILL SILVER DISTRICT

YUKON

Attachment D

Prepared by:

www.accessconsulting.ca

ALEXCO RESOURCE CORP.

2008/2009 Mine Wall Testing Plan

February 2010

Table of Contents

List of Figures

List of Appendices

1.0 INTRODUCTION

Mine wall testing was undertaken for underground development completed during 2008/2009 in accordance to the Mine Wall Testing Plan submitted in 2008 under the Water Use Licence QZ07-078. The sampling was done in a systematic way by a team of Alexco Resource Corp. (Alexco) geologists. The sampling was done every 10 linear meters of development and the samples were analyzed with ICP MS by ALS Chemex Labs out of Vancouver, B.C. One sample every 40 linear meters was also analyzed with Acid Base Accounting (ABA) using the lab procedures outlined in the Mine Wall Testing Plan.

1.1 METHODS

The method of sampling selected by the team of geologists was a linear chip sample along one of the ribs (mine wall). These samples varied in that they were taken perpendicular to the orientation of the metamorphic fabric to best represent what the geochemical characteristics of the excavated mine wall are. These samples were an average of 4kg.

Sample locations were measured from underground survey points and marked on the mine wall with spray paint. All data was recorded into a database and sample locations were also recorded into an Auto-Cad drawing of the mine.

The mine wall samples were graphed and compared to the composite samples from the Waste Rock Management Plan (WRMP) taken during excavation in order to assess what, if any, geochemical changes have occurred within the rocks and if those changes can lead to a prediction of the long-term geochemical rock characterization.

The sampling method of the samples taken for the Waste Rock Management Plan (WRMP) is outlined in Water Use Licence QZ07-07 along with the compositing procedures and schedule. The composites generally represent 10 m – 12 m of linear development and are comprised of multiple samples taken during the excavation. For each ~10m representing a composite sample, a Correlation ID was assigned to that sample. Any other sample falling within that length of the mine was also assigned the same Correlation ID creating a spatial relationship between samples and data sets. Due to the variability of these composites lengths, a 1:1 comparison is difficult between this data set (WRMP) and the Mine Wall Testing Plan (MWTP) data set. In cases where no MWTP samples fell within the area of the composite sample, no Correlation ID was assigned to that sample. There was an average of 1.2 MWTP samples for every WRMP composite sample.

Within the WRMP dataset there is also a subset of ABA and ICP data that represents a single blasting round which was composited and sent out for lab verification that the field call criteria was accomplishing the goals set out. Where a MWTP sample fell within the spatial area which one of these smaller composites represents, this WRMP composite is also assigned a Correlation ID and is included in the analysis. The analysis of this sample in comparison to the MWTP sample should represent the most accurate correlation available.

Due to the infrequency of ABA analysis on both data sets, there are only 5 sets of samples that directly correlate the acid base accounting characteristics over time. Of these five samples from the WRMP composite set, none of these are from single round composites and all of them represent lengths between 8.9 m - 14.8 m.

1.2 RESULTS

Data tables showing all of the MWTP geochemical and ABA analyses are presented as Appendix A. A comparison of the paste pH between the two sample sets shows a scattering of results from 7.90 to 8.80 with no clear major trends in the data. (see Figure 1). These results well exceed the lower limits of pH for waste rock as outlined in the WRMP and also show no major changes over the 6-9 month lag period between excavation and mine wall testing.

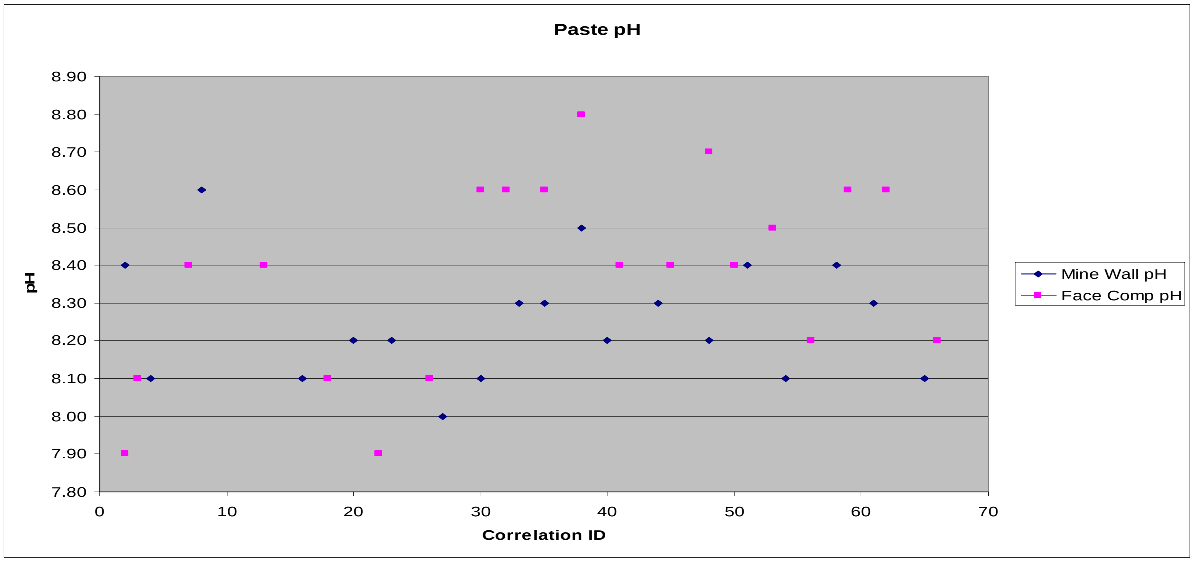

Figure 1 Paste pH comparison between mine wall samples and face composite samples

ICP data from both data sets is complete and shows a very clear correlation existing between both Pb and Zn. (see Figure 2).

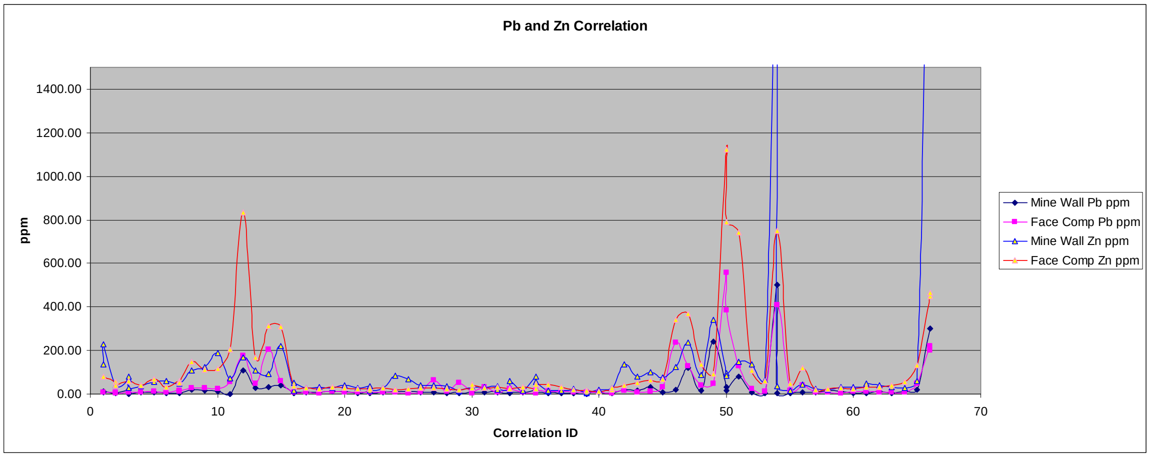

Figure 2 Pb and Zn comparison between mine wall and face composite samples

There are clearly visible zones of elevated levels of both Pb and Zn occurring within both data sets. The Zn levels are elevated much more so than the Pb within these zones. High Zinc spikes within the Mine wall samples or the absence of, may be due to sampling right in a small Siderite stringer zone which would have driven the elevated levels in the larger composite sample in the Face Composite data set and the opposite for the absence of a pronounced spike in the Mine Wall dataset. Both the Pb and Zn spikes fall well below the allowable 5,000 ppm limit for potentially metal leaching rocks. The highest recorded Zn level was 2,790 ppm and the highest Pb level was 558 ppm.

From this data and the different nature of the sampling methods used in both data sets, it is inconclusive whether any detectable amount of Pb and Zn metal leaching has taken place over the 6-9 month lag period.

A comparison of the Sulphur levels in both datasets show a good correlation (see Figure 3), and suggests that the sulphur distribution within the excavated rock to date is evenly distributed within lithological packages and not dominantly controlled by structures such as siderite stringer zones as seen with the Pb and Zn levels.

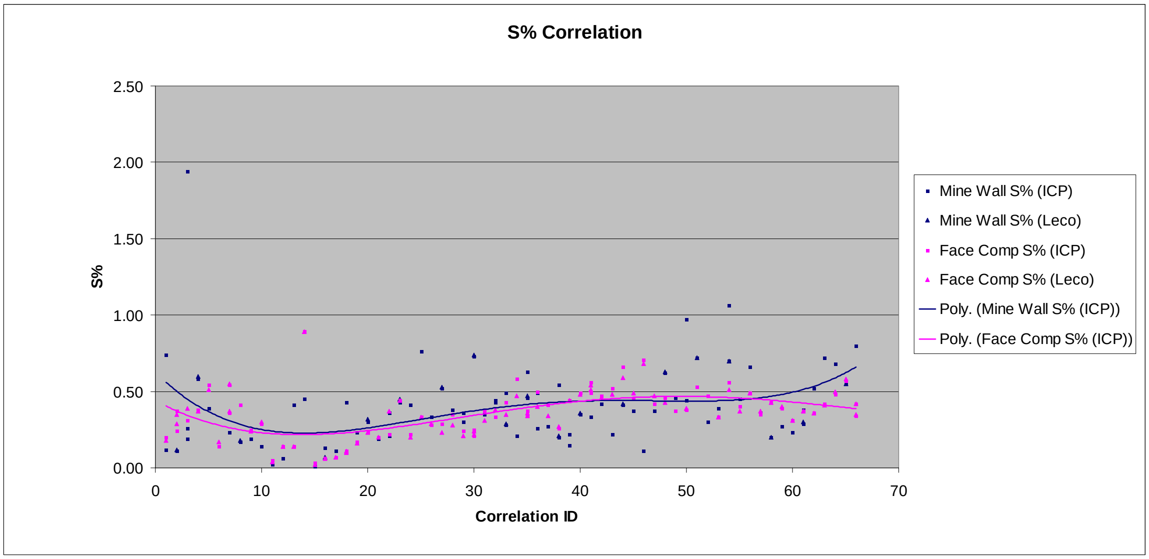

Figure 3 Sulphur Correlation with a polynomial trend line

A comparison of Ca% levels between the two datasets shows similar levels of Ca%, but no major trends are evident within the data. The Ca% distribution falls within the general scattering of data points between 0.5% - 5.0% with an average value of 2.3 in the MWTP dataset and an average value of 2.65 in the WRMP dataset.

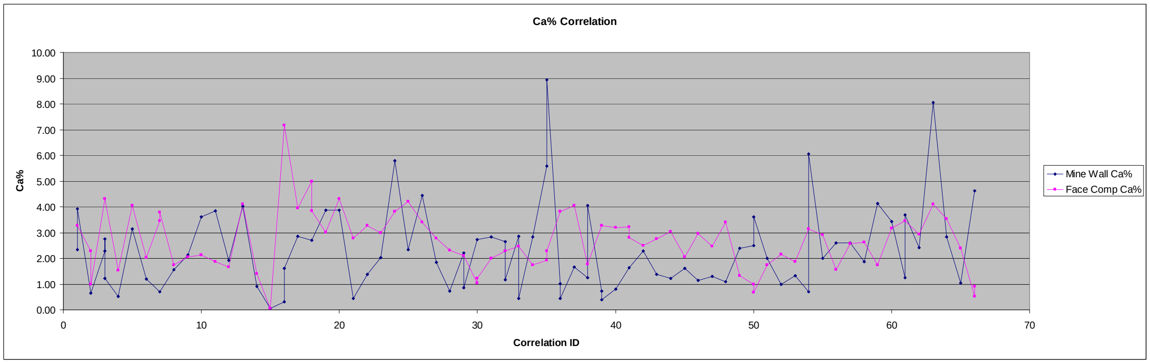

Figure 4 Calcium Correlation

The ABA data collected from the two data sets poses much more of a problem in trying to correlate changes and trends between the two data sets. There were 19 ABA samples collected from the MWTP dataset and 20 ABA samples collected from the WRMP dataset. Of these samples only five from each set are valid for correlation over time. This subset of data is too small to rely on for identifying trends and changes in the ARD potential of the excavated rock and mine walls.

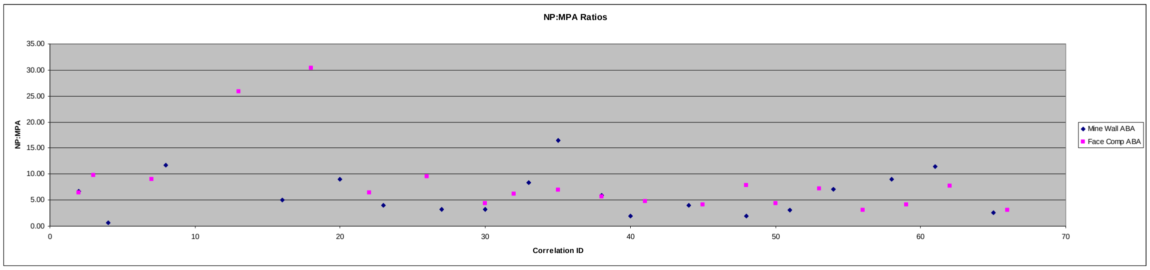

Figure 5 NP:MPA ratios

1.3 DISCUSSION

The comparison of the geochemical data collected from the two datasets works well for Pb and Zn since each composite or sample was routinely analyzed using ICP. The comparison of NP:MPA ratio is much more problematic due to the slightly differing frequencies of ABA analysis that was conducted on each sample set. From the entire dataset there are only 5 directly correlative sets of MWTP and WRMP sample pairs. This is insufficient to draw any reasonable conclusions from.

Data collected supports the visible observation that there is no significant change in the geochemical characteristics of the mine wall exposed during excavation over a 6-9 month lag time, most importantly oxidation. Analysis of the datasets show no apparent change in several key indicators in which oxidation and delayed onset of P-AML characteristics would manifest as. Expected trends of oxidation and delayed onset of P-AML characteristics would include:

(a) Decrease in the S% as pyrite is oxidized;

(b) Decrease in Ca% modified via carbonate flushing or oxidation/neutralization;

(c) Decrease in NP:MPA ratio;

(d) Decrease in paste pH; and

(e) Decrease in metals (Zn, Pb, Ag) due to metal leaching.

1.4 RECOMMENDATIONS AND CONCLUSIONS

Due to the results obtained in 2009 and a full review of the data collected, there are several recommended to the Mine Wall Testing Plan should be made. The proposed changes would consist of either:

(1) Discontinuation of the Mine Wall Testing Plan as the data collected to date shows no significant geochemical changes have occurred over the 6-9 month lag from the time of excavation. With the discontinuation of the Mine Wall Testing Plan, visual inspection of all excavation completed by Alexco Resource Corp. over the life of the mine should be conducted, documented, and submitted annually. Inspections would be conducted by trained site geologists and would consist of visibly inspecting all mine walls for signs of oxidation. If at some point in time there is a change in the state of oxidation, local sampling of the mine wall will be conducted and the sample will be sent out for geochemical analysis.

(2) Conducting an ongoing geochemical study of the mine walls. This would consist of annual sampling of the mine wall within the Bellekeno East Decline and the Bellekeno 625 Bypass. Samples would be collected from the same location as the initial Mine Wall Testing Plan samples and the results from annual testing could be

used to directly correlate any changes within the rocks over a period of years. Results of such a study could be used to determine if mine wall testing for all excavation conducted in Bellekeno is necessary, and what lag time would be sufficient in order to detect changes in the mine wall geochemistry.

Results from the MWTP to date show that as a whole, the data are roughly comparable to the geochemical and ABA data collected during the routine face sampling for the Waste Rock Metals and Acid Base Accounting Testing Plan. The time lag between excavation and sampling for the MWTP does not appear to have resulted in any detectable weathering or geochemical changes in the mine walls over that period.

Several suggestions for improving the MWTP have been discussed above, but no changes to the plan are being requested at this time. At some point in the future, a request to modify the MWTP may be submitted to the Board for approval.

ALEXCO RESOURCE CORP.

2008/2009 Mine Wall Testing Plan

Appendix A

2009 Mine Wall Samples

SampleID	Mine_ID	Face_ID	Fizz_Rating	Paste_pH	Ag_ppm	Pb_ppm	Zn_ppm	Al_pct	Ars_ppm	Ba_ppm	Be_ppm	Bi_ppm	Ca_pct	Cd_ppm	Co_ppm
E604634	Bellekeno_600 HW Drive Wall Sa	P65_S_0			-0.5	11	118	2.65	50	580	0.7	-2	1.04	-0.5	3
E604635	Bellekeno_600 HW Drive Wall Sa	P65_S_10			461	9520	33400	0.42	9280	30	-0.5	12	0.64	321	28
E604636	Bellekeno_600 HW Drive Wall Sa	P65_S_20			1.9	111	895	3.55	158	630	0.8	-2	1.63	2.7	7
E604637	Bellekeno_600 HW Drive Wall Sa	P70_S_0			0.5	16	116	2.7	18	410	0.9	-2	2.02	-0.5	9
E604638	Bellekeno_600 HW Drive Wall Sa	P70_S_10			1.3	46	188	0.68	15	150	-0.5	3	10.3	0.9	1
E604639	Bellekeno_600 N Dr Wall Sampli	A49_NE_17			1.3	7	172	5.87	13	150	0.9	-2	5.8	0.5	38
E604640	Bellekeno_600 N Dr Wall Sampli	A49_NE_7			2.7	-2	574	6.2	480	230	1	-2	4.53	3.5	39
E604594	Bellekeno_600 N Dr Wall Sampli	P79_NE_0			-0.5	3	107	7.68	11	370	0.6	-2	7.34	-0.5	37
E604643	Bellekeno_600 N Dr Wall Sampli	P79_NE_10			-0.5	12	163	7.75	16	130	0.7	-2	6.13	0.6	35
E604642	Bellekeno_600 N Dr Wall Sampli	P79_NE_20			-0.5	4	111	7.25	-5	130	0.9	-2	6.32	-0.5	34
E604641	Bellekeno_600 N Dr Wall Sampli	P79_NE_30			1	3	185	5.98	29	240	1.1	-2	5.28	-0.5	31
E606296	Bellekeno_Bypass Wall	P10_SW_10	3	8.36	-0.5	7	453	0.46	12	60	-0.5	-2	0.49	1.5	3
E606297	Bellekeno_Bypass Wall	P10_SW_20	4	8.76	-0.5	8	137	0.64	9	110	-0.5	-2	2.35	-0.5	4
E604611	Bellekeno_Bypass Wall	P11_NE_8.3			82.5	339	31700	1.12	260	160	-0.5	6	0.3	444	4
E606298	Bellekeno_Bypass Wall	P14_SW_0	4	8.16	-0.5	12	230	2.67	26	340	0.6	-2	3.91	0.8	4
E606299	Bellekeno_Bypass Wall	P14_SW_12.2	3	8.35	-0.5	4	41	0.44	-5	70	-0.5	-2	0.65	-0.5	2
E606300	Bellekeno_Bypass Wall	P14_SW_22.2	4	7.95	-0.5	19	70	4.43	14	530	1.3	-2	2.28	-0.5	6
E604601	Bellekeno_Bypass Wall	P16_SW_0	3	8.44	-0.5	6	82	3.13	8	130	0.5	-2	2.76	-0.5	15
E604603	Bellekeno_Bypass Wall	P16_SW_17.1	3	7.96	-0.5	7	37	2.23	12	500	0.7	-2	0.51	-0.5	4
E604602	Bellekeno_Bypass Wall	P16_SW_7.1	4	8.47	-0.5	2	28	0.86	-5	130	-0.5	-2	1.23	-0.5	2
E604604	Bellekeno_Bypass Wall	P20_SW_0	4	8.26	-0.5	10	58	1.92	5	350	0.5	-2	3.15	-0.5	4
E604605	Bellekeno_Bypass Wall	P20_SW_10	4	8.32	0.5	4	62	0.75	-5	170	-0.5	-2	1.2	-0.5	3
E604606	Bellekeno_Bypass Wall	P20_SW_20	3	8.26	-0.5	6	48	3.11	8	600	1.1	-2	0.71	-0.5	4
E604608	Bellekeno_Bypass Wall	P22_SW_16.5			0.8	17	123	8.99	16	1490	2.4	-2	2.14	-0.5	12
E604607	Bellekeno_Bypass Wall	P22_SW_6.5	2	8.42	-0.5	22	109	8.75	15	1540	2.6	-2	1.55	-0.5	11
E604609	Bellekeno_Bypass Wall	P25_SW_5.4	4	8.27	-0.5	13	190	7.84	34	1180	2	-2	3.61	-0.5	10
E604610	Bellekeno_Bypass Wall	P27_SW_0	4	8.73	-0.5	2	72	0.47	14	80	-0.5	-2	3.84	-0.5	2
E604630	Bellekeno_Bypass Wall	P27_SW_10			-0.5	110	170	0.43	16	140	-0.5	-2	1.92	1.3	4
E604631	Bellekeno_Bypass Wall	P27_SW_20			0.6	27	107	1.97	6	540	0.5	-2	4.03	-0.5	3
E604632	Bellekeno_Bypass Wall	P29_SW_0			0.7	31	91	1.29	86	350	0.5	-2	0.9	0.8	2
E604633	Bellekeno_Bypass Wall	P29_SW_10			0.6	41	220	0.32	41	80	-0.5	-2	0.05	2.4	4
E606268	Bellekeno_East Decline Wall	P13_W_0	4	8.43	-0.5	5	20	1.46	49	230	-0.5	-2	2.87	-0.5	4
E606269	Bellekeno_East Decline Wall	P13_W_10	3	7.43	-0.5	7	62	4.34	333	630	1.1	-2	0.43	-0.5	5
E606270	Bellekeno_East Decline Wall	P13_W_20	4	8.14	-0.5	7	16	0.73	7	90	-0.5	-2	2.83	-0.5	3
E606271	Bellekeno_East Decline Wall	P13_W_30	4	8.31	0.5	18	81	5.04	18	830	1.2	-2	5.59	0.5	7
E606272	Bellekeno_East Decline Wall	P15_W_0	4	8.35	-0.5	13	58	3.32	9	610	0.8	-2	8.94	-0.5	7
E606273	Bellekeno_East Decline Wall	P15_W_10	3	8.24	-0.5	5	14	0.75	5	130	-0.5	-2	1.01	-0.5	2
E606274	Bellekeno_East Decline Wall	P15_W_20	2	7.96	-0.5	7	18	1.14	7	180	-0.5	-2	0.43	-0.5	3
E606275	Bellekeno_East Decline Wall	P15_W_30	3	8.72	-0.5	6	15	0.7	-5	120	-0.5	-2	1.65	-0.5	4
E606276	Bellekeno_East Decline Wall	P15_W_40	4	8.41	-0.5	6	21	0.58	-5	100	-0.5	7	1.24	-0.5	1
E606277	Bellekeno_East Decline Wall	P15_W_50	4	8.61	-0.5	4	26	1.26	7	180	0.6	2	4.06	-0.5	2
E606278	Bellekeno_East Decline Wall	P15_W_60	2	8.43	-0.5	2	6	0.38	-5	40	-0.5	4	0.72	-0.5	2
E606279	Bellekeno_East Decline Wall	P18_W_0	2	8.45	-0.5	4	9	0.43	5	70	-0.5	3	0.4	-0.5	2
E606280	Bellekeno_East Decline Wall	P18_W_10	2	8.28	-0.5	7	22	0.78	-5	120	-0.5	4	0.81	-0.5	2
E606281	Bellekeno_East Decline Wall	P18_W_20			0.5	6	29	1.34	-5	230	-0.5	2	1.64	-0.5	4
E606282	Bellekeno_East Decline Wall	P18_W_30	2	8.28	-0.5	22	135	8.17	27	1330	1.8	-2	2.28	0.8	13
E606283	Bellekeno_East Decline Wall	P19_W_0			-0.5	15	81	5.27	23	850	1.2	-2	1.37	0.6	9
E606284	Bellekeno_East Decline Wall	P19_W_10	2	8.47	-0.5	33	100	1.53	20	240	-0.5	4	1.22	1.3	4
E606285	Bellekeno_East Decline Wall	P19_W_20	3	8.65	-0.5	9	76	4	16	750	1	-2	1.6	0.8	9
E606286	Bellekeno_East Decline Wall	P21_W_0	3	8.30	-0.5	21	123	5.11	11	800	1	-2	1.15	0.8	7
E606287	Bellekeno_East Decline Wall	P21_W_10	3	8.41	0.7	120	236	3.05	16	490	0.7	3	1.29	2.3	6
E606288	Bellekeno_East Decline Wall	P21_W_20	3	8.54	-0.5	17	90	4.79	18	770	1.1	-2	1.08	-0.5	13

SampleID	Mine_ID	Face_ID	Fizz_Rating	Paste_pH	Ag_ppm	Pb_ppm	Zn_ppm	Al_pct	Ars_ppm	Ba_ppm	Be_ppm	Bi_ppm	Ca_pct	Cd_ppm	Co_ppm
E606289	Bellekeno_East Decline Wall	P21_W_30	4	8.67	0.6	240	341	1.34	8	230	-0.5	-2	2.39	2.8	4
E606290	Bellekeno_East Decline Wall	P21_W_45	4	8.61	0.8	34	96	1.04	7	170	-0.5	-2	2.5	1.1	2
E606291	Bellekeno_East Decline Wall	P23_W_0	4	8.63	0.5	16	85	2.65	11	510	0.8	-2	3.62	0.6	6
E604612	Bellekeno_East Decline Wall	P23_W_10			1.5	82	149	1.3	18	210	-0.5	-2	2	1.9	6
E604613	Bellekeno_East Decline Wall	P28_W_0			-0.5	9	138	0.82	7	110	-0.5	-2	0.99	1.6	2
E604614	Bellekeno_East Decline Wall	P28_W_10			0.6	3	64	1.94	12	370	0.6	-2	1.32	-0.5	3
E604615	Bellekeno_East Decline Wall	P28_W_20			3	501	2260	1.01	41	170	-0.5	-2	0.71	29.9	2
E604616	Bellekeno_East Decline Wall	P30_W_0			-0.5	6	35	1.02	13	250	-0.5	-2	6.05	-0.5	2
E604617	Bellekeno_East Decline Wall	P30_W_10			-0.5	4	17	0.53	-5	160	-0.5	-2	2	-0.5	2
E604618	Bellekeno_East Decline Wall	P30_W_20			-0.5	7	46	1.71	5	380	0.5	-2	2.59	-0.5	3
E604619	Bellekeno_East Decline Wall	P30_W_30			-0.5	9	25	0.85	5	180	-0.5	-2	2.61	-0.5	4
E604620	Bellekeno_East Decline Wall	P30_W_40			-0.5	15	20	0.53	-5	100	-0.5	-2	1.88	-0.5	1
E604621	Bellekeno_East Decline Wall	P30_W_50			-0.5	14	34	0.98	6	160	-0.5	-2	4.12	-0.5	4
E604622	Bellekeno_East Decline Wall	P41_W_0			-0.5	4	31	1.58	7	290	-0.5	-2	3.43	-0.5	3
E604623	Bellekeno_East Decline Wall	P41_W_10			-0.5	7	34	2.34	9	400	0.8	-2	1.25	-0.5	3
E604624	Bellekeno_East Decline Wall	P41_W_20			-0.5	6	49	2.92	-5	410	0.8	-2	3.69	-0.5	4
E604625	Bellekeno_East Decline Wall	P41_W_30			-0.5	12	41	3.18	7	490	1	-2	2.41	-0.5	3
E604626	Bellekeno_East Decline Wall	P41_W_40			0.7	5	31	1.3	8	370	-0.5	-2	8.04	-0.5	1
E604627	Bellekeno_East Decline Wall	P41_W_50			-0.5	11	29	0.89	12	190	-0.5	-2	2.82	-0.5	2
E604628	Bellekeno_East Decline Wall	P41_W_60			-0.5	22	62	1.97	17	290	0.5	-2	1.03	-0.5	7
E604629	Bellekeno_East Decline Wall	P41_W_70			2.4	299	2790	5.03	55	880	1.2	-2	4.62	26.1	10
E606292	Bellekeno_East Decline Wall	P5_E_10	4	7.85	-0.5	10	33	2.42	7	360	0.7	-2	2.71	-0.5	2
E606293	Bellekeno_East Decline Wall	P5_e_20	4	8.23	-0.5	10	29	1.61	6	170	-0.5	-2	2.85	-0.5	2
E606294	Bellekeno_East Decline Wall	P5_E_30	2	7.92	-0.5	5	15	0.4	-5	60	-0.5	-2	0.31	-0.5	2
E606295	Bellekeno_East Decline Wall	P5_E_37	4	8.92	-0.5	7	51	1.71	7	240	0.5	-2	1.62	-0.5	4
E606251	Bellekeno_East Decline Wall	P5_W_0	4	8.45	-0.5	12	30	1.73	5	240	0.5	2	3.87	-0.5	2
E606252	Bellekeno_East Decline Wall	P5_W_10	4	8.81	-0.5	11	40	2.45	-5	330	0.6	-2	3.87	-0.5	4
E606253	Bellekeno_East Decline Wall	P5_W_20	2	8.13	-0.5	6	29	2.15	-5	330	0.6	-2	0.44	-0.5	2
E606254	Bellekeno_East Decline Wall	P6_W_0	3	8.63	-0.5	11	38	1.9	-5	280	0.5	-2	1.37	-0.5	3
E606256	Bellekeno_East Decline Wall	P6_W_15.6	4	8.57	-0.5	8	29	1.97	-5	300	0.5	-2	2.03	-0.5	4
E606257	Bellekeno_East Decline Wall	P6_W_25.6	4	8.67	-0.5	11	83	1.75	5	240	-0.5	-2	5.8	0.5	3
E606258	Bellekeno_East Decline Wall	P6_W_35.6	3	7.95	-0.5	12	69	5.09	9	730	1.4	-2	2.33	-0.5	8
E606255	Bellekeno_East Decline Wall	P6_W_5.6	4	8.91	-0.5	5	17	0.83	-5	110	-0.5	2	1.37	-0.5	3
E606259	Bellekeno_East Decline Wall	P7_W_0	4	8.43	-0.5	10	39	2.02	9	270	0.5	-2	4.43	-0.5	3
E606260	Bellekeno_East Decline Wall	P7_W_10	4	8.28	-0.5	8	41	1.88	8	260	0.5	-2	1.85	-0.5	5
E606261	Bellekeno_East Decline Wall	P7_W_20	2	8.03	-0.5	5	37	1.84	8	250	0.5	-2	0.74	-0.5	2
E606262	Bellekeno_East Decline Wall	P7_W_30	4	8.10	-0.5	7	14	0.86	-5	120	-0.5	-2	2.22	-0.5	2
E606263	Bellekeno_East Decline Wall	P8_W_0	3	8.44	-0.5	6	17	0.74	5	120	-0.5	-2	0.87	-0.5	2
E606264	Bellekeno_East Decline Wall	P8_W_10	4	8.34	-0.5	8	31	1.25	-5	180	-0.5	-2	2.73	-0.5	3
E606265	Bellekeno_East Decline Wall	P8_W_20	4	8.17	-0.5	8	34	1.86	7	280	0.5	-2	2.83	-0.5	3
E606266	Bellekeno_East Decline Wall	P8_W_30	4	8.30	-0.5	13	36	1.3	9	200	-0.5	-2	2.66	-0.5	3
E606267	Bellekeno_East Decline Wall	P8_W_40	4	7.97	-0.5	7	22	1.92	15	260	0.6	-2	1.18	-0.5	3

SampleID	Cr_ppm	Cu_ppm	Fe_pct	Ga_ppm	K_pct	La_ppm	Mg_pct	Mn_ppm	Mo_ppm	Na_pct	Ni_ppm	P_ppm	S_pct	Sb_ppm	Sc_ppm	Sr_ppm	Th_ppm	Ti_pct
E604634	58	10	1.55	10	0.75	20	0.09	169	-1	0.05	17	410	0.45	8	5	56	-20	0.15
E604635	10	463	9.75	10	0.1	10	0.18	22100	-1	0.01	15	110	4.66	453	1	23	-20	0.01
E604636	74	22	1.95	10	1.15	20	0.26	570	1	0.09	26	650	1.14	11	7	94	-20	0.24
E604637	114	74	4.89	10	0.59	10	0.11	263	5	0.08	55	630	0.75	8	4	128	-20	0.15
E604638	22	2	0.71	-10	0.17	10	0.17	227	-1	0.01	3	640	0.26	-5	2	212	-20	0.05
E604639	3	227	11.1	20	0.19	10	2.57	1680	-1	1.47	36	770	0.03	-5	40	255	-20	1.73
E604640	13	289	12.5	30	0.37	10	2.27	1960	-1	1.15	22	1090	0.11	8	40	181	20	1.92
E604594	107	198	8.81	20	0.13	10	3.46	1425	1	1.91	68	690	0.02	-5	37	279	-20	1.04
E604643	105	175	9.17	20	0.11	10	3.42	1545	-1	2	71	630	0.03	5	35	280	-20	0.95
E604642	9	321	10.35	30	0.11	10	2.34	1660	-1	1.77	27	980	0.03	5	36	343	-20	1.41
E604641	1	429	11.4	30	0.43	10	1.83	1880	-1	1.83	4	1380	0.03	-5	37	228	-20	1.6
E606296	122	42	2.02	-10	0.07	10	0.13	399	7	0.04	23	210	0.1	-5	1	23	-20	0.06
E606297	124	30	1.8	-10	0.16	10	0.12	411	7	0.03	24	190	0.12	-5	1	70	-20	0.05
E604611	99	186	5.29	10	0.36	10	0.12	15550	3	0.07	12	990	1.58	76	3	21	-20	0.05
E606298	110	37	2.6	-10	0.62	20	0.32	369	5	0.1	25	670	0.74	-5	5	135	-20	0.17
E606299	76	41	1.59	-10	0.11	-10	0.07	161	4	0.01	17	150	0.11	-5	1	24	-20	0.04
E606300	133	56	3.23	10	1.02	30	0.14	180	4	0.32	35	890	1.94	-5	8	301	-20	0.29
E604601	114	98	3.98	10	0.19	10	0.56	551	4	0.14	31	420	0.19	-5	13	83	-20	0.34
E604603	87	16	1.31	10	0.64	20	0.13	102	2	0.1	16	500	0.58	-5	4	63	-20	0.14
E604602	89	19	1.51	-10	0.23	10	0.17	167	4	0.04	14	250	0.26	-5	2	45	-20	0.06
E604604	117	79	2.42	-10	0.48	20	0.35	258	5	0.06	26	650	0.39	-5	4	116	-20	0.13
E604605	66	16	1.56	-10	0.18	10	0.34	206	3	0.01	10	630	0.14	-5	2	23	-20	0.06
E604606	116	39	1.7	10	0.86	20	0.16	129	4	0.12	21	400	0.23	-5	5	87	-20	0.17
E604608	178	32	5.22	20	1.73	40	0.77	330	5	0.39	59	1230	0.19	-5	17	269	20	0.36
E604607	199	35	4.77	20	1.79	40	0.61	290	7	0.45	59	1230	0.17	-5	16	345	20	0.32
E604609	177	49	5.13	20	1.37	30	0.48	381	5	0.34	56	1090	0.14	-5	16	228	-20	0.34
E604610	118	42	1.76	-10	0.12	10	0.04	251	7	0.02	18	300	0.02	-5	1	66	-20	0.04
E604630	41	139	2.97	-10	0.12	10	0.03	597	5	0.02	26	380	0.06	6	1	22	-20	0.04
E604631	40	20	1.19	-10	0.49	10	0.2	189	-1	0.09	9	510	0.41	-5	4	141	-20	0.12
E604632	54	41	2.1	-10	0.36	10	0.12	206	2	0.02	14	380	0.45	-5	2	29	-20	0.07
E604633	51	78	3.26	-10	0.12	-10	0.01	1140	6	0.01	42	180	0.01	8	1	10	-20	0.02
E606268	68	20	1.25	-10	0.33	10	0.14	106	2	0.04	15	360	0.28	-5	3	93	-20	0.09
E606269	127	29	2.68	10	0.94	20	0.22	141	4	0.1	30	370	0.49	5	8	78	-20	0.25
E606270	82	16	1.46	-10	0.14	10	0.11	154	4	0.02	18	190	0.21	-5	1	190	-20	0.05
E606271	135	38	3.19	10	1.16	20	0.5	255	4	0.13	37	670	0.63	5	10	277	-20	0.25
E606272	118	45	2.82	10	0.78	20	0.48	249	6	0.08	33	770	0.46	-5	6	271	-20	0.17
E606273	108	31	1.68	-10	0.19	10	0.08	136	6	0.02	21	240	0.26	-5	2	32	-20	0.07
E606274	100	42	1.63	-10	0.3	10	0.08	118	4	0.03	21	260	0.49	-5	2	38	-20	0.1
E606275	120	50	1.88	-10	0.17	10	0.11	166	6	0.02	22	270	0.27	-5	1	50	-20	0.06
E606276	101	26	1.5	-10	0.15	10	0.11	249	7	0.02	16	230	0.2	-5	1	37	-20	0.04
E606277	62	13	1.51	10	0.28	10	0.18	155	5	0.04	17	330	0.54	-5	2	109	-20	0.08
E606278	66	17	1.31	-10	0.06	-10	0.06	118	5	0.02	12	140	0.15	-5	1	26	-20	0.04
E606279	65	10	1.05	-10	0.08	-10	0.08	88	5	0.01	11	160	0.22	-5	1	14	-20	0.05
E606280	111	26	1.59	-10	0.13	10	0.09	128	7	0.03	20	260	0.35	-5	1	32	-20	0.07
E606281	92	35	2.08	-10	0.27	10	0.24	203	5	0.05	21	340	0.33	6	3	72	-20	0.07
E606282	210	52	6.24	10	1.59	40	0.92	515	7	0.16	68	950	0.42	-5	15	221	20	0.16
E606283	106	20	3.73	10	1.03	20	0.6	315	3	0.09	41	580	0.22	-5	10	134	-20	0.15
E606284	109	43	3.43	-10	0.27	10	0.36	314	6	0.03	24	530	0.41	8	3	54	-20	0.07
E606285	107	35	3.51	10	0.92	20	0.63	330	5	0.09	34	600	0.37	-5	8	119	-20	0.13
E606286	99	33	3.65	10	0.97	30	0.55	558	3	0.07	38	610	0.11	-5	10	121	-20	0.18
E606287	94	20	3.11	10	0.77	20	0.39	2120	4	0.07	33	420	0.37	5	6	99	-20	0.13
E606288	107	41	3.39	10	0.97	20	0.37	466	4	0.08	44	640	0.62	-5	9	111	-20	0.21

SampleID	Cr_ppm	Cu_ppm	Fe_pct	Ga_ppm	K_pct	La_ppm	Mg_pct	Mn_ppm	Mo_ppm	Na_pct	Ni_ppm	P_ppm	S_pct	Sb_ppm	Sc_ppm	Sr_ppm	Th_ppm	Ti_pct
E606289	87	28	2.21	-10	0.36	10	0.26	2880	4	0.04	21	350	0.46	-5	3	73	-20	0.07
E606290	62	13	1.22	-10	0.22	10	0.13	245	3	0.03	15	300	0.44	-5	2	64	-20	0.07
E606291	116	23	2.61	10	0.56	20	0.59	277	7	0.08	35	800	0.97	-5	5	172	-20	0.14
E604612	174	78	4.75	-10	0.29	10	0.26	460	9	0.03	43	790	0.72	6	3	76	-20	0.06
E604613	45	14	1.59	-10	0.13	10	0.18	328	1	0.03	7	520	0.3	-5	2	33	-20	0.07
E604614	40	13	1.68	10	0.42	10	0.27	176	1	0.07	11	420	0.39	-5	4	69	-20	0.12
E604615	39	13	3.11	-10	0.33	10	0.18	6650	1	0.04	8	410	1.06	-5	2	18	-20	0.07
E604616	38	6	1.44	-10	0.22	10	0.28	214	1	0.04	9	550	0.7	-5	2	135	-20	0.05
E604617	36	4	0.81	-10	0.15	10	0.13	116	1	0.02	3	320	0.45	-5	1	37	-20	0.05
E604618	46	17	1.21	10	0.44	10	0.25	112	1	0.06	11	380	0.66	-5	3	97	-20	0.1
E604619	77	77	3.48	-10	0.21	10	0.11	181	4	0.03	37	380	0.36	-5	2	77	-20	0.06
E604620	29	111	0.77	-10	0.14	-10	0.13	67	-1	0.01	5	210	0.2	-5	1	51	-20	0.04
E604621	56	71	3.25	-10	0.26	10	0.22	215	3	0.03	27	400	0.27	6	2	162	-20	0.05
E604622	43	29	1.37	-10	0.42	10	0.29	104	1	0.04	10	500	0.23	-5	3	107	-20	0.09
E604623	53	30	1.05	10	0.63	10	0.19	69	-1	0.11	9	330	0.38	-5	4	118	-20	0.17
E604624	60	16	1.71	10	0.67	20	0.36	122	1	0.08	14	400	0.29	-5	5	185	-20	0.17
E604625	62	36	1.78	10	0.82	20	0.41	105	1	0.11	15	440	0.52	-5	6	152	-20	0.18
E604626	40	8	1.11	-10	0.32	10	0.28	123	1	0.05	8	490	0.72	-5	3	198	-20	0.07
E604627	33	10	1.39	-10	0.22	10	0.21	198	1	0.02	6	870	0.68	-5	2	61	-20	0.05
E604628	64	91	4.77	10	0.37	10	0.22	322	5	0.06	41	610	0.55	7	4	68	-20	0.08
E604629	92	84	8.04	10	1.83	20	0.38	14900	5	0.12	51	800	0.8	12	10	150	-20	0.13
E606292	107	22	1.79	10	0.37	10	0.08	182	5	0.07	21	450	0.43	-5	4	99	-20	0.15
E606293	66	24	1.62	-10	0.21	10	0.07	119	3	0.05	16	360	0.11	-5	3	117	-20	0.14
E606294	89	22	1.68	-10	0.06	-10	0.02	134	5	0.01	19	170	0.06	-5	1	14	-20	0.05
E606295	94	40	1.61	-10	0.23	10	0.17	182	5	0.1	29	310	0.13	-5	3	69	-20	0.1
E606251	96	79	1.74	10	0.32	10	0.22	180	5	0.06	18	430	0.23	-5	3	125	-20	0.11
E606252	89	46	1.73	10	0.45	10	0.22	165	3	0.07	18	550	0.3	-5	4	159	-20	0.17
E606253	86	32	1.64	10	0.45	20	0.09	99	3	0.05	18	460	0.19	-5	4	65	-20	0.15
E606254	95	39	1.88	-10	0.39	10	0.26	166	5	0.05	22	460	0.36	-5	4	81	-20	0.12
E606256	112	35	2.13	-10	0.39	20	0.25	156	4	0.05	24	430	0.43	-5	4	92	-20	0.15
E606257	112	66	2.1	-10	0.32	10	0.36	206	6	0.04	26	450	0.41	-5	3	184	-20	0.1
E606258	161	29	2.65	10	1.04	30	0.29	158	5	0.14	42	1100	0.76	-5	8	211	-20	0.3
E606255	79	22	1.29	-10	0.15	10	0.14	102	4	0.02	13	190	0.21	-5	2	54	-20	0.07
E606259	100	42	1.9	10	0.4	10	0.28	204	5	0.05	22	400	0.33	-5	4	173	-20	0.12
E606260	87	24	1.87	-10	0.37	10	0.32	142	4	0.05	25	330	0.52	-5	4	84	-20	0.12
E606261	86	18	1.38	10	0.34	10	0.14	89	3	0.04	18	360	0.38	-5	3	65	-20	0.13
E606262	88	32	1.51	-10	0.17	10	0.08	188	4	0.03	16	360	0.3	-5	1	69	-20	0.07
E606263	84	25	1.42	-10	0.17	10	0.07	113	4	0.02	16	220	0.36	-5	1	34	-20	0.06
E606264	82	30	1.87	-10	0.25	10	0.24	153	4	0.03	19	360	0.73	-5	3	98	-20	0.07
E606265	129	40	2.03	-10	0.39	10	0.33	206	6	0.06	26	360	0.35	-5	3	115	-20	0.1
E606266	93	31	1.71	-10	0.28	10	0.17	180	5	0.04	20	330	0.43	-5	2	117	-20	0.07
E606267	110	23	1.63	-10	0.36	10	0.1	129	5	0.07	23	540	0.44	-5	3	113	-20	0.15

SampleID	Tl_ppm	U_ppm	V_ppm	W_ppm	MPA	FIZ_RATE	NNP	NP	pH	NP_MPA	S_IR08	S_GRA06a	S_CAL06	C_GAS05	CO2_GAS05
E604634	-10	-10	47	-10											
E604635	20	20	8	30	145.60	2	-88	58	7.90	0.40	4.66	-0.01	4.66	1.15	4.20
E604636	-10	-10	77	-10											
E604637	-10	-10	61	-10											
E604638	-10	-10	15	-10											
E604639	-10	10	782	-10	1.30	2	45	46	8.50	36.80	0.04	0.01	0.03	0.48	1.80
E604640	-10	-10	572	-10											
E604594	-10	-10	346	-10											
E604643	-10	10	329	-10	0.90	2	38	39	8.50	41.60	0.03	-0.01	0.03	0.37	1.40
E604642	-10	10	415	-10											
E604641	-10	10	210	-10											
E606296	-10	-10	10	-10											
E606297	-10	-10	14	-10											
E604611	-10	-10	28	10	50.30	2	-12	38	6.50	0.76	1.61	0.03	1.58	0.58	2.10
E606298	-10	-10	49	-10											
E606299	-10	-10	9	-10	3.80	2	21	25	8.40	6.67	0.12	0.01	0.11	0.23	0.80
E606300	-10	-10	87	-10											
E604601	-10	-10	125	-10											
E604603	-10	-10	49	-10	18.80	2	-6	13	8.10	0.69	0.60	0.02	0.58	0.14	0.50
E604602	-10	-10	19	-10											
E604604	-10	-10	44	-10											
E604605	-10	-10	21	-10											
E604606	-10	-10	58	-10											
E604608	-10	-10	159	-10											
E604607	-10	-10	159	-10	5.60	2	60	66	8.60	11.73	0.18	0.01	0.17	0.81	3.00
E604609	-10	-10	153	-10											
E604610	-10	-10	11	-10											
E604630	-10	-10	15	-10											
E604631	-10	-10	33	-10											
E604632	-10	-10	24	-10											
E604633	-10	-10	12	-10											
E606268	-10	-10	29	-10	9.10	2	67	76	8.30	8.39	0.29	0.01	0.28	0.94	3.50
E606269	-10	-10	79	-10											
E606270	-10	-10	15	-10											
E606271	-10	-10	90	-10											
E606272	-10	-10	61	-10	14.70	3	227	242	8.30	16.48	0.47	0.01	0.46	3.06	11.20
E606273	-10	-10	16	-10											
E606274	-10	-10	23	-10											
E606275	-10	-10	15	-10											
E606276	-10	-10	12	-10	6.60	2	32	39	8.50	5.94	0.21	0.01	0.20	0.44	1.60
E606277	-10	-10	25	-10											
E606278	-10	-10	8	-10											
E606279	-10	-10	9	-10											
E606280	-10	-10	18	-10	11.30	2	10	21	8.20	1.87	0.36	0.01	0.35	0.23	0.80
E606281	-10	-10	29	-10											
E606282	10	-10	153	-10											
E606283	-10	-10	102	-10											
E606284	-10	-10	36	-10	13.10	2	40	53	8.30	4.04	0.42	0.01	0.41	0.65	2.40
E606285	-10	-10	81	-10											
E606286	-10	-10	97	-10											
E606287	-10	-10	59	-10											
E606288	-10	-10	95	-10	19.70	2	17	37	8.20	1.88	0.63	0.01	0.62	0.48	1.70

SampleID	Tl_ppm	U_ppm	V_ppm	W_ppm	MPA	FIZ_RATE	NNP	NP	pH	NP_MPA	S_IR08	S_GRA06a	S_CAL06	C_GAS05	CO2_GAS05
E606289	-10	-10	28	-10											
E606290	-10	-10	24	-10											
E606291	-10	-10	60	-10											
E604612	-10	-10	37	-10	22.50	2	48	70	8.40	3.11	0.72	-0.01	0.72	0.84	3.10
E604613	-10	-10	20	-10											
E604614	-10	-10	43	-10											
E604615	-10	-10	25	10											
E604616	-10	-10	22	-10	21.90	3	132	154	8.10	7.04	0.70	-0.01	0.70	1.99	7.30
E604617	-10	-10	14	-10											
E604618	-10	-10	32	-10											
E604619	-10	-10	23	-10											
E604620	-10	-10	10	-10	6.30	2	50	56	8.40	8.96	0.20	-0.01	0.20	0.70	2.60
E604621	-10	-10	23	-10											
E604622	-10	-10	29	-10											
E604623	-10	-10	42	-10											
E604624	-10	-10	51	-10	9.40	3	98	107	8.30	11.41	0.30	0.01	0.29	1.35	5.00
E604625	-10	-10	56	-10											
E604626	-10	-10	27	-10											
E604627	-10	-10	22	-10											
E604628	-10	-10	48	-10	17.20	2	27	44	8.10	2.56	0.55	-0.01	0.55	0.41	1.50
E604629	10	-10	105	10											
E606292	-10	-10	49	-10											
E606293	-10	-10	41	-10											
E606294	-10	-10	11	-10	2.20	2	9	11	8.10	5.03	0.07	0.01	0.06	0.09	0.40
E606295	-10	-10	31	-10											
E606251	-10	-10	33	-10											
E606252	-10	-10	48	-10	10.00	2	80	90	8.20	9.00	0.32	0.02	0.30	1.11	4.10
E606253	-10	-10	43	-10											
E606254	-10	-10	37	-10											
E606256	-10	-10	39	-10	14.10	2	42	56	8.20	3.98	0.45	0.02	0.43	0.67	2.40
E606257	-10	-10	32	-10											
E606258	-10	-10	95	-10											
E606255	-10	-10	17	-10											
E606259	-10	-10	36	-10											
E606260	-10	-10	33	-10	16.60	2	37	54	8.00	3.26	0.53	0.01	0.52	0.68	2.50
E606261	-10	-10	36	-10											
E606262	-10	-10	17	-10											
E606263	-10	-10	16	-10											
E606264	-10	-10	24	-10	23.10	2	51	74	8.10	3.20	0.74	0.01	0.73	0.91	3.30
E606265	-10	-10	34	-10											
E606266	-10	-10	24	-10											
E606267	-10	-10	40	-10											

Alexco Keno Hill Mining Corp
1150-200 Granville Street
Vancouver BC V6C 1S4

April 27th, 2010

Yukon Water Board
Suite 106, 419 Range Road
Whitehorse, Yukon   Y1A 3V1

Attention: Ms. Carola Scheu, Manager

Dear Ms. Scheu:

Re: Bellekeno Mine Water Licence Application QZ09-092,
Response to Yukon Water Board Letter dated April 21, 2010 re: Review for Adequacy and Supplemental Information

Further to our receipt of the above noted letter and our subsequent meetings with you, the following provides our responses to the issues raised in your letter. Our response follows the paragraph numbering in your letter. Additional documents that we are including as components of our responses are submitted as attachments to the response.

1. Water Management Preliminary Designs

The issues related to the Land Application System are addressed as follows. The other design issues raised in item 1 are addressed in correspondence from EBA dated April 23, 2010, please see Attachment A.

The mill pond discharge will be directed to a surface land application system capable of handling 10 liters per second peak event flow.

The terminus of the system will be located approximately 200 meters downslope from the mill pond, as shown on Figure 6-8 of the Main Application report, September 2009.

Point of discharge will be just below the Christal Lake access road, and approximately 50 meters upslope from Christal Creek.

A preliminary design of the discharge system consists of a 200 meter long 6” HDPE or Yelowmine pipe that will collect water from the mill pond and directs it into a series of ~ 2” HDPE or Yelowmine lateral distribution pipes. Drip emitters or open air atomizers would be fed off of the lateral distribution pipes. Typical application rates of the system are on the order of 0.12 lpm/m^2.

The discharge will be directed onto the approximately 0.5 meter to 1.2 meter thick peat-rich organic mat, above the soil strata, and eventually will report to Christal Creek at a point approximately 350 meters upstream from Christal Lake.

Routine inspection of this system will include examining the drip emitters and pipe connection to ensure no breaks or blockage in the piping, or soil erosion occurring. Corrections and or repairs will be rapidly affected if needed. A picture of a similar land application system installed and operated by Alexco at the Brewery Creek Mine is shown in Figure 1.

Figure 1. Alexco installed land application system at Brewery Creek Mine

2. Environmental Monitoring Program

The Minnow report referred to in your letter respects a long term, district wide monitoring program for the closure planning underway for the entire Keno Hill District. With our application, we supplied studies (i.e. the Water Quality Assessment for United Keno Hill Mines and the Aquatic Resources Assessment for United Keno Hill Mines) that were referenced in and used by Minnow to develop its recommendations for long term district wide closure planning as set forth in the draft Minnow Report to which you refer. We supplied these studies in support of our application only because they contain baseline data that is relevant to and helpful for developing a monitoring plan specifically for the Bellekeno Mine project, and we used data from these studies to do so.

Because the Minnow report to which you refer addresses long term monitoring for a district wide closure plan, it is not relevant to this application, and therefore it would not be beneficial to supply the report for the purposes of this application. None of this report was used to support conclusions or management plans developed for the Bellekeno Mine. This is why we have not supplied the report and do not intend to do so

With respect, it is not accurate to consider that the Minnow report would lead to more or less rigorous monitoring provisions in the Bellekeno Mine Type A Water Licence we are seeking, or that monitoring terms of the Bellekeno Mine Water Licence might become immediately obsolete if the licence were to issue in the absence of our provision of the report because the Minnow report does not address and has no relevance for determining appropriate monitoring requirements for the Bellekeno mine project. Again, it deals with closure planning for the Keno Hill District and not the area we are focused on in our water licence application.

In any event, we are advised by Minnow that the recommendations and conclusions of the anticipated work currently being carried out by Minnow will not significantly vary from work to date.

For all of these reasons, we respectfully submit that the Minnow report, whether in draft or final form, should not be required as a pre-requisite for the Board to make a determination of adequacy on our application, or to the determination of the terms of the water licence for the Bellekeno mine. Our application addresses both our proposed monitoring program for the Bellekeno mine and our proposed licence term respecting monitoring.

We append a letter as Attachment D from Minnow dated April 27, 2010, which sets out our consultant's explanation of the above.

3. Outstanding Hydrology Data

Although the data referred to will not change any of the conclusions upon which our application is based, and was for this reason not used in our application, it is presented herewith in its unprocessed (raw) form. We are presently in the process of converting that data as part of our site wide monitoring and will submit the converted data during the public review.

4. Clarification of Mill Water Use

We confirm that the amount of water we are requesting for the mill water use is 81 m^3/day, which is 64.8 m^3/day with a 25% contingency.

5. Outstanding SRK Geochemical Report

A portion of the SRK report entitled 2007/08 Geochemical Studies, Keno Hill Silver District, YT referred to in page 5-21 of the Main Application Report (Exhibit 1.1) is provided as Attachment C. This reference provides evidence of the high metal attenuation properties of site, as asserted in the original reference in Exhibit 1.1.

6. Passive Closure Water Treatment Systems

The passive operational phase of the bio-reactor system described in the application and in our Preliminary Decommissioning Plan refers to the occasional augmentation of carbon source to ensure the effective operation of the bioreactor. For greater clarity, our use of the term "passive" is not intended to imply total 'walk away' closure; rather it is used to denote the lowest possible level of ongoing human intervention after closure. Therefore the data we have already supplied to the Board is descriptive of the process that we intend to employ at Bellekeno on closure.

In any event, the approved preliminary decommissioning and reclamation plan for the mine is part of the Quartz Mining Licence QML-0009, and security to cover the cost of undertaking this plan has been assessed by Government of Yukon and the initial tranche of such security has been posted by Alexco. Similarly, costs for mine pool treatment, presented in the preliminary decommissioning and reclamation plan as a contingency depending on water quality, have been assessed and security has been required by Government of Yukon under the Quartz Mining Licence.

7. Revision of the Application

We accept the comment that with multiple information requests and responses, it may now be more difficult to follow our application. We agree that a consolidation and re-issue of our entire application incorporating all amendments would be ideal. Given the benefit of enough time, we would consolidate all of the materials in support of our application into one document. However, we have long passed the time in our licence processing schedule where this work may be completed without material risk to our critical path and to our proposed project. Over the past several months during the adequacy review period, we understood from your office that the way that we have proceeded was and would continue to be an acceptable approach to responding to adequacy review questions.

However, for ease of review by Board members and intervenors and for the purposes of the public hearing, we will prepare a document that will consolidate and present the critical changes to our application in a manner that makes the application easier to follow and consider.

In order to streamline the review of our application, we intend to hold a series of one-on-one meetings with various stakeholders and specialist regulatory departments (including those who indicated interest in the Bellekeno Mine application during YESAA screening) in the few weeks leading up to the public hearing in order to help them navigate through the materials.

In closing we wish to express our surprise at your assertion that we have delayed in producing critical information that you have requested from us. As you are aware, we have been engaged in an ongoing dialogue with your officials since submitting our water licence application specifically regarding the type and level of detail of information required for the purposes of this application. We have already supplied, either in the application or by way of responses to questions you have asked, the information that you are now requesting in your letter or, alternatively, we have provided the rationale for why we are not supplying certain information, as is now re-iterated in this letter.

We trust you have all of the information you require to declare our application adequate and we look forward to receiving that declaration as soon as possible. Should you have any questions, please contact our office at 604-633-4888.

Sincerely,
Alexco Keno Hill Mining Corp

Robert L. McIntyre, R.E.T., CCEP, AScT.
Vice President, Business Development
Alexco Keno Hill Mining Corp

cc. external D. Buyck, NNDFN, J. Janes, Yukon Water Board
cc. internal C.Nauman, B.Thrall, T.Hall, D.Whittle, Alexco Resource Corp.
M. Pockey, Faskens Martineau; E. Allen, T. Lunday, Access Consulting

Attachments:

Attachment A: EBA Letter April 23, 2010

Attachment B: Raw Hydrology Data, KV-7, KV9, KV-41

*Attachment C: Excerpt from SRK report "*2007/08 Geochemical Studies, Keno Hill Silver District, YT"

Attachment D: Minnow letter April 27, 2010

ALEXCO

ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT A
EBA Letter
(Q-1)

April 23, 2010

CREATING AND DELIVERING BETTER SOLUTIONS
www.eba.ca

April 23, 2010 EBA File: W14101178.003

Alexco Resource Corp.
#3-151 Industrial Road
Whitehorse, Yukon Y1A 2V3

Attention: Mr. Rob McIntyre, Vice President

Subject: Response to Water Board Questions
Water Management Preliminary Designs

1.0 INTRODUCTION

In a meeting held on April 22, 2010 between Alexco Resource Corp. (Alexco), EBA Engineering Consultants Ltd. (EBA), Yukon Water Board and their consultant, Cord Hamilton, P. Eng. (Water Board), several concerns raised by the Water Board specific to the Water License application were discussed. Alexco requested that EBA provide further information with regard to the following three items:

- Physical and flow characteristics of all channels and flumes on the mill site,
- Liner system design for the mill site pond, and
- Spillway design for the mill site pond.

The Water Board determined that they do not have sufficient information to comment on whether or not the channels and flumes were adequately designed to accept the expected flows. The Water Board also requires clarification on whether or not there is a spillway proposed for the Mill Site Pond and if so, clarify the details of the preliminary design and if not, justify the reasoning for leaving it out of the design.

2.0 CHANNELS AND FLUMES

There are two channels and one flume proposed to aid in surface water management of the site. The two channels run along the toe of the proposed Dry-Stacked Tailings Facility (DSTF) and the flume runs from the confluence of the two channels to the proposed Mill Site Pond. These features are shown in Figure 1.

The proposed channels are excavations into the existing gravel soils. Their proposed dimensions are shown in a cross-section in Figure 1. There is no liner proposed for these channels and it is expected that the existing gravel soils will be sufficient to resist the shear forces generated by the flowing water in the channels. Existing ditches observed on site, which were also excavated into the existing gravels have been shown to be capable of conveying water during freshet and summer storm events without significant erosion.

The proposed flume is to be constructed from engineered fill, select gravel borrowed from the area. Its proposed dimensions are shown in a cross-section in Figure 1. A geosynthetic liner system is proposed for the flume. The liner system is not finalized at this time but may be High-Density Polyethylene (HDPE), low-linear-density polyethylene (LLDPE), geosynthetic clay liner (GCL) or other commercially available ditch lining product. The liner system ultimately selected will be designed and installed in accordance with the manufacturer's specifications and recommendations.

Flow depths and velocities for the channels and flumes are summarized in Table 1.

TABLE 1: FLOW CHARACTERISTIC SUMMARY

	Northwest Ditch	Southwest Ditch	Flume
Contributing Area (ha)	2.37	1.41	3.78
Peak Flow (1:200 freshet) (m^3/s)	0.0076	0.0044	0.012
Bottom Width (m)	1	1	1
Sideslopes (H:1V)	2	2	2
Average Gravel (%)	2	5.8	3
Mannings 'n'	0.025	0.025	0.01
Flow Depth (m)	0.02	0.01	0.01
Flow Velocity (m/s)	0.39	0.44	0.91
Minimum D_{50} for gravel (mm)	10	10	Not gravel lined

3.0 MILL SITE POND

The proposed Mill Site Pond is an excavation in existing soils. The preliminary design is for it to be lined with a geosynthetic liner; however, this may be reviewed in the detailed design phase of the project to determine if the native silt in the area can be effectively used to retain water. The currently proposed geosynthetic liner system is shown in Figure 2. The geosythetic to be used has not been determined at this stage; however, it could be an HDPE, LLDPE, or GCL type of product. The liner system ultimately selected will be designed and installed in accordance with the manufacturer's specifications and recommendations.

4.0 MILL SITE POND SPILLWAY

EBA did not provide a preliminary design for a spillway at the Mill Site Pond as it is not likely to be subjected to an overtopping scenario. The pond will have an active discharge, through a water treatment plant by means of a drip emitter. The proposed design flow rate of the drip emitter is 10 L/s, which is the anticipated peak flow rate corresponding to the 1:200 year freshet. Therefore, the pond could only overtop if this discharge system was for some reason inoperative.

The pond has an operating volume of 2,524 m³. Assuming the pond was empty at the beginning of freshet, with no discharge from the pond, it would take until day 8 to fill at a conservative 1:200 year freshet inflow rate for the catchment (6.27 ha) (Clearwater, 2009). However, the pond has a 0.5 m freeboard which must be filled prior to overtopping, corresponding to a total volume of 3,150 m³. It would take until day 11 to fill this volume at a conservative 1:200 year freshet inflow rate for the catchment (Clearwater 2009). This should be sufficient time to either reactivate the existing drip emitter or install a new system of discharge.

However, should the discharge mechanism still be inoperative after day 11 and the Mill Site Pond overtops, the water will begin to flow from the pond overland to the southwest, the low point of the pond crest is shown in Figure 2. The water will most likely infiltrate into the soils west of the pond and ultimately flow in the shallow aquifer to Christal Lake, which is a similar procedure to the proposed method of discharge. The overtopping of the pond crest should not put the pond into any imminent danger of catastrophic failure; however, it may cause some erosion to the southwest and western edges of the facility which could be repaired with onsite equipment.

5.0 CLOSURE

We trust this letter meets your present requirements. Should you have any questions or comments, please contact the undersigned.

Yours truly,
EBA Engineering Consultants Ltd.

CHRISTOPHER J. DIXON

Apr. 23/10

J. RICHARD TRIMBLE

April 23/10

Christopher J. Dixon, P.Eng.
Project Engineer, Yukon Region
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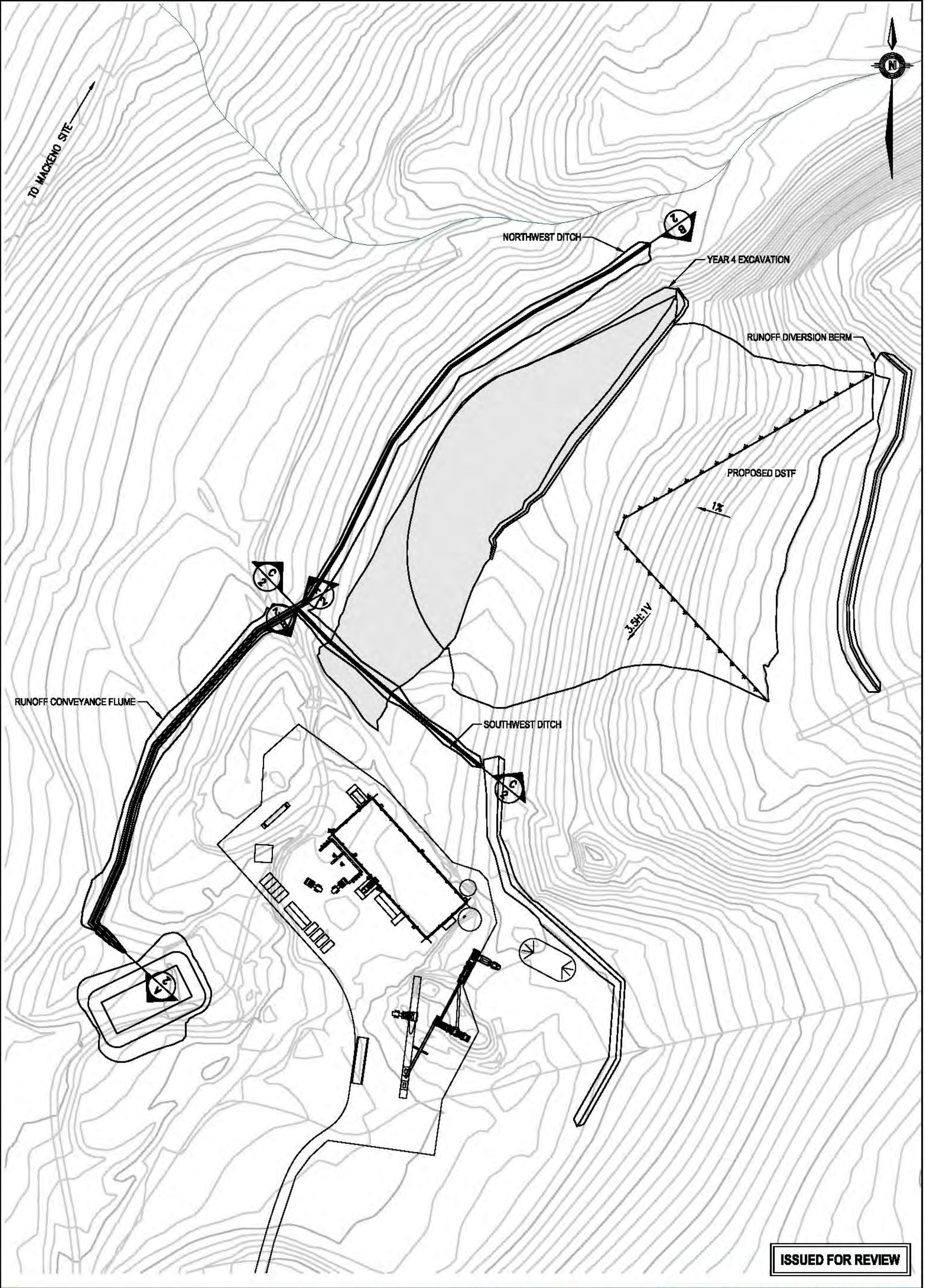
PERMIT TO PRACTICE
EBA ENGINEERING CONSULTANTS LTD.
SIGNATURE
Date April 23/10
PERMIT NUMBER PP003
Association of Professional
Engineers of Yukon

Q:\Whitehorse\Data\0201drawings\Keno\W14101178 Mill Site Search\3 Site Overview\W14101178.003 Engineering Support Services\W14101178003 Figure 1 20100423.dwg [FIGURE 1] April 23, 2010 - 2:37:47 pm (BY: KEN TOMCZYK)



ISSUED FOR REVIEW

CLIENT

ALEXCO

DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

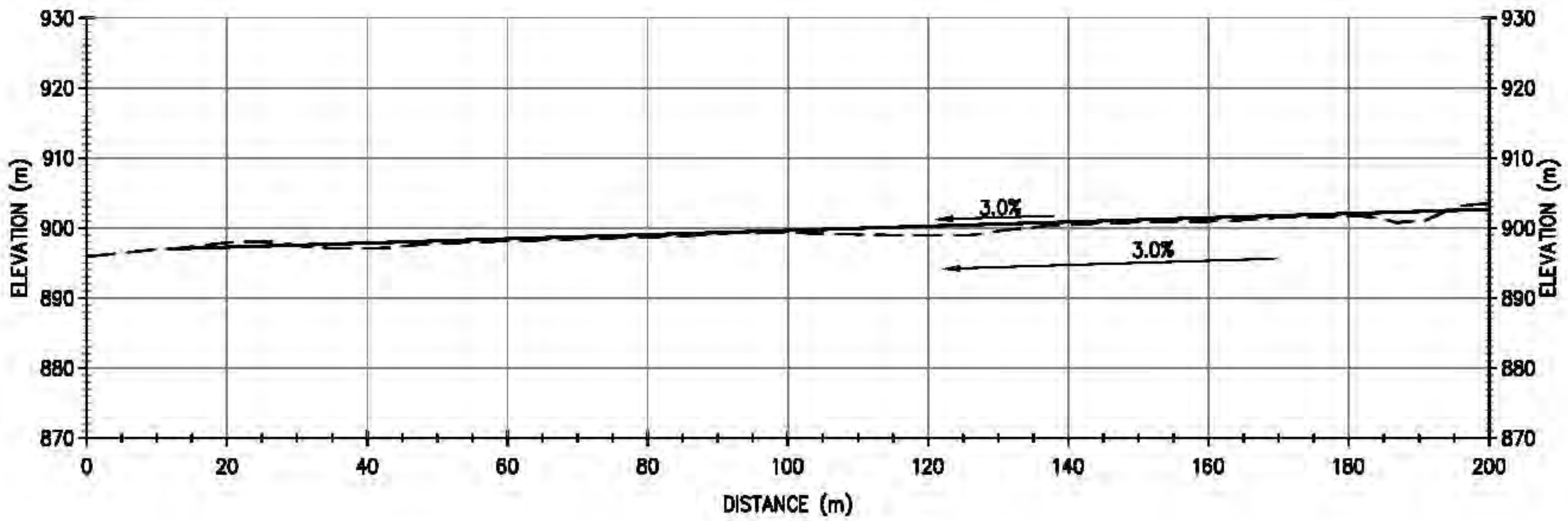
CONVEYANCE NETWORK PLAN

0 50
Scale: 1: 1 500 (metres)

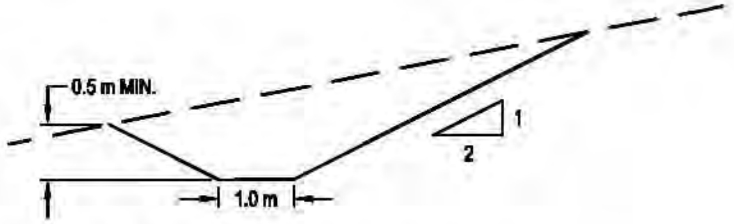
NOTES
1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

EBA Engineering Consultants Ltd.

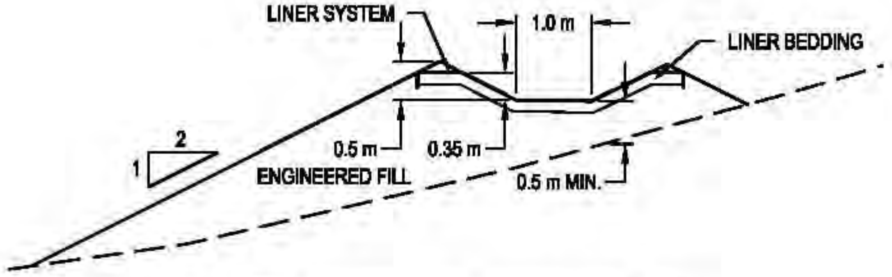
PROJECT NO.	DWN	CKD	REV	
W14101178.003	KJT	CJD	0	**Figure 1**
OFFICE	DATE			
EBA-WHSE	April 23, 2010			



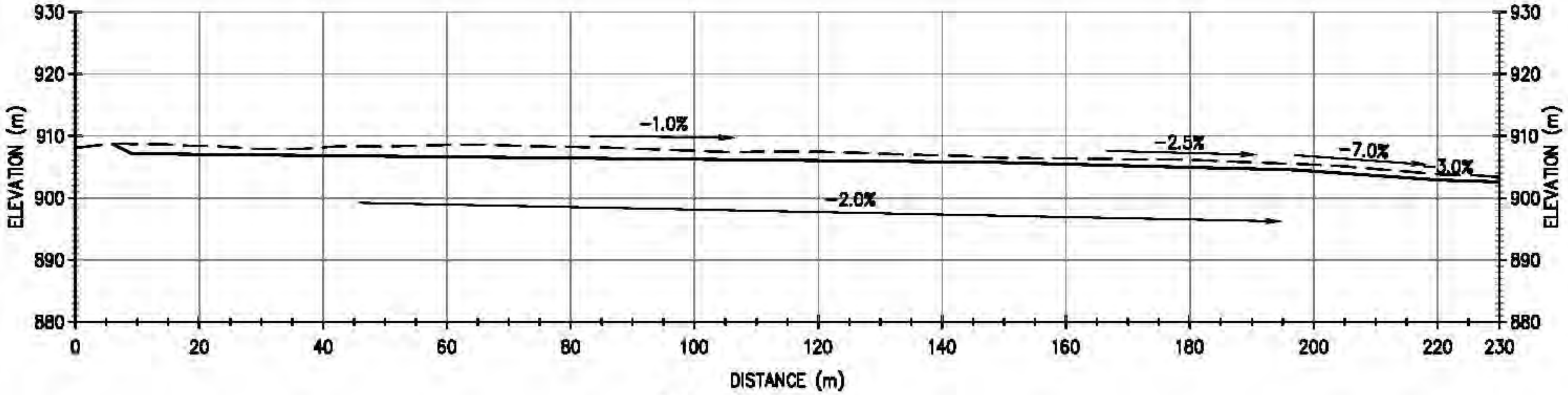
A/1 FLUME PROFILE
SCALE 1:1,000



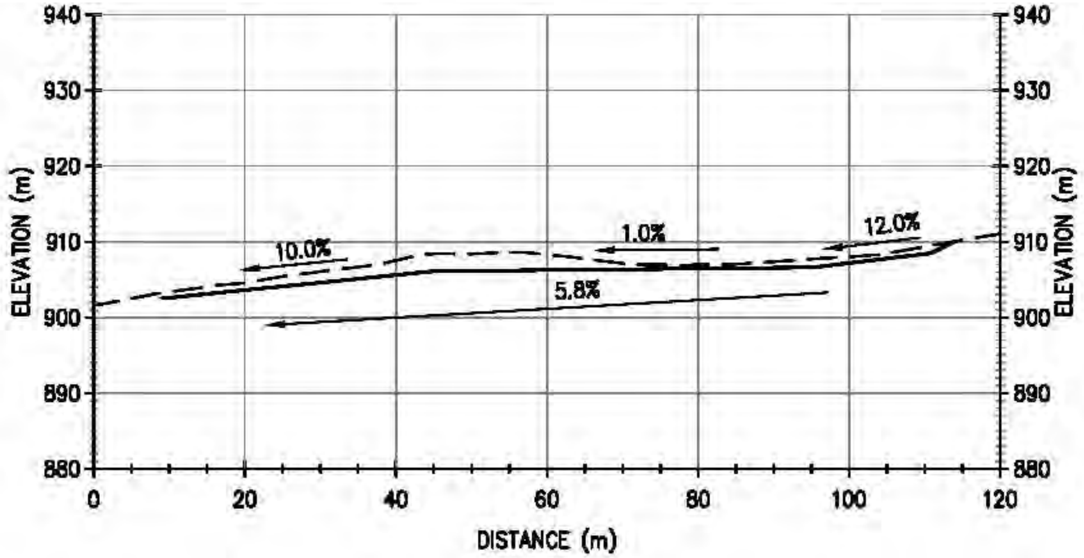
1/1 RUNOFF COLLECTION DITCH DETAIL
SCALE 1:250



2/1 RUNOFF CONVEYANCE FLUME DETAIL
SCALE 1:250



B/1 NORTHWEST DITCH PROFILE
SCALE 1:1,000



C/1 SOUTHWEST DITCH PROFILE
SCALE 1:1,000

ISSUED FOR REVIEW

0 50
Scale: 1: 1000 (metres)

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ALEXCO

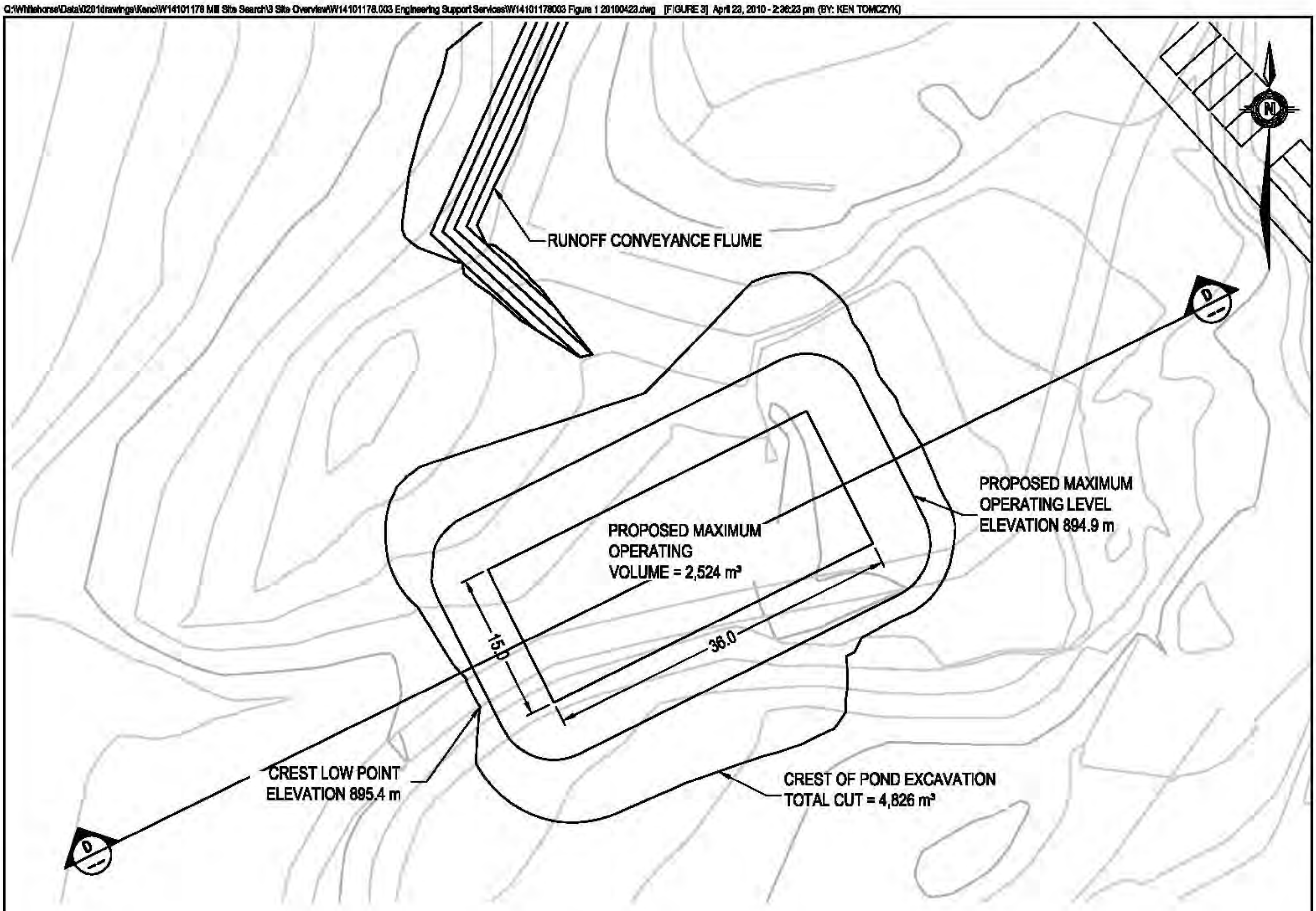
EBA Engineering Consultants Ltd.

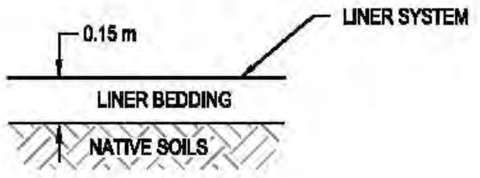
DRY-STACK TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

CONVEYANCE NETWORK PROFILES & DETAILS

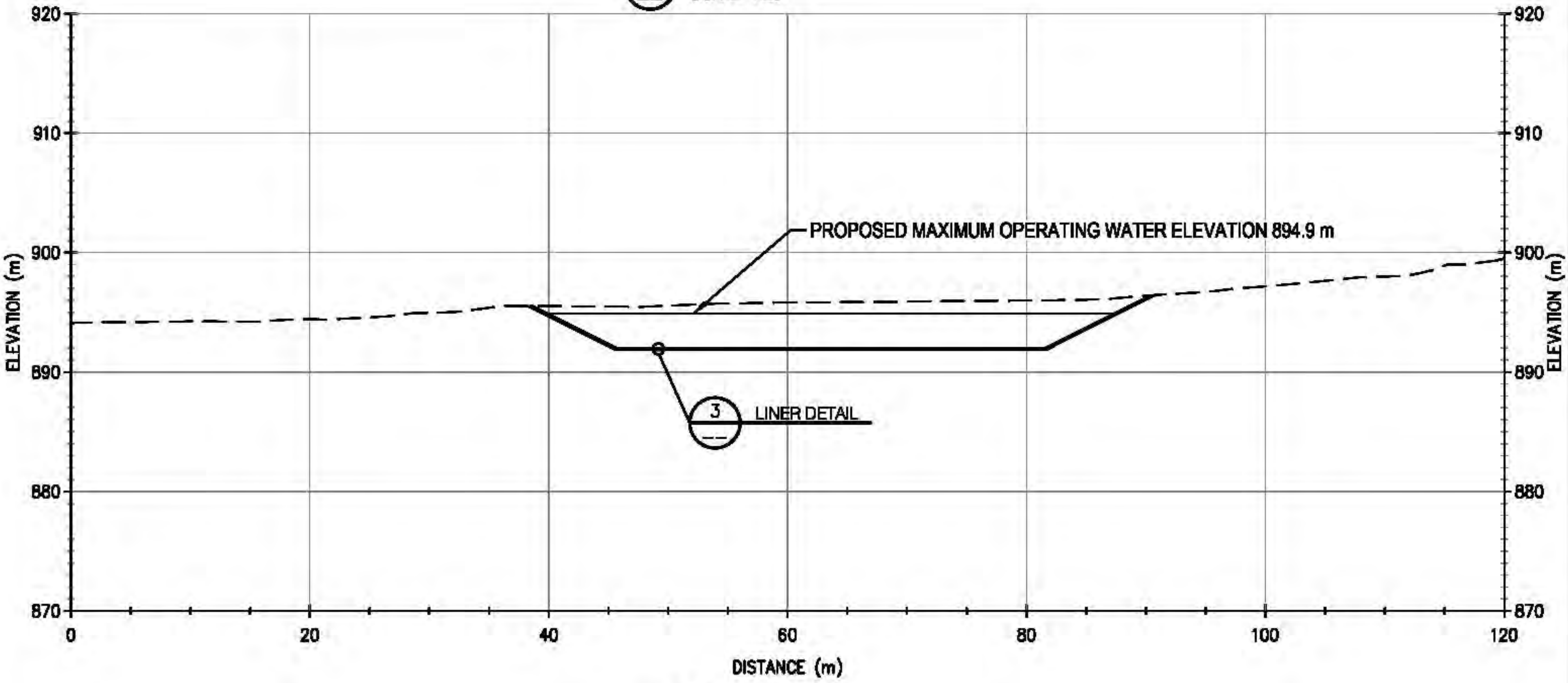
PROJECT NO.	DWN	CKD	REV	
W14101178.003	KJT	CJD	0	Figure 2
OFFICE	DATE			
WHSE	April 23, 2010			

Q:\Whitehorse\Data\0201drawings\Wanda\W14101178 Mill Site Search\3 Site Overview\W14101178.003 Engineering Support Services\W14101178003 Figure 1 20100423.dwg [FIGURE 2] April 23, 2010 - 2:37:18 pm (BY: KEN TOMCZYK)





3 LINER DETAIL
SCALE 1:25



D POND SECTION
SCALE 1:500

ISSUED FOR REVIEW

NOTES

1. NTS MAP ZONE 8 M/14 NAD 83
2. CONTOUR INTERVALS - 1.0 m
3. BASE PLAN/DRAWING PROVIDED BY ALEXCO RESOURCES

0 25
Scale: 1: 500 (metres)

CLIENT
ALEXCO

EBA Engineering Consultants Ltd.

DRY-STACKED TAILINGS FACILITY DESIGN
BELLEKENO MINE MILL SITE, YUKON

WATER COLLECTION POND
PLAN AND PROFILE

PROJECT NO.	DWN	CKD	REV
W14101178.003	KJT	CJD	0

OFFICE: EBA-WHSE
DATE: April 23, 2010

Figure 3

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ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT B

Raw Hydrology Data, KV-7, KV9, KV-41

(Q-3)

April 23, 2010

KV-7 Christal Creek Discharge Data

Date	**Time**	**Staff Gauge (m)**	**Discharge (measured) m^3/sec**
20-Jun-08	13:30	0.31	0.086155
3-Jul-08	10:10	0.38	0.15941
13-Aug-08	11:30	0.5	0.4376
18-Sep-08	15:45	0.42	0.51843
2-Oct-08	9:20	0.5	0.41966
5-Jun-09	15:00	0.4	0.44174
6-Jul-09	15:00	0.37	0.124245
11-Aug-09	14:20	0.39	0.07899
8-Sep-09		0.38	0.26923
6-Oct-09	12:10	0.435	0.22895

Level logger launched July 24, 2008

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BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT C

Excerpt from SRK report "2007/08 Geochemical Studies, Keno Hill Silver District, YT"

(Q-5)

April 23, 2010

2007/08 Geochemical Studies, Keno Hill Silver District, YT

Prepared for:

Elsa Reclamation and
Development Company Ltd.

Prepared by:

SRK Consulting
Engineers and Scientists

Project Reference Number
SRK 1CE012.001

February 2009

2007/08 Geochemical Studies, Keno Hill Silver District, YT

Elsa Reclamation and Development Company Ltd.

1150 – 200 Granville Street
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SRK Project Number 1CE012.001

February 2009

Author
Dylan MacGregor, G.I.T. (B.C.)
Senior Geochemist

Reviewed by
Daryl Hockley, P.Eng.
Principal Consultant

Groundwater chemistry is monitored at Dam 3 in wells GT10 and GT12. Zinc concentrations from October 2007 monitoring (0.005 mg/L in GT10 and 0.006 mg/L in GT12) were used together with the estimated annual groundwater flux (SRK 2008a) of 18 m^3/day to arrive at an estimated zinc load of 0.04 kg Zn/year reporting from the VTF west of Dam #3 via groundwater.

Surface water from the facility is discharged seasonally either through the Dam 3 decant culvert, or by siphoning water over the dam from Pond 3. As discussed in Section 2.4.3, zinc flux leaving the VTF is estimated to be at least 14.9 kg/ year, based on daily monitoring records gathered from November 2007 to October 2008. As was noted, the surface water zinc load is almost certainly somewhat higher than 14.9 kg/yr due to underestimation of Dam #3 decant volumes during peak flows. The combined annual zinc loading estimate leaving the VTF via surface water and groundwater is therefore estimated to be at least 15 kg (>14.9 kg via Dam #3 decant and 0.036 kg via groundwater), and it is clear that the most of the zinc leaving the VTF does so via surface water.

A sensitivity analysis carried out as part of the 2007 groundwater assessment suggested an upper bound on the groundwater flux beneath Dam #3 on the order of 2075 m^3/day (SRK 2008a). At this upper bound groundwater flux, groundwater zinc loading would be 4.2 kg/year, or roughly 25% of the load from the VTF. It is clear that, given the groundwater zinc concentrations observed in 2007, the total zinc load leaving the VTF is not particularly sensitive to the groundwater flux estimate.

Current water management within the VTF includes seasonal lime addition to the Pond 1 decant water as required to lower total zinc concentrations in Pond 3 to less than the discharge limit of 0.5 mg/L. The zinc load removed through lime addition can be estimated from the mass of lime consumed annually at the VTF with an allowance for treatment efficiency. For simple lime addition systems, lime efficiency is commonly in the range of 30%. In 2008, 5.95 tonnes of lime (as CaO) were consumed in VTF water treatment, and a rough estimate of zinc removed from water within the VTF was 2100 kg.

Tailings Porewater Chemistry and the Role of Attenuation

The preceding section discusses the magnitude of zinc loads that leave the VTF annually, with estimated magnitudes of surface water and groundwater loads reflecting zinc concentrations typically less than 0.5 mg/L at Dam 3 (in Pond 3 discharge and in wells GT10 and GT12). These low zinc concentrations in water leaving the VTF are in contrast to some of the measured porewater zinc concentrations discussed in Section 2.4.3. In particular, the porewater within the Old Tailings deposit had zinc concentrations in the 200 to 300 mg/L range (at H4S and at Ditch Seep) in October 2007.

Infiltration of precipitation into the tailings deposits displaces an equivalent volume of porewater. However, the water chemistry in Pond 3, in groundwater beneath the tailings (wells H4D, H5D and H6D), and in groundwater downgradient of the tailings (wells GT7, GT8, GT9, GT10 and GT12) all indicate that contaminant flux out of the tailings is much less than that indicated by zinc concentrations in the Old Tailings porewater. Groundwater sulphate concentrations in the range of hundreds of mg/L, both beneath the tailings and downgradient, indicate that sulphate loading from the tailings is reporting to these monitoring points and that these wells are therefore adequately intercepting the tailings seepage plume. The zinc and sulphate concentrations in tailings porewater and groundwater lead to two conclusions: first, that water chemistry in the existing monitoring wells reflects the influence of tailings seepage, and second, that there is a significant degree of attenuation of zinc and other metals that is occurring.

The monitoring wells installed within and beneath the Old Tailings (H4S and H4D) provide strong evidence that this attenuation process occurs in the peat that is present at the interface between the tailings and the original ground. Monitoring well H4S is screened entirely within the tailings and yielded porewater containing 194 mg/L dissolved zinc and 2794 mg/L sulphate in October 2007. The adjacent monitoring well H4D is screened in silty gravel immediately below the 3 metre thick peat layer, and October 2007 dissolved zinc and sulphate concentrations were 0.48 and 441 mg/L respectively. The sulphate concentrations between the two monitoring points are reduced by about a factor of 6, whereas zinc concentrations are reduced approximately 400 times. Other metals were reduced by lesser factors, including cadmium (126-fold reduction), manganese (57-fold reduction) and iron (15-fold reduction).

At present, the attenuating process that is occurring in the VTF peat is not known, however other studies of zinc attenuation suggest that sorption onto organic matter plays an important role.

- One such study, undertaken along the flowpath of the untreated Galkeno 300 discharge in 2000 found that, under near-surface conditions, attenuation in peat occurred largely by adsorption to organic matter and by co-precipitation of zinc with manganese oxide minerals (MacGregor, 2002).

- Another study conducted on the Rose Creek tailings facility at the Faro Mine in 2005 found that zinc was being removed from tailings porewater by sorption onto peat. Testing of peat samples recovered from beneath the tailings area found high zinc concentrations in the organic material, and good correlations between zinc concentration and organic carbon. Attenuated zinc mass was found to be typically 8 to 9% of the mass of organic carbon, with individual estimates ranging up to 24% (mass Zn/mass C) (SRK, 2006). There was no evidence that the zinc removal capacity was exhausted at these levels of attenuation.

Although the Rose Creek peat may have had slightly higher or lower capacity to attenuate zinc, the typical attenuation of 9% Zn per unit of organic carbon can be used to determine the scale of attenuation capacity that is likely to be provided by the peat underlying the VTF. Assuming a peat dry bulk density of 250 kg/m^3 and an average organic carbon content of 39% (Hossain, 2006), a peat layer one metre thick could attenuate about 9 kg of zinc per m^2 of plan surface area.

Observed peat thicknesses were 3 m (H4D), 2 m (H5D), and 0.5 m (H6D). The flatter areas (at H4D and H5D) appeared to have thicker accumulations of peat, with the Old Tailings borehole (H4D) returning the thickest intersection of peat. Using the parameters noted above, 2 m of peat could attenuate about 18 kg of zinc per unit of plan surface area, and a 3m thick peat layer could attenuate about 26 kg zinc/ m^2.

The total mass of zinc contained within the tailings provides an upper bound for total zinc that could possibly be leached from the tailings over time. The average zinc content of the Old Tailings samples tested in 2007 was 0.5% Zn. Assuming an average 2 m thickness of tailings, and using a tailings bulk density of 2000 kg/m^3, the estimated total mass of zinc in the Old Tailings is equivalent to about 21 kg Zn per m^2 of surface area.

The average contained zinc mass of 21 kg/m^2 is in the range of attenuation capacity of 2 to 3 m of peat by sorption processes alone. There are a number of other geochemical processes which may also contribute to limiting zinc flux from the VTF, including: sorption to iron hydroxides and manganese oxides, both within the tailings and potentially within the peat and underlying mineral soils; sorption to clays in the underlying mineral soils; and potentially sulphate reduction and precipitation of metal sulphides within the peat and in underlying mineral soils.

Complete leaching of all contained zinc from the tailings is highly unlikely due to several factors. One is that a considerable portion of the tailings are presently saturated, and any zinc sulphide minerals are isolated from atmospheric oxygen. Secondly, iron oxyhydroxides and manganese oxides within the tailings are effective scavengers of zinc ions from solution through sorption and coprecipitation, and will act to retain zinc within the tailings deposit.

In summary, there appears to be sufficient capacity within the underlying peat to attenuate all the zinc contained within the tailings (should it be released) by sorption alone. There are other processes that are likely to be occurring to varying degrees which will enhance the attenuation capacity provided by the peat. Finally, it is unlikely that 100% of the contained zinc would be leached out of the tailings. Considering all these factors, it is unlikely that zinc loadings to the underlying aquifer will increase significantly in future.

This conclusion relies on an assumption that the tailings will not become strongly acidic, and that sorption within the peat will remain important. The development of strongly acidic conditions could cause release of any metals sorbed to the peat. For this reason it is still necessary to assess the acid generation potential of the tailings; the following section provides a discussion of this topic.

2.5.3 Evaluating Potential for Increase in Metal Loadings Due to Acid Generation

Assessment of AP

Pyritic Sulphur

AP reported from ABA analyses was compared against the AP value calculated from the pyrite abundance reported for each sample by XRD (AP_{XRD}). The results of this comparison are summarized in Table 2-14, which illustrates that the reported AP values are a conservative

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ALEXCO KENO HILL MINING CORP.

BELLEKENO TYPE A WATER LICENCE APPLICATION QZ09-092 –

Response to Review for Adequacy and Supplemental Information

ATTACHMENT D

Minnow Letter Re: Clarification of Intended Minnow Reports (Q-2)

April 23, 2010

minnow
environmental inc.

2 Lamb Street
Georgetown, Ontario
L7G 3M9

April 27, 2010

Access Consulting Group
A Member of Alexco Resources Corp.
Suite 1150, 200 Granville Street
Vancouver, B.C.
V6C 1S4

Attention: Mr. Robert McIntyre

Re: Clarification of Intended Use of Minnow Reports

Dear Mr. McIntyre;

As you are aware, Minnow Environmental Inc. (Minnow) has completed the following reports for Access Consulting Group;

1. Water Quality Assessment Report for United Keno Hill Mines. Prepared for Elsa Reclamation and Development Company, Whitehorse, YT, July 2008.
2. Aquatic Resource Assessment Report for United Keno Hill Mines. Prepared for Elsa Reclamation and Development Company, Whitehorse, YT, March 2009.

These reports were prepared for the Elsa Reclamation and Development Company (ERDC) in support of the closure of UKHM. They summarize baseline conditions based on existing information available at the time of their preparation. They are relevant to the Bellekeno mine, insofar as they provide baseline information for the Bellekeno project area. Conclusions and recommendations from these reports are not relevant to the Bellekeno Mine but rather are intended to be considered in the context of the closure plan.

In addition to the reports noted above, Minnow is also in the process of completing a Long-Term Aquatic Monitoring Program (LTAMP) report in support of the closure plan. This report entitled "*Long-Term Aquatic Monitoring Program for United Keno Hill Mine*" is currently in draft form and the monitoring design will not be finalized for a few years when sufficient water quality data is available. The scope of this report pertains to the long-term district-wide closure monitoring for the UKHM and does not have material relative to the Bellekeno Mine project nor was the Bellekeno Mine project considered in its development. Further, the recommendations and conclusions of this report will not change in light of the outcome/findings of the modeling and environmental management plans for the Bellekeno Mine.

In summary, the initial two reports prepared by Minnow may be relevant to the Bellekeno project in that they summarize baseline information for the region which includes part of the Bellekeno study area. However, the long-term aquatic monitoring program was not developed in light of the Bellekeno Mine and it is not appropriate to extrapolate the findings of this study to the Bellekeno Mine Project. The LTAMP is intended for the assessment of the district-wide closure plans.

I trust that the above provides clarity on the intended use of the project work we have conducted for Access Consulting Group. However, should you require any additional information or clarification, please do not hesitate to contact me.

Yours truly,

Minnow Environmental Inc.

Cynthia Russel

Cynthia Russel, B.Sc.

President