AKHM

ALEXCO KENO HILL MINING CORP.

Keno Hill Silver District Operations

Lucky Queen and Onek Deposit Production

Project Proposal Submission to YESAB

December 2011

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Project Proposal Submission to YESAB

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ACRONYMS

ABA	Acid Base Accounting
AKHM	Alexco Keno Hill Mining Corp.
ANFO	Ammonium Nitrate/ Fuel Oil
C&F	Cut and Fill
CEWQG	Canadian Environmental Water Quality Guidelines
CRF	Cemented Rock Backfill
DSTF	Dry Stack Tailings Facility
EMR	Energy, Mines and Resources
ERDC	Elsa Reclamation Development Company
FNNND	First Nations Of Na-cho Nyak Dun
GCDWQ	Guidelines For Canadian Drinking Water Quality
GCL	Geosynthetic Clay Liner
KHSD	Keno Hill Silver District
LH	Longhole
LHD	Load Haul Dump (Loader)
LTA	Lost Time Accident
MAP	Mean Annual Precipitation
MLU	Mining Land Use (Approval)
MMER	Metal Mining Effluent Regulations
N-AML	Non-Acid Metal Leaching
OCF	Overhand Cut and Fill
P-AML	Potential Acid Metal Leaching
QML	Quartz Mining Licence
RCP	Reclamation and Closure Plan
TDS	Total Dissolved Solids

UCF	Underhand Cut and Fill
UKHM	United Keno Hill Mines Ltd.
WRDA	Waste Rock Disposal Area
WRMP	Waste Rock Management Plan
WRSF	Waste Rock Storage Facility
WUL	Water Use Licence
YEC	Yukon Energy Corporation
YESAA	*Yukon Environmental and Socio-Economic Assessment Act*
YESAB	Yukon Environmental and Socio-Economic Assessment Board
YG	Yukon Government

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EXECUTIVE SUMMARY

After our first year of successfully operating the Bellekeno mine and Keno District Mill, Alexco Keno Hill Mining Corp (AKHM) now proposes to strengthen our operation by incorporating production of two new ore deposits in the Keno Hill Silver District. Development and production of Onek and Lucky Queen deposits consists of mining newly discovered extensions of previously mined orebodies at Lucky Queen and Onek.

The purpose of the Project is to increase the operational certainty of the Keno Hill Silver District mining operations by developing access to additional underground sources of ore, which will contribute to the overall planned production scenario. Sourcing mill feed from more than one ore zone at a time is a prudent approach to development of this property that is comprised of narrow vein deposits; one that was followed by the districts' previous owners, United Keno Hill Mines Ltd. (UKHM).

Production from the two new orebodies will be incorporated into the current mining operations without expanding either currently licenced mill tonnage throughput, or total tonnage mined. There will be no additional tonnage of tailings deposited on the Dry Stack Tailings Facility. There will be no additional use of water for milling, and no change to the mill water balance resulting from the Project. Water required for mining at Onek and at Lucky Queen is addressed in this project proposal.

The existing Waste Rock Management Plan will be applied to waste rock generated from Lucky Queen and Onek.

Mining activities at the two new sites will require additional employees; therefore a minor camp expansion at the Flat Creek Camp is described.

The Project will require the amendment of the existing Type A Water Use Licence QZ09-092, and Quartz Mining Licence QML0009, which will require an assessment under the *Yukon Environmental and Socioeconomic Assessment* Act (YESAA) at the Designated Office level.

As part of environmental assessment for the permitting of the Bellekeno Mine, and then continued under the environmental baseline work being undertaken to support development of district reclamation plan, Alexco has begun characterizing the groundwater regime around Keno City. Recent analytical results indicate there has been a negative effect on groundwater quality from the Onek 400 adit discharge. Recognizing that the Onek 400 discharge will therefore require installation and operation of a water treatment plant in the future, Alexco has decided to incorporate a water treatment plant into the Project. Details for this plant are presented here, which consists of a simple lime addition plant and settling pond, the type currently in use at other sites for care and maintenance activities.

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1 INTRODUCTION

Alexco Keno Hill Mining Corp. (AKHM) continues to develop the mineral resources of the Keno Hill Silver District. Alexco proposes to bring the newly discovered extensions of the historic Lucky Queen and Onek deposits into production in order to supplement the Bellekeno mining operations (hereinafter referred to as the "Project"). The new Lucky Queen and Onek ore deposits are located adjacent to the historic Onek and Lucky Queen silver/lead/zinc mines and will be milled along with Bellekeno ore at the existing Keno District Mill. Alexco proposes to commence mining at Lucky Queen and Onek in mid-2012, upon procurement of the necessary regulatory authorizations.

This submission is intended to meet the requirements for evaluation pursuant to the *Yukon Environmental and Socio-economic Assessment Act* (YESAA) by the Yukon Environmental and Socio-economic Assessment Board (YESAB) Mayo Designated Office.

Alexco's Environmental Policy is attached in Appendix A.

1.1 PROPONENT INFORMATION

Alexco has been actively developing the Keno Hill Silver District since 2006 under a unique contractual arrangement with the Governments of Canada and Yukon; whereby, it can enter into production at newly discovered deposits within the district while it undertakes reclamation activities to remediate historic environmental impacts.

AKHM is a wholly owned subsidiary of Alexco and has been incorporated for operation of mineral extraction and development in the Keno Hill Silver District. Alexco continues to advance the development and eventual implementation of the District Wide Closure Plan which addresses the historic environmental liabilities of the district from past mining activities.

1.1.1 Contact Information

PROPONENT	
ALEXCO KENO HILL MINING CORP. Suite 1150 – 200 Granville Street Vancouver, British Columbia V6C 1S4 Telephone: (604) 633-4888 Fax: (604) 633-4887	Contact: Brad Thrall, EVP & Chief Operating Officer Email: bthrall@alexcoresource.com
AGENT	
ACCESS CONSULTING GROUP #3 Calcite Business Centre 151 Industrial Road Whitehorse, Yukon Y1A 2V3 Telephone: (867) 668-6463 Fax: (867) 667-6680	Contact: Lauren Haney, Environmental Permitting Manager Email: lhaney@accessconsulting.ca

1.2 PROJECT PURPOSE

The Bellekeno Mine was commissioned in January 2011 and is currently the only deposit supplying ore to the Keno District Mill. One of the primary purposes of developing the Lucky Queen and Onek deposits is to reduce the operational risk of conducting mining operations with only one deposit supplying ore to the mill. The history of the Keno Hill Silver District is one of numerous high grade but narrow vein deposits being mined simultaneously to supply ore to a single mill. This same operational approach is being developed by Alexco, through the incorporation of the Lucky Queen and Onek deposits into its current Keno Hill Silver District operations.

With the addition of Lucky Queen and Onek, the operating risk is reduced through:

- Additional ore sources and prepared, available mining locations (underground "stopes");
- Improved ore grade management through blending ore sources;
- Maximizing mill capacity and reduced unit costs;
- Reduced impact on production when development and backfill stages and cycles occur; and
- Extension/enhancement of overall operations sustainability.

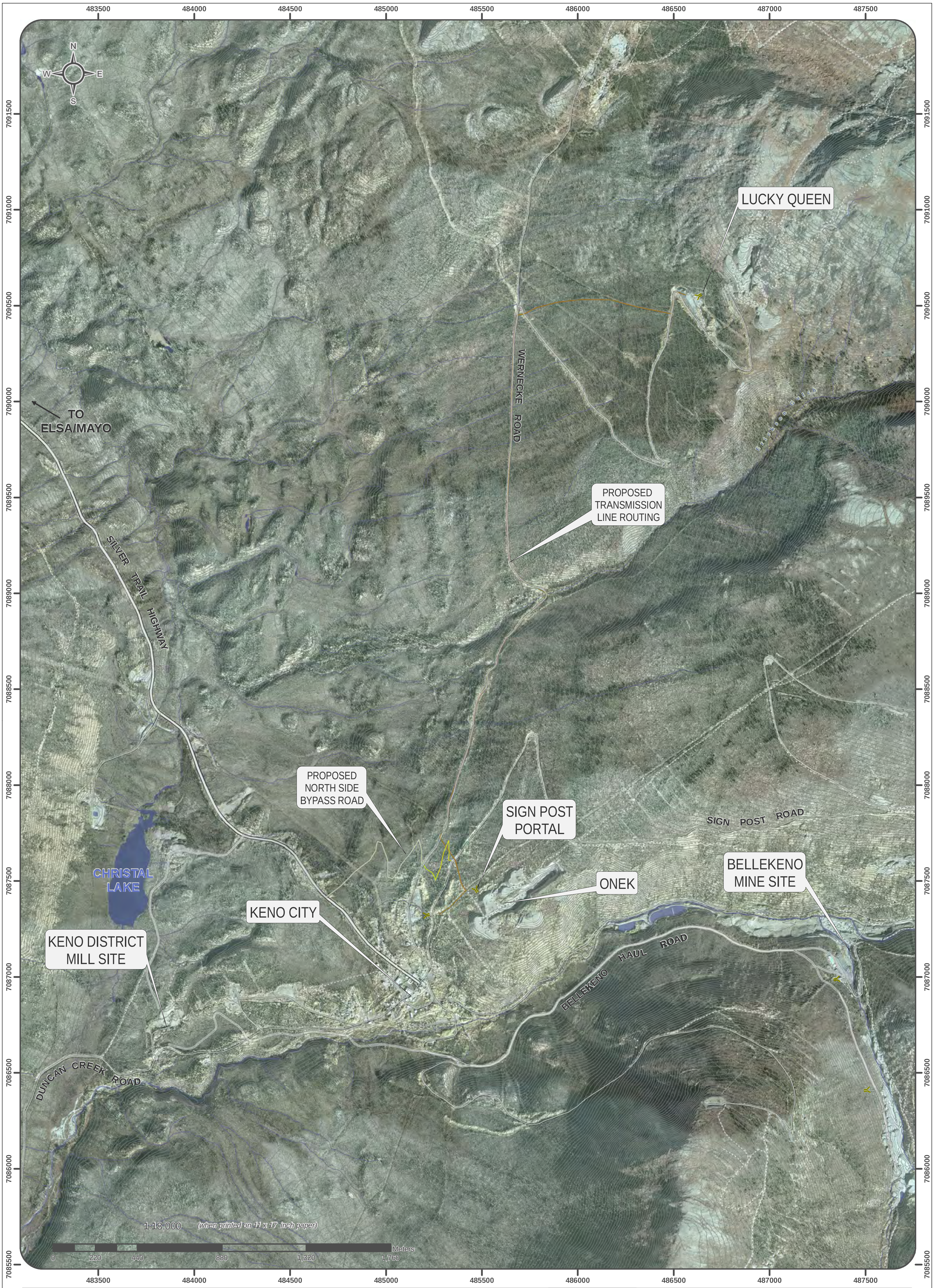
Reducing the operational risk from a single mine ore source will improve operating efficiency, and enhance project economics and ability to operate at lower commodity prices which will promote further exploration and development of the District. This will eventually lead to an extended overall project life and, by extension, the socio-economic benefits and sustainability provided through the development of the Keno Hill Silver District.

One of the outcomes of additional mine ore sources will be a fluctuation in tonnage rates and production from each of the mines in operation. Rather than operating at a fixed daily and monthly production level as is currently the case with Bellekeno (i.e. 250 tpd), the addition of Lucky Queen and Onek will result in a range of tonnage and production levels from each mine, depending on specific operating conditions, such as availability of developed underground "stope" faces, development requirements and backfill cycles.

1.3 PROJECT LOCATION

The Keno Hill Silver District is located in central Yukon (63˚ 55'N, 135˚ 29'W), 354 km due north of Whitehorse. Access to the property is via the Alaska, Klondike and Silver Trail Highways from Whitehorse to Mayo (407 km) and an all-weather gravel road northeast from Mayo to Elsa (45 km); a total distance of 452 km.

The Keno Hill Silver District is located on and around Galena Hill, Keno Hill and Sourdough Hill and are collectively known as the Keno Hill Silver District. The property lies along the broad McQuesten River valley with three prominent hills to the south of the valley. Lucky Queen is located approximately 4 km northeast of Keno City and Onek is situated about 500 m northeast of Keno City (Figures 1-1, 1-2 and 1-3).



Adit

Proposed Bypass Road

Proposed Transmission Line

Highway

Local

Track

Contour (5 m intervals)

Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006. Site hydrography and contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

AKHM

ACCESS

ALEXCO KENO HILL MINING CORP.
PROPOSED DEVELOPMENT PLAN

FIGURE 1-1

ONEK AND LUCKY QUEEN AREA OVERVIEW

DRAWN BY JP	DECEMBER 2011	VERIFIED BY LH

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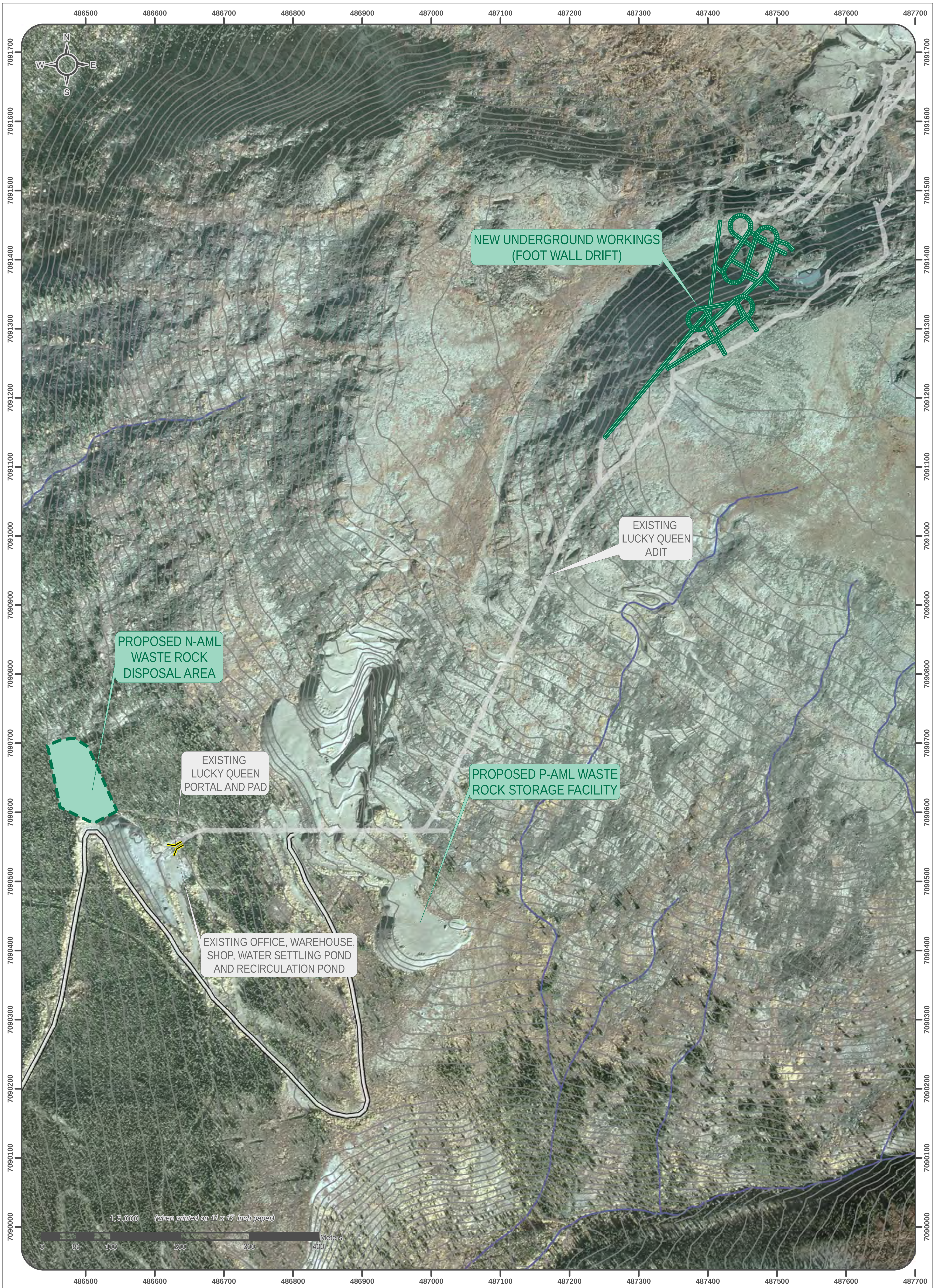

Proposed Underground Workings	EXISTING Existing Features
Existing Underground Workings	PROPOSED Proposed Features
Contour (5 m intervals)	

Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006. Site hydrography and contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

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ACCESS

ALEXCO KENO HILL MINING CORP.
PROPOSED DEVELOPMENT PLAN

FIGURE 1-2

LUCKY QUEEN

DRAWN BY JP	DECEMBER 2011	VERIFIED BY LH

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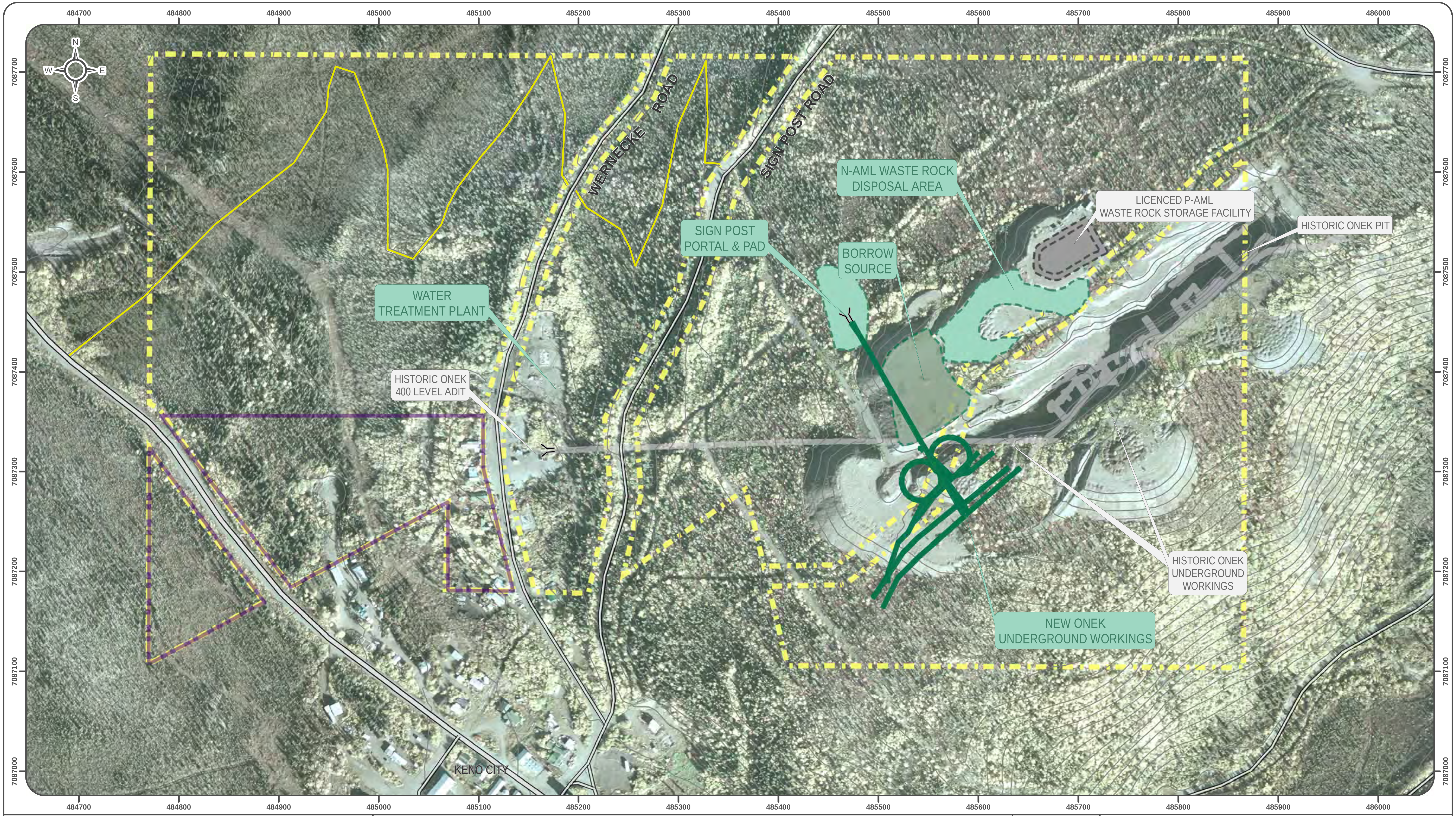

Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006.

Site contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

Meters
0 20 40 80 120 160

1:3,500 *(when printed on 11 x17 inch paper)*

Adit
Proposed Bypass Road
Highway
Local
Contour (5 m interval)
Proposed Mine Development
Historical Underground Workings
Lot 960
Lot 960 Sublot
Proposed Borrow Source
Proposed Features
Existing Features

AKHM
ACCESS

ALEXCO KENO HILL MINING CORP.
PROPOSED DEVELOPMENT PLAN

FIGURE 1-3

ONEK

Drawn By JP	DECEMBER 2011	Verified by LH

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1.4 ENVIRONMENTAL AND SOCIO-ECONOMIC CONTEXT

Table 1-1 summarizes existing environmental conditions in the Keno Hill project area. The Keno Hill Silver District lies within the Yukon Plateau – North Ecoregion, just south of the Wernecke Mountains. The terrain consists of concordant, rolling, upland areas separated by wide valleys. Alpine mountain peaks extend above the uplands locally. Many valleys include peatlands, palsas, fens and meadows of sedge tussocks. Upper slopes may be covered with scree material, with treeline occurring at 1,350 to 1,500 m. The area has been influenced by the latest glaciation but shows more subtle evidence of an earlier event as well.

Except for a few localized areas, the soils are not strongly weathered or deeply leaching. They also exhibit a poor profile development, particularly those underlain by permafrost. The Keno Hill-Galena Hill area is in the region of permanently frozen ground. The permafrost is irregularly distributed and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, soil types, amount of vegetative cover, and presence of flowing underground and surface water. At high elevations and on slopes with a northern exposure it is generally present. Regional and local geological conditions are presented in Appendix B.

The Keno Hill Silver District supports a variety of wildlife including ungulates, fur-bearers, small mammals, upland game birds and waterfowl. Moose are the most important subsistence animal in the area. Repeated survey work over the last 15 years indicates a healthy, stable moose population that has in recent years reached a maximum level of harvest (Lortie, 2009).

Woodland caribou are not presently found in the immediate study area with the exception of the appearance, in summer, of fewer that 10-12 caribou scattered in very small groups in the Mt. Hinton and Bunker Hill areas. Sheep were formerly present on Keno Hill, but hunted to extinction in the early 20th century.

The Lucky Queen and Onek sites lie within the traditional territory of the First Nation of Nacho Nyak Dun (FNNND) and near the communities of Keno City and Mayo. The area has been shaped by mineral development over the past hundred years. Silver and lead ore deposits were discovered on Keno Hill in the early 1900s and the area has since seen fluctuating levels of ongoing quartz and placer mining and exploration. Today, the area supports not only mineral development, but also tourism, recreation, traditional pursuits, as well as the local people.

Keno City is a small community situated at the end of the Silver Trail Highway with a population of roughly 12 permanent residents. The community was originally established to support mining operations in the area and the community's population has fluctuated over the last hundred years in response to local mineral development activity. Today, Keno City is a quiet community with residences, a few small businesses, the Keno City Mining Museum, and the Keno City Alpine Interpretive Centre.

The community of Mayo is located approximately 50 km from the project site. Mayo has a population of roughly 450 people and serves as a distribution and service centre for the surrounding area, supporting mineral development, tourism and other activities. Mayo is also the administrative centre for the FNNND. In addition to being a tourist destination, the community is a base for wilderness and mining tourism, canoeing, hiking, big-game hunting and fly-in fishing.

Table 1-1. Keno Hill District Environmental Setting Summary

Region:	**Yukon**
Topographic Map Sheets	NTS 105M/14 & 105M/13
Geographic Location Name Code	Keno City
Latitude	63° 54' 32" N
Longitude	135° 19’ 18” W
Drainage Region	Stewart River drainage region
Significant Watersheds	McQuesten River, Lightning Creek and Stewart River Watershed, Mayo River
Nearest Communities	Mayo, Keno City
Road Access	Silver Trail Highway
First Nations Traditional Territory	Na cho Nyak Dun
Ecoregion	Yukon Plateau (North)
Study Area Elevation	900-1350 m asl (Above Sea Level)
Vegetation Communities	Northern boreal forests occupy lower slopes and valley bottoms spruce, pine and alder Grasses and sedges, mosses occupy forest floor Heavy moss and lichen growth resident as ground cover understory of shrub willow, Open and forest fringe areas of willow and scrub birch, and various flowering plant species
Wildlife Species	Caribou, grizzly and black bear, moose, beaver, wolf, lynx, marten, wolverine, western tanager, magnolia warbler, white-throated sparrow, bald eagle, furbearers and small animals
Fish Species	Bering and Beaufort Sea salmonids and freshwater species, including: Arctic grayling, Arctic char, lake trout, trout perch, lake whitefish, broad whitefish, burbot, inconnu, Arctic Cisco, Northern pike, slimy sculpin

1.5 ASSESSMENT AND REGULATORY CONTEXT

Alexco and its subsidiaries undertake a variety of activities at the Keno Hill Silver District, including care and maintenance, water treatment of historic adit drainages, site closure planning, mining exploration, ongoing environmental monitoring, and operation of new mines. These activities are authorized under a suite of project approvals. Table 1-2 includes the existing approvals related to new mine development.

Table 1-2. Existing Development and Production Approvals

Mine Production	Advanced Exploration
• YESAB Project # 2009-0030 Decision Document	• YESAB Project # 2008-0039 Decision Document
• Quartz Mining Licence (QML-0009, expires 2025)	• Class 4 Mining Land Use Approval (LQ00240, expires 2018)
• Type A Water Use Licence (QZ09-092, expires 2020)	• Type B Water Use Licence (QZ07-078, expires 2018)

The proposed project will require amendment of the existing Water Licence QZ09-092 and QML-0009. Additional minor approvals will also be required (e.g. septic system installation permit to accommodate expansion of Flat Creek camp).

2 PROJECT DESCRIPTION

2.1 PROJECT AND ASSESSMENT SCOPE

The proposed project involves underground development and mining of the Lucky Queen and Onek deposits and milling these ores at the existing Keno District Mill. Construction and initial development at both sites is anticipated to begin in Q2 2012 following issuance of regulatory approvals. Production at both sites is planned to begin during Q3 2012. With the addition of Lucky Queen and Onek into the mine operations along with Bellekeno, the current authorized ore tonnage cap of 613,000 t would be reached in approximately Q3 2015.

The general scope of the project is outlined provided in Table 2-1 and specific details are provided in the following subsections. Subsequently, activities related to the project but not included within the scope are described.

No change in the currently licenced and authorized tonnage for ore, waste or tailings deposition is being proposed. The currently authorized volumes of material will be reallocated from Bellekeno alone to a combination of Bellekeno, Lucky Queen and Onek. Development and production of Lucky Queen and Onek will be incorporated into mining activities currently authorized under the existing Water Licence (QZ09-092) and Quartz Mining Licence (QML-0009) in terms of:

- The maximum annual average production rate will not exceed 400 t/d (QML-0009).
- Ore from Bellekeno, Lucky Queen and Onek will not exceed a combined total tonnage of 613,000 t (QML-0009).
- Tailings from Bellekeno, Lucky Queen and Onek deposits will not exceed a combined total tonnage of 322,000 t in the Dry Stack Tailings Facility (QZ09-092).
- Waste rock tonnage placed on the surface removed from Bellekeno, Lucky Queen and Onek will not exceed a combined total tonnage of 500,000 t (QML-0009).
- P-AML waste rock from Bellekeno, Lucky Queen and Onek stored on surface will not exceed a combined total tonnage of 125,000 t (QML-0009).

Figure 2-1 represents the relative allocation of ore, waste and tailings from the three deposits. These allocations will ultimately vary depending on likely fluctuations in the final mine plans and performance of each of the three mines.

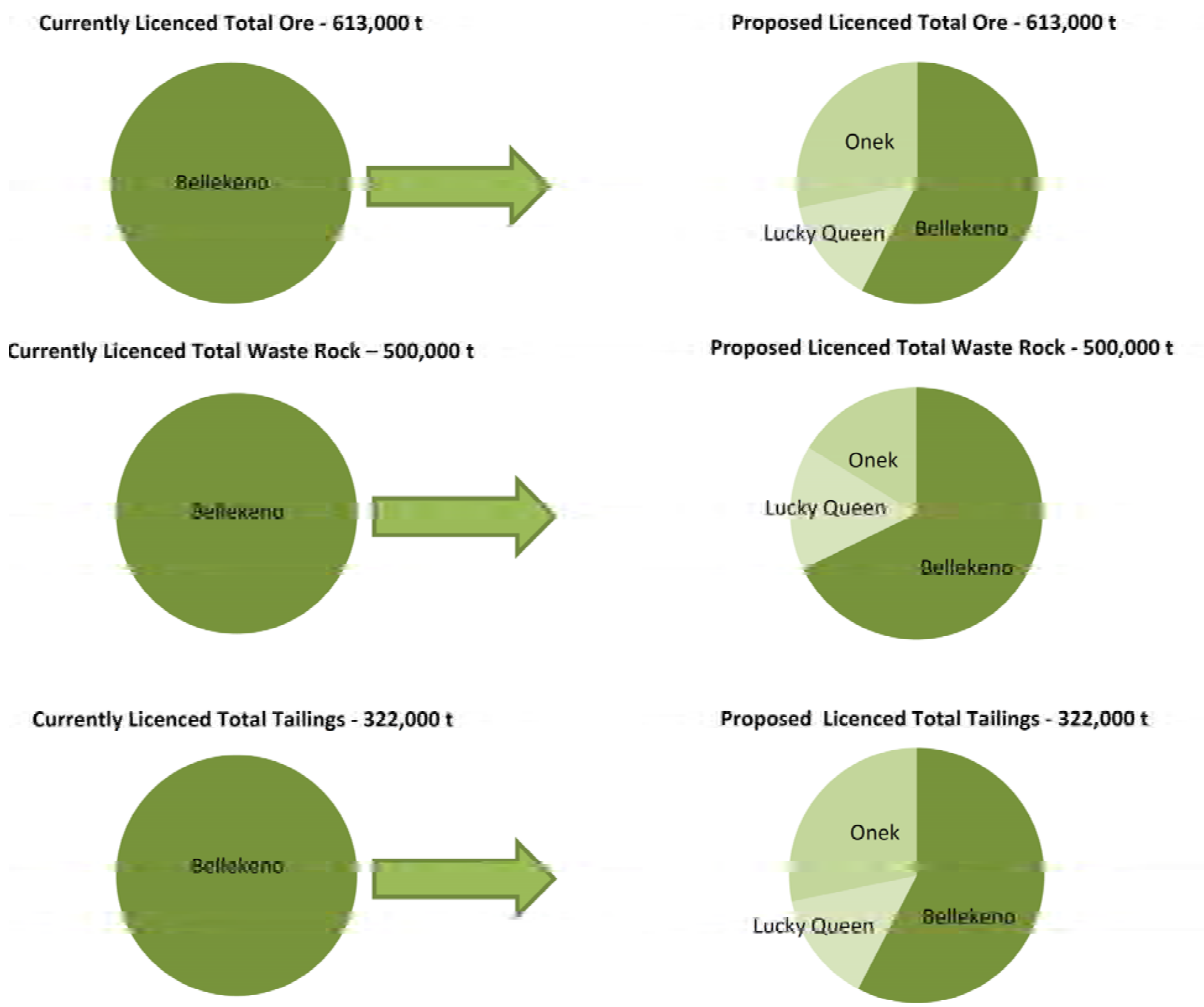


Figure 2-1. Relative Distributions of Ore, Waste Rock and Tailings from Bellekeno, Lucky Queen and Onek

Table 2-1. Scope of the Assessment

	Lucky Queen	**Onek**
Ore Tonnages	Up to 150,000 t	Up to 250,000 t
Mining Development	New development drift off historic 500 level adit *(no intersection with historic mine workings)* Cut and fill Track haulage	240 m decline; ramping (no intersection with historic workings) Cut and fill Truck haulage
Maximum Approximate Waste Rock Tonnages	44,000 t P-AML 80,000 t N-AML	50,100 t P-AML 93,000 t N-AML
P-AML Waste Rock Storage	New P-AML Waste Rock Storage Facility at Lucky Queen site based on approved generic design	Licenced Onek P-AML Waste Rock Storage Facility and an additional P-AML Waste Rock Storage Facility at Onek site based on approved generic design
N-AML Waste Rock Disposal	New Waste Rock Disposal Area at Lucky Queen	New Waste Rock Disposal Area on historic waste rock dump at Onek Road upgrade and maintenance Backfill
Tailings management	Deposition of tailings on the licenced Dry Stack Tailings Facility is outside the scope of this assessment – refer to next section Paste backfill	Deposition of tailings on the licenced Dry Stack Tailings Facility is outside the scope of this assessment – refer to next section Paste backfill
Water use and management	91.4 m^3/d (73.1 m^3/d plus 25% contingency) from underground workings and proposed groundwater well Onsite TSS management (No dewatering required) (No discharge to surface water)	112.5 m^3/d (90 m^3/d plus 25% contingency) from underground workings, treated Historic Onek 400 level adit discharge and proposed groundwater well Onsite TSS management (No dewatering required) (No discharge to surface water) Construction and operation of water treatment plant to treat Historic Onek 400 level adit discharge, and Sign Post Portal discharge (contingency measure). Treatment sludge from Onek 400 plant to be deposited at the Valley Tailings disposal area
	Flat Creek camp expansion – additional water use of 14.3 m^3/d (11.4 m^3/d plus 25% contingency)	

	Lucky Queen	**Onek**
Access/ Ore Transport	Development of the North Side Bypass Road to appropriate standards for ore haulage No additional road access creation required Traffic will be routed via Wernecke Road, the North Bypass Road and Christal Lake Road to transport ore between Lucky Queen and the Keno District Mill	Upgrade and maintenance of North Side Bypass to appropriate standards for ore haulage Traffic will be routed via the North Bypass Road and Christal Lake Road to transport ore between Onek and the Keno District Mill
Footprint extension	New N-AML Waste Rock Disposal Area (~0.75 ha)	Sign Post Portal Pad development (~1 ha)
Personnel requirements	~17 additional staff	~17 additional staff
Power	Onsite generator and eventually grid power (spur transmission line)	Onsite generator and eventually grid power
Auxiliary facilities	Operation of portal bench facilities (temporary ore stockpile, plant services, miners' dry area, offices, trailers, portal, settling ponds, fuel and explosives storage) Expansion of Flat Creek camp to accommodate additional personnel, including septic system upgrade and expansion (up to 200 person from 148) Explosives use	

2.1.1 Activities Outside the Assessment Scope

Because this project involves amendments to only certain portions of existing licences for the mining operations, Table 2-2 is included which describes activities associated with the proposed project that have been previously assessed as part of other Keno Hill District Development projects, and are therefore outside the scope of this assessment. Accompanying rationale and applicable authorizations are outlined for each activity.

Table 2-2. Activities Outside the Scope of the Assessment

Activity	Rationale	Applicable Authorization(s)
Current Bellekeno mining operations	The proposed project does not include any changes to mining operations at the Bellekeno deposit.	QML-0009
		QZ09-092
Operation of the mill	Lucky Queen and Onek ore will be milled at the licenced Keno District Mill, involving only minor operations adjustments. No changes to water use/ management are proposed.	QML-0009: 15.6; Schedule B: Mill Development and Operations Plan; Noise Abatement Plan
		QZ09-092: 14(h-k)
Operation of the Dry Stack Tailings Facility	The total tonnage of tailings deposited on the DSTF will not change. Apart from any operational changes that may be implemented as a result of the monitoring and surveillance program, there are no planned changes to operation of the DSTF proposed as part of this project. Deposition of Lucky Queen and Onek tailings on the DSTF is not a part of the assessment scope. As explained in Section 4, the geochemical characteristics of the Lucky Queen and Onek tailings are shown to be sufficiently similar to Bellekeno tailings. By extension, leachate from the DSTF is predicted to be effectively managed by the current DSTF design features currently operating.	QML-0009: 15.10; 15.12; Schedule B – Dry Stack Tailings Facility Development and Operations Plan
		QZ09-092: 14l
Initial development of Sign Post Portal Pad	Sign Post Portal Bench is located on Lot 960, titled to Alexco. Surface development on titled land is permitted without an authorization under the *Quartz Mining Act*.	Certificate of Title Lot:960 Group:1054 Plan:21884
Deposition of Onek 400 discharge treatment sludge at the Valley Tailings Area	The Onek 400 treatment system is a federal responsibility. The treatment sludge is predicted to have similar characteristics to the sludge from other district treatment systems (e.g. Silver King; Galkeno 900).	QZ06-074: 20(f)

2.1.2 Mine Site Liability

Responsibility for the historic environmental liabilities within the Keno Hill Silver District lies with the Government of Canada, as outlined in the Subsidiary Agreement between Alexco/ERDC, Government of Yukon and Government of Canada. The current Subsidiary Agreement in effect contains a Production Unit provision that addresses the question of historic environmental liability if/when Alexco brings historic mines back into production and operation. A Production Unit is a surface area footprint that encompasses the required infrastructure and facilities included in a mining production area. Under the Subsidiary Agreement, any historic terrestrial liabilities (i.e. waste dumps, roads, etc) that are within the Production Unit remain the responsibility of Canada and any water related liabilities associated or created with the new mine area or Production Unit become the responsibility of Alexco.

Based on the current Subsidiary Agreement provisions, Table 2-3 summarizes the responsibility of historic liabilities at both the Onek and Lucky Queen sites once a Production Unit is declared and the mines go into the production phase.

Table 2-3. Lucky Queen and Onek Development and Production Project Liabilities

Alexco Liabilities	Aboriginal Affairs and Northern Development Canada (AANDC) Liabilities
Lucky Queen	
New N_AML Waste Rock Disposal Area Newly rehabilitated Lucky Queen portal Portal pad New mine water management New P-AML Waste Rock Storage Facility(ies)	Existing waste rock storage dump Wernecke Road
Onek	
North Side Bypass Road Sign Post portal pad Onek portal N-AML Waste Rock Disposal Area P-AML Waste Rock Storage Facilities Surface portal pad facilities New mine water management	Existing Onek waste rock storage dumps Onek 400 adit and water management and treatment, including sludge deposition at the Valley Tailings disposal area

2.2 EXISTING SITE CONDITIONS

2.2.1 Lucky Queen

The Lucky Queen site area gently slopes down to the northwest. It is located at the upper limit of the subalpine and is vegetated with grasses, willows and a few lone spruce trees. Soil cover is sparse and is composed mostly of residual soils formed by the weathering of the underlying bedrock and from the decomposition of granular till. Given the aspect of the slope and the elevation, the site is underlain by permafrost. Permafrost is reported to extend below the 300 level of the mine (400 feet below surface) (AMC 1996).

The original Lucky Queen mine was initially accessed by shaft, but during later development a long adit was driven at the 500 level to access the lower levels of the workings. The adit was collared near the Black Cap open pit and extends 5,700 feet to the workings, creating two distinct surface areas of development, one near the upper shafts, and one near the lower adit.

2.2.2 Onek

The historic Onek site consists of the 400-level adit at the lower area and two large joined pits above the main workings. A shaft present within the pits was partially destroyed during pit development. There are also several large pit dumps containing over 600,000 t of waste rock, as well as a smaller amount of adit waste rock near the adit.

The main open pit area is located on a relatively flat plateau above Keno City, cut perpendicularly into the hillside. Development of the pit site extends downhill with gravel roads. The north (uphill) end of the pit area is at a considerably higher elevation than the southern end and due to the site aspect and slope; the downslope portion of the pit has relatively low walls compared to the upslope end. Water does not flow on surface in the pit area, and is likely funnelled through the underground workings.

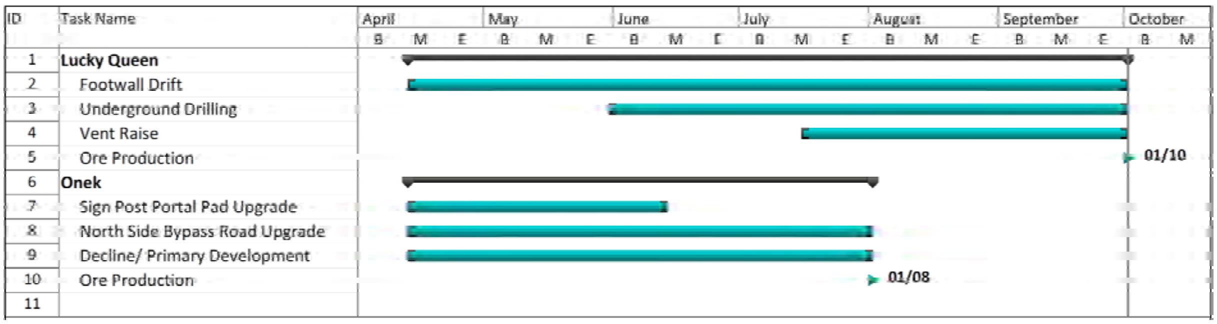
In addition to waste rock, there are several small (approx. 1000 t) piles of low grade ore stockpiled on the tops of the waste dumps. These dumps are siderite-rich and highly oxidized. Because of the small amount of fines and the scarcity of water in the dumps, they exhibit very little natural revegetation; however, there is a small amount of local natural revegetation where there is enough fine-grained material and water.

There is a hydraulic connection between the pit and the underground workings, primarily through the Fisher shaft. This hydraulic connection is of particular interest at Onek, due to the history of ice damming in the adit, and subsequent sudden release of stored water as the ice plug was displaced. This ceased to occur when the open pit was developed in the mid-1980s. However, the adit continues to drain water from the underground workings.

2.3 PROJECT SCHEDULE

Table 2-4 outlines the schedule for undertaking the key components of the Project.

Table 2-4. Project Timeline (2012)



2.4 MINE PLAN

Development and production of the Lucky Queen and Onek deposits represent the next stage of mine development in the Keno Hill Silver District following the successful development and commissioning of the Bellekeno mine in 2010. Once in production, operations at Lucky Queen and Onek will be very similar in nature and will be developed and mined concurrently with the Bellekeno mine and are viewed as supplemental and satellite ore sources and feed to the Keno District Mill.

Mine production from the three underground mines will fluctuate depending on available stope faces, development requirements, geotechnical conditions, ore feed grade and mill availability. The limiting factor in maximum ore tonnage is the mill capacity and licenced combined maximum production rate of 400 tpd.

2.4.1 Lucky Queen Deposit

The Lucky Queen deposit was mined by Treadwell Yukon Limited from 1927 to 1932 when reserves were exhausted, producing 123,000 tons of ore at 97.8 ounces per tonne (“opt”) Ag from two ore shoots.

The Lucky Queen vein and strike extensions were explored intermittently by surface overburden drilling, trenching and soil sampling throughout the 1950's, 1960's, 1970's and early 1980's. An exploration drift, collared near the Black Cap prospect and approximately 1,800 m in length, was developed by UKHM in 1985-1987. It was designed to come in underneath the historical Lucky Queen workings and attempted to raise into the No 2 Inclined shaft but was not completed prior to UKHM ceasing operations in the district. No production decision was made from this work. The Lucky Queen vein structure has a strike length, defined by drilling, of approximately 650 m and is open along strike to both the northeast and southwest with reported thicknesses of a few centimetres to several meters.

The Lucky Queen vein structure has an average strike of approximately 43 degrees azimuth, with local variations ranging from 25 to 60 degrees, and an average dip of around 45 degrees to the south, within a range of 30 to 55 degrees. Mineralized zones are largely composed of brecciated wallrock, siderite (± limonite), vein quartz and ore minerals including, silver sulphosalts, galena, sphalerite and native silver. Minor primary minerals present include arsenopyrite and pyrite.

Due to its relatively thinner vein widths, the Lucky Queen mine will be a lower tonnage producer compared to Bellekeno and Onek but will provide the necessary higher grade ore to balance and maintain the overall mill feed grade.

Figure 2-2 and Figure 2-3 show the Lucky Queen development plan. Access to the Lucky Queen deposit will be accomplished via rehabilitating the historic 500 level adit for track mining at the Lucky Queen Mine.

The first phase of the development of the Lucky Queen mine is to re-establish the integrity of the historic adit entrance and establish surface support facilities followed by testing and replacing timber support in 1,100 m of drift. These activities do not require drilling, blasting or excavation of waste material and will be completed under the current Class 4 Mining Land Use Approval (LQ00240).

Once the historic 1,100 m exploration drift is rehabilitated through testing and replacement of timbers as necessary, a 175 m footwall drift will be constructed to allow underground definition drilling to be completed followed by final detailed mine planning and production designs. The footwall drift will also serve as the main access and development point from the rehabilitated track assess into the new Lucky Queen deposit. Other than the rehabilitation and use of the 500 level adit, development of the new Lucky Queen deposit has no physical connection with the historically mined Lucky Queen workings.

Approximately 1,100 m of narrow gauge rail system will be rehabilitated to transfer ore and waste rock from working areas to the portal location. Ore will be dumped at the trestle and transferred to standard end dump haul trucks. Underground haulage of ore will be accomplished by battery operated locomotives containing 3 to 4 rocker dump muck cars each capable of carrying approximately 3 t of material.

Rehabilitation is currently underway at Lucky Queen by inspecting and replacing timber support as necessary with new ground support technologies for safe access. Main development headings and associated cross-section dimensions are provided below:

Adit	3.0 m W x 3.0 m H
Ore Access	3.0 m W x 3.0 m H
Ventilation Raise	2.5 m W x 2.5 m H
Misc. Development	5.0 m W x 4.0 m H (includes sumps, re-muck bays, substations, Load Haul Dump (LHD) Loader access, explosive magazine, etc.).

2.4.2 Onek Deposit

In 1922, the Onek Mining Company Ltd. was organized to explore the core Onek claims via a number of open cuts and shallow underground workings in two shafts. In 1950 to 1952, United Keno Hill Mines Ltd. ("UKHM") reopened the shafts and drove an adit in from the northwest to drift along the vein strike at the 400 Level for about 1,300 feet, driving raises up into the historic workings along the way. The Onek Mine was revisited in the early 1960's with limited success. All mining at Onek ceased in 1965, until the late 1980's, when a 20 - 40 m deep open pit was developed by UKHM over the length of the majority of the Onek workings around the historical shafts.

The Onek vein system comprises at least three individual vein faults occurring within a broad northeast striking, southeast dipping structural zone with a strike length of approximately 600 m.

Figure 2-4and Figure 2-5 show the development plans for the Onek deposit. Similar to Lucky Queen, development of Onek will not intersect or connect into the historic Onek mine workings or impact the Onek 400 adit. Access to the Onek underground mine will be accomplished via new ramp development for conventional truck access. The new Onek decline is approximately 240 m long (approximately one-third the length of the Bellekeno decline) at a decline of 10% and dimensions 3.5m W x 3.5 m H. Development headings and associated cross-section dimensions are provided below.

Main Ramp	3.5 m W x 3.5 m H.
Ore Access	3.5 m W x 3.5 m H
Ventilation Raise	2.5 m W x 2.5 m H
Misc. Development	5.0 m W x 4.0 m H (includes sumps, re-muck bays, substations, Load Haul Dump (LHD) Loader access, explosive magazine, etc.).

Explosives use is not anticipated to affect the integrity of the existing Onek waste rock dumps that lie above the new underground workings. The minimum pillar between the new decline and existing waste dump stricter is estimated to be a minimum of 20 m. Blasting vibration will be controlled by limiting the long-period detonator charge as necessary.

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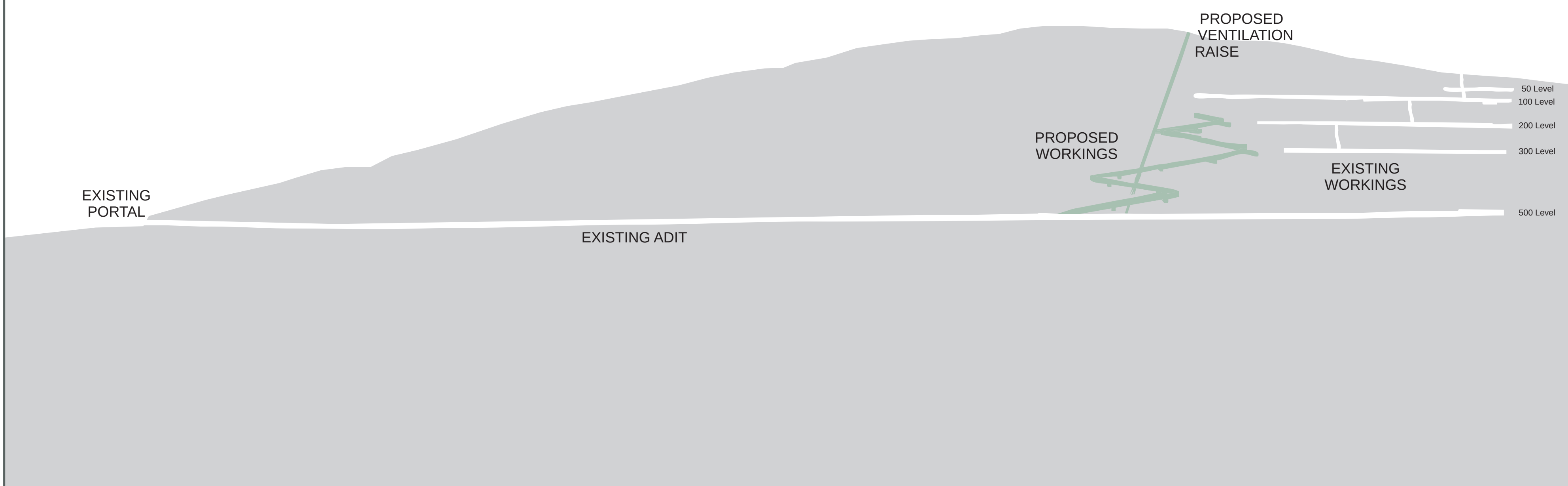

CONCEPTUAL DRAWING; FEATURES ARE NOT TO SCALE

AKHM

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ALEXCO KENO HILL MINING CORP.

FIGURE 2-2
LUCKY QUEEN DEVELOPMENT PLAN - CONCEPTUAL CROSS SECTION

DRAWN BY MD	NOVEMBER 2011	VERIFIED BY LH

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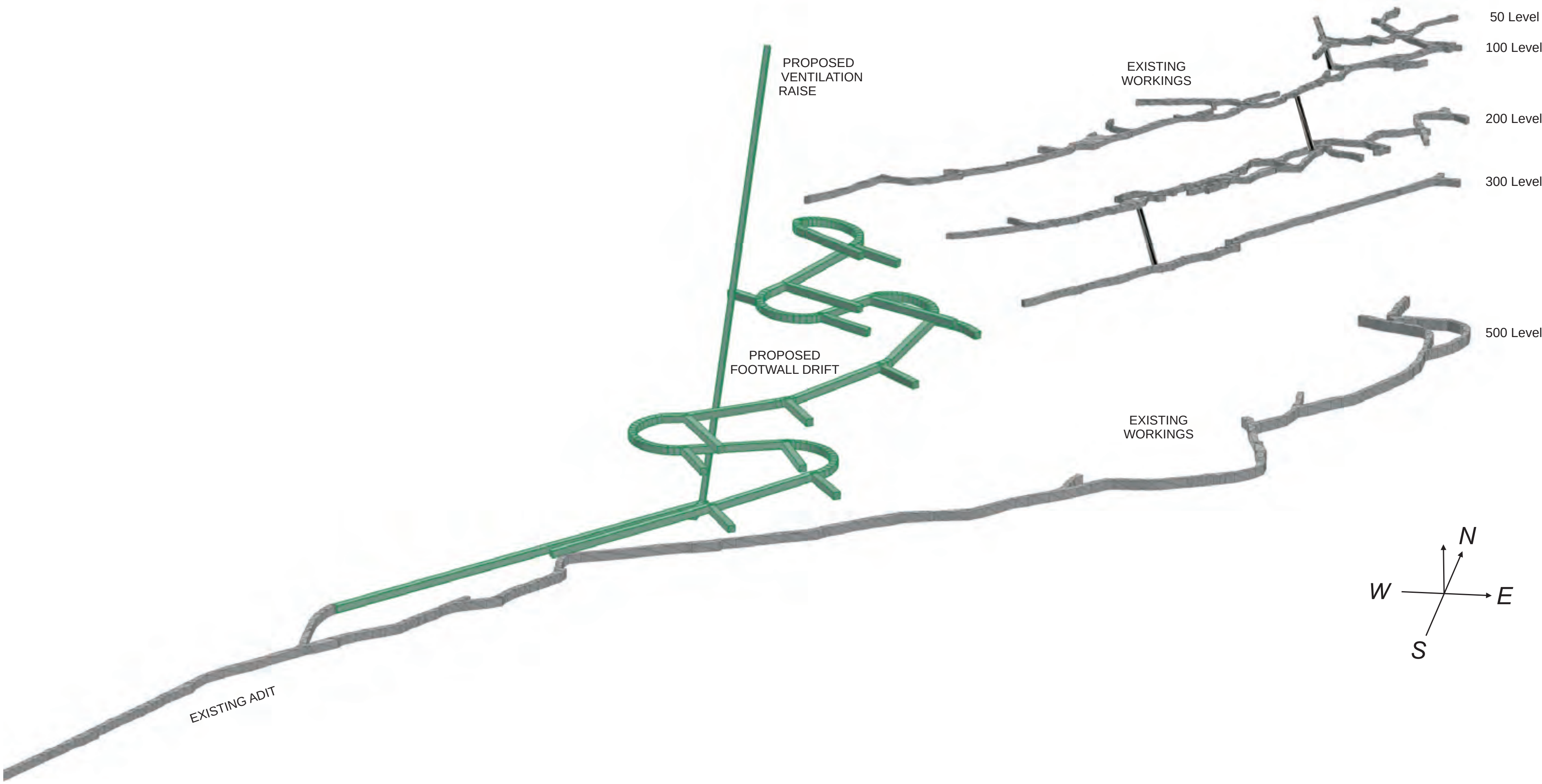

CONCEPTUAL DRAWING; FEATURES ARE NOT TO SCALE

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FIGURE 2-3
LUCKY QUEEN DEVELOPMENT PLAN -
CONCEPTUAL OBLIQUE SECTION

DRAWN BY MD	NOVEMBER 2011	VERIFIED BY LH

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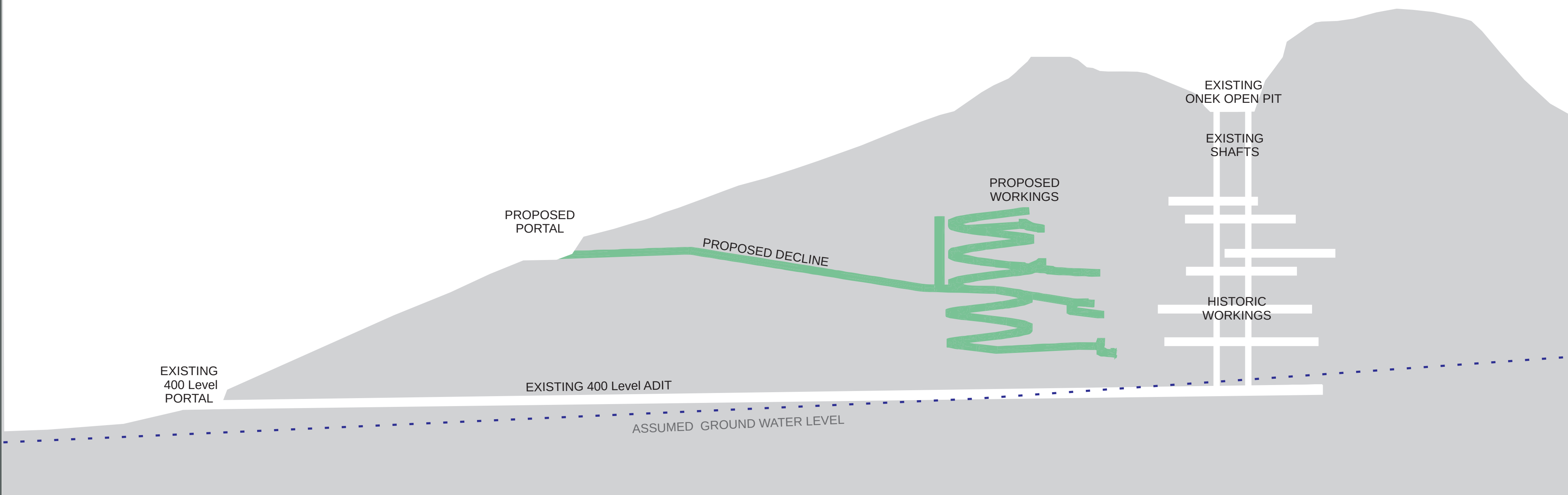

CONCEPTUAL DRAWING; FEATURES ARE NOT TO SCALE

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FIGURE 2-4
ONEK DEVELOPMENT PLAN -
CONCEPTUAL CROSS SECTION

DRAWN BY MD	NOVEMBER 2011	VERIFIED BY LH

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Oblique_LQ_Existing_and_Proposed_UndergroundWorkings_Schematics_20111208.cdr

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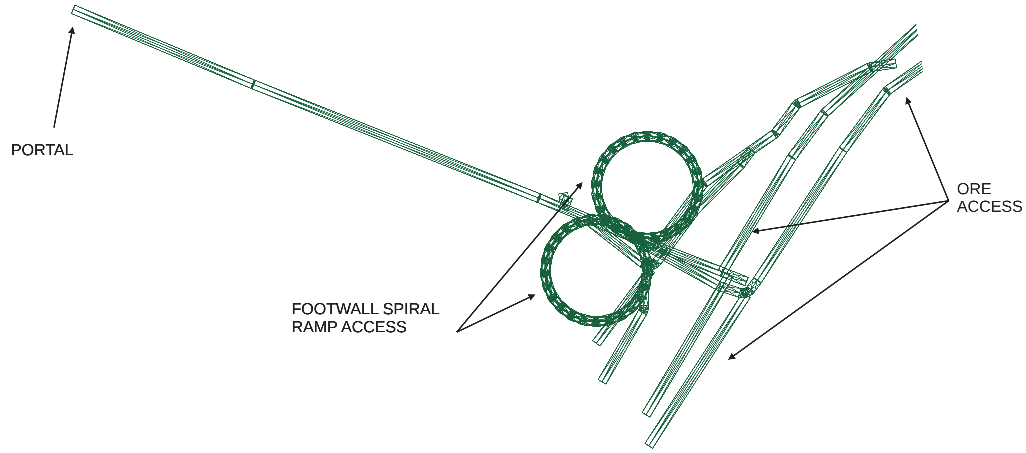
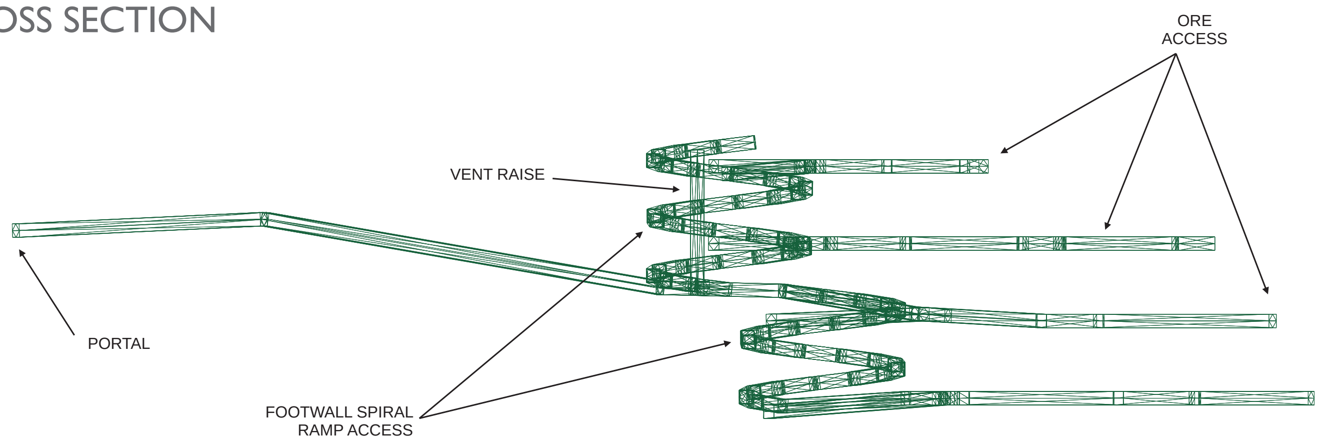
ONEK UNDERGROUND DEVELOPMENT

PLAN VIEW



CROSS SECTION



ISO VIEW

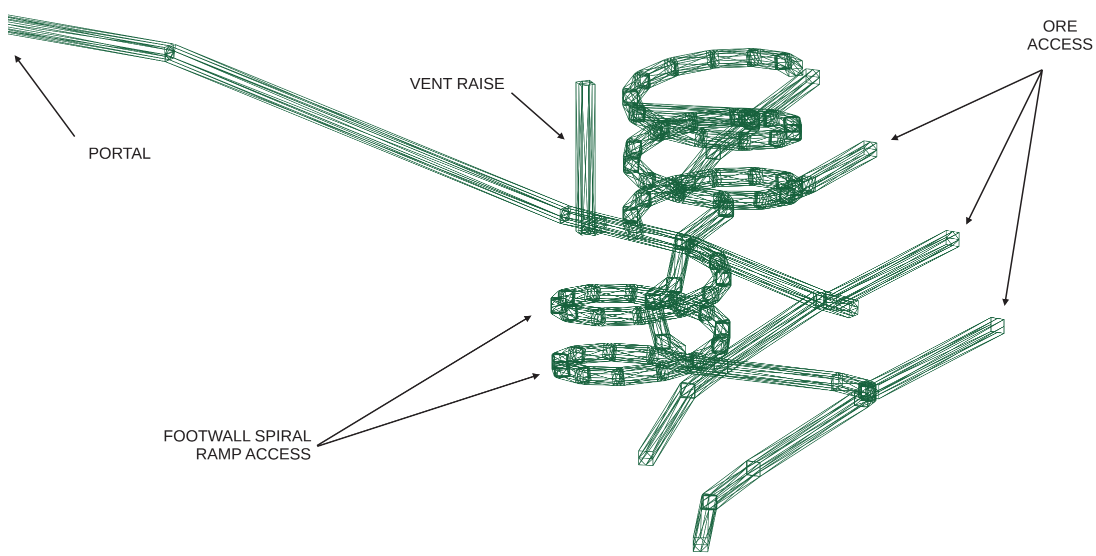


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FIGURE 2-5

ONEK DEVELOPMENT PLAN - CONCEPTUAL UNDERGROUND WORKINGS

DRAWN BY MD	DECEMBER 2011	VERIFIED BY LH

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2.4.3 Mining Method Selection

Mining method selection for both mines is contingent on the characteristics of the deposits and must take into account deposit geometry, geology, geotechnical characteristics, ore recovery, hydrogeology, and other variables. Current mining operations at Bellekeno have confirmed the need to employ a range of mining methods to suit localized characteristics.

Upon preliminary review of the deposit characteristics, three main mining methods were determined to be suitable for different parts of the Lucky Queen and Onek deposits. These methods consist of mechanized overhand and underhand cut and fill (C&F), shrinkage stoping and longhole (LH) stoping for pillar recovery. The actual methods used, and variations of the methods applied, will depend on site specific conditions in each area of the deposit. A summary of the proposed methods is shown in Table 2-5.

Table 2-5. Mining Method Selection

Selected Mining Methods	Justification
Overhand or Underhand Cut and Fill	Selected for less competent rock, less dilution, better ground control and optimized ore recovery
Shrinkage	Selected for the narrow vein sections with reasonably competent rock
Long Hole	Selected to extract the remaining pillars towards the end of the mine life

2.4.4 Drilling

A minimum of one jumbo drill will be necessary to meet production targets for each deposit. The jumbo will be dedicated to development of new ramps and accesses and drilling in the cut and fill stopes. A second, smaller, micro jumbo will be used in small headings and as a back-up for when the main jumbo is down for maintenance and service. In addition hand held drills may be required if the vein geometry dictates.

A combination of micro jumbo and several jacklegs will be used at Lucky Queen to provide drilling for headings and ground support.

2.4.5 Mucking

Mucking at the Lucky Queen mine will be accomplished by a small 1.2 m^3 scoop tram at the working areas. Ore will then be transferred to the transfer raises (ore pass) at certain levels and will be loaded on the track rocker dumps where it then gets transferred to the surface.

Mucking at Onek will be accomplished by two 2.5 m^3 Load Haul Dump Loaders (LHD) to meet production targets. One 2.5 m^3 LHD will be dedicated to production from the stopes and fill placement. The second

2.5 m^3 LHD will be used for mineralized and waste rock mucking and in addition to waste fill placement when the other LHD is unavailable. A 1 m^3 LHD will be used where mechanized mucking in narrow veins is needed.

2.4.6 Mine Support Facilities

Support facilities for Lucky Queen and Onek will be located on each site's portal bench. Support facilities include: plant services, miners' dry area, offices, trailers, portal, settling ponds, fuel and explosives storage, and temporary ore stockpile.

The Lucky Queen Portal Pad (top surface of the waste rock storage dump) is an existing structure that does not require upgrades or modifications in order to support development and production at the Lucky Queen deposit.

Initial development of the Sign Post Portal Bench for the Onek Mine began in the summer 2011; however, additional construction is required prior to use. Further development of the bench will require approximately 40,000 t of material, which will be sourced from existing waste dump material at Onek (see Figure 2-6), as well as waste material from decline development, as available. Section 3.4.2.1 addresses the use of the existing dumps.

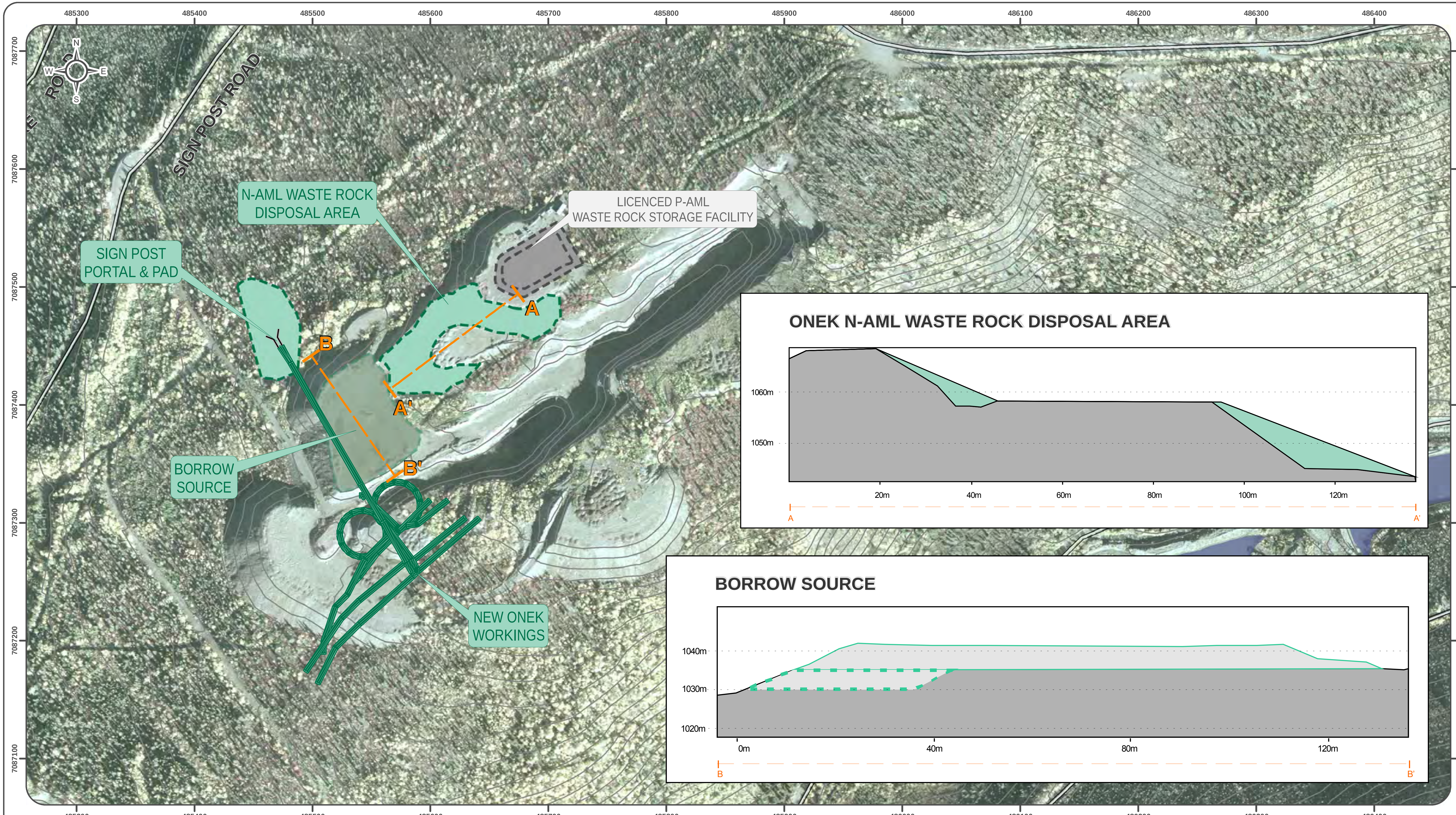
2.5 SITE ACCESS AND TRANSPORT

Alexco remains committed to reducing the impact of its mining activities on the local residents. To this end, we will be constructing another bypass road to the north of town so that the mine-to-mill ore haul will not go through the center of town as it did historically. The North Side Bypass Road, shown in Figure 2-7, will be developed to direct mine traffic to/from Onek and Lucky Queen around Keno City.

2.5.1 Traffic Routing and Volumes

Ore will be hauled between Lucky Queen and Onek and the mill via the new North Side Bypass Road, the Christal Creek Road and Duncan Creek Road (Figure 2-7). The general alignment is shown; however, the exact route will be selected through consultation with Keno City residents.

Trucks coming from Lucky Queen will travel down the Wernecke Road and turn west onto the North Side Bypass Road; haul trucks from Onek will be routed across Sign Post Road to the Bypass Road.



Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006.

Contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

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0 15 30 60 90 120 Meters

1:3,000 *(when printed on 11 x17 inch paper)*

- Cross Section
- Adit
- Highway
- Local
- Contour (5 m interval)
- Proposed Mine Development
- Proposed Features
- Existing Features
- Proposed Borrow Source

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PROPOSED DEVELOPMENT PLAN

FIGURE 2-6

ONEK - SURFACE DEVELOPMENT

Drawn By JP	DECEMBER 2011	Verified by LH

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An average of 15 roundtrips per day with 15 t highway legal dump trucks will be required for both Onek and Lucky Queen mining operations. The ore from Lucky Queen will be hauled using conventional over the highway dump trucks with a trailer during times of the year when road conditions permit. Ore from Onek will be hauled to the mill using over the highway dump trucks as well. Ore haulage to the mill will primarily be limited to dayshift hours (7 am – 7 pm) but haulage outside of these hours may be necessary on occasion due to production constraints and road/weather conditions. Minimal delivery truck trips per day using the 7t flatbed truck will also be necessary to deliver materials and supplies to Onek and Lucky Queen. As soon as the North Side Bypass Road is complete, mine traffic will be directed to this new road to reduce and minimize traffic through Keno City.

2.5.2 Road Development and Traffic Management Measures

The Traffic Management Plan, developed under QML-0009, will be updated as part of project licencing to incorporate Lucky Queen and Onek mine traffic and management of the North Side Bypass Road development and maintenance/upgrade.

Approximately 55,000 t of road building material will be sourced from an existing waste rock dump at Onek (see Figure 2-6). The Waste Rock Management Plan protocols will be applied to ensure only N-AML waste rock is used. Section 3.4.2.1 describes the use of existing waste dump material.

As part of standard practice, the routing will be surveyed and engineering drawings will be developed to ensure the road is built to appropriate standards. Conceptual and construction engineering drawings will be provided to regulatory authorities as required.

The routing does not cross or come within 30 m of any watercourse or waterbody. Ditching along the road will facilitate appropriate drainage. Culverts will be installed at the intersections with the Silver Trail Highway, Wernecke Road and Sign Post Road for drainage. The cleared vegetative debris and topsoil will be stockpiled along the routing for road reclamation.

There will be stop signs to stop mine traffic at the intersections with Sign Post Road, Wernecke Road and the Silver Trail Highway. The line-of-sight distance requirements of YG Highways & Public Works Transport Branch and the Highway Access/ Works within a Right-of-Way permits will be adhered to in order to ensure public and worker safety.

Signage warning of crossing/turning mine dump trucks (over the highway dump trucks) will be installed along Sign Post Road, Wernecke Road and the Silver Trail Highway in accordance with the requirements and direction of YG Highways & Public Works Transport Branch officials.

The North Side Bypass Road will be a radio controlled road accessible to mine traffic only. Signs will be installed at the road access points prohibiting public traffic from traveling on it. The maximum speed limit will be 40 km/h, reduced to 20 km/h at blind corners and road crossings.

Potential socio-economic effects associated with project traffic are addressed in Section 7.

2.6 WORKER HEALTH & SAFETY

Operations at the Keno Hill Silver District fall under the jurisdiction of the *Occupational Health & Safety Act* and Regulations administered by the Yukon Workers' Compensation Health & Safety Board. Alexco has in place a Health & Safety Policy (Appendix A) and both will continue to be adhered to during the course of operations at Onek and Lucky Queen. Mining operations at Bellekeno have surpassed a year without a Lost Time Accident (LTA). This represents over 150,000 manhours worked without a LTA underground.

All personnel and Contractors will meet the standards outlined in the Occupational Health and Safety Legislation, Mine Safety Rules, and Regulations of the Worker's Compensation Board.

Alexco has an established program for achieving and maintaining a healthy and safe workplace. In the Keno Hill Silver District there are currently emergency first aid responders providing 24-hour service. There are multiple first aid rooms and an ambulance on the site as well.

Alexco policy requires that all employees (including contractors' employees) have pre-employment medical examinations including a drug and alcohol test. All employees will be fully equipped with the proper personal protective equipment standard for working underground, taking into consideration hazards caused by noise level, air born particulates and confined work space.

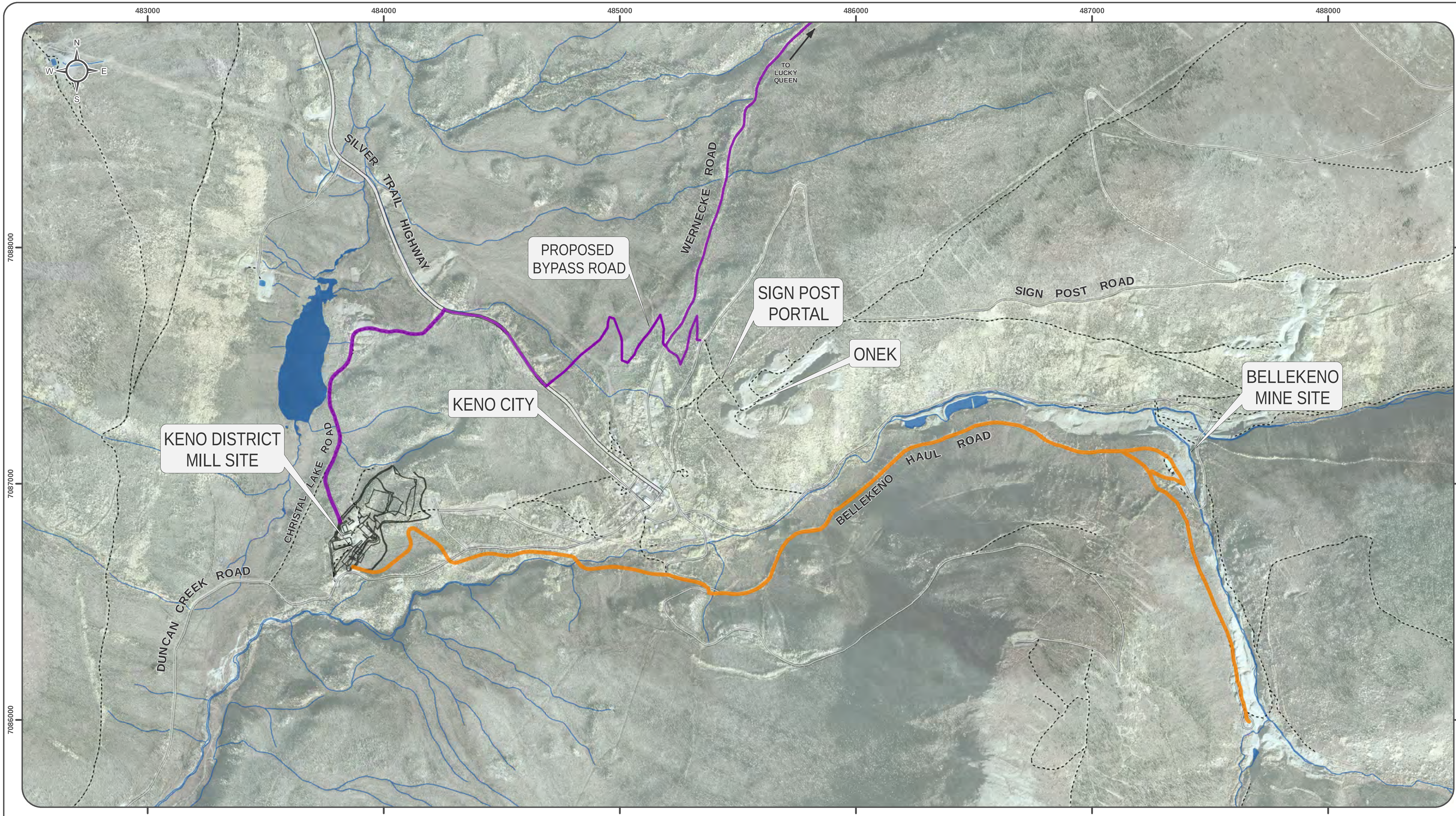
All new employees will have a site wide and safety orientation and another orientation of the underground work site prior to commencing work. Regular safety meetings with supervisors, safety officer and employees are mandated. Any changes in procedures, equipment, or hazards require immediate notification to employees.

Underground contractors, Alexco personnel and others will have to comply with the Yukon OH&S regulations in addition to Alexco and contractors in-house standards.

A Safety Coordinator/Officer specific for the underground operation will ensure all workers are orientated to all aspects of the work site including hazard identification, protective equipment requirements and that medical and health requirements are followed according to legislation. That position is also charged with ensuring continued training and skill development for all personnel.

2.7 POWER REQUIREMENTS AND GENERATION

Power for the Keno Hill Silver District is supplied by Yukon Energy Corporation (YEC). The Mayo hydro facility was recently upgraded with a new penstock and turbine plant providing additional capacity (Mayo B). Currently the power for the Keno Hill Silver District is supplied by a 69 kV overhead line from Mayo and is then stepped down at the Onek transformer to 6.9 kV for further distribution to the Bellekeno mine. The Onek substation has a design capacity of 999 kVA. The Onek substation will require upgrade prior to full mine production at Onek as this substation will supply both the Bellekeno and Onek mines.



Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006.

Site hydrography and contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

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1:15,000 *(when printed on 11 x 17 inch paper)*

0 100 200 400 600 800 Meters

Bellekeno Haul Road
Lucky Queen and Onek Haul Traffic Routing
Highway
Local
Track
Watercourse
Waterbody

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ALEXCO KENO HILL MINING CORP.
PROPOSED DEVELOPMENT PLAN

FIGURE 2-7

LUCKY QUEEN AND ONEK HAUL ROAD

Drawn By JP	DECEMBER 2011	Verified by LH

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Power requirements at Onek are estimated at 300 kW (6,570 MWh/yr). Power will be supplied at Onek initially by diesel generators and eventually via transmission lines.

Electrical power for Lucky Queen will initially be provided via on site diesel powered generators although a power line extension from the Onek substation to Lucky Queen is eventually anticipated and has been scoped into this assessment (Figure 1-1shows the routing). Depending on future economics, hydro power from the YEC grid may be extended to the Lucky Queen mine through an extension at the Onek substation. Under full operating conditions, Lucky Queen is expected to require 900kW (19,710 MWh/yr). Lucky Queen requires considerably more power than Onek in order to supply its track haul operations and additional ventilation requirements due to its longer mine access.

2.8 FLAT CREEK CAMP EXPANSION

The currently licenced Flat Creek Camp facilities will require expansion to accommodate additional project personnel. Currently, Alexco is permitted to operate septic systems for 148 people. In order to accommodate the additional personnel required for the project, Alexco proposes to expand the systems for up to 200 people. Minor clearing (less than 0.5 ha) will be required for expansion of the Flat Creek system. All disposal facilities will comply with the *Public Health and Safety Act*, Sewage Disposal Systems Regulations.

An additional camp accommodations trailer will be added to the existing Flat Creek camp facility however, there is sufficient space in the vicinity of the existing trailers on previously disturbed ground. No additional footprint will be required.

2.9 WASTE MANAGEMENT

Project waste will be managed according to the Waste Management Plan in place under the QML-0009[1].

[1] Available on YG Energy, Mines & Resources website at
http://www.emr.gov.yk.ca/mining/pdf/mml_bellekeno_waste_management_plan_revision_1.pdf

2.10 FUEL AND HAZARDOUS MATERIALS MANAGEMENT

Fuel and petroleum products required for mine development and production at Onek and Lucky Queen will be managed appropriately at each site. A 20,000 L Envirotank will be established on the Sign Post Portal pad to supply the Onek mining operations. There is an existing 2,400 L double-walled tank at Lucky Queen positioned on the portal pad.

2.10.1 Explosives

Explosives will be used in mining operations at both sites. Onsite manufacturing will not be required. At Lucky Queen, up to 4,500 kg of explosives will be stored in an appropriate location on the portal bench. Up to 9,000 kg of explosives will be stored on the Sign Post Portal pad. Explosives use, transport, handling, storage and disposal is governed by the Yukon *Occupational Health and Safety Act* Blasting Regulations and Occupational Health & Safety Regulations, and the *Transport of Dangerous Goods Act* and Regulations.

The blasting product will be ammonium nitrate / fuel oil (ANFO) and augmented with stick powder where needed. Detonators will be non-electric and tied in with detonator cord. Powder and cap magazines will be located on surface and proximal to the respective portals for Lucky Queen and Onek. The explosive magazines will be located at appropriate distances away from the portals and other buildings as dictated by regulations. Explosives and detonators will be conveyed to the working headings on as need basis transported via approved day boxes. Excess explosives will be returned to the magazine at the end of the shift. A log book will be maintained in the magazine as required by regulations.

3 WASTE ROCK CHARACTERIZATION AND MANAGEMENT

The geology and mineralization at Onek and Lucky Queen share a number of similarities with the Bellekeno deposit including: they occur within the same major lithologic unit, are similar in general age and are similar style of mineralization. As such, the geochemical characteristics of the rocks are similar.

Geochemical characterization studies using the exploration drillhole geochemistry database consisting of acid base accounting (ABA) and metal assay results for both Onek and Lucky Queen were undertaken in order to determine if the Waste Rock Management Plan currently in place for the management of waste rock at Bellekeno is suitable for use at Lucky Queen and Onek. Additionally, the study was completed to characterize and identify which rock units will be encountered during development of the Onek and Lucky Queen mines. The geochemical characterization studies for Onek and Lucky Queen are attached as Appendix C and D, respectively. The results of the geochemical rock characterization at the Onek and Lucky Queen sites has shown that the characterization of the materials is similar to the materials present at the Bellekeno Mine and that the current Waste Rock Management Plan will be protective when applied to both these mining areas. The Bellekeno Waste Rock Management Plan can be found online as Appendix B of the Construction Site Plan[2].

3.1 HISTORY AND PERFORMANCE OF THE WASTE ROCK MANAGEMENT PLAN

The Waste Rock Management Plan (WRMP) was established in 2008 for the management of excavated waste rock during advanced underground exploration and development activities prior to mine licensing and production at the Bellekeno Mine. These activities were licenced and carried out under Mining Land Use approval LQ00240 and Type B Water Use Licence (WUL) QZ07-078. The WRMP was determined to be effective and adopted for the Bellekeno Mine operations and production, which was licenced under QML-0009 and WUL QZ09-092 and commenced at the end of 2010.

Feedback and demonstration of the effectiveness of the WRMP is provided primarily through periodic review of routine geochemical testing of excavated materials as a check of the field screening criteria. Longer term geochemical stability and water quality prediction information is provided through the Mine Wall Testing Plan, Hydrogeology Study Plan, Groundwater Monitoring Plan and Monitoring and Surveillance Plan, which also form parts of the major mine licences (QML-0009 and QZ09-092). The results and synthesis of annual WRMP activity are summarized and presented each year as part of the

[2] Available on the YG EMR Mineral Resources Branch at http://www.emr.gov.yk.ca/mining/pdf/mml_bk_construction_site_plan_revision_1_november2009.pdf

annual reports which are requirements of the major mine licences. Highlights from the 2010 annual report are summarized below.

- The compositing frequency was adequate to confirm the general rock characteristics of Non-Acid Metal Leaching (N-AML) rock while verifying the accuracy of the field screening classification.
- The sampling methodology was found to be adequate in producing accurate and representative characterization of each blast round during the field screening process.
- Additional ABA data collected from all Potential Acid Metal Leaching (P-AML) composites has added to the understanding of the correlation between lithology and geochemical characteristics.
- Carbonate estimation in the field has remained difficult in samples with low to moderate amounts of available carbonate for neutralization (<100 kg CaCO3/tonne).
- During the WRMP field screening program in 2010, a total of 2,024 t (3.68% of the total excavated tonnage) originally classified through field investigations as N-AML was shown through geochemical testing to be P-AML. Graphitic schist initially proved to be especially difficult for geologists to accurately classify in a field setting. In order to address potential misclassification in the field, the waste rock screening program has been updated with a focus on measures employed to confirm classifications, especially in excavation areas containing graphitic schist. No changes to other aspects of the WRMP are required.

  The misclassified rock represented a small percentage of the overall excavated material, but was sent to surface and mixed with net neutralizing material and is not expected to result in any generation of net AML. The response measures implemented to address this operational application of the WRMP demonstrate the importance of feedback mechanisms and adaptive management in improving the efficacy the WRMP.

While there are some suggestions for improvement and streamlining of the WRMP within the annual report summaries, the WRMP has been effective overall in the identification, segregation, operational management and geochemical verification of excavated materials at the Bellekeno Mine. The robust feedback mechanisms featured within the WRMP and in the other related plans will help ensure the efficacy of waste rock management activities at other mines within the district.

The annual reports which contain complete WRMP summaries are available online at Yukon Government Energy Mines and Resources website:

http://www.emr.gov.yk.ca/mining/bellekeno.html

The annual reports for Water Use Licences QZ07-078 and QZ09-092 which also contain WRMP summaries are available in hard copy at the Yukon Water Board's office.

3.2 ROCK MANAGEMENT CATEGORIES

The rock at the Lucky Queen and Onek deposits can be categorized as follows: Non-Acid Metal Leaching waste rock (N-AML), potentially-acid metal leaching (P-AML) waste rock, mineralized rock, and ore. Waste rock and Ore excavated from the Lucky Queen and Onek mines will be categorized and managed according to the existing Waste Rock Management Plan:

- Non-Acid Metal Leaching Waste Rock (N-AML): Rock of non-economic grade with no significant potential for the generation of net acidity or metal leaching. The major waste rock lithologies at Onek are anticipated to be comprised of approximately 65% N-AML rock. The waste rock at Lucky Queen is expected to be comprised of approximately 65% N-AML rock. Rock field-classified as N-AML will be stored in designated Waste Rock Disposal Areas (WRDAs) and used for general construction purposes as required.
- Potentially-Acid Metal Leaching (P-AML) Waste Rock and Mineralized Waste Rock of no Economic Interest: Rocks field-classified as P-AML will be stored in designated lined P-AML waste rock storage facilities. In addition to P-AML wall rocks, some material especially along the margins of zoned veins contain mostly gangue minerals such as siderite, pyrite and quartz, but do not contain economic amounts of silver (Ag), zinc (Zn), or lead(Pb) minerals and therefore are of no economic interest. Due to their increased likelihood for acidic or metal leaching, all such mineralized non-economic rock is considered to be P-AML and will be stored in P-AML Waste Rock Storage Facilities (WRSFs), or used as cemented rock backfill (CRF).
- Mineralized Rock and Ore: Ore and vein material which contains significant Ag, Zn or Pb minerals may be temporarily stockpiled at the surface at the mine site before being transported to the mill. Confirmatory assay will determine whether this rock is milled, or is sent to the P-AML WRSF or hauled back underground to be incorporated in the cemented rock backfill material. This material will be temporarily stockpiled on surface for a maximum of 30 days.

The ultimate fate and use of these rock types are summarized in Table 3-1.

Table 3-1. Summary of Management Protocols for Rock Types

Rock Management Category	Management Procedures
N-AML Waste Rock	Storage in designated waste rock disposal areas (WRDAs) Use for general construction purposes
P-AML Waste Rock	Stored in P-AML WRSFs Used to fill underground voids as cement rock fill (CRF)
Mineralized Rock and Ore	Milled for mineral recovery if deemed of economic grade If deemed uneconomic grade: Stored in P-AML WRSFs Used to fill underground voids as CRF

3.3 ESTIMATED ROCK QUANTITIES

A total of approximately 143,000 t and 124,000 t of waste rock are anticipated to be generated at Lucky Queen and Onek over the mine life of each respective program. Waste rock volumes and tonnages for each respective deposit including a breakdown by the major lithologic units are shown in Table 3-2 and Table 3-3.

Table 3-2. Lucky Queen Waste Rock Excavation Estimate

Lucky Queen	GNST	QTZT	GSCH/ICQS	Total
Cubic Metres	951	41,602	4,755	47,308
Tonnes	2,472	108,166	12,362	123,000
% of Total Excavation	2%	88%	10%	100%
% N-AML	100%	65%	57%	65%
% P-AML	0%	35%	43%	35%

Table 3-3. Onek Waste Rock Excavation Estimate

Onek	Sericite Schist (SSCH)	Greenstone (GNST)	Quartzite (QTZT)	Graphitic Schist/Interbedded Carbonaceous Quartzite and Schist (GSCH/ICQS)	Total
Cubic Metres	5,155	6,175	34,254	9,416	55,000
Tonnes	13,404	16,056	89,060	24,480	143,000
% of Total Excavation	9%	11%	62%	17%	100%
% N-AML	72%	100%	56%	71%	65%
% P-AML	28%	0%	44%	29%	35%

3.4 WASTE ROCK MANAGEMENT

A summary of waste rock management for Lucky Queen and Onek over the life of mine for each deposit is shown in Table 3-4 and Table 3-5.

Table 3-4.Lucky Queen Waste Rock Management

Lithology	Total estimated tonnage	Tonnage P-AML per year	Tonnage N-AML per year	P-AML Rock Management	N-AML Rock Management
Quartzite	21,634	7,572	14,062	New Waste Rock Storage Facility as per approved EBA design or underground as CRF	N-AML Waste Rock Disposal Area, road upgrade and maintenance and general construction
Graphitic Schist	2,472	1,063	1,409		
Greenstone	494	0	494		
Annual Total	24,600	8,635	15,965		
Project Proposal Total	123,000	43,175	79,825		

Table 3-5. Onek Waste Rock Management

Lithology	Total estimated tonnage	Tonnage P-AML per year	Tonnage N-AML per year	P-AML Rock Management	N-AML Rock Management
Quartzite	17,812	7,837	9,975	Onek WRSF, additional facility based on approved EBA design, or underground as CRF	Onek Waste Rock Disposal Area/Portal construction/ upgrade material; road upgrade and maintenance and general construction
Graphitic Schist	4,896	1,420	3,476		
Greenstone	3,211	0	3,211		
Sericite Schist	2,681	751	1,930		
Annual Total	28,600	10,008	18,592		
Project Proposal Total	143,000	50,040	92,960		

Upon P-AML or N-AML determination as per the WRMP, directions will be given to the surface crew for hauling and disposal of the waste rock as described in the following sections. These management protocols will mitigate potential effects associated with improper waste rock disposal, such as soil and surface/groundwater contamination. During operations, all waste rock will be immediately classified and moved to the appropriate disposal area or storage facility depending on type, thereby negating the need for a temporary waste rock classification area.

3.4.1 Lucky Queen Waste Rock Management

N-AML waste rock (80,000 t) will be deposited as an extension to the existing waste rock disposal areas (WRDAs) at Lucky Queen (Figure 1-2). EBA has provided a geotechnical review of the location of the Lucky Queen N-AML WRDA in Appendix E. Additionally, waste rock that is not potentially acid generating or metal leaching will be used for general construction including repairs and surface capping of the existing site access roads. At Lucky Queen up to 0.75 hectares of clearing will be required to accommodate the new N-AML WRDA (see Appendix E for additional details).

Rock that is considered P-AML will be stored in the proposed P-AML Waste Rock Storage Facility at Lucky Queen. The P-AML Waste Rock Storage Facility at Lucky Queen will be built as per EBA's Typical Waste Containment Facility Design[3]. Preliminary mine plans indicate that there is the potential for a significant portion of the P-AML waste rock to be disposed of underground as backfill. The exact volume of P-AML materials that would be expected to be used for backfill depends on the mining sequence and availability of areas for backfilling and as such it is not possible to provide an exact number.

3.4.2 Onek Waste Rock Management

Rock that is not potentially acid generating or metal leaching will be used for general construction including construction, repairs and surface capping of the new and existing site access roads. Additionally, N-AML waste rock will be deposited on top of the existing Waste Rock Disposal Areas (WRDAs) at Onek (Figure 2-6).

Rock that is considered P-AML will be stored either in the P-AML Waste Rock Storage Facility (WRSF) to the north of the Onek historic open pit which was previously licenced for Bellekeno advanced exploration and development or a new proposed P-AML Waste Rock Storage Facility at Onek if required. Should additional surface storage capacity for P-AML waste rock be required, additional WRSFs will be constructed as per EBA's WRSF design and upon site inspection and location approval by an engineer There is sufficient existing surface disturbance area at Onek to accommodate the footprint required for an additional P-AML Waste Rock Storage Facility.

Preliminary mine plans indicate that there is the potential for a significant portion of the P-AML waste rock to be disposed of underground as backfill. The exact volume of P-AML materials that would be expected to be used for backfill depends on the mining sequence and availability of areas for backfilling and as such it is not possible to provide an exact number.

3.4.2.1 Historic Onek Waste Rock Dump as a Borrow Source

Approximately 95,000 t of material from existing historic dumps at Onek will be borrowed to construct the North Side Bypass Road (~55,000 t) and the Sign Post Portal Pad (~40,000 t). Figure 2-6 shows the

[3] This document can be found on the YESAB Online Registry (YOR file no. 2009-0030-007-01, Appendix C).

waste rock dumps identified as the primary and contingency borrow sources at Onek. Material from the existing dumps will be used instead of development/production N-AML rock from Onek, because the road and pad will be constructed in advance of Onek development and production.

The primary borrow source dump has a volume of approximately 415,000 t. The inset cross section in Figure 2-6 shows the approximate shape of waste that will be removed from the dump. Excavation will begin from the south end of the dump and proceed to the ramp at the north end. The excavation is expected to be flat; any slopes will be recontoured at 3:1. The Waste Rock Management Plan protocols will be applied to the dump material to ensure only N-AML waste rock is used for road and pad construction.

4 TAILINGS CHARACTERIZATION AND MANAGEMENT

Ore from Onek and Lucky Queen will be processed at the existing Keno District Mill Site, currently processing Bellekeno ore. Tailings generated from Lucky Queen and Onek ore processing will be deposited in the previously assessed and licenced Dry Stack Tailings Facility (DSTF) and paste backfilled at their respective mines. The mill and DSTF are not a part of the scope of the proposed Project. Information about those facilities is located in YESAB Project 2009-0030 document registry. There will also be no increase in planned tailings tonnage throughput rates or overall volumes processed form the currently licenced totals.

Although mill operation is not part of the Project scope, an overview of the Keno District Mill Site is shown in Figure 4-1.

Figure 4-1 Aerial View of Keno District Mill

4.1 METALLURGICAL TESTING OF ONEK AND LUCKY QUEEN ORE

Process Research Associates Ltd. was commissioned by Alexco to undertake a precious and base metal recovery study on samples originating from the Onek and Lucky Queen deposits during surface drilling programs completed in 2010. The purpose of this testing was to determine the recovery of silver (Ag), lead (Pb) and zinc (Zn) in the flotation circuits in the existing mill, and to evaluate the environmental parameters of the residual tailings. Representative samples from drill core were used to produce a composite sample of Onek and Lucky Queen for metallurgical testing.

The results of the metallurgical testwork indicate that Onek and Lucky Queen ore samples respond well to the current metallurgical flowsheet operating at the mill. There is a direct relationship between metal recovery, head grade and adequate base metals galena and sphalerite (PbS and ZnS) in the feed to maximize silver recovery. Therefore balancing the mill feed grade through the concurrent mining of Lucky Queen, Onek and Bellekeno will assist and be important in optimizing metallurgical performance from the Lucky Queen and Onek deposits. The metallurgical results shown in Table 4-1 are not from locked cycle tests but demonstrate the importance of adequate base metal concentrations in the feed grade, most notably sufficient galena to optimize overall lead and silver recovery. Additional optimization testwork will be required for final reagent addition optimization through locked cycle testwork.

Table 4-1 summarizes the results of the metallurgical tests completed on Onek and Lucky Queen.

Table 4-1. Metallurgical Testwork Summary of Onek and Lucky Queen Ore

Test ID	Sample ID	Products	Mass (%)	Grade			Recovery		
				Ag (g/t)	Pb (%)	Zn (%)	Ag (%)	Pb (%)	Zn (%)
F7	Onek	Head Grade		92.3	0.21	25.17			
		Pb Cl Conc	0.6	6899.4	32.23	11.35	48.4	74.0	0.3
		Zn Cl Conc	37.3	45.9	0.04	53.29	21.7	6.2	85.3
		Final Tails	44.4	2.2	0.01	0.23	1.2	0.4	0.4
F8	Onek	Head Grade		333.8	3.59	12.03			
		Pb Cl Conc	2.8	5196.5	70.97	3.10	46.5	56.7	0.7
		Zn Cl Conc	16.2	127.0	0.24	48.44	6.7	1.1	68.1
		Final Tails	65.0	11.0	0.08	1.76	2.3	1.5	9.9
F9	Lucky Queen	Head Grade		2251.8	4.49	3.15			
		Pb Cl Conc	6.6	33084.2	65.86	2.97	93.3	95.1	5.7
		Zn Cl Conc	4.3	214.7	0.16	58.79	0.4	0.2	73.6
		Final Tails	80.3	8.3	0.06	0.10	0.3	1.1	2.4
F10	Lucky Queen	Head Grade		4527.7	10.40	4.58			
		Pb Cl Conc	12.1	34837.3	70.47	1.88	84.6	87.3	4.8
		Zn Cl Conc	5.9	301.2	0.74	58.94	0.4	0.4	72.5
		Final Tails	67.7	20.9	0.09	0.06	0.3	0.6	0.9

4.2 ONEK AND LUCKY QUEEN TAILINGS CHARACTERIZATION

Following metallurgical testing of Onek and Lucky Queen samples, standard ABA analysis was completed on the remaining tailings samples, similar to the approach for Bellekeno samples during the previous assessment.

The results shown in Table 4-2 are for the bulk tailings produced from the metallurgical flowsheet tested. As the results indicate, the tailings from Onek and Lucky Queen are well above a standard neutralization potential (NP) ratio (3:1) and potential acid generation is not expected. One of the primary reasons for the high NP ratio is the significantly less acid potential due to lower total sulphur and base metals (i.e. PbS) in Onek and Lucky Queen as compared to Bellekeno.

Table 4-2. Onek and Lucky Queen Tailings ABA Summary

Item	Sample ID	$S_{(T)}$ %	$S_{(SO4)}$ %	Paste pH	Acid Potential	Neutralization Potential (NP)		
						Actual	Ratio	Net
1	F7 Final tailing	0.17	0.03	7.8	4.4	36.8	8.4	32.4
2	F8 Final tailing	0.15	0.05	7.8	3.1	26.0	8.3	22.9
3	F9 Final tailing	0.18	0.04	8.2	4.4	20.4	4.7	16.0
4	F10 Final tailing	0.19	0.04	7.5	4.7	17.8	3.8	13.1
DUP	F7 Final tailing	0.17	0.03	7.8	4.4	37.1	8.5	32.8
Bellekeno Tailings, January to May 2011 Monthly Average		2.61	0.06	8.1	81.62	276.2	3.4	194.6

The final tailings deposited in the DSTF will be a combination of Onek, Lucky Queen and Bellekeno ores. Given the current performance of the Bellekeno tailings as presented in Section 4.2.1 and the ABA testwork completed for Onek and Lucky Queen, bulk tailings stored on the DSTF are not a concern from an acid generating potential perspective. The Onek and Lucky Queen tailings are shown to be geochemically similar or better to Bellekeno in Table 4-2 and Table 4-3, and therefore the storage of the Onek and Lucky Queen tailings in the DSTF is appropriate.

Metals analysis of the tailings from the Lucky Queen and Onek metallurgical program was completed and the results are shown in Table 4-3.

Table 4-3. Onek and Lucky Queen Tailings Metallurgical Analysis

Elements	Units	Sample ID				Bellekeno Tailings
		F7 Cut Tail	F8 Cut Tail	F9 Cut Tail	F10 Cut Tail	January to May 2011 Monthly Average
C-Inorg	%	0.34	0.06	0.21	0.23	3.91
S(SO4)	%	0.03	0.05	0.04	0.04	0.06
Ag	ppm	3.2	9.6	9.6	23.2	53.08
Al	%	0.36	0.36	0.99	0.49	1.12
As	ppm	344	406	13	22	3526
Ba	ppm	18	30	169	80	180
Bi	ppm	<2	<2	<2	<2	3
Ca	%	0.65	0.28	0.48	0.27	1.55
Cd	ppm	14.4	131.1	4.9	3.0	255
Co	ppm	<1	2	3	<1	14.6
Cr	ppm	168	180	454	77	19
Cu	ppm	384	370	281	226	270
Fe	%	18.38	18.82	5.8	6.99	13.73
K	%	0.07	0.09	0.37	0.18	0.33
La	ppm	15	<10	<10	<10	8.66
Mg	%	0.55	0.39	0.36	0.32	0.40
Mn	ppm	52200	51678	21651	27757	42420
Mo	ppm	<1	<1	2	<1	0.81
Na	%	0.02	0.02	0.03	0.02	0.074
Ni	ppm	52	36	69	33	20
P	ppm	115	165	141	122	178
Pb	ppm	81	744	423	686	3498
Sb	ppm	<5	<5	9.0	<5	60
Sc	ppm	3	2	2	1	4
Sr	ppm	10	12	20	10	42
Ti	%	<0.01	<0.01	0.02	<0.01	0.04
Tl	ppm	15	20	<10	11	0.424
V	ppm	5	6	17	8	22
W	ppm	<10	177	<10	<10	1.46
Zn	ppm	1937	15630	697	416	1749

4.2.1 Bellekeno Tailings Characterization

Characterization of the actual tailings generated from Bellekeno ores has been ongoing and the results of the humidity cell tests currently in operation on representative tailings from the Bellekeno deposit for the first 11 weeks of humidity cell operation are shown in Figure 4-2, Figure 4-3 and Figure 4-4. The ABA and metallurgical monthly averages from January to May 2011 for the Bellekeno tailings are shown in Table 4-2 and Table 4-3, respectively. The preliminary results from the humidity cells indicate that the geochemical properties of the Bellekeno tailings are stable and no acid generation or other typical parameters of concern are showing any negative trends. Most notably pH, sulphate and acidity are not increasing over time and do not show any typical trends associated with potential acid generating material.

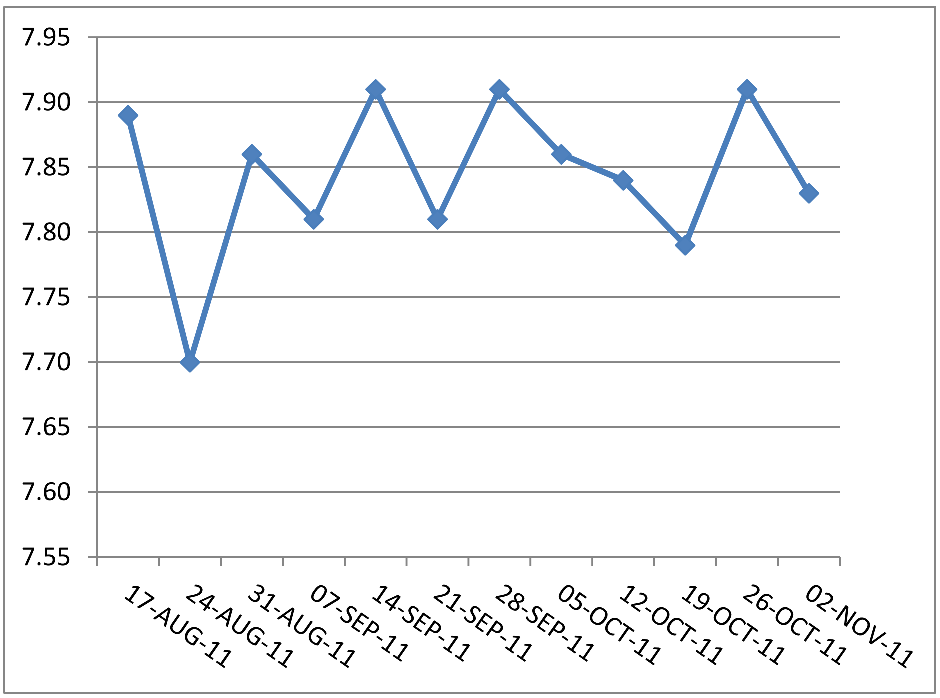


Figure 4-2. Bellekeno Tailings Humidity Cell pH Data

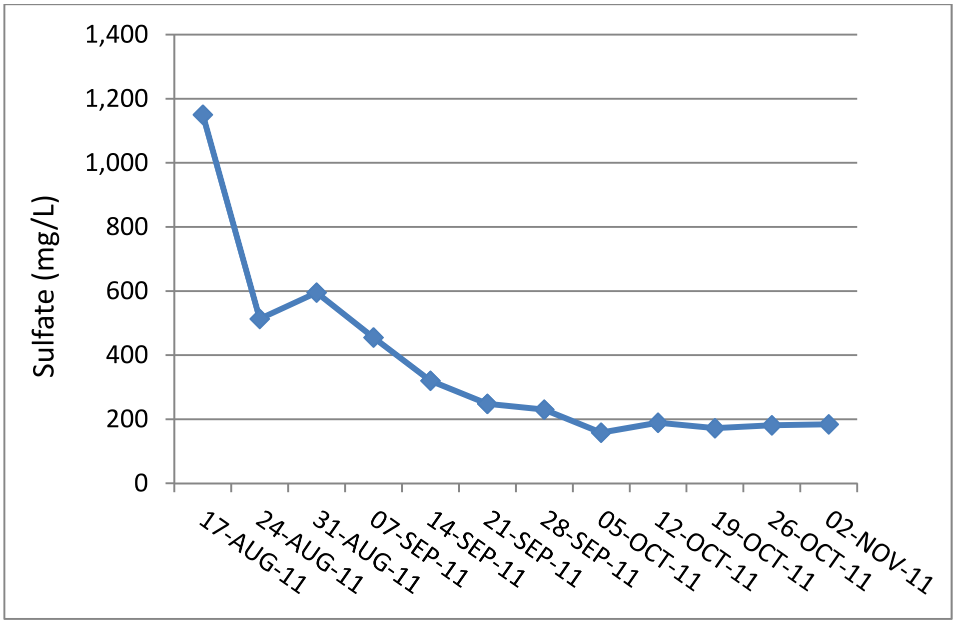


Figure 4-3. Bellekeno Tailings Humidity Cell Sulfate Data

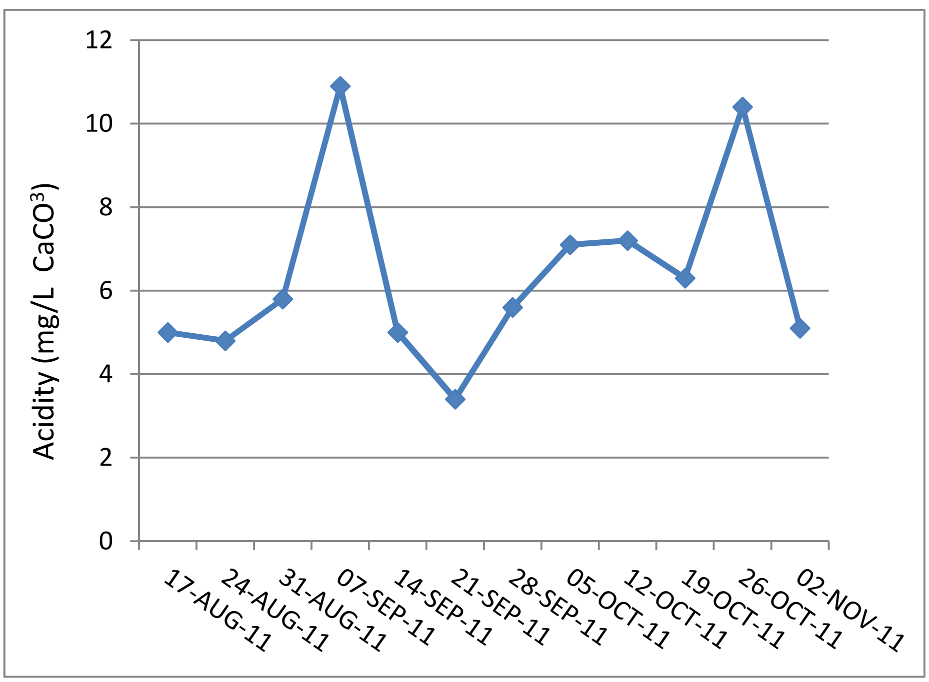


Figure 4-4. Bellekeno Tailings Humidity Cell Acidity Data

Laboratory test results were used previously to assess and predict the pore water quality of the filtered tailings from Bellekeno. This pore water quality was used to predict environmental effects from storage of tailings in the Dry Stack Tailings Facility. Table 4-4 compares the actual pore water of tailings from Bellekeno against the prediction of pore water quality obtained from laboratory testing on Bellekeno. The comparison demonstrates that the actual porewater is significantly better than predicted from the testwork.

Table 4-4. Bellekeno Tailings Porewater Data

Elements	Units	Bellekeno Pore Water From Testwork	Actual Tailings Pore Water Chemistry (March 31, 2011)	Actual Tailings Pore Water Chemistry (June 30, 2011)
Sb	mg/L	<0.1	0.0754	0.0553
As	mg/L	<0.2	0.0078	0.005
Cd	mg/L	0.12	0.0055	0.00272
Ca	mg/L	145	606	832
Cr	mg/L	<0.01	<0.005	<0.005
Cu	mg/L	0.64	0.0261	<0.01
Fe	mg/L	4.77	0.033	<0.060
Pb	mg/L	0.45	0.144	0.102
Ag	mg/L	<0.02	0.0077	0.0182
Zn	mg/L	20.31	0.076	0.028

Of most significance is the significantly lower zinc concentration in the pore water as compared to the testwork. The estimate of 20 mg/L zinc was used as the basis for potential environmental effects on groundwater from the DSTF and the comparison demonstrates that the initial estimate was highly conservative and actual water quality is significantly improved. In addition, a geosynthetic clay liner (GCL) layer was added to the DSTF design and has been installed below the DSTF footprint as a requirement under MMER to capture and measure any seepage from the tailings. The liner feature below the DSTF was not considered during the original assessment of the Bellekeno mine or a condition of the QML, but rather an outcome during the water licensing phase. The combination of the substantially high ABA ratio (3.8 to 8.4 : 1) due to the lower sulphur content of the Onek and Lucky Queen ores, preliminary results of the Bellekeno humidity cell tests, similarity of the Onek and Lucky Queen geochemical characteristics, consideration of the actual performance of the Bellekeno tailings and porewater chemistry compared to previously assessed testwork, and the addition of a GCL layer to the DSTF design give considerable confidence and justification for depositing filtered tailings from Onek and Lucky Queen into the currently authorized DSTF.

5 WATER CHARACTERIZATION AND MANAGEMENT

5.1 SURFACE WATER CONDITIONS

Selected historic data pertaining to the Onek 400 adit, Lucky Queen adit and Christal Creek watershed have been provided below. Key objectives of the data analysis were to determine or understand:

- Trends in adit discharge water quality over time to anticipate future water quality concerns; and
- Comparison between data sets and appropriateness of each for interpreting site water quality.

The proposed Onek and Lucky Queen mine sites are near Keno City and are contained within the Christal Creek watershed (Figure 5-1). Christal Lake drains into Christal Creek, which is fed by Erikson Gulch and eventually drains into the South McQuesten River.

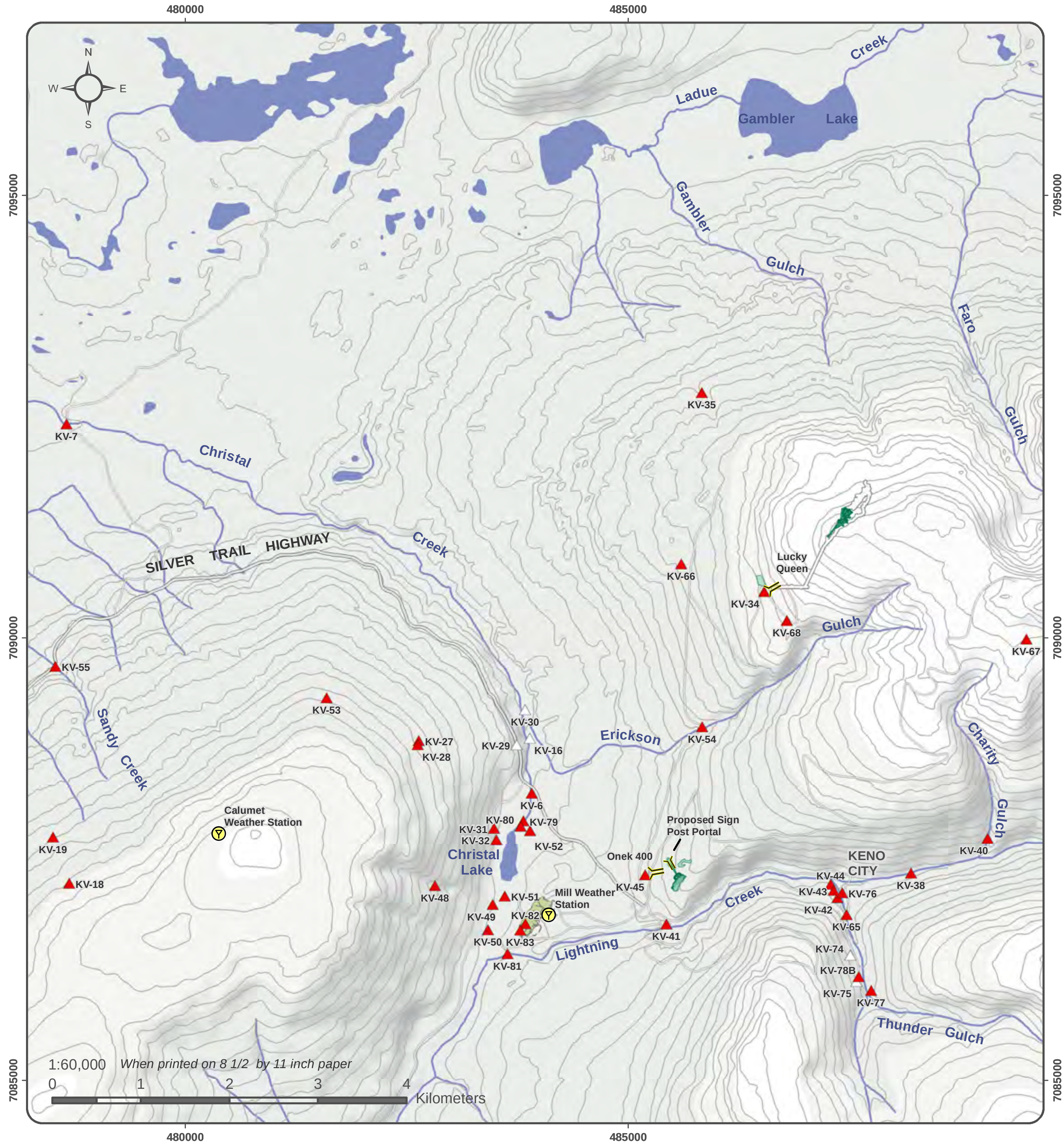
Water quality sampling has been carried out at a number of sampling stations in this area including the Lucky Queen adit, Onek 400 adit, and along Christal Creek and its tributaries. A summary of conclusions from field studies and existing data for the area is as follows:

- A number of contaminant sources drain directly to Christal Lake and the Christal Creek watershed, including: Galkeno 900 adit, Galkeno 300 adit, Onek 400 adit, UN adit, and the old Mackeno tailings that are situated near the northeast shore of Christal Lake;
- Median total zinc concentrations of the Onek 400 adit discharge from data collected between 1997 and 2011 were 69.8 mg/L with a flow of 0.75 L/s; and
- The Onek 400 adit discharge was sampled seven times in 2011 and the total zinc and adit discharge ranged from 27.4 to 186 mg/L and 0.5 to 1.5 L/s, respectively.
- The Lucky Queen adit has been sampled eight times in 2011 with a maximum zinc concentration of 0.22 mg/L and the adit discharge has been measured twice with a maximum flow of 1 L/s.
- There is currently no active chemical treatment of water emanating from either the Onek 400 adit or the Lucky Queen adit, and monitoring of both of these sites is carried out under QZ06-074.

5.1.1 Historic Lucky Queen Adit

The Lucky Queen adit (KV-34) is located on Keno Hill north of the Erickson Gulch watershed. The adit is not connected to the historic Lucky Queen pit and associated underground workings. Water discharging from the Lucky Queen adit is likely the result of meteoric water infiltration reaching the 500 level workings. The Lucky Queen adit was intentionally barricaded in 2009 by Alexco to prevent inadvertent human access and for public safety concerns. Rehabilitation of the portal was initiated during the summer of 2011. Flows were recorded twice during the late-summer of 2011 at 1 L/s and 0.65 L/s (Table 5-1). The flow of 1 L/s was measured during the rehabilitation of the underground workings when dewatering of accumulated water within the underground workings occurred; therefore this flow was not representative of natural conditions. The flow of 0.65 L/s was taken after the standing water in the adit had been pumped out and is considered representative of natural conditions.

The frequency of the Lucky Queen adit discharge monitoring program was increased in conjunction with the rehabilitation of the Lucky Queen adit. The samples collected and provided below may not be representative of baseline conditions as they were collected while activities were being conducted in the underground workings. Total zinc concentrations ranged from 0.04 to 0.22 mg/L, and total cadmium ranged from 0.0004 to 0.0027 mg/L (Figure 5-2). Both of these parameters are well below any licence discharge criteria currently in use in the KHSD. Discharge from the Luck Queen adit is directed to a small settling pond for management of total suspended solids and then infiltrates into the ground approximately 50 to 100 m from the adit portal. Less than 1 L/s of water travels approximately 3 km through the ground becoming attenuated prior to reaching Christal Creek. There is no direct surface water connection between the Lucky Queen adit and Christal Creek although the topography of the area drains in the direction of the Christal Creek watershed and thus it is thought that Lucky Queen waters eventually report there. The Lucky Queen adit is not within the Erickson Gulch watershed.



Adit
Monitored
Discontinued
Highway
Local
Contour (100 ft)
Watercourse
Existing Mine Feature Footprint
Proposed Mine Feature Footprint
Waterbody
Mill Site

LUCKY QUEEN AND ONEK MINE PRODUCTION

FIGURE 5-1

EXISTING SURFACE WATER MONITORING NETWORK

Datum: NAD 83; Projection: UTM Zone 8N

AKHM

ACCESS

DRAWN BY JL	DECEMBER 2011	VERIFIED BY KW

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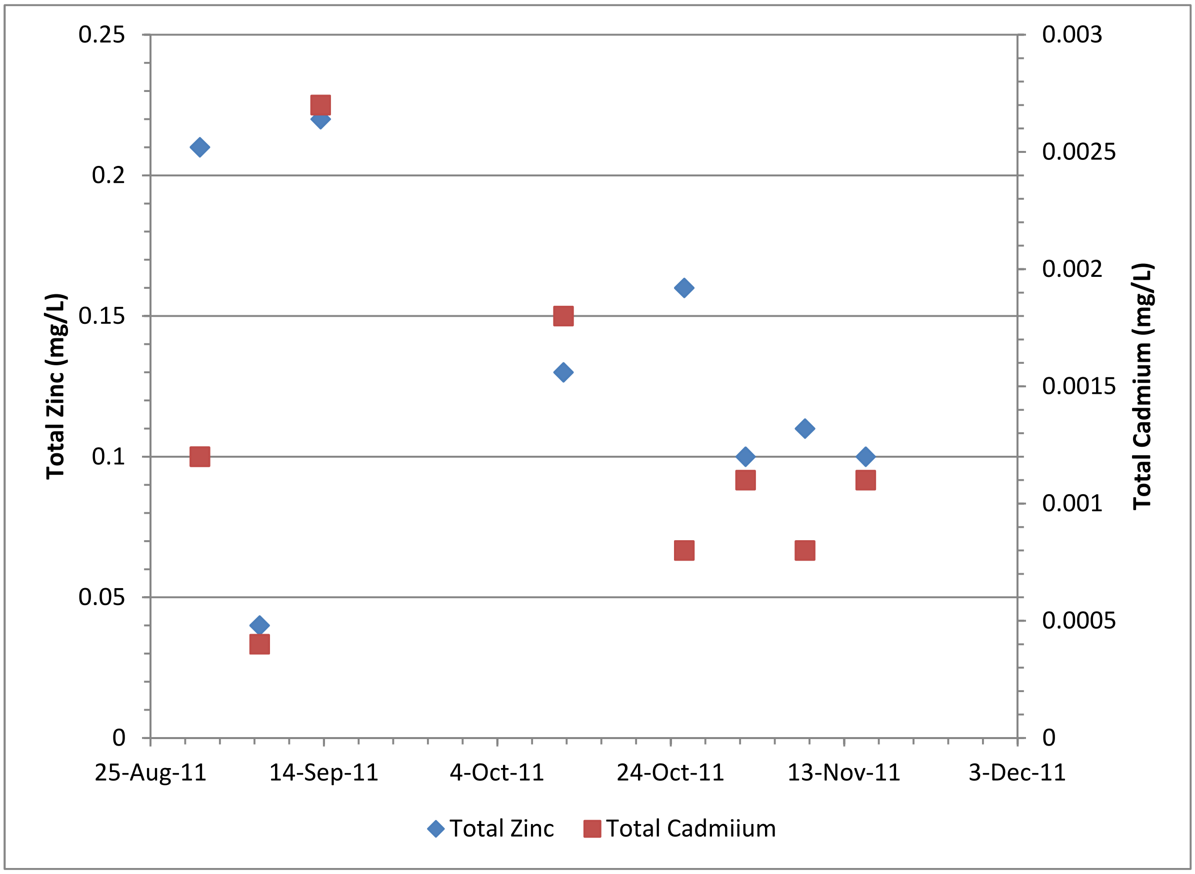


Figure 5-2. Lucky Queen Adit (KV-34) Total Zinc and Cadmium Concentrations, 2011

5.1.2 Historic Onek 400 Level Adit Discharge

The historic Onek 400 adit is located northeast of Keno City, within the valley below Keno Hill just east of the Gambler Gulch Trail. The adit is connected by shafts that daylight into the historically mined Onek Pit. Discharge rates from the Onek 400 adit (KV-45) vary greatly throughout the year and are presumed to be dependent on inflows to a backfilled shaft within the pit. The hydraulic connection between the pit and adit results in a rapid response of adit discharge during freshet and large rainfall events. Discharge as high as 7.3 L/s has been recorded during freshet, decreasing to approximately 0.5 L/s during low flow periods.

Figure 5-3 and Table 5-1 presents Onek 400 adit water quality data from 2005 to 2011. Total zinc concentrations ranged from 27.4 to 186 mg/L, while cadmium ranged from 0.308 to 6.4 mg/L. Figure 5-3 shows that spikes in zinc and cadmium concentrations correlate with higher flows experienced during freshet or large rainfall events that flush the accumulated weathering products from the underground workings that were developed on vein from the Onek 400 mine.

Discharge from the Onek 400 adit infiltrate into the ground about 50 m from the adit opening during low flow, and may travel several hundred m during spring and early summer before infiltrating to ground. The low discharge volume (Median = 0.75 L/s, where n = 15, measured between 2006 and 2011) likely migrates downward and mixes with the natural groundwater flow system where it is diluted. A groundwater evaluation of the Keno City area suggests that the affected groundwater near the Onek 400 adit migrates southwest and then turns northwest towards Christal Lake. This migration pathway occurs in glacial deposits and possibly in bedrock as well.

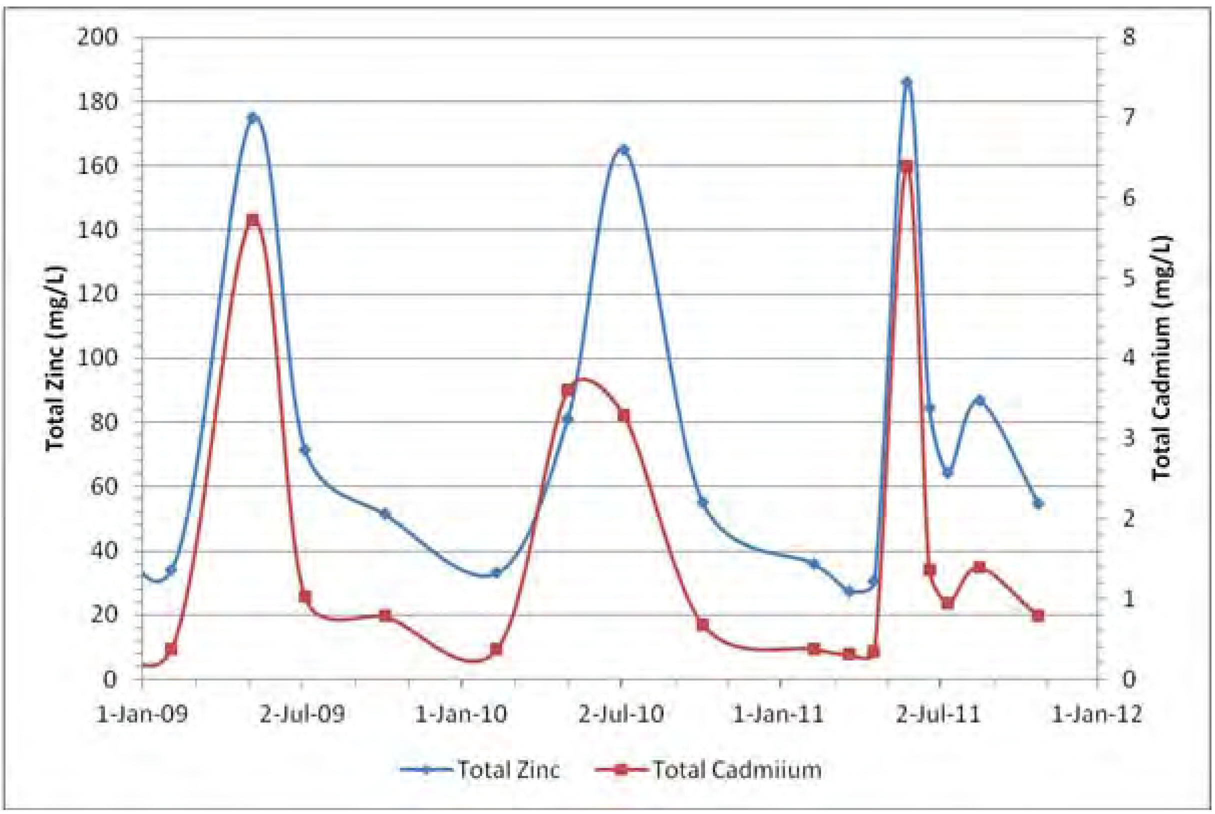


Figure 5-3. Onek 400 Adit Discharge (KV-45) Total Zinc and Cadmium Concentrations, 2009-2011

Table 5-1. Onek 400 Adit and Lucky Queen Adit Water Quality Summary Statistics

	Onek 400 Adit (KV-45)		Lucky Queen Adit (KV-34)
Zinc, Total (mg/L)	**2005-2011**	**2011**	**2011**
Count	26	8	8
Minimum	27.4	27.4	0.04
Maximum	186	186	0.22
Count <DL	0	0	0
Standard Deviation	47	51.7	0.06
1st Quartile	52	34.8	0.10
Median	72.1	59.7	0.12
3rd Quartile	113	85.3	0.17
Cadmium, Total (mg/L)	**2005-2011**	**2011**	**2011**
Count	26	8	8
Minimum	0.308	0.308	0.00040
Maximum	6.4	6.4	0.00270
Count <DL	0	0	0
Standard Deviation	1.611	2.031	0.000715
1st Quartile	0.606	0.369	0.00080
Median	0.986	0.863	0.00110
3rd Quartile	1.992	1.377	0.00135
pH (field)	**2006-2011**	**2011**	**2011**
Count	22	7	8
Minimum	6.42	7.16	9.28
Maximum	8.05	8.05	9.28
Count <DL	0	0	0
Standard Deviation	0.41	0.32	0.51
1st Quartile	7.17	7.57	7.81
Median	7.46	7.84	8.00
3rd Quartile	7.71	7.9	8.15
Discharge (L/s)	**2006-2011**	**2011**	**2011**
Count	15	5	2
Minimum	0.5	0.5	0.65
Maximum	7.3	1.5	1.0
Standard Deviation	2.06	0.43	-
1st Quartile	0.5	0.5	0.74
Median	0.75	0.5	0.825
3rd Quartile	1.85	0.75	0.91

5.1.3 Christal Creek Catchment

Christal Creek flows northwest from Christal Lake for approximately 22 km before it flows into the South McQuesten River. Water chemistry and aquatic resources in the creek have been influenced by previous mine and milling operations including tailings deposition and adit discharge. Christal Creek receives input water from Galkeno 900 adit, Galkeno 300 adit, and seepages (surface and groundwater) from workings on the west face of Keno Hill. Christal Lake has been a receptor for effluent from various mines including Galkeno 900 and the Mackeno Mill area and Mackeno tailings, contributing to metal loading in Christal Creek.

Within the Christal Creek catchment there are 11 active licenced monitoring sites (Table 5-2). Monitoring in this watershed begins at Christal Creek before its confluence with Hinton Creek (KV-50) and ends at the mouth of Christal Creek where it enters the South McQuesten River (KV-8). There are no significant tributaries to Christal Creek upstream of Hinton Creek; however, it is unknown to what degree mine-related discharges may have an influence on the drainage above KV-50 as there are known to be historical workings upstream of this sampling location. It is reasonable to assume that water quality at KV-50 reflects some degree of mine-related contamination as a result of its proximity to mining areas, but could also reflect naturally mineralized seep areas.

Table 5-2. Christal Creek Catchment Water Quality Monitoring Sites

SITE	SITE DESCRIPTION	MONITORING FREQUENCY
KV-6	Christal Creek at Keno Highway	Monthly
KV-7	Christal Creek at Hanson Road	Monthly
KV-8	Christal Creek at mouth	Monthly
KV-48	Hinton Creek u/s Calumet Drive	Quarterly
KV-49	Hinton Creek u/s Christal Creek	Quarterly
KV-50	Christal Creek u/s Hinton Creek	Quarterly
KV-51	Christal Creek d/s Hinton Creek	Quarterly
KV-52	Natural spring to Christal Lake at Old Mackeno pumphouse	Monthly
KV-54	Erickson Gulch at Road to Lucky Queen	Quarterly
KV-79	Christal Creek d/s of Mackeno Tailings	Quarterly
KV-80	Christal Creek u/s of Mackeno Tailings	Quarterly

Of these stations, data were investigated for KV-6, KV-7, KV-8, KV-16 and KV-30 for a water quality assessment conducted in 2008 (Minnow, 2008). Data for these stations were examined to determine which parameters regularly exceed background concentrations and Canadian Environmental Water Quality Guidelines (CEWQG). Parameters that exceeded the highest benchmark (background or guideline) in more than 50% of samples included:

- KV-6 – cadmium, lead, sulphate and zinc;
- KV-7 – cadmium, sulphate and zinc;
- KV-8 – cadmium, sulphate and zinc;
- KV-16 – cadmium, nitrite, phosphorous, sulphate and zinc;
- KV-30 – cadmium, nitrite, sulphate and zinc.

In addition, parameter that exceeded both the background concentrations and water quality guideline (if available) in more than 10% of samples collected at each station include:

- KV-6 – arsenic, calcium, conductivity, hardness, iron, magnesium, manganese, nitrite, selenium, silicon, silver, sulphur, total suspended solids and uranium;
- KV-7 – arsenic, calcium, chromium, conductivity, hardness, iron, lead, magnesium, nitrite, silicon, silver, sulphate, sulphur and total suspended solids;
- KV-8 – calcium, conductivity, hardness, iron, lead, magnesium, nitrite, silicon, silver, strontium and sulphur;
- KV-16 – arsenic, calcium, chromium, conductivity, hardness, iron, lead, magnesium, manganese, selenium, silicon, silver, strontium, sulphur and uranium;
- KV-30 – aluminum, arsenic, calcium, chromium, conductivity, hardness, iron, lead, magnesium, manganese, phosphorous, silicon, silver, strontium, sulphur, total dissolved solids, total suspended solids and uranium;

Historically, concentrations of cadmium and zinc have been significantly elevated above the Canadian Environmental Water Quality Guidelines with mean values more than ten times the CWQG in both Christal Creek and Flat Creek (Minnow, 2008). Since 2006, concentrations of cadmium and zinc have been in the same range as observed historically in the South McQuesten River. The improving trend in water quality is part of the success of care and maintenance activities, which in this case includes upgrades to the water treatment systems at Galkeno 300 and Galkeno 900.

During 2010, the Keno District Mill was constructed and commissioned within the Christal Creek watershed. Now, and in future years during mill operation, discharge water resulting from milling activities will enter the Christal Creek watershed. During 2010, even though permitted to discharge water from the Mill, there was no discharge from the Mill to the Christal Creek watershed; however, water treatment will be carried out in the future as required to treat mill water prior to discharge to Christal Creek.

5.2 GROUNDWATER CONDITIONS

The groundwater regime in the vicinity of the Onek and Lucky Queen mines is characterized by mountain slope topography with topographic relief of roughly 1000 m over a horizontal distance of 6.5 km. The profile of relief for Lucky Queen and Onek are shown in Figure 2-3 and Figure 2-4, respectively. Keno Hill is also typified by extensive permafrost and a relatively low temperature gradient; this can retard the infiltration of meteoric water and affect groundwater migration along the hillside.

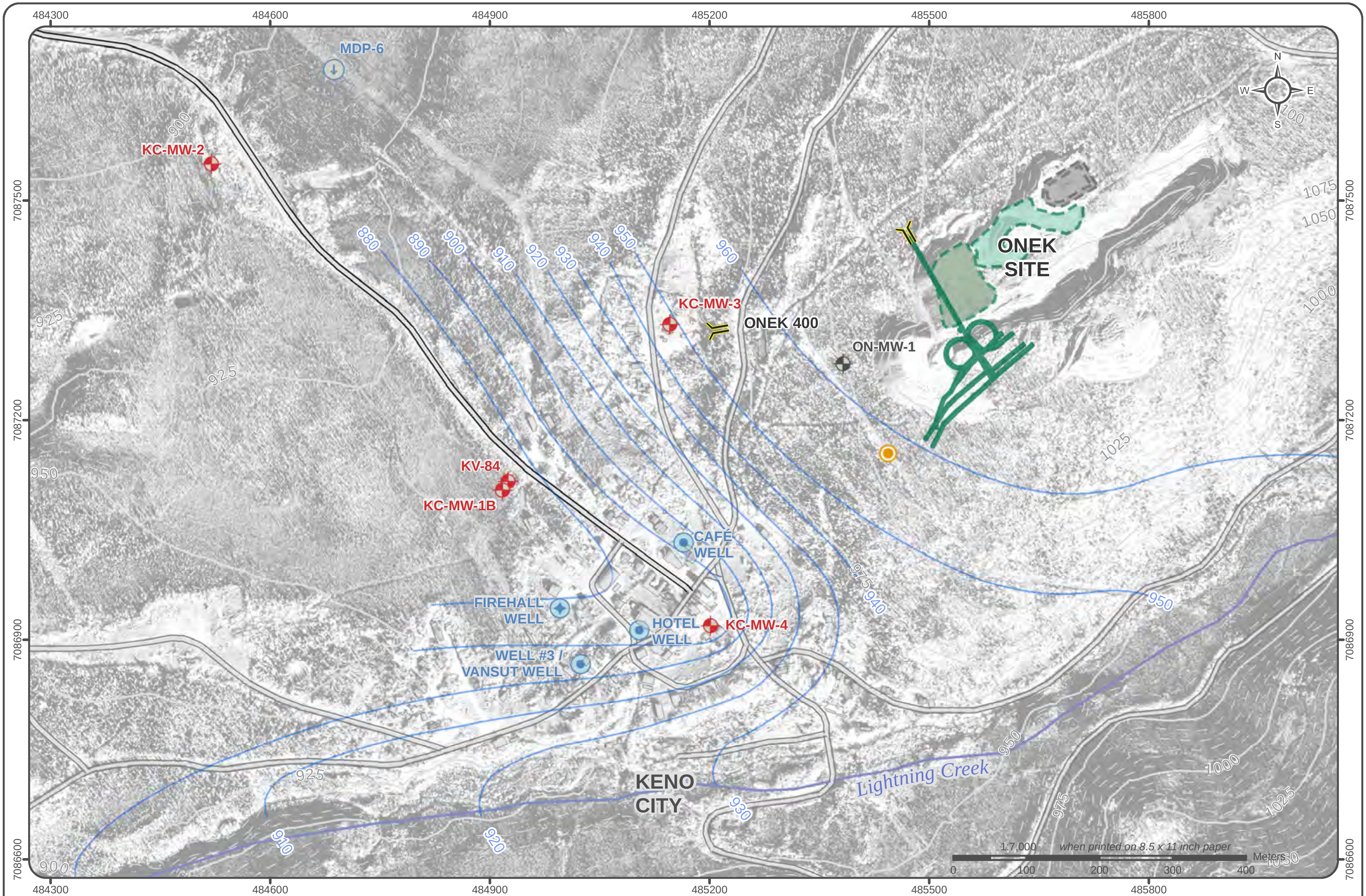
Groundwater passing through Keno Hill also has a high degree of structural control as a result of geology of the area. Faults, fractures, vein systems, and mining excavations can act as preferential pathways for groundwater flow.

Alexco in partnership with the Federal Government have initiated a program to characterize the groundwater resource and potential impacts of historical mining from the historic Onek 400 adit. The investigation is ongoing, with preliminary results discussed in a Draft Keno City Groundwater Evaluation (Interralogic, 2011).

Preliminary results show that the groundwater flow regime in the area of Onek Mine is generally conformant with the surface topography as shown in Figure 5-4. Groundwater below Keno City generally travels in northwest direction somewhat parallel to the Silver Trail Highway. It is postulated that a higher permeability feature in bedrock or glacial deposits extends from the central part of Keno City to the northwest and this controls the general flow direction.

Surface outflow from the Onek 400 adit infiltrates to the groundwater table and migrates to the southwest where it commingles with the northwest flowing groundwater pathway. Hydrogeologic interpretations presented in the Draft Keno City Groundwater Evaluation (Interralogic, 2011) predict that groundwater affected by Onek 400 Adit discharge does not impact the Keno City drinking water supply well. This interpretation is supported by the water samples taken from this well.

The Lucky Queen Mine is perched high on the western slope of Keno Hill. Because no groundwater investigations have taken place in this area, knowledge is limited to understanding the way water travels through the underground workings. The groundwater flow regime at Lucky Queen is expected to generally be conformant with the surface topography and flow in the direction of Christal Creek, which is approximately 3km west of the Lucky Queen adit.



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Datum: NAD 83; Map Projection: UTM Zone 8N

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- Proposed monitoring Well
- Groundwater Well
- Geotechnical Well
- Private Drilled Well
- Public Drilled Well
- Manual Drive Point
- Groundwater Contours
- Proposed Mine Development
- 5 Meter Contours
- 25 Meter Contours
- Proposed Footprints
- Proposed Borrow Source
- Exisiting Footprints

AKHM

ACCESS

ONEK MINE AND SURROUNDING AREA

FIG 5 - 4

ONEK GROUNDWATER MONITORING LOCATIONS

DRAWN BY JP	DECEMBER 2011	VERIFIED BY TL

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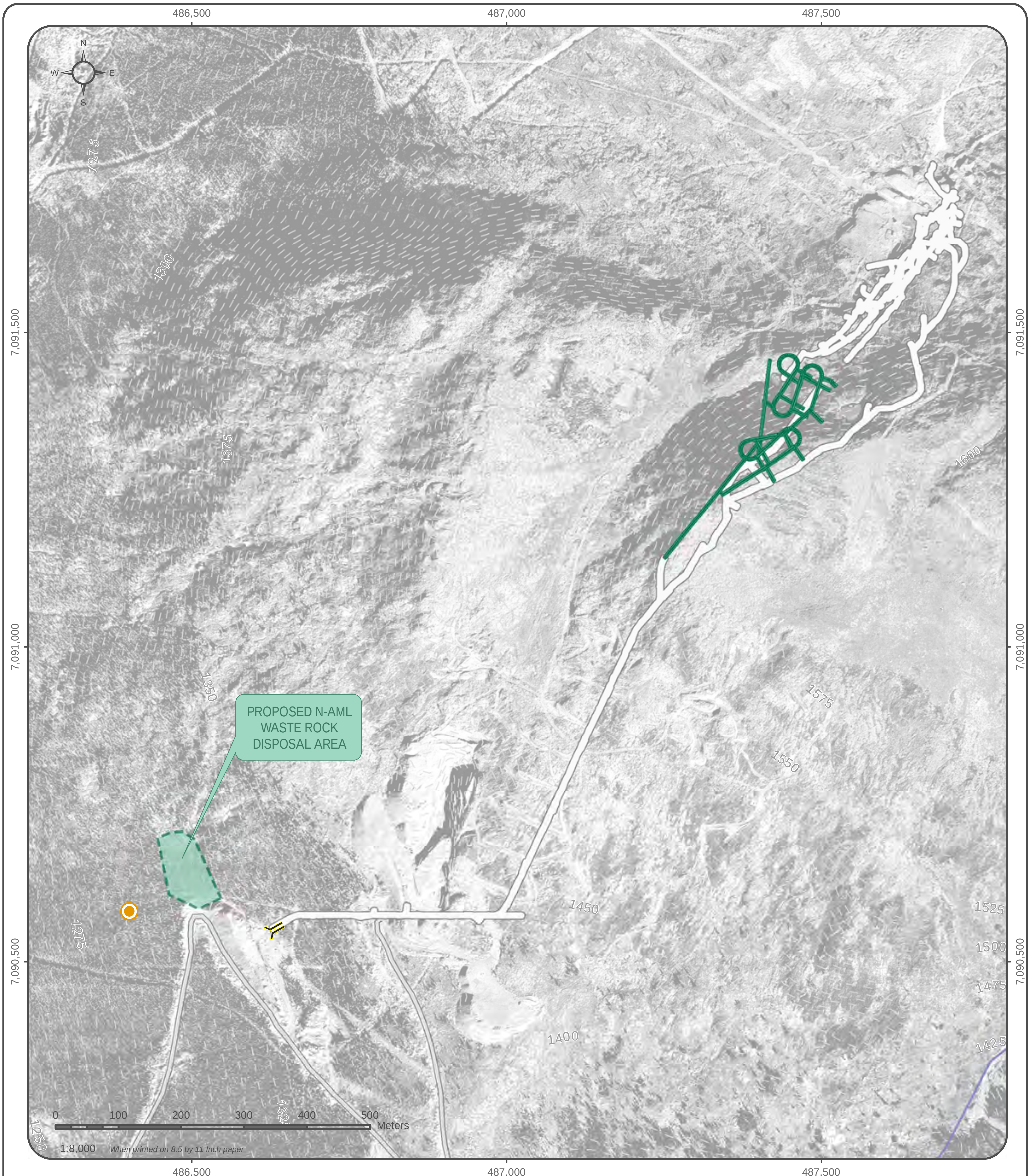

Proposed monitoring Well

5 Meter Contours

25 Meter Contours

Existing Underground Workings

Proposed Footprints

Aerial photograph obtained from Geodesy Remote Sensing Inc., Calgary Alberta. Imagery acquired September 13th and 14th 2006.National topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Reproduced under license from Her Majesty the Queen, as represented by the Minister of Natural Resources Canada. All rights reserved.Datum: NAD 83; Projection: UTM Zone 8N

AKHM ACCESS

LUCKY QUEEN MINE DEVELOPMENT

FIGURE 5-5

LUCKY QUEEN GROUNDWATER MONITORING LOCATIONS

DRAWN BY MD	DECEMBER 2011	VERIFIED BY KW

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5.2.1 Groundwater Quality

In 2011 a groundwater well, ON-MW-1, was installed upgradient of the Onek 400 adit, immediately below the area of the new Onek deposit, to establish background groundwater elevation and quality (Figure 5-4, Figure 5-5andTable 5-3). Table 5-3 summarizes the groundwater quality data for the November 21, 2011 sampling event for three wells down gradient of the new Onek deposit: KC-MW-2, KC-MW-3 and ON-MW-1. KC-MW-2 and KC-MW-3 are screened in overburden, whereas ON-MW-1 is screened in bedrock.

Well ON-MW-1 is located upgradient of the Onek 400 adit discharge and downgradient of the historic Onek open pit and waste rock facilities. ON-MW-1 is similar in water quality to the downgradient well, KC-MW-2, with the exception of elevated sulphate, iron and manganese which exceeded the aesthetic objectives identified in the Guidelines for Canadian Drinking Water Quality (GCDWQ) (Health Canada, 2010). This may be a result of ON-MW-1 being downgradient of the historic waste rock facilities and being a deeper bedrock well. Well KC-MW-2 did not exceed any of the guidelines identified in the GCDWQ when sampled on November 21, 2011.

KC-MW-3 is located immediately downgradient of the Onek 400 adit and was installed to assess the potential impact the historic Onek 400 adit discharge could have on groundwater quality in the Keno City area. Background groundwater quality in the vicinity of the historical Onek 400 adit at KC-MW-3 is slightly elevated with respect to some metals given impact from adit discharge, the mineralized nature of the area, and possible impacts from groundwater in the historical Onek mine open pit and waste rock facilities. Onek 400 adit discharge exits the adit and travels north westwards in a bermed channel until, it disappears completely to ground roughly 50 m from the adit. Impact of the infiltration appears to be most significant to the northwest of the adit and Keno City. The Onek 400 adit was driven on vein and as such contains a high degree of mineralized materials which leach metals into water passing through it (Table 5-1). The primary contaminants of concern are cadmium and zinc.

In 2010, a sampling program among the drinking water wells in the immediate vicinity of Keno City was completed that included the Café Well, Hotel Well, Fire Hall Well (Keno City drinking water supply well) and the VanSut Well. The Guidelines for Canadian Drinking Water Quality were exceeded in these wells for selenium and total dissolved solids (TDS) at the Keno City Cafe well and manganese at the Keno City Hotel and Fire Hall well (Table 5-4).

Table 5-3. Groundwater data from November 21, 2011 Sampling Event

Parameter	GCDWQ	KC-MW-2	KC-MW-3	ON-MW-01
		21-Nov-11	21-Nov-11	21-Nov-11
Groundwater Level masl		881.06	949.61	962.01
Anions				
Dissolved Sulphate mg/L	500	117	374	764
Physical Properties				
Conductivity us/cm	-	402	933	1690
pH	6.5-8.5	7.76	7.45	7.87
Total Suspended Solids mg/L	-	11.1	15.0	126
Dissolved Metals mg/L				
Dissolved Antimony (Sb)	0.006	0.00017	0.0005	0.00017
Dissolved Arsenic (As)	0.01	0.00143	0.0007	0.00245
Dissolved Barium (Ba)	1	0.0888	0.0153	0.0245
Dissolved Boron (B)	5	<0.05	<0.3	<0.05
Dissolved Cadmium (Cd)	0.005	0.000570	0.937	0.000138
Dissolved Chromium (Cr)	0.05	0.0002	<0.0005	0.0002
Dissolved Copper (Cu)	1	0.00085	0.0043	0.00007
Dissolved Iron (Fe)	0.3	0.003	<0.005	4.27
Dissolved Lead (Pb)	0.01	0.000982	0.00177	0.000058
Dissolved Manganese (Mn)	<0.05	0.00956	0.0267	1.54
Dissolved Mercury (Hg)	0.001	<0.00001	<0.00005	<0.000020
Dissolved Selenium (Se)	0.01	0.00124	0.0004	0.00005
Dissolved Uranium (U)	0.02	0.00256	0.00103	0.0107
Dissolved Zinc (Zn)	5	0.0287	52.4	0.0159
Dissolved Calcium (Ca)	-	58.0	142	363
Dissolved Magnesium (Mg)	-	11.5	17.8	39.3

Table 5-4. Concentrations of Parameters Under Health Canada's Drinking Water Quality Guidelines at Wells in the Immediate Vicinity of Keno City.

		Keno City Cafe Well	Keno City Hotel Well	Keno City Fire Hall Well	VanSut Well	VanSut Well	Health Canada Guidelines for Drinking Water Quality (GCDWQ)
Parameter[1]	**Unit**	**26-Nov-2010**	**8-Dec-2010**	**8-Dec-2010**	**26-Nov-2010**	**8-Dec-2010**	
Antimony	mg/L	0.00006	0.00003	0.00013	0.0001	0.00008	0.006
Arsenic	mg/L	0.00005	0.00008	0.00263	0.00248	0.00169	0.01
Barium	mg/L	0.057	0.0938	0.103	0.114	0.111	1
Boron	mg/L	<0.05	<0.05	<0.05	<0.05	<0.05	5
Cadmium	mg/L	0.000155	0.000007	0.00124	0.000314	0.000129	0.005
Chromium	mg/L	0.0003	0.0002	0.0004	0.0005	0.0005	0.05
Lead	mg/L	0.000115	0.00011	0.000493	0.000182	0.000478	0.01
Manganese	mg/L	0.0306	0.226	0.554	.00078	.00195	0.05
Selenium	mg/L	0.0139	0.00063	0.00201	0.00267	0.0023	0.01
TDS	mg/L	660	120	410	270	160	500
Uranium	mg/L	0.00301	0.000117	0.00934	0.00143	0.000564	0.02

1. Parameters are in dissolved concentrations

5.3 PROJECT WATER USAGE

This Project will require water use for expansion of the Flat Creek camp for an additional 50 persons, and underground development and operation of Onek and Lucky Queen mines. Combined total increased water usage for the additional camp personnel, Lucky Queen and Onek mines operations is estimated to be 183 m^3 per day or 66,795 m^3 per year.

5.3.1 Lucky Queen Underground Development and Production

Lucky Queen underground development and production will require up to 56.25 m^3/day. Daily water usage during ongoing underground mine development and operation is estimated at 45 m^3/day when mining at an estimated maximum rate of 150 tpd. This water will be used to support activities including percussion drill water use, dust suppression and equipment cooling, and minor use for sanitation. With a 25% increase for contingencies, total water usage for underground development, production and drilling is estimated at 56.25 m^3/day. The sources for underground development and operation include: percolated meteoric water encountered during mining, a groundwater supply well located near the adit portal and re-use of water from the settling pond. Mine water recovered in sumps will be used as much as possible. Based on current water recycle rate at the Bellekeno mine, it is estimated that up to 25% of the water could be recycled.

5.3.2 Onek Underground Development and Production

Onek underground development and production will require up to 112.5 m^3/day. Daily water usage during ongoing underground mine development and operation is estimated at 90 m^3/day when mining at an estimated maximum rate of 300 tpd. This water will be used to support activities including percussion drill water use, dust suppression, equipment cooling and minor use for sanitation. With a 25% contingency, total water usage for underground development, production and drilling is estimated at 112.5 m^3/day. The water sources for underground development and operation include: the treated Onek 400 adit discharge, percolated meteoric water encountered during mining and a groundwater well located by the adit portal. Mine water recovered in sumps will be used as much as possible. Based on current water recycle rate at the Bellekeno mine, it is estimated that up to 25% of the water could be recycled.

5.3.3 Flat Creek Camp

As the camp is expanded for the mine development and operations of Lucky Queen and Onek mines there will be a need for increased water usage. The Flat Creek Camp requires an additional 14.25 m^3/day to support 50 additional people. Based on current camp use at the site a predicted use of 228 litres per person per day has been selected. For an additional 50 persons this translates to 11.4 m^3/day. This is consistent with YG Environmental Health guidance figures of 200 litres per person per day. With a 25% increase in use for fire protection, total camp water use requirements are estimated at 14.25 m^3/day. This will bring the total water usage for the Flat Creek camp to 57 m^3/day from the 42.75 m^3/day authorized in Water Use Licence QZ09-092.

Domestic water for the camp is currently pumped from a cistern buried in Flat Creek. It is piped via insulated-heat traced pipeline to a water treatment facility about 100 m to the north, located in the existing camp facility. The treatment plant consists of 5,000 L of storage, a water softener, UV treatment and chlorination. Monthly samples are submitted for analyses for bacteriological parameters and semi-annually for complete chemical analysis.

A planned water well to augment water usage from Flat Creek between Flat Creek and the camp near the old fire water storage building has not yet been drilled, but will be drilled during 2012 in order to meet the needs of the expanded camp. Water will be pumped to the existing storage and water treatment system.

5.4 MINE WATER BALANCE

This section presents an overview of basic variables that affect the water balance at each of the three points of water use and discharge in this project. Data from two Environment Canada Atmospheric

Environment Service weather stations in the Keno Hill area (Elsa town site from 1948-1965, and 1974-1989; and Keno Hill from 1974-1982) were used to evaluate climactic parameters for the Lucky Queen and Onek mine development project. Important variables are mean annual precipitation and evapotranspiration. These two parameters were considered the key parameters in developing the water balance for the Keno Hill area as a whole as presented in the Bellekeno YESAB project proposal. A climate station was installed at the Keno District Mill site in 2011, but this dataset is currently insufficient to incorporate into this application. Future applications will incorporate data from the recently installed climate station.

Mean annual precipitation (MAP) has been shown within the Keno Hill Silver District to increase with increasing elevation. The significant relief over which the Keno Hill area spans is well represented by the two historical weather stations with Elsa at 814 m and the Galena Hill weather station at 1472 m. This facilitated derivation of the relationship between elevation and precipitation for the site. In combination with site evapotranspiration, calculations have been used to predict annual precipitation, evapotranspiration, and net precipitation for the Lucky Queen and Onek mine (See Table 5-5). The close proximity and similar elevation allow Elsa to be a proxy for the Flat Creek Camp and the Onek Mine. Whereas Galena Hill acts as a proxy for Lucky Queen due to its proximity and similar elevation.

Table 5-5. Precipitation and Evapotranspiration at Select Keno Hill District Locations

Site	Mean Annual Precipitation (mm)	Mean Annual Evapotranspiration (mm)	Annual Net Precipitation (mm)	Data Source
Galena Hill (1472 m Elevation)	585	205	380	AES Climate Station, UKHM Site Characterization Report, 1996
Elsa Town site (814 m Elevation)	420	230	190	AES Climate Station, UKHM Site Characterization Report, 1996
Onek Mine, Sign Post adit (1025 m Elevation)	473	222	251	Calculated based on site elevation-precipitation relationship
Lucky Queen adit (1350 m Elevation)	554	210	344	Calculated based on site elevation-precipitation relationship

5.4.1 Onek Mine Water Balance

For Onek mine development and production, water for drilling purposes and dust suppression will come from the following sources: infiltrated meteoric water in the mine, treated Onek 400 discharge and potentially a groundwater supply well. Water will be used and recycled from the underground workings to the extent possible. Approximately 25%, of the water used in underground development may be recycled. Table 5-1 identifies the median flows from the existing Onek 400 adit, which incorporates higher flows observed during spring and summer from the connection with the Onek pit shafts and being below the groundwater table. As mentioned previously, the new Onek mine workings will not intersect the historic Onek 400 mine workings.

Sumps will be constructed underground for temporary water storage and reuse and sediment settling of mine water. Sump location and relocation are contingent on mining / pumping efficiencies relative to mining, production and underground development rates. Table 5-7 overviews the mine water balance during Onek mine development and operations. See Figure 5-7 for a schematic representation of the Onek mine water balance.

The Onek mine will use new mine area water encountered during development as a primary source and the treated Onek 400 adit discharge as a secondary source. The treated Onek 400 water will be both trucked and pumped up to the Onek Mine. Additionally, a groundwater supply well will be used as contingency source for when the Onek 400 water treatment plant may not be sufficient or in operations. The new Onek adit and mine workings will not have significant groundwater inflows because the workings are above the groundwater table. Meteoric infiltration into the mine will not be large because the mine footprint is relatively small and no discharge from the adit is anticipated.

Surface water management features such as ditches will be constructed above the adit portal and around waste rock storage facilities to divert minor volumes of surface water around the mine surface foot print. The surface water volume to be managed is anticipated to be minimal at the site. The water that is diverted around the mine site will not be discharged to surface water and will infiltrate ground. Prior to the development of the Sign Post portal decline, a water storage/settling pond will be constructed. The pond is anticipated to only be used actively during the development of the decline and thereafter will be used as a contingency water management facility. The Water Management Plan that is part of WUL QZ09-092 will be updated to include the surface water management for Onek as part of the Water Licence amendment process.

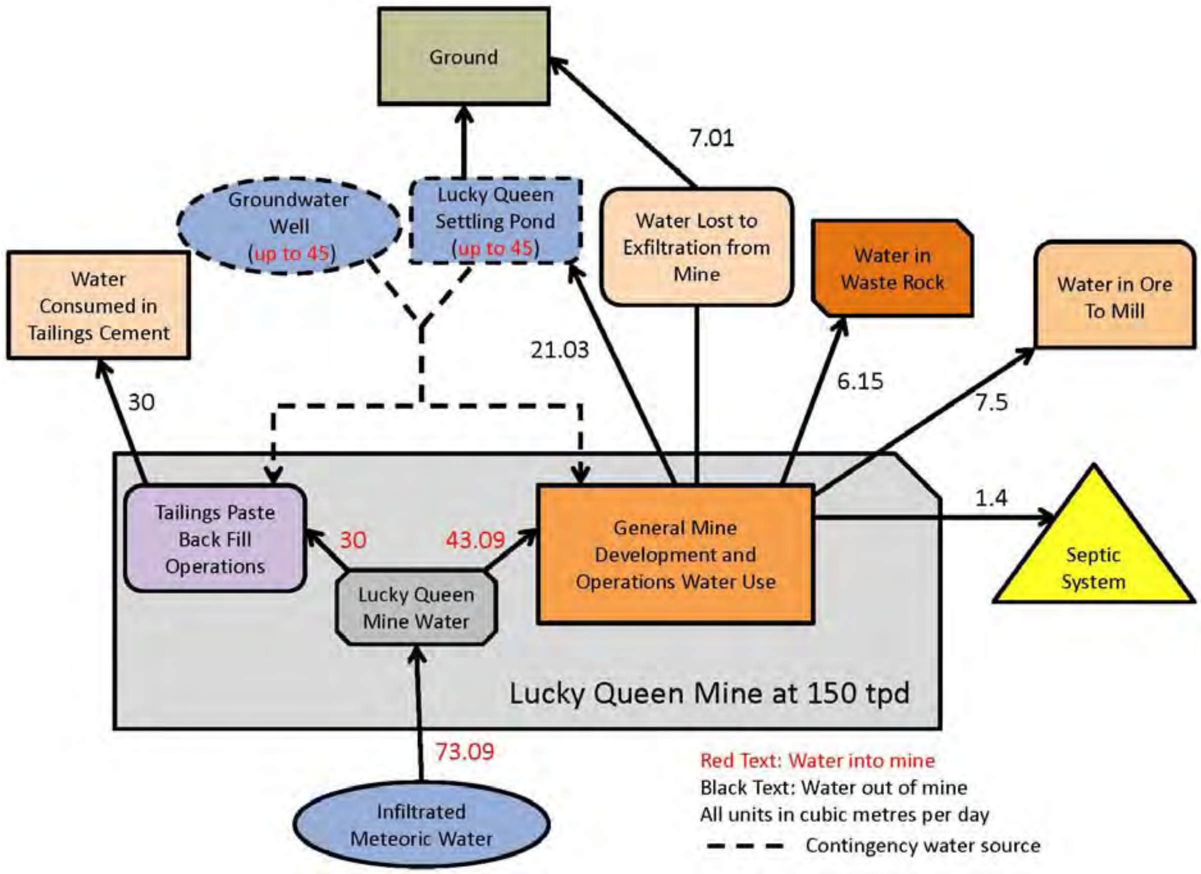


Figure 5-6. Lucky Queen Mine Water Balance Schematic

5.4.2 Lucky Queen Mine Water Balance

For the Lucky Queen mine development and production, water for drilling purposes and dust suppression will be sourced from infiltrated meteoric water entering the mine. If the volume of water entering the mine by infiltrated meteoric water is less than the required amount for mining operations, the contingency water sources (groundwater supply well, and Black Cap seep) will be used to supply the mine operations. Water will be used and recycled from the underground workings to the extent possible as the primary source. Approximately 25% of the water used in underground development may be recycled. Table 5-6 identifies the typical flows for existing Lucky Queen and Onek water sources.

Table 5-6. Typical Water Discharge from the Lucky Queen, Onek 400 and Black Cap Seeps

	Lucky Queen Adit (KV-34)	Black Cap Seep	Onek 400 adit (KV-45)
Typical Flow (m^3/day)	56.16	<25	64.8

Sumps will be constructed underground for temporary water storage, reuse and sediment settling of mine water. Sump location and relocation are contingent on mining / pumping efficiencies relative to mining, production and underground development rates. Additionally, a settling pond will be constructed near the Lucky Queen adit and may be used as a water source for the mine through recirculation. Table 5-7 overviews the mine water balance during Lucky Queen mine development and operations. See Figure 5-6 for a schematic representation of the Lucky Queen mine water balance.

The Lucky Queen mine site design includes a settling/polishing pond adjacent to adit portal. The settling/polishing pond is also the secondary mine water makeup source, which will further reduce the use of the proposed groundwater well.

Surface water management features such as ditches will be constructed around the adit portal and waste rock storage facilities to divert minor volumes of surface water around the mine surface foot print. A ditch around a portion of the Lucky Queen adit and waste rock facility currently exists that manages the minimal runoff that occurs at the site. The existing ditches would be extended around the new surface mine footprint to divert the minimal additional water anticipated. The water that is diverted around the mine site will not be discharged to surface water and will go to ground. The Water Management Plan that is part of WUL QZ09-092 will be updated to include the surface water management for Lucky Queen as part of the Water Licence amendment process.

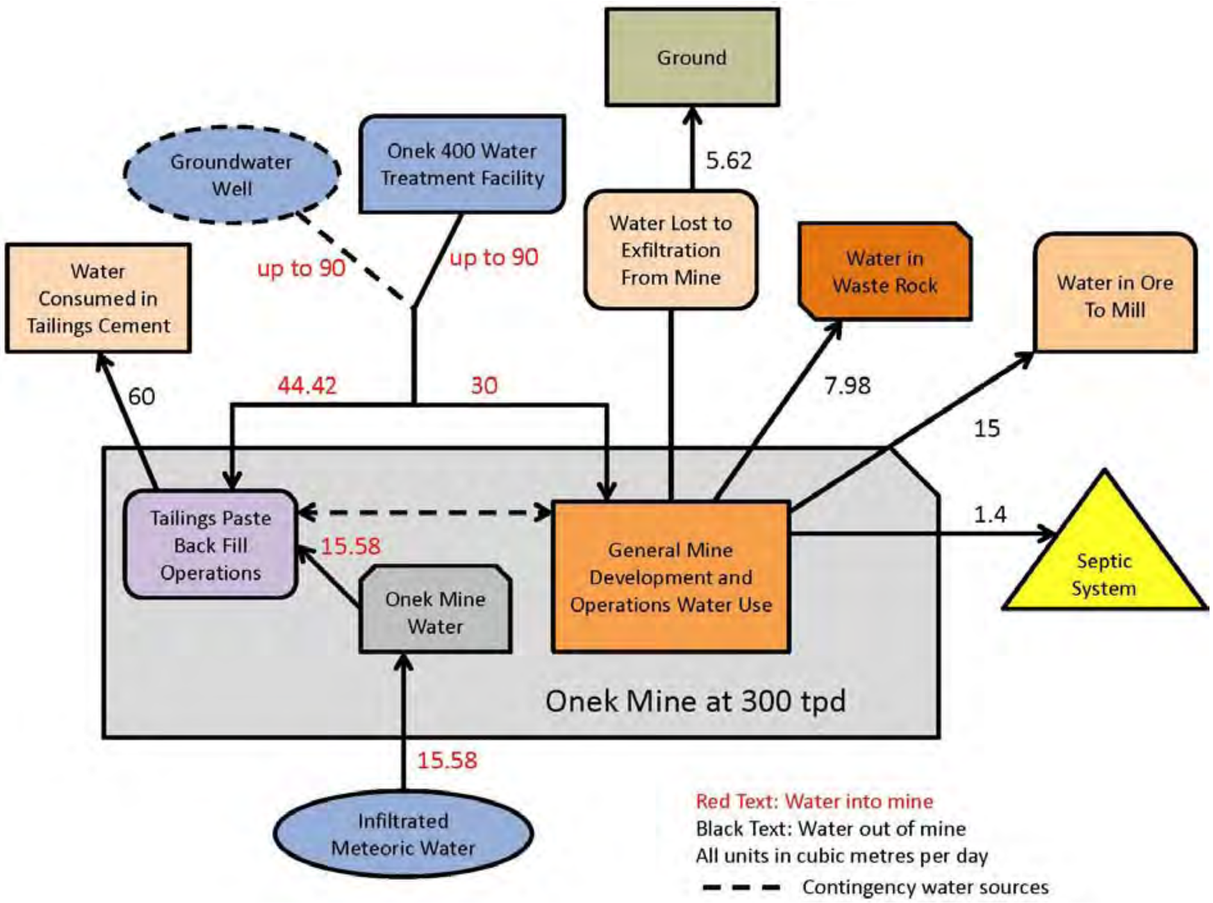


Figure 5-7. Onek Mine Water Balance Schematic

Table 5-7. Lucky Queen and Onek Mines Water Balance

Process Description	Lucky Queen (m^3/day)	Onek (m^3/day)
Total Water Into Mine[1]	73.09	90
General Mine Development and Operations[2,3]	15	30
Water Used in Tailings Backfill[4]	30	60
Mine water Recharge from Infiltration[5]	73.09	15.58
Total Water Out of Mine	73.09	90
Water to Septic[6]	1.4	1.4
Water in Ore to Mill[7]	7.5	15
Water in Waste Rock[8]	6.15	7.98
Water Consumed in Tailings Backfill[4]	30	60
Water Lost by Exfiltration from Mine to underlying Groundwater	7.01	5.62
Lucky Queen Adit Discharge to Ground	21.03	-
Water Sources		
Onek 400 Treated water[9]	-	Up to 90
Groundwater Well[10]	Contingency up to 45	Contingency up to 90
Potential Process Recycle Water[11]	up to 11.25	up to 22.5
Onek Sign Post Portal Discharge to Ground	-	0

[1]Total Water into Mine calculated as water required for mining operations and tailings backfill and does incorporate the use of mine water recharge. If the mine water recharge rate is greater than the mine operation water requirements then the recharge rate has been used as the total water into the mine.

[2]Includes water for sanitation and water lost in waste rock and in ore to mill, based on six people per mine

[3]Water Sources that will contribute to water use for General Mine Development and Operations

[4]Assuming 100% of tailings backfill water is taken up in hydration reactions

[5]Estimated based on conservative infiltration rate of 0.35 for precipitation given in Table 5-5 and mine footprint area.

[6]Subtracted from general mine development and operations

[7]Pore water (5% moisture) in ore based on maximum mining rate of 150 and 300 tpd for Lucky Queen and Onek, respectively.

[8]Pore water lost in waste rock

[9]Onek 400 adit will be treated and will supply supplemental water up to 90 m^3/day as required

[10]Proposed groundwater well adjacent to the mine portals may supply up to maximum daily rate as a contingency water source

[11]Assuming up to 25% recycling of general mine operations water and 100% of tailings backfill water; however, ***no recycling*** is conservatively assumed for water balance and water use estimates

5.5 CHARACTERIZATION AND MANAGEMENT OF POTENTIAL EFFECTS ON WATER

5.5.1 Lucky Queen Mine

Significant adverse effects on surface water or groundwater quality/quantity from development and production of the Lucky Queen Mine are not anticipated. Underground mining at Lucky Queen is not anticipated to significantly change existing adit discharge quality because of the mitigations being proposed including the positioning of the new underground workings primarily in rock units that are N-AML and backfill operations to cover P-AML rock surfaces. The existing Lucky Queen adit discharge meets the effluent quality standards identified in Water Use Licence QZ09-092 without any treatment, therefore treatment of the Lucky Queen adit discharge is not anticipated or being proposed. The containment pond at the adit portal will provide opportunity for total suspended solids to settle prior to discharge to ground. If identified through Water Licence monitoring and the adaptive management plan, a water treatment plant would be installed at the Lucky Queen to meet the proposed effluent quality standards.

The Lucky Queen adit discharge volume is not expected to increase significantly over the present rate as the historic 500 level underground workings are anticipated to generate the majority of adit discharge water. The historic underground workings represent a surface infiltration area of ~106,000 m^2; whereas the new workings will increase the existing footprint area by only ~32,000 m^2, therefore the new workings will represent a ~23% surface area increase for meteoric water infiltration resulting in an increase in infiltrated water from 56 m^3/day to 85m^3/day. During the mine operations a decrease in the adit discharge is anticipated from 73.09 m^3/day (0.85 L/s) to 21.03 m^3/day (0.24 L/s) when mining at 150 tpd and is not a significant effect to the local groundwater quantity.

The new Lucky Queen underground workings will be developed above the groundwater table. The geometry of the Lucky Queen development places the adit at the topographic low point (Figure 2-2), resulting in a drain effect at the Lucky Queen adit (500 level). The Lucky Queen mine operations only requires 45 m^3/day where as the historic working currently produce up to 56 m^3/day, Thus, the majority of the water entering the underground workings will be consumed in mining and the minor portion of water that will exit the adit will have no significant retention time within the new mine workings.

The Lucky Queen adit discharge must pass a distance over 3 km to reach the receiving environment, Christal Creek, following infiltration into the groundwater aquifer down the side of Keno Hill. This process is likely to take place relatively slowly because of low ground temperatures and perennial permafrost conditions. Attenuation processes have been well documented in the area to remove metals from water sources as they flow in the soils, removing metals concentrations up to 90%. The eventual downstream receptor (3km from Lucky Queen), Christal Creek, will continue to be monitored by the current water licence and adaptive management plan. Additionally, one groundwater wells will be installed downgradient of the adit discharge and downgradient of N-AML waste rock facility to provide monitoring to determine that the mitigative measures are working as expected.

5.5.2 Onek Mine

The new underground workings at Onek will not intersect the historic Onek 400 workings and underground mining is predicted to not affect the historic Onek mine; thus significant changes to the flows or quality from the Onek 400 adit discharge are not predicted. The data collected to date supports the assertion that the proposed Project will not adversely impact groundwater. The water balance estimates that water lost by exfiltration from the mine to groundwater will be 5.67 m3/day (0.06L/s). This small flow rate will not likely cause an impact to groundwater. Alexco is nonetheless proposing to treat the Onek 400 adit discharge at a treatment facility to be located outside the Onek 400 portal as described in Section 5.5.2.1 and Appendix F. The water treatment plant will treat the water to meet the licence standards associated with the historic mines in the district as set forth in QZ06-074.

The new Onek workings are anticipated to be net water neutral and under normal conditions, no discharge from the adit is anticipated. The new Onek underground workings will be developed above the local groundwater table, which appears to be controlled by the Onek 400 adit (elevation ~960 masl). This is consistent with the water level measured in ON-MW-1 also approximately 960 masl. The geometry of the Onek development places the underground workings at the topographic low point of 970 masl (Figure 2-4). The Onek mine operations anticipates up to 15.58 m^3/day of meteoric water to infiltrate the underground workings; whereas, the mining operations will require 90 m^3/day when mining at a maximum production rate of 300 tpd. Thus, the majority of the water entering the underground working will be consumed by the mining activities. The main underground workings of the Onek mine will be positioned in N-AML host rock; using proposed backfill operations to cover P-AML rock, changes to groundwater quality from the new mine development areas are not anticipated. Additionally, the water infiltrating the mine will have minimal exposure time to the underground workings as it will be consumed at a similar rate it is produced underground during operations.

As mentioned above, with no adit discharge and anticipated minimal seepage to groundwater, no significant change to groundwater quality or quantity is anticipated from mining activities. Nonetheless, groundwater in the vicinity of Onek and Keno City will continue to be monitored through the current water licence (QZ09-092) and the corresponding Adaptive Management Plan. Additionally, it is proposed that one monitoring well will be located and monitored downgradient of the portal pad, N-AML waste rock storage area and underground workings, and upgradient of Keno City, to provide monitoring to determine that these mitigative measures are working as expected.

5.5.2.1 Water Treatment at Historic Onek 400 Level Adit

Alexco has been conducting environmental investigations on behalf of, and in conjunction with, the Governments of Yukon and Canada for the past five years to support closure planning for the historic mining activity throughout the KHSD. As part of these studies, Alexco's groundwater investigations have recently documented groundwater with elevated concentrations of cadmium and zinc beneath the northern end of Keno City, which is presumed to have arisen from discharge from the Onek 400 adit impacted by historic mining activities.

The data has been reported to regulatory authorities, and will be dealt with separately from the project described in this document. However, the linkage between the discovery of affected groundwater and this project is that Alexco has adopted a 'higher duty of care' approach to any potential new mine discharge; specifically we will incorporate the construction and operation of a new water treatment plant at the historic Onek 400 adit portal, into this project. Because the groundwater conditions are the result of historic mining activities, construction and operation of the treatment plant at Onek 400 will require the participation of Government of Canada.

The approach to the development of the new Onek mine as described in this application will limit any effect on the environment, and the Onek 400 adit will be a primary monitoring point to confirm that no incremental loading is caused by the mining activities in the new area on the Onek vein (the Onek 400 adit is below the new mine workings and could be expected to be the first place where the new mine workings' effect on groundwater could be observed). However, the presence of a treatment plant at Onek 400 will provide a redundancy feature for the project were any effects to be caused to the water percolating in the vein from the new mine areas into the groundwater around the Onek 400 adit. The project as designed is not expected to cause a measureable increase in either water quantity, or a measureable incremental load to the Onek 400 adit discharge, and thence the new proposed treatment plant. The addition of the cemented rock fill and tailings backfill replacing the vein material should both increase the alkalinity of the water percolating through this structure, as well as by the removal of the source (by mining) and the replacement with a lower permeability feature (cemented rock fill) the loading from this area should decrease as a result of the mining activity. However, on the precautionary principle, it is prudent to incorporate the Onek 400 water treatment plant into this project assessment to ensure that any temporary effects that might arise from the mining activity are adequately planned for and appropriate mitigative contingencies are present.

Further, Alexco believes that given the discovery of affected groundwater caused by the historic Onek mine, a water treatment plant would eventually have to be built to prevent additional chemical loading from the Onek 400 adit as part of the broader district wide closure plan. In accordance with Alexco's environmental policy, we believe that immediate response is necessary and implementation of a water treatment plant is required to prevent further degradation of the groundwater beneath Keno City. It is felt that the soonest this plant could receive regulatory approval is to incorporate it into the Lucky Queen and Onek applications.

The plant will consist of a standard skid mounted, automated lime addition tank and pump assembly, coupled with a fenced sediment pond system or clarification and sludge pressing system to capture metalliferous lime sludge. The sludge will be similar in composition to the sludge currently being produced at the mill water treatment plant and will similarly be deposited in the Valley Tailings area. Similar plants are currently in operation at Silver King 200, Galkeno 900 and Galkeno 300. These systems have proven effective at treating mine discharges with high metals content and fluctuating flows that are influenced by seasonal variations in meteoric water inflows, as is the case with the Onek 400 adit discharge. Given the historic nature of the Onek 400 adit, monitoring and eventual operation of a water treatment plant at Onek 400 will fall under WUL 06-074 (and a subsequent amendment) which governs care and maintenance activities throughout the district.

A complete technical description of the water treatment plant is provided in Appendix F.

5.5.3 Summary of Mitigation and Management Measures

Alexco proposes to implement the following measures to address potential effects on water quality/quantity:

- Implement the existing Water Management Plan modified through the licencing process.
- Implement Waste Rock Management Plan (under QML-0009).
- Construct, as necessary, new water treatment and retention infrastructure at Lucky Queen in order to avoid release of non-compliant water. Settlement ponds will be used to settle out metals and sediment.
- Reuse and recycle underground mine water to the extent possible.
- Conduct routine groundwater and surface water monitoring in accordance with monitoring programs refined through the licencing process.
- Implement existing Adaptive Management Plans modified through the licencing process.

5.5.3.1 Proposed Monitoring and Effluent Discharge Standards

Surface Water Monitoring

As part of the monitoring program the Lucky Queen adit (KV-34) is proposed to be monitored on a daily interval during mine operations and weekly if the mine is not in operations. The Onek adit is not anticipated to have discharge, but as a contingency a monitoring station will be established to confirm this prediction. The above two monitoring locations would be subject to the proposed effluent discharge standards as listed in WUL QZ09-092. If seeps establish at the toes of the proposed N-AML waste rock facilities at Onek and Lucky Queen, monitoring stations will be established and monthly sampling will occur.

The P-AML waste rock storage facilities will be capped with an impermeable cover upon closure. Before this cap is in place, however, meteoric water may accumulate in these lined facilities. Should the need arise, accumulated water will be periodically pumped using a vacuum truck and transported to a water treatment plant for treatment.

Prior to the development of the Sign Post portal decline, a water storage/settling pond will be constructed. The pond is anticipated to only be used actively during the development of the decline and thereafter will be used as a contingency water management facility. It is proposed that the pond will be monitored weekly if discharging.

Groundwater Monitoring

In addition to the groundwater monitoring program that is currently in place through WUL QZ09-092 additional groundwater monitoring wells will be installed and monitored as part of routine monitoring for the Lucky Queen and Onek mine sites. It is proposed that one well at Lucky Queen be installed downgradient of the Lucky Queen adit discharge and N-AML waste rock facility. It is proposed at Onek that one monitoring well be installed downgradient of the new Onek deposit being mined in this project. The monitoring wells will be installed and sampled a minimum of twice prior to mining operations to establish baseline groundwater quality conditions. The proposed monitoring wells will be monitored on a quarterly basis. These additionally monitoring wells will be incorporated into the water licence and adaptive management plan.

Effluent Discharge Standards

Effluent discharge standards for underground and development activities at the Bellekeno mine under WUL QZ09-092 are listed in Table 5-8. The effluent discharge standards in place for Bellekeno are being proposed for the new Lucky Queen and Onek. The discharge from the Onek 400 water treatment plant will be under the criteria listed in QZ06-074. The Onek and Lucky Queen mines will also become subject to the MMER, which specifies authorized discharge limits of deleterious substances for a number of set parameters. Thus, the amended Type A water licence for mining and milling development and operations is expected to reflect MMER (Table 5-8).

Table 5-8. Proposed Effluent Discharge Standards for Lucky Queen and Onek Mines

	Maximum Concentration		
Parameter	**Monthly Mean**	**Composite**	**Grab Sample**
pH	6.0 to 9.5 pH Units		
Suspended Solids	15 mg/L	22.5 mg/L	30 mg/L
Ammonia Nitrogen			5.0 mg/L
Arsenic (Total)	0.5 mg/L	0.75 mg/L	1.0 mg/L
Cadmium (Total)			0.05 mg/L
Copper (Total)	0.3 mg/L	0.45 mg/L	0.6 mg/L
Lead (Total)	0.2 mg/L	0.3 mg/L	0.4 mg/L
Nickel (Total)	0.5 mg/L	0.75 mg/L	1.0 mg/L
Radium 226	0.37 Bq/L	0.74 Bq/L	1.11 Bq/L
Silver (Total)			0.10 mg/L
Zinc (Total)	0.5 mg/L	0.75 mg/L	1.0 mg/L

6 FIRST NATIONS AND STAKEHOLDER ENGAGEMENT

Since the decision was made in the late summer of 2011 to proceed with additional proximal sources of ore for the Keno District Mill, Alexco has actively engaged stakeholders to present detailed information about the project, and to seek expression of any particular concerns raised. Alexco has engaged the FNNND, YESAB, regulators, and stakeholders on the proposed project. Table 6-1 summarizes the topics discussed and issues raised by the various stakeholders during the preliminary consultations undertaken as part of this application.

Although it is understood that formal opportunities for stakeholder consultation are embedded into the Yukon's modern regulatory regime, stakeholder engagement is sought prior to submission of projects by Alexco policy. In this manner, it is hoped that a more informed environmental review can result.

6.1 FIRST NATION OF NA-CHO NYAK DUN

Alexco has a signed Comprehensive Cooperation and Benefits Agreement (the "Agreement") that formally describes the nature of the relationship between it and the First Nation of Nacho Nyak Dun ("FNNND"). The Agreement, signed on June 8th, 2010, recognizes both Alexco's mineral rights as well as FNNND's aboriginal rights, and sets out rights, obligations and opportunities for both parties.

Individual chapters in the Agreement include human resources (employment and training), contracting, a formal drug and alcohol policy, business contracting and business partnering opportunities, environmental issues and financial resourcing for the Agreement including legacy funding contributions. Implementation of the Agreement is formalized through regular Quarterly Implementation Meetings, wherein senior representatives of the parties meet to review all aspects of the two parties' interaction over the past calendar quarter, a forecast of upcoming opportunities such as contracts and employment, as well as upcoming regulatory events such as the amendments described in this document. All new job vacancies are posted on FNNND website to ensure opportunities are not missed.

Since environmental matters occupy prime importance with FNNND, the Agreement includes detailed discussion about respecting and protecting the environment, including enhanced opportunities for FNNND to be involved in environmental management of all operations, from mining through to closure and reclamation. The Agreement describes the process to be followed with respect to consultation around new or amendments to existing permits and licences. This process, called the Cooperative Engagement Process, mandates Alexco to engage FNNND earlier in the mine permitting process than they would otherwise be involved, giving them unique opportunity to provide input that may influence the intended course of action on any of the many aspects of project design. This process has been followed, and will continue through the permitting process for this application.

Table 6-1. Summary of Engagement Activities

Date (2011)	Location	Party	Representatives	Topics	Follow up/ Action
Aug 31	FNNND Government House, Mayo	FNNND Government	Dennis Buyck, Lands and Resources Anne Leckie, Executive Director	• FNNND outlined their general position on development in their traditional territory. • FNNND explained that they would like to address with Alexco certain issues with the Cooperation Agreement between FNNND and Alexco. • Discussed general proposed project details. • Cooperation Agreement. • FNNND raised issues and concerns about the Dry Stack Tailings Facility and it proximity to and potential impact on the adjacent permafrost lens. • Discussed FNNND's involvement in development and review of assessment and regulatory applications and future engagement opportunities.	Meetings between Alexco and FNNND negotiators. Follow up with FNNND Technical Advisor to discuss the proposed project and address DSTF issues.
		Alexco / Access	Tom Fudge, Alexco Lauren Haney, Access Kai Woloshyn, Access		
Sept 28	EMR Oil & Gas Branch Boardroom, Whitehorse	YG EMR Minerals	Bob Holmes, Director Arlene Kyle, Licencing Officer Erin Dowd, Mining Technologist Judy St Amand, Regional Mining Lands Officer Tim Smith, Mining Lands Manager	• Presented the proposed project details and provided rationale. Explained that Lucky Queen and Onek will provide flexibility and risk reduction by providing alternative ore sources. • Briefly discussed the broader context of district-wide licencing and associated district-wide management plans and mitigation strategies. • Discussed ore and waste rock characterization, waste rock disposal/ management, material balance, tailings characterization • Discussed proposed permitting timeline. • Existing waste dumps and mine drainage at Onek may need to be addressed. • Security will need to be updated. • Discussed liability issues and ensuring that liability between Alexco and THE FEDERAL GOVERNMENT is dealt with. It was noted that liability could affect the scope of activities proposed in the YESAB and regulatory submissions. Liability also affects closure mitigation and security. • Briefly addressed the reclamation and closure plan for Lucky Queen and Onek. • Water Board Secretariat indicated that it will review the Water Licence amendment application prior to formal adequacy review upon issuance of a Decision Document.	Development of "Licencing Analysis" outlining proposed amendments to WUL and QML. Development of assessment and permitting timeline. Further engagement on project scoping.
		Yukon Water Board Secretariat	Carola Scheu, Manager Neil Salvin, Licencing Officer Jennifer Logan, Licencing Officer		

Date (2011)	Location	Party	Representatives	Topics	Follow up/ Action
		Alexco / Access	Brad Thrall, Alexco Rob McIntyre, Alexco Lauren Haney, Access	• Noted the significance of having BK experience to show that management plans, treatment systems, etc work. • Explained that there is no plan to move the mill at present. • Discussed the new bypass road and it was noted that a Water Licence could be triggered if culverts are required. • Discussed the volume of material to be submitted and it was agreed that to the extent possible the submissions should be concise. • Noted that future amendments to increase the overall ore volume may be required. • Discussed project scoping generally and MLU/QML and WUL amendment requirements. • Discussed scope of advanced exploration activities and what should be included in YESAB submission. Also discussed which exploration activities might be included in the QML versus the MLU Approval.	
Sept 28	Access Office, Whitehorse	FNNND	Kim Winnicky, Technical Advisor Bill Slater, Technical Advisor	• Informal meeting • Preliminary introduction to proposed project. • Discussed general project details and key issues, including waste rock tonnages and management; ore/tailings characteristics. • Alexco confirmed commitment to begin Cooperative Engagement Process immediately	Arrange formal meeting when additional project detail available.
		Alexco	Brad Thrall, Alexco Rob McIntyre, Alexco Lauren Haney, Access		
Oct 5	YESAB Mayo Designated Office, Mayo	YESAB Mayo Designated Office	Loralee Johnstone, Manager	• Presented general project details and assessment/licencing timelines. • Discussed the importance of Alexco's experience with Bellekeno and considered inclusion of a "lessons learned" section on water quality/discharge, water management, dust management, noise, tailings characteristics and management, waste rock management. • Noted that Keno residents have engaged Chief Medical Officer Brendan Hanley to address dust and noise issues on their behalf. He will likely be a part of Adequacy Review. • Indicated that site liability issues should be dealt with before starting the assessment process. Liability issues are likely to come up during the assessment process. • Discussed project scoping at length. Scoping is likely to be a key issue for this assessment. Discussed further scoping meetings involving YESAB as well as regulators. • Suggested a section outlining what activities are included within the scope of the assessment and which are not, plus rationale. • Noted that YESAB will scope maximum tonnages. Also noted that YESAB will now consider viable options in the assessment process.	Ensure YESAB participation in future scoping discussions with regulators. Update YESAB on any significant changes to proposed project scope.
		Alexco	Brad Thrall, Alexco Lauren Haney, Access		

Date (2011)	Location	Party	Representatives	Topics	Follow up/ Action
				• Explained that Alexco is considering treating the Onek 400 level adit discharge. • Briefly discussed district-wide assessment and licencing and management protocols. • Discussed the bypass road. Raised issues of traffic volumes, erosion mitigations. • Suggested improvements to maps and figures of the mine plan to help conceptualize underground workings. • Discussed volume of information to be submitted to the assessment.	
Oct 24	Access office, Whitehorse	Keno Residents Alexco	Dirk & Tracy Reintmeister Brad Thrall, Alexco Rob McIntyre, Alexco	• Discussed access to Wernecke/Sign Post and continued use of the road to Onek/Lucky Queen. • Suggested knocking top off of berms during winter for snowmobile/dog sled use. • Identified that fuel trucks and large transport will be routed through town until the bypass road is in place. • Discussed dust control in town. • Concerned about the use of jake breaks on trucks coming down from Lucky Queen and noise if we plan to use the highway trucks for ore transport. • Concerned about blast vibrations from Onek and discussed some form of communication/protocol to notify of blasting times. • Expressed concerns about how the heritage process is working and involvement of Keno residents. Suggested developing a working group for heritage discussions. (This issue pertains to Keno Hill Silver District Care & Maintenance undertakings)	Consider options to maintain resident access to Wernecke and Sign Post Roads and discuss further with residents.
Oct 24	Access Office, Whitehorse	FNNND Alexco	Kim Winnicky, Technical Advisor Brad Thrall, Alexco Rob McIntyre, Alexco	• Discussed baseline ABA work on tailings from testwork at Onek/LQ. • Suggested installing a piezometer at the base of the waste dump that the existing Onek PAML storage facility is built on. • Suggested humidity cell tests for tailings from Onek/LQ. • Highlighted the importance of training opportunities for FNNND in the permitting/assessment/field stages.	Review of YESAA submission documentation.
Oct 24	Village office, Mayo	Village of Mayo Alexco	Mayor and Town Council Scott Bolton, Chris Pavlovich, Michael McGuinness, Trevor Elliss Brad Thrall, Alexco Tom Fudge, Alexco Rob McIntyre, Alexco	• Discussed proposed project including timelines. • Indicated that Mayo has a need for demolition of an existing building with asbestos. Contractor quotes are significant, inquired whether Alexco assist or interested in assisting. • Alexco committed to reviewing capacity internally to determine potential to assist; • Expressed general support for the project. • Question where solid waste was to be transported, and Alexco confirmed none will be shipped to Mayo	-
Oct 25	Keno City Café, Keno City	Keno Residents and Community	Mike Mancini Daniel Schuenemann	• Presented Lot 960 letter of commitment and discussed generally.	Another meeting round in Keno.

Date (2011)	Location	Party	Representatives	Topics	Follow up/ Action
		Club	Greg Keitel Gil Bradet Jordan Theriault	• Concerned about maintaining access to Wernecke and Sign Post Roads and continued use of the road to Onek/Lucky Queen. • Discussed brushing a separate trail next to the road for winter use and/or an existing trail. • Inquired as to whether the mill is not now considered to be a district-wide mill. • Discussed the size of the potential water treatment plant at Onek.	
		Alexco	Brad Thrall Tom Fudge		
Nov 9	AlexcoHead Office, Vancouver and teleconference	YESAB Mayo Designated Office	Loralee Johnstone, Manager	• Discussed the only significant change to the proposed project scope: treatment of Onek 400 level adit discharge. Discussed the issues around which water licence the activity will fall under. • Discussed the stakeholder engagement activities conducted to date and further engagement activities planned. Addressed some of the specific issues raised during the stakeholder meetings, including resident access to/use of Wernecke and Sign Post Roads, noise and dust. • Addressed potential socio-economic effects on Mayo, which are anticipated to be minimally negative and there are potential benefits such as jobs and population growth. • Addressed dust specifically and Alexco explained that the dust report was sent to Brendan Hanley, but no response has been received.	Follow up meeting with regulators on scoping and to review draft licencing analysis.
		Alexco	Brad Thrall, Alexco Lauren Haney, Access (by phone)		
Nov 22	EMR Minerals Branch Boardroom	EMR Minerals	Bob Holmes, Director Arlene Kyle, Licencing Officer Erin Dowd, Mining Technologist Judy St Amand, Regional Mining Lands Officer Tim Smith, Mining Lands Manager	• Confirmed the scope of the project and the assessment. Discussed the sequencing of project activities. • Discussed approach to addressing project elements that are outside the scope of assessment in terms of providing appropriate rationale. • Addressed how to assess and licence a range of ore and waste rock tonnages. The Water Board suggested using "combined" water use rate terminology from placer mining Water Licence applications. • It was noted that having several applicable Decision Documents is confusing and it was suggested that Alexco provide a table in the application that cross references activities with their applicable Decision Document. • YESAB and the regulators reiterated the importance of clearly describing THE FEDERAL GOVERNMENT versus Alexco liability within the application documents. • Discussed including information on the performance of existing management plans and key facilities (e.g. DSTF). • Discussed YESAB's approach to Adequacy Review and YESAB indicated that they would solicit input from regulators. The Water Board confirmed that it could participate in a limited capacity. • Discussed whether the proposed early mill rate increase from 250 tpd to 400 tpd is an assessable activity and should be included in the scope of the assessment. • Identified and discussed water sources for each deposit.	Bob Holmes to get back to Alexco on the early mill rate increase.
		Yukon Environment Water Resources	Jon Bowen, Manager		
		Yukon Water Board	Neil Salvin, A/ Manager Jennifer Logan, Licencing Officer		
		YESAB	Loralee Johnstone, Manager, Mayo Designated Office Jennifer Anthony, Manager, Whitehorse Designated Office		
		Alexco	Brad Thrall, Alexco		

Date (2011)	Location	Party	Representatives	Topics	Follow up/ Action
			Rob McIntyre, Alexco Lauren Haney, Access Kai Woloshyn, Access	• The Water Board inquired about the stability/integrity of the existing waste dumps at Onek with underground blasting below them. • Discussed the Onek 400 level adit discharge treatment system. • Discussed potential effects on local residents. • It was noted that the Monitoring & Surveillance Plan is out for review with Environmental Health/ YG Environment	
Nov 22	Yukon Environment	Yukon Environment Water Resources	Jon Bowen, Manager, Water Resources Troy Searson, Water Inspections Officer Diane Gunter, Manager, Environmental Affairs	• Discussed details of the Onek 400 adit discharge treatment plant. • Discussed regulatory options for addressing the Onek 400 adit discharge treatment plant.	-
		Alexco	Brad Thrall, Alexco Rob McIntyre, Alexco		
Dec 6	Mayo Mining Inspections Office	EMR	Bill Leary, Senior Natural Resources Officer	• Discussed the scope of the proposed project. • Discussed potential effects on local residents – especially in terms of maintaining local residents' access to Wernecke and Sign Post Roads. • Addressed public access on active mining roads in the Lucky Queen and Onek area, as well as appropriate explosives storage locations on site.	-
		Village of Mayo	Scott Bolton; Trevor Elliss		
		YESAB	Loralee Johnstone, Manager, Mayo Designated Office		
		Alexco	Tom Fudge		
Dec 6	Access Consulting Group Boardroom, Whitehorse	FNNND	Dennis Buyck, Lands and Resources Kim Winnicky, FNNND Technical Advisor Jim Cassey, BGC	• Discussed use of the DSTF for Lucky Queen and Onek tailings. • Discussed BGC's technical review of the DSTF. • Addressed future tailings storage requirements for the Keno Hill Silver District.	-
		Alexco	Brad Thrall, Alexco Justin Pigage, EBA		
Dec 6	Mayo Curling Rink Lounge	Mayo community	-	• Discussed general aspects of the proposed project. • Distributed project information overviews with maps and contact information.	-

7 SOCIO-ECONOMIC EFFECTS ASSESSMENT AND MANAGEMENT

The socio-economic effects assessment considers potential effects of the Project on the following valued components:

- Community Health & Well-being
- Land and Resource Use
- Local Economic and Human Resources
- Heritage Resources

7.1 COMMUNITY HEALTH & WELL-BEING

Addressing potential effects on community health and well-being is of key importance given the proximity of the proposed project to Keno City. During the Bellekeno Mine assessment and licencing process, Keno City residents and YESAB raised concerns about possible impacts on community health & well-being in terms of dust and noise generation, as well as mine traffic considerations.

7.1.1 Noise

During the Bellekeno Mine assessment process (YESAB Project #2009-0030), Keno City residents raised concerns about noise from construction and mining activities. In addressing these concerns, YESAB conducted a noise assessment and recommended mitigative measures to address associated potential significant adverse effects. The general conclusion of the impact assessment in the YESAB Evaluation Report noted that although the estimated noise levels fell within the middle of the range for what is socially acceptable for daytime construction (63dB), some minor health effects were possible given the relatively quiet ambient levels. YESAB suggested practices for noise source controls, noise path controls, noise receptor controls and other mitigations in order to "minimize and alleviate the effects so they are no longer considered significant."

The following terms and conditions were included in the project Decision Document:

> *65. Conduct a noise impact study prior to project implementation. The study must aim to achieve the following:*
>
> *a.Analyze baseline conditions during conditions of low ambient noise.*
> *b.Calculate the potential noise emissions from all activities that generate significant noise.*
> *c.Calculate the noise emission level that the closest receiver may experience due to those activities. Consideration must be given to local environmental conditions (e.g. terrain,*

temperature inversions, and downwind conditions relative to sensitive receivers) and proposed mitigations.

d.Calculate the cumulative noise emission of this project in combination with existing and proposed activities (e.g. care and maintenance, Keno City).

66. Develop a noise abatement and management plan based on the results of the noise impact study. The plan must aim to achieve the following:

a. Identify appropriate measures to reduce noise emissions.
b. Incorporate these measures into project design and implementation.

67. Upon commencement of each block of operations (e.g. crusher; bypass construction; ore traffic), a verification study will be conducted. This will consist of continuous monitoring over a two week period. Monitoring will aim to capture the ambient noise levels at sensitive receivers, inclusive of what the project is contributing. If unacceptable noise levels are identified further measures to reduce the noise levels are required.

The QML stipulated that a Noise Abatement Plan be developed, which "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" (QML-009 Schedule B).

Alexco conducted a preliminary baseline sound monitoring study in 2009 and the results were incorporated into the Noise Abatement Plan submitted in November 2009 under the QML[4]. This study characterized the baseline noise conditions at several locations in and around Keno City and the project sites.

Alexco established eight sound monitoring locations as a result of Bellekeno project assessment and licencing (Figure 7-1). Alexco monitored sound levels during construction and initial operations as per licence requirements. Alexco's studies determined there was not a significant increase in noise levels during the Bellekeno development and initial production period at any of the Keno City monitoring sites. They also found that noise levels measured at all testing locations, including the mill site, were within the 50-90 dBA range deemed to be socially acceptable for daytime noise limits. The crushing plant does not operate and trucks are not hauling from 7pm to 7am.

[4] Available on YG Energy, Mines and Resources website at http://www.emr.gov.yk.ca/mining/pdf/mml_bk_noise_abatement_plan.pdf

Alexco commissioned a third-party technical review of the noise monitoring studies, which found that the Bellekeno mine not exceed 40 dBA Leq during the nighttime and 50 dBA during the daytime. Noting that Yukon does not have specific noise guidelines in place, the third-party reviewer indicated that the results of Alexco's studies appear to be in compliance with the British Columbia and Alberta guidelines for daytime permissible noise levels (50 dBA). The consultant recommended specific guidelines for conducting further noise surveys, including longer sampling periods, which Alexco will incorporate into the monitoring measures outlined below.

7.1.1.1 Effects Characterization

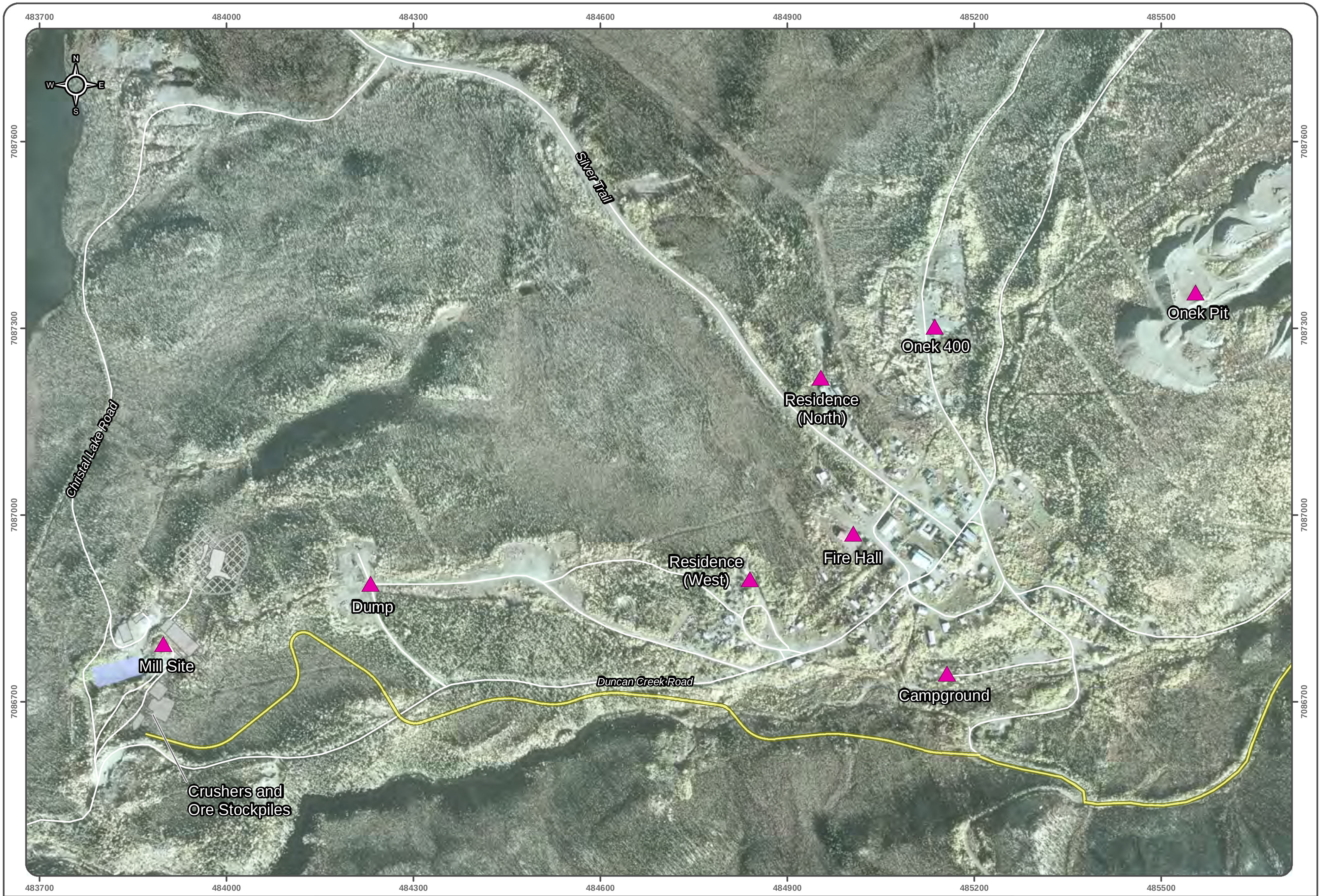
This scope of this assessment includes noise generated at the Lucky Queen and Onek mine sites, and haul truck traffic to and from the sites.

Noise from the Mine Sites

At the Lucky Queen and Onek mine sites, noise will be generated by several sources, including site traffic and backup alarms, blasting, ventilation fans and earth moving. Noise levels are likely to be comparable with current levels at Bellekeno. Lucky Queen is expected to be far enough away from Keno City with a considerable forest barrier to not result in significant noise level increases within the community. Onek is much closer to the community and noise from the site may be heard in town. Most of the noise at the Onek mine site will be generated at the Sign Post Portal Bench which is further from Keno City than the rest of the Onek site. There will be some intermittent noise associated with trucks hauling P-AML waste rock to the Onek P-AML Waste Rock Facility on the northeast side of the site. The treatment system at the Onek 400 level adit will generate minimal noise as the equipment will be housed in a small building.

Alexco proposes the following measures to address potential effects associated with noise generation:

- Onsite mobile equipment at Onek around the surface portal will be limited to the day shift period (6am to 7pm) as much as practical.
- Blasting near the surface at Onek will only be conducted during the dayshift period (7am to 7pm) and a community notification protocol will be developed.
- An earth berm will be constructed on the southwest borders of the Sign Post Portal Bench to act as a sound barrier and to deflect noise away from Keno City.
- Alexco will continue to conduct noise level monitoring in the community at the existing stations. There is baseline noise data for Onek available from the existing monitoring stations at the Onek 400 level adit and Onek pit. If noise complaints are received, Alexco commits to working with the stakeholders to address the issues. If warranted, Alexco will consider installing an additional monitoring station at the northeast corner of the community near Onek.



Aerial photography flight date: July 13th 2006. Ortho-rectification produced by Challenger Geomatics Ltd. Mill pond spatial data obtained from Y.E.S. Mill structures. dry stack tailing facility featureas and haul road surveyed by Alexco personnel December 2010.

Datum: NAD 83; Map Projection: UTM Zone 8N

1:7,000 *When printed on 8.5 by 11 inch paper*

Meters 0 50 100 200 300 400

Sound Monitoring Location

Ore Haul Road

DSTF As-Built Dec 2010

Mill_PickUp_Liner_Polygon

Cleared Area

AKHM

ACCESS

BELLEKENO PROJECT

FIGURE 7-1 CONSTRUCTION AND INITIAL OPERATIONS SOUND MONITORING

DRAWN BY JP	AUGUST 2011	VERIFIED BY : EA

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Noise from Mine Traffic

As Section 2.5 describes, an average of approximately 15 roundtrips per day using 15 t trucks will be required to haul ore from Lucky Queen and Onek to the mill. Some light traffic will also be required. Figure 2-7 shows the routing.

The ore haulage from Onek and Lucky Queen will offset some of the tonnage that would have been sourced from Bellekeno. It was anticipated that the number of haul trips per day would increase from an average of roughly eight trips per day to 14 when the mill production rate increases to 400 t/d; however, with Onek and Lucky Queen, only eight to 10 haul trips per day from Bellekeno are anticipated at when production reaches 400 tpd.

The North Side Bypass Road will be constructed in early 2012 to avoid mine traffic through Keno City, which will help significantly to reduce noise within the community. The access point along Wernecke Road has been sited as far from residents as possible, while staying within the boundaries of Lot 960 and abiding by regulated sight line distance requirements.

Alexco proposes the following mitigations to address the noise associated with mine traffic to and from Onek and Lucky Queen:

- Haul trucks will only operate during the day (7am to 7pm). Periodic use beyond these hours may be necessary based on weather and operational conditions.
- Avoid the use of engine breaks in the vicinity of Keno City
- Lucky Queen and Onek Mine traffic management protocols will be incorporated in the Traffic Management Plan under QML-009.

7.1.2 Dust

Dust generation and associated impacts featured prominently during the Bellekeno assessment and licencing process and continue to be an important ongoing operational issue. Dust effects from the crushers, DSTF, and the tailings and concentrate load out areas were assessed previously and required mitigative measures have been incorporated into project licences.

Dust monitoring and management continues through implementation of the recently updated Monitoring and Surveillance Plan under the QML-0009[5]). There are currently four dust monitoring stations situated around the mill site (see the Monitoring and Surveillance Plan, Figure 2). Alexco employs a two-stage monitoring system, in accordance with the Decision Document provisions for dust monitoring:

> *69. Monitoring dust conditions is an important step in controlling dust impacts. Simple TSP (dustfall) monitoring is a simple and inexpensive way to determine dust deposition at the sampling locations. This test can be done at the site by the proponent with little cost or training necessary.*
>
> *70. If warranted by initial dustfall measurements indicating TSP concentrations in excess of 150 micrograms per cubic metre (the BC Air Quality Objectives and Standards Level A criteria) at the fence line, the proponent shall conduct more sophisticated monitoring with high volume samplers and re-evaluate and improve dust suppression techniques to achieve the TSP objective.*

Results summarized in Appendix G indicate that the highest dust deposition rate measured was over an order of magnitude below the trigger for the Phase 2 sampling.

7.1.2.1 Effects Characterization

Potential sources of dust associated with the proposed project include fugitive dust emissions from the Lucky Queen and Onek mine sites, and from the haul roads. Alexco will continue to implement the Monitoring and Surveillance Plan will help to mitigate the potential effects associated with increased dust emissions at the mill site due to the project.

Alexco also proposes to implement the following measures to control dust from the project:

- Dust will be controlled by application of water as necessary and/or use of non-petroleum dust suppressants (e.g. Calcium Chloride).
- Where possible, progressive reclamation measures, such as revegetation, will be implemented to help stabilize the soil and control dust.

If Keno residents raise concerns about dust from Onek and/or Lucky Queen, Alexco will work with the stakeholders to identify additional mitigation options.

[5] Available at YG Energy, Mines and Resources website at http://www.emr.gov.yk.ca/mining/pdf/mml_bellekeno_monitoring_and_surveillance_plan_revision_1.pdf

7.1.3 Vibrations from Underground Blasting

Keno City residents raised concerns about underground blasting at Onek and whether the blasting vibrations might be felt in their homes. Although Alexco is of the opinion that it is unlikely the vibrations will be perceptible by residents, it is very difficult to definitively predict. It is possible that vibrations from blasts in the underground workings closest to the community may be felt in Keno City.

In order to address the uncertainty in characterizing this potential effect, Alexco proposes to work closely with the residents to determine whether underground blasting is affecting them. All residents will be notified when blasting is to begin and directed to contact an assigned Alexco representative if the vibrations are perceptible. Periodically, as the underground workings are developed closer to the community, residents will be notified and asked to contact the representative if there are any issues.

If blasting vibrations affect residents, Alexco will implement certain mitigations, such as:

- Working with the residents to determine appropriate blasting timing windows.
- Notifying the residents of blasting.
- Grouping blasting events to the extent possible to reduce the frequency of disturbance.

7.2 LAND AND RESOURCE USE

The regional land use within the Keno Hill Silver District has evolved from a long history of occupation and development. Significant development activity and local population fluctuations have historically occurred in the area. The general area is utilized for several purposes by a variety of users. Figure 7-2 depicts some key land and resource uses. Regional land use has been influenced by the following activities:

- the area has been utilized by First Nations for thousands of years;
- a variety of anthropogenic activities have occurred throughout the region including both hard rock and placer mining, forestry, hunting and gathering, transportation, recreation and residential;
- the project footprint lies within Registered Trapline Concession (RTC) #82; Lucky Queen is near the border of RTC#83;
- the sites lie within outfitting Concession #7;
- numerous historic mining related structures exist in the general area and are of interest to local community groups and government; and
- the area is known and used for recreational pursuits and has potential for tourism development.

This section addresses: recreation and tourism; First Nations subsistence harvesting and traditional use; sport/ commercial hunting, fishing and trapping; and mineral development.

In general, potential effects on land and resource use resulting from the project are not anticipated to be significant, because Lucky Queen and Onek are situated within the area of existing historic disturbance, minimal footprint expansion is proposed, and Lucky Queen and Onek represent relatively small scale operations. There has been increased activity at both Lucky Queen and Onek recently due to exploration activities at the site.

Recreation and Tourism

As described above, recreation and tourism are highly important for the area. Keno City residents expressed concerns about maintaining access to Wernecke and Sign Post Roads and intersecting trails during the winter, which they use for dog sledding, snowmobiling, skiing, snowshoeing, etc. Residents suggested levelling berms at access points to ensure snowmobiles and dogsled passage. It was also suggested that a trail be established adjacent to the roads as alternate access for recreational users. Alexco commits to continuing to work with Keno City residents to determine appropriate mitigations and ensure their access and recreational use is maintained, while maintaining public safety as a first priority.

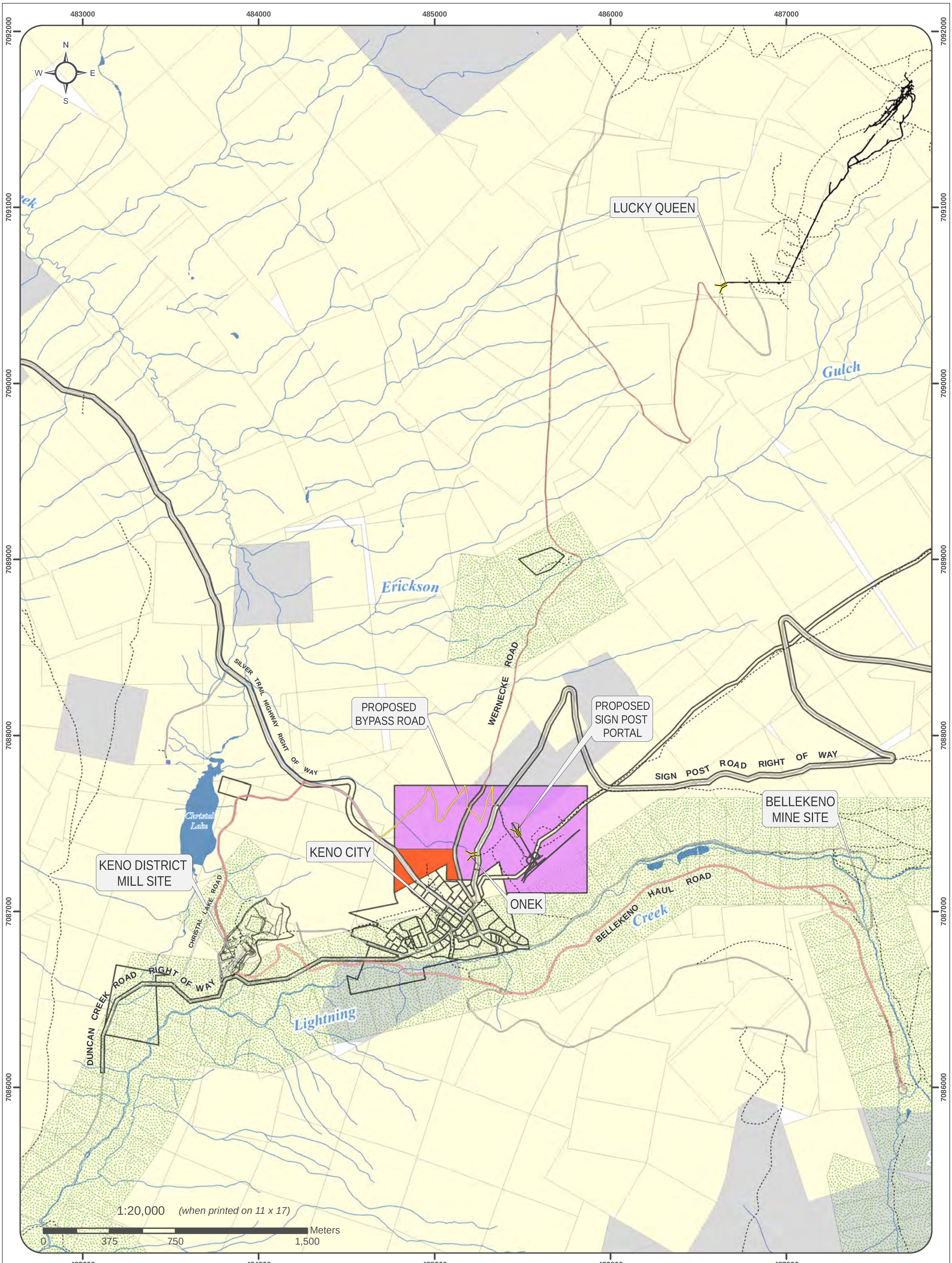
Tourists generally drive from Mayo, through Elsa, to Keno City and may travel up the Wernecke or Sign Post Roads. Potential effects on recreation and tourism are characterized in terms of aesthetics and public safety.

The mine sites are not anticipated to significantly affect the visual aesthetics of the area because they are existing sites currently in active use by Alexco and the footprint extension is minimal. The visual disturbance of mine traffic to and from the Lucky Queen and Onek sites is expected to be minimal, because the traffic will be routed along the private controlled North Side Bypass Road, which limits the amount of traffic on the Silver Trail Highway, Wernecke Road and Sign Post Road. The North Side Bypass Road has been routed to limit mine traffic traversing these roads (traffic will have to travel along the Silver Trail Highway for a short distance); however, mine traffic will cross them.

Risks to public health and safety result from access to the active mine sites and interactions with mine traffic along public roads. Signage will be posted at the site access roads to Lucky Queen and Onek prohibiting the public from entering the mine site and warning of the dangers.

As Section XX describes, there will be stop signs to stop mine traffic at the intersections with Sign Post Road, Wernecke Road and the Silver Trail Highway. The line-of-sight distance requirements of YG Highways & Public Works Transport Branch and the *Highway Access/ Works within a Right-of-Way* permits will be adhered to in order to ensure public and worker safety.

Signage warning of crossing/turning mine haul trucks will be installed along Sign Post Road, Wernecke Road and the Silver Trail Highway in accordance with the requirements and direction of YG Highways & Public Works Transport Branch officials.



Proposed Bypass Road	Highway	Watercourse	Land Parcels/Dispositions	Placer Claim & Lease
Haul Road	Local	Waterbody	Lot 960	Other Quartz Claims
Christal Lake Road	Track		Lot 960 Sublot	Alexco Quartz Claims

Notes: The current extent falls within the Single Trap ID #82 and Outfitting Concession ID #7.

This map is for illustrative purposes only. This is not a legal document. Quartz claim boundaries are current as of August 1, 2011. Placer claim boundaries are current as of August 29, 2011. Land Disposition data obtained from EMR Lands, current as of April 28, 2011. Data Source: http://geomaticsyukon.ca Site hydrography and contours derived from 2006 aerial imagery obtained from Aero Geometrics, Calgary Alberta.

Datum: NAD 83; Projection: UTM Zone 8N

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ALEXCO

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ALEXCO KENO HILL MINING CORP.
ONEK AND LUCKY QUEEN

FIGURE 7-2

LAND AND RESOURCE TENURE
ONEK AND LUCKY QUEEN

DRAWN BY JP	DECEMBER 2011	VERIFIED BY LH

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The North Side Bypass Road will be a radio controlled road accessible to mine traffic only. Signs will be installed at the road access points prohibiting public traffic from traveling on it. The maximum speed limit will be 40 km/h, reduced to 20 km/h at blind corners and road crossings.

First Nations Subsistence Harvesting

The proposed project is not anticipated to impact traditional harvesting pursuits. While First Nations subsistence harvest in the general region, the Keno Hill area is not known to be of particular importance for this purpose, most likely because of the high level of activity on the property. There is no settlement land in the vicinity of the project area. The project includes activities on two existing historic sites with minimal footprint expansion. There is currently noise and traffic at both sites associated with exploration activities. Potential impacts on traditional pursuits were not raised during First Nation and stakeholder engagement for the project.

Sport/Commercial Hunting, Fishing and Trapping

Very limited sport/commercial hunting or trapping is conducted in the Keno Hill Silver District, likely because of the high level of mineral development activity and general use of the area.

The project sites lie within RTC#82, which is currently unassigned (though FNNND have expressed interest in the trapline), and near RTC#83, assigned to Christine Hager. Alexco is aware of some trapping on Galena Hill, but otherwise trapping in the district is limited. The project is not anticipated to affect trapping. Alexco personnel will continue to be instructed not to disturb trapping equipment or activities.

Lucky Queen and Onek lie within hunting outfitting concession #7, operated by Rogue River Outfitters. The outfitter is not known to use the site area, and impacts on outfitting activities are not anticipated.

There is some fishing in the area; however, neither Lucky Queen nor Onek are near or likely to impact watercourses or waterbodies and consequently, the project is not anticipated to affect fishing activities.

Mineral Development

Alexco owns the majority of quartz claims in the Keno Hill Silver District; however, there are some third-party claim blocks in the vicinity of the project area. There are also several placer claims in the area. Alexco has interacted with other mineral development users for several years and is of the opinion that continued communication will address any issues concerning claim holders.

7.3 LOCAL ECONOMY AND HUMAN RESOURCES

The economy of Keno City is based on tourism and mining. Tourism has been described as a small but growing economic sector. In addition to the Keno City Mining Museum, which provides excellent historical perspective on the Keno Hill Silver District, a population of butterflies also exists in the region and attracts interested individuals. The “signpost” viewpoint on Keno Hill Summit also attracts numerous tourists throughout the summer months.

The economy of Mayo is linked to the provision of services to the people of Mayo and the surrounding areas. One third of the jobs in the community are related to government services, including First Nation and territorial administration. Placer mining and mineral exploration and development also provide an economic base for the community. Construction also provides considerable employment to Mayo residents. Tourism in the Mayo area is a growing industry. Accommodations, food services, recreation services (i.e. guiding and outfitting) and retail cater to tourists and provide employment for local residents. Tourist attractions in the area are linked with the history of mining around Mayo and Keno City. Camping and hiking, hunting and fishing, and other outdoor pursuits comprise the activities undertaken by tourists in the area.

The Mayo Official Community Plan outlines local economic conditions and describes community priorities: "Mayo's economy is presently based on its role as a regional administrative and service centre, mineral exploration and placer mining and tourism. In addition, traditional activities play a large role in the community's economic life. Diversification and stabilization of the regional economy remains a community priority" (2006, p. 11). The Mayo Official Community Plan recognizes opportunities for local economic diversification in terms of supporting mineral exploration and development, expanding the local service sector, maximizing the use of the local labour force and reducing dependence on outsiders to fill local employment opportunities.

In cooperation with industry (developers/companies), the FNNND Development Corporation is establishing a number of training, work, and apprenticeship programs in the community. The First Nation works toward participation in land developments in their traditional territory and employs many FNNND citizens.

7.3.1 Economic and Employment Opportunities

Alexco's operations in the Keno Hill Silver District have provided numerous economic and employment opportunities to local and regional people and businesses. Alexco currently employs 70 Yukoners and 15 Mayo residents and FNNND citizens on site. Alexco has entered into joint venture partnerships through the FNNND Development Corporation and has retained local contractors to provide a variety of services. The current mine contractor that will be developing the Onek and Lucky Queen mines is a FNNND joint venture company. The Comprehensive Benefits and Cooperation Agreement between FNNND and Alexco guides the creation of business development and employment opportunities for the First Nation.

Production at Onek and Lucky Queen is expected to create an additional 35 positions: 12-13 miners, 4 electricians, 4 mechanics, 4 supervisors, and 10 ancillary personnel. To the extent possible, Alexco intends to source these positions locally or regionally. Under the Comprehensive Benefits and Cooperation Agreement between FNNND, Alexco notifies FNNND about new job postings as part of the company's internal posting procedure.

7.4 HERITAGE RESOURCES

The general area has rich historical significance and is characterized by numerous historic/ heritage resources, largely related to past mineral development. As part of the UKHM Closure Plan, Elsa Reclamation Development Company (ERDC) is developing a district-wide heritage plan in consultation with stakeholders, including YG Heritage Resources, FNNND, the Silver Trail Tourism Association, the Binet House Museum, the Village of Mayo, Keno City Mining Museum, Keno City and AANDC.

Adverse effects on heritage resources are not anticipated. New footprint development that could result in impacts on heritage resources includes development of the North Side Bypass Road, and the extension of the waste rock dump at Lucky Queen. In order to mitigate potential significant effects of the project on heritage resources, Alexco proposes to implement the existing Heritage Resources Protection Plan developed under QML-0009[6]. The Plan outlines specific response and notification protocols and mine site personnel training to protect heritage resources. Alexco will engage stakeholders and proposes to invite local residents and interested parties on a ground truthing exercise to confirm the North Side Bypass Road routing.

[6] Available on YG Energy, Mines and Resources website http://www.emr.gov.yk.ca/mining/pdf/mml_bk_heritage_resources_protection_plan.pdf

8 DECOMMISSIONING, RECLAMATION AND CLOSURE

Alexco has in place an approved Reclamation and Closure Plan (RCP) for the Bellekeno Mine including the mine and Keno District Mill facilities. Financial security for implementation of the Bellekeno RCP is fully posted with Yukon Government and the plan is scheduled to be updated every two years.

Minor modifications and updates to the Bellekeno RCP will be required to include new disturbances associated with the development of Onek and Lucky Queen. The addition of Onek and Lucky Queen will have no effect on the closure of the mill facilities or the Bellekeno mine.

8.1 CLOSURE OBJECTIVES

Closure objectives established in the Bellekeno RCP will be incorporated into the closure of the Onek and Lucky Queen mines. To ensure that the overall closure philosophy can be achieved, the following primary closure objectives were emphasized during the development of the Bellekeno RCP and will be continued for the update of the Lucky Queen and Onek RCP, Protect Public and Worker Health and Safety, and Protect and Restore the Environment by:

- incorporating progressive reclamation where possible;
- providing slope stabilization and erosion control on linear and non-linear disturbances;
- ensuring long-term chemical stability of the waste rock storage areas and components constructed from waste rock to minimize effects to downstream aquatic resources;
- ensuring the long term physical stability of materials placed into the dry stack tailings facility;
- ensuring the long-term physical stability of key structures such as the dry stack tailings facility, portals, waste rock storage facilities, and access roads;
- conducting post closure monitoring of the site and adaptive management to assess effectiveness of closure measures for the long term;
- Ensure Land Use Commensurate with Surrounding Lands;
- Ensure Meaningful Participation of the FNNND;
- Ensure Cost Effectiveness; and
- Realize a Walk-away Closure Scenario.

These closure principles and objectives work to ensure both physical stability and chemical stability of the site in the long term and are reflective of the guidelines derived from the YG's Reclamation and Closure Policy. The effectiveness of closure measures implemented at the Bellekeno Mine will be the subject of review by regulatory agencies and under the Yukon Quartz Mining Act; the company would be able to apply for a certificate of closure from the Yukon Government once there is agreement with their effectiveness.

Closure objectives can be considered in terms of the following key areas:

- (geo)chemical stability;
- water quality;
- physical stability; and,
- land use, aesthetics and public health and safety.

At closure the facilities for which physical stability must be addressed will be the portals, waste rock storage areas, any access roads not decommissioned, mill pad, and dry stack tailings facility.

8.2 MINE CLOSURE MEASURES

There are only minor amendments and adjustments necessary to the Bellekeno RCP to incorporate development activities at Onek and Lucky Queen. The same closure measures associated with the Bellekeno mine will be transferred and used for closure of similar facilities at Onek and Lucky Queen.

8.2.1 Closure Objectives

The objective for decommissioning the Onek and Lucky Queen mine infrastructure is to ensure: (1) physical stability (2) chemical stability of any mine discharge (3) that there are no threats to public health and safety, and (4) that the mine area is reclaimed such that it is aesthetically acceptable.

8.2.2 Closure Measures

Closure of the Onek and Lucky Queen mines will include restricting access and identifying and removing hazards and hazardous materials. Concern regarding physical stability of infrastructure at closure will be mitigated for the most part through disassembly and removal from the site, and by eliminating underground access. Additional chemical stability objectives will be associated with any soil contamination by fuel, chemicals or other wastes in the areas around the portal and treatment system. Since both mines are above the groundwater table and not expected produce a long term mine pool and discharge, water management and treatment is not currently anticipated.

At closure, underground equipment will be removed from the underground mine through the respective portals. The portal will remain temporarily accessible at closure for the rehandling of P-AML waste rock back into the underground. The portal entrances will be blocked by inserting rock fill to protect human health and safety and prevent wildlife access. This method, in use at other northern Canadian mines, allows for movement of water and air through the opening, as well as allowing for any movement of rock walls, to prevent failure as would occur with a concrete plug for example.

Reclamation of the portal sites will include removal of the surface facilities and other buildings (e.g. explosives and cap magazine). Fuel tanks will be cleaned and removed along with liners for reuse or landfilling. Any additional debris will also be removed for reuse or proper disposal. All solid waste will be disposed of in accordance with the Yukon Environmental Act Solid Waste Regulations. Alexco has a permitted commercial solid waste facility located in Elsa. All waste petroleum products and any other special waste, as defined in the Special Waste Regulations will be disposed of in accordance with the Regulations. Any soil contamination will be documented through a final site contamination assessment. Contaminated soil will be removed and/or remediated in an approved manner. A land treatment facility has been constructed near the Elsa Valley Tailings Facility for remediation of such soils for district closure, and can be used for remediation of any hydrocarbon contamination at the Onek and Lucky Queen mines. The portal sites would then be recontoured and scarified to facilitate revegetation and establish drainage. Signage will be installed to indicate the portal presence.

8.3 WASTE ROCK CLOSURE MEASURES

Waste rock extracted from the Onek and Lucky Queen mines will be characterized according to industry standards laid out in the Waste Rock Management Plan. Waste rock is identified as being one of the following types: (a) potentially acid-generating (P-AML) (b) non-acid-generating (N-AML). Waste rock is separated according to its acid-generation potential and stored in a manner protective of the environment.

8.3.1 Closure Objectives

During operations and at closure, the physical and chemical objectives for the waste rock storage facilities and disposal areas are erosion control, geotechnical stability and geochemical stability.

8.3.2 Closure Measures

P-AML waste rock from mine development activities will be placed in a lined waste rock storage facility (WRSF). The facility design ensures containment of waste rock, runoff and infiltration.

Rock that is not potentially acidic or metals-leaching (N-AML), will be deposited in a waste rock disposal area (WRDA) as described in Section 3-4.

Permanent P-AML WRSF

WRSFs for P-AML waste rock will be constructed in accordance with the approved engineered designs. Waste rock placement protocols will be developed with closure measures in mind to ensure that at closure, when all waste rock is in place, that minimal recontouring will be necessary. The final facilities will be recontoured as necessary to ensure its long-term stability.

The facilities will be covered with a total 0.5m depth cover consisting in the bottom portion of low-permeability borrow material to minimize infiltration of meteoric water. The top potion of the cover shall consist of growth medium that will be seeded to promote vegetative growth.

In the event that water accumulates in the bottom of the P-AML before cover placement, it will be pumped using a vacuum truck and transported to a water treatment plant for treatment.

Non-AML WRDA

In order to further increase stability and improve aesthetics, Alexco will recontour the WRDA by pulling the crests back with an excavator followed by scarification and revegetation of the flat surface of the WRDA. The final overall (crest to crest) slope of the WRDA will be 3H:1V.

8.4 ROAD CLOSURE MEASURES

All roads either developed new or reconstructed/upgraded from existing roads will be subject to standard road decommissioning and reclamation measures at closure, these roads include:

- the newly constructed North Side Bypass Road;
- the upgraded road from above the Wernecke turn off to Lucky Queen;
- the upgraded access road to the Onek portal;

These roads will be resloped and scarified, culverts removed and seeded in areas where erosion control is necessary.

8.4.1 Closure Objectives

The primary consideration for the physical stability of roads at closure will be slope stability where culverts have been removed and intermittent drainage channels have been established through the road alignments which could lead to localized erosion.

8.4.2 Closure Measures

Standard road decommissioning and reclamation measures at closure include culvert removal, resloping banks and removal of the safety berm to reflect the natural topography as well as provide stability, and surface scarification to encourage natural revegetation). Regrading/contouring the roads will ensure that runoff sheds off the road surface. Localized seeding will take place where erosion control is necessary.

9 PROJECT ALTERNATIVES

There are several project alternatives that were considered in developing this Project Proposal. Each of these are further described and rational for the final alternative selection is discussed.

Pursuing advanced exploration at Onek and Lucky Queen

An alternative to the advancement of Onek and Lucky Queen into production is the interim step of advancement exploration. This approach would require amendment of the AML and WUL to allow the necessary activities of advanced exploration to proceed. The activities required under advanced exploration are also required for production of these two deposits, including the development of the Onek portal and decline and the construction of the Lucky Queen footwall drift and exploration drilling. Alexco has developed increased confidence in its understanding of the geological models and resources from surface exploration that an interim phase of advanced exploration is not necessary and would add unnecessary time and cost to the project schedule.

Development at Silver King

Advancing Silver King to advanced exploration and production at this time is a project consideration and alternative. The current condition of the underground mine at Silver King requires dewatering and adit rehabilitation prior to entering the decline and additional exploration drilling. The time required to dewater the Silver King mine and rehab the SK 100 adit would add significant time (at least one year) to the overall schedule and therefore is not included in this project proposal. WUL 06-074 allows dewatering and rehab activities to proceed and therefore these tasks are not necessary in this project proposal and can move forward under current authorizations.

Alternative Locations for Onek Portal and Decline

Alternative locations for entering the Onek deposit were considered, presented and discussed with the community of Keno City. A new decline entering from the Lightning Creek drainage into the Onek deposit was considered. This approach however would result in an incline rather than a decline and long term water management from adit discharge could be an issue. The structural geology of that alternative was not acceptable as it would cross a schist unit that would increase the overall geotechnical risk of that alternative. In addition, the potential portal entrance for the Lightning Creek side would have potentially interfered with the local placer operation in terms of access and dual operations.

Consideration was given to rehabilitating the Onek 400 adit as the primary access into the new Onek deposit. The current geotechnical condition of the adit is highly deteriorated and would require significant rehabilitation, beyond the cost of driving a new decline from the Sign Post Portal alternative. Current adit drainage and historic ice plugs would present additional water management risk and liability. The Onek 400 adit is also directly across from local Keno City residents and the increase in noise and industrial activity within such close proximity was considered not acceptable by Alexco.

Use of Current Road System for Ore Haulage

The use of the current Wernecke road that crosses Lot 960 and into Keno City would be a project alternative for long term access and ore transport to the Keno District Mill. This alternative was discounted after discussions with Keno City residents where significant concern was raised not only during the permitting of the Bellekeno mine but for traffic impact on Keno City for Onek and Lucky Queen. Alexco considered the transport of ore through Keno City was not acceptable based on previous consultation and commitments. There will be an interim period when equipment and materials will be transported through Keno City during the construction of the North Bypass Road but this is an interim and short term measure.

Limited Resource Development

The scope of the proposed Project includes mining a limited amount of the mineral resource of Lucky Queen and Onek. Mining the full resource at each deposit was not proposed in part because insufficient environmental information exists at this time to support assessment and licencing applications in terms of appropriate baseline data and environmental protection measures.

10 REFERENCES

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Appendix A

ALEXCO

Health, Safety and Environmental Policy Statement

Alexco Resource Corp. is committed to preventing the accidental loss of any of its resources, including employees and physical assets.

In fulfilling this commitment to protect both people, property and the environment, Alexco management will provide and maintain a safe and healthy work environment, in accordance with industry standards and in compliance with legislative requirements, and will strive to eliminate any foreseeable hazards which may result in property damage, accidents, or personal injury/illness.

Alexco recognizes that the responsibility for health, safety and environment are shared. All employees will be equally responsible for minimizing accidents, incidents and spills within our facilities and on our work sites. Safe work practices and job procedures will be clearly defined in the company's Health and Safety Manual for all employees to follow.

Accidental loss can be controlled through good management in combination with active employee involvement. Safety is the direct responsibility of all managers, supervisors, employees, and contractors.

All management activities will comply with company safety requirements as they relate to planning, operation and maintenance of facilities and equipment. All employees will perform their jobs properly in accordance with established procedures and safe work practices.

I trust that all of you will join me in a personal commitment to make safety a way of life.

CRN

Clynt R. Nauman. President and CEO

Sept. 25 '11

Date

***The safety information in this policy does not take precedence over Yukon Occupational Health and Safety Regulations. All employees should be familiar with the Yukon *Occupational Health and Safety Act* and the *Regulations*.**

ALEXCO RESOURCE CORP.

ENVIRONMENTAL POLICY

It is the policy of Alexco Resource Corp. ("Alexco") to protect people and the environment through safe and responsible operation of all of its projects. We are committed to manage the projects in accordance with all applicable laws and in accordance with prudent and ethical business practice. It is Alexco's expectation that all those associated with the company, including employees, consultants, contractors, and visitors, will strive to implement Alexco Resource Corp.'s environmental policy in day to day operations. General requirements for employees, consultants, contractors and visitors are as follows:

1. Provision of Environmental Safeguards: Employees, consultants, contractors and visitors shall implement environmental safeguards equal to or better than industry standards. These include, for example, storing hazardous products within secondary containment, and maintaining an adequate inventory of spill response equipment capable of remediating spills of all hazardous products in inventory.
2. Preventing Product Releases: Employees, consultants, contractors and visitors will take measures to prevent spills of hazardous products to land or water. Should an accidental spill occur, all applicable regulations and permits shall be adhered to, and in addition, shall be immediately reported to the designated Alexco representative.
3. Minimizing Disturbance: Employees, consultants, contractors and visitors will ensure that disturbance to land, water, wildlife, and archeological remains are minimized. Any unexpected disturbance will be immediately reported to the designated Alexco representative.
4. Good Housekeeping Practices: All work areas will be maintained in a clean and tidy state.
5. Education: Contractors and visitors will ensure that all persons under their responsibility are aware of Alexco's environmental policy and its importance.
6. Training: Contractors and visitors will ensure that all persons under their responsibility are trained with respect to maintaining environmental compliance in all aspects of their operation.
7. Monitoring: Contractors and visitors will permit Alexco personnel to inspect their on-site facilities, and shall, in a timely manner, address any concerns brought forth.

Appendix B

1 REGIONAL GEOLOGY

The Keno Hill Silver District is located in the western part of the Selwyn Basin in an area dominated by deformed and metamorphosed Upper Proterozoic to Mississippian sedimentary rocks formed at the edge of a continental margin. During the Jurassic and Cretaceous, the area was subjected to compressional tectonic forces producing two major thrust sheets (Robert Service and Tombstone) and widespread folding. Early large scale deformation produced recumbent folds, resulting in local structural thickening of strata. A second (and possibly third) deformational event produced gentle south westerly plunging syn- and antiform pairs.

The Robert Service Thrust Sheet in the south is composed of Late Proterozoic to Cambrian sandstone, locally with interbedded limestone and argillite, a Cambrian to Middle Devonian succession of siltstone, limestone and chert, and Upper Devonian argillite, chert, and chert pebble conglomerate. The latter unit uncomfortably overlies the lower units.

The Tombstone Thrust Sheet to the north consists of Devonian phyllite, felsic meta-tuffs and metaclastic rocks, overlain by Carboniferous quartzite. This latter rock unit is locally thickened due to folding and or thrusting and hosts the mineralization of the Keno Hill Silver District.

Intrusive rocks formed during four episodes of plutonism. Early Paleozoic fine-grained diabase occurs as metre-scale dikes and sills in the Upper Proterozoic to Lower Cambrian rocks. During the Mid-Triassic, gabbros to diorites formed pods of various sizes, primarily in the Devonian and Mississippian rocks of the Tombstone thrust sheet. A third phase of plutonism took place around ninety-two million years ago in the early Cretaceous and resulted in widespread and voluminous Tombstone intrusions of commonly granitic to granodioritic composition. The youngest magmatic activity occurred around sixty-five million years ago in the Upper Cretaceous and resulted in the formation of peraluminous megacrystic potassium feldspar granite.

In addition to where polymetallic veins were exploited, the area hosts a number of occurrences, and showings of tungsten, copper, gold, lead, zinc, antimony and barite. Tin, tungsten, and molybdenite occurrences are possibly related to the suite of Cretaceous intrusion, whereas lead, zinc, and barite occur in stratiform calcareous sedimentary rocks of early to mid-Paleozoic age typical of sediment-hosted deposits.

2 PROPERTY GEOLOGY

The Keno Hill District is underlain primarily by Yukon Group metasedimentary rocks, locally divided into three formations; Upper Schist, Central Quartzite and Lower Schist. The Upper Schist (Hyland Group, pre-Cambrian to Cambrian age) overlies the quartzite in what is inferred to be a thrust contact (Robert Service Thrust) and consists of quartz-mica schist, quartzite, graphitic schist and minor limestone. The Central Quartzite (Keno Hill Quartzite, Mississippian age) contains thick-and thin-bedded quartzite, massive quartzite, graphitic phyllite, graphitic schist, calcareous schist and minor Triassic greenstone. This unit is approximately 700 m thick and is host to most of the past producing ore bodies. Structurally juxtaposed below the quartzite is the Lower Schist which has been correlated with the Devonian-Mississippian Earn Group. The Lower Schist includes graphitic schist, argillite, thin-bedded quartzite, calcareous schist, phyllite, slate, sericite schist, minor thick-bedded quartzite and locally significant intervals of Triassic greenstone. The greenstone forms sills and / or boudins and consists of metadiorite and metagabbro. The sills and boudins form bodies up to one kilometre long and thirty metres thick. Regional, greenschist facies metamorphism of all units is believed to have occurred in the Middle Cretaceous, about 105 million years ago.

A number of quartz-feldspar porphyritic sills have intruded the stratigraphy parallel to schistosity. The sills are most common in the Lower and Upper Schists and can reach thicknesses of up to fifty metres; reports of occurrences in the Central Quartzite are inconclusive and vague. The quartz-porphyry sills are believed to be of Cretaceous age.

Structurally, the property is characterized by four sets of faults; many of which have been filled by hydrothermal minerals, forming veins. The oldest fault set consists of south dipping structures that are generally parallel to foliation and are apparently associated with the Tombstone Thrust Fault since movement was contemporaneous or slightly later. Locally, brittle deformation has been observed along these structures. A second fault set, known as "longitudinal veins" strikes north east to east northeast and dips steeply southeast. The latest movement along these faults is sinistral with offsets locally reaching more than 150 metres; however, more than one episode of movement commonly is indicated. Depending on the competency of the host rock, longitudinal veins can be up to thirty metres wide in an anatomising system of sub-veins. Essentially all mineralized rock was mined from these longitudinal veins. A third set of faults, known as "transverse faults", is north-west striking and dips steeply to the north. Transverse faults typically do not contain silver and lead mineralization but are commonly filled by quartz with trace to minor arsenopyrite, pyrite and jamesonite.

A younger set of faults, known as cross faults, strike north to north east with a dip of sixty degrees west to south west and offset vein or longitudinal faults by up to 2,000 metres. In the western part of the property, dextral movement is the most recent event along these structures, whereas in the eastern part of the property sinistral movement with less magnitude prevails.

At Keno Hill, the largest accumulation of ore minerals occurred in structurally prepared competent rocks, such as the Central Quartzite, resulting in areas of increased fluid flow. Incompetent rocks like phyllites tend to produce fewer and smaller, if any, open spaces, limiting fluid flow and resulting mineral precipitation.

Mineralization in the Keno Hill Silver District is of the polymetallic silver-lead-zinc vein type. In general, common gangue minerals include manganiferous siderite and to a lesser extent quartz and quartz breccia as well as calcite and other carbonates. Silver occurs in argentiferous galena and argentiferous tetrahedrite (freibergite). In supergene assemblages, silver is further found as native silver, in polybasite, stephanite, and pyrargyrite. Lead occurs in galena and zinc in sphalerite, which is iron-rich. Other sulphides include pyrite, arsenopyrite (locally gold-bearing) and chalcopyrite.

The veins of the Keno Hill Silver District display characteristics associated with both mesothermal and epithermal deposits and it is not clear if a continuum exists or if separate and distinct mineralizing events are involved. The most prominent examples of epithermal style mineralization are found in the western part of the district, although the Lucky Queen mine on Keno Hill produced native silver and ruby silver in quantity. Proximity to a magmatic heat source has often been called upon to explain the district zonation, though this is by no means a complete explanation.

Mineral zonation is common within base metal-rich veins (zinc-rich margin and silver/lead-rich center). Changes in mineralogy within individual oreshoots is less clearly documented, although there has long been a conviction that silver and lead rich zones occur higher in the veins while zinc becomes dominant at depth. Anecdotal evidence suggests that vertically stacked oreshoots may repeatedly show zoning of lead rich upper portions to zinc dominant roots, but data confirming this has not been found. In general, Pb-Zn mineralization appears to be nearly contemporaneous in age.

Mechanisms triggering deposition of ore and gangue minerals have been suggested by district wide studies of fluid inclusions and light stable isotopes. Fluid boiling appears to have been ubiquitous and some evidence exists for fluid mixing. The hydrothermal fluids responsible for mineral deposition contained significant quantities of CO2 which may have "boiled" during abrupt changes in pressure produced during fluid movement from confined fractures to more open conduits formed in quartzite.

Irrespective of stratigraphic formations or regional map units only a few major rock types are commonly encountered in the area of the old mine workings. These are:

- schists and phyllites with variable carbon content;
- chloritic phyllites or schists;
- quartzites and phyllitic quartzites;
- sericite-quartz phyllites; and,
- greenstones.

3 PHYSIOGRAPHY AND SURFICIAL GEOLOGY

The Keno Hill Silver District lies within the northeastern part of the Yukon Plateau, and the terrain is mountainous with elevations ranging from 1,848 m (Summit of Keno Hill) to 610 m (McQuesten River valley). The area has been profoundly influenced by the latest glaciation but shows more subtle evidence of an earlier event as well.

The lower slopes of Galena Hill show clear evidence of ice marginal deposits such as kame terraces related to the glacial lobes occupying the major valley. The retreat of the Cordilleran ice sheet has had a major impact on the south McQuesten valley. Till blankets much of the valley and glacio-fluvial deposits are widespread. Glacio-lacustrine deposits formed in ice marginal lakes occur in the deeper part of the valley. Large meltwater streams have left huge meander scars. Boyle (1965) provides the following additional description of the physiography and glacial deposits in the area.

Galena Hill trends northeast between Duncan Creek and the McQuesten River valley. It has an elevation of 4,740 feet, a moderately steep southwestern slope, and steeper north, northwestern, and southeastern slopes. The terrain above 4,300 feet is relatively flat and rolling, and marked by several level grassy meadows. The north, northwestern, and southeastern slopes of the hill are crossed by several streams that have cut steep gulches into the rock strata. The principal streams responsible for these gulches are Galena, Flat, Brefalt, and Sandy Creeks and Porcupine Gulch on the northwestern slope and Hinton and Fisher Creeks on the eastern and southeastern slopes.

Keno Hill and Sourdough Hill are adjacent hills separated by Lightning Creek. Keno Hill trends northeast and lies between the Keno Ladue-McQuesten River valley and Allen, Faith, Lightning, and Christal Creeks. The hill has relatively gentle southern and southeastern slopes and a precipitous northern slope, marked by two cirques, Faro Gulch and Silver Basin Gulch. The terrain above 4,500 feet is relatively flat and rolling with five prominent rocky knolls known as Keno, Minto, Monument (the highest point on Keno Hill, elevation 6,065 feet), Caribou, and Beauvette. On the slopes of the hill several streams follow steep gulches in the rock strata, the principal ones being Gambler, Faro, McKay, and Silver Basin on the northern slope, Faith, Hope, and Charity on the northeastern and southern slopes, and Erickson on the western slope.

Sourdough Hill lies southwest of Keno Hill and trends north between Thunder, Lightning, and Duncan Creeks. The part of the hill described in this report is on the northern and northwestern slopes, which are gentle up to 4,200 feet and from there rise abruptly to a steep rocky hogsback that trends southwest for some 6,000 feet.

Extensive rock outcrops are uncommon on Galena, Keno, and Sourdough Hills, and with the exception of the gulches and cirques where relatively good geological sections are present, detailed mapping can only be done by observing float. Below an elevation of 4,400 feet rock outcrops are sparse, and the slopes are covered with till, soil, rock debris, much, and muskeg, in which conifers, birch, aspen, Arctic black-birch, and other vegetation grow abundantly. Above this elevation the soil is thin, outcrops are more numerous, the ground is covered with local rock float, the terrain is treeless, and the vegetation is limited to alpine species and grassy meadows.

The lower slopes of the hills were severely glaciated during Pleistocene time by ice-sheets that spread, from the east, over the entire area. Glacial till, gravel, and other debris lie in a series of benches on the slopes of the hills and floor the valleys. The deposits are generally 5 feet to 20 feet thick, but in some areas as on the southern slope of Keno Hill facing Lightning Creek and north of Christal Lake, they are 30 feet to 50 feet thick or more.

The Keno Hill-Galena Hill area is in the region of permanently frozen ground. The permafrost is irregularly distributed and its occurrence is dependent upon the elevation, hillside exposure, depth of overburden, amount of vegetative cover, and presence of flowing underground and surface water. At high elevations and on slopes with a northern exposure it is generally present. Thus, on Keno Hill, the mine workings on the top of the hill and on the northern slope encountered permafrost some 400 feet below the surface. On the northern slopes of Sourdough Hill and Galena Hill a similar situation prevails, and frost and ice lenses have been encountered at depths of 250 feet or more in the mine workings. On the lower southern slope of Keno Hill, however, the workings of the Onek and Mount Keno mines show little evidence of permafrost. In places where surface and underground water are flowing the permafrost has been thawed out and frost free windows and strips are present. These provide access and egress for waters that are oxidizing the lodes.

The effects of frost action, soil creep, and slope wash are marked on the hills, particularly at the higher elevations. Frost action is responsible for features such as stone rings and stripes, and produces a general 'boiling action' that brings rock float, mineralized float, and soil from deeper layers to the surface, thus facilitating the mapping of both the underlying bedrock and the tracing of vein faults. On steep slopes, however, frost action and land creep have transported float downhill places, 100 feet or more, making the accurate mapping of contacts and vein faults difficult.

Appendix C

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Memorandum

To: Jim Harrington, Brad Thrall, Alexco Keno Hill Mining Corp.

From: Ethan Allen, Scott Davidson, Access Consulting Group

Date: December 7, 2011

Subject: Geochemical Rock Characterization, Onek
Keno Hill District, Yukon

1. PURPOSE AND SCOPE

This report summarizes results of a geochemical characterization of rock from the Onek deposit area within the Keno Hill Silver District (KHSD), Yukon.

1.1 PURPOSE

The purpose of this memorandum is to review the geochemical characteristics of geologic materials in the Onek zone especially with regard to its potential for the generation of net acidity and/or metal leaching (AML). The objective is to provide technical basis to support management of rock to be excavated from Onek during Alexco Resource Corporation's (Alexco) proposed underground development and mining program.

1.2 STUDY APPROACH

This evaluation consists of data analysis and integration of two datasets: 1) acid base accounting (ABA) of 2006-2010 Onek drill core (50 samples) and 2) multi-element ICP metals and lithology database from Onek drill core (4437 samples).

This analysis builds on the geochemical characterization studies done in order to define AML controlling and correlating factors for the KHSD as a whole (Altura 2008a). Altura utilized a review static testing data from site-wide geochemical sampling conducted during 1995 to 1996 on weathered rock dump and pit samples. Key geochemical and field diagnostic factors that appear to either control or correlate to the generation of net acidity and/or metal leaching in the KHSD rock suite were applied in order predict the relative proportions of potentially AML (P-AML) and non-AML (N-AML) rock. The available ABA and ICP geochemistry data were reviewed to assess the applicability of existing waste rock segregation and management protocol are appropriate at the Onek deposit. This study employed similar methodologies and is compared with and builds on the geochemical characterization of the Bellekeno Zone (Altura 2008b) in order to confirm that the waste rock management system currently used by Alexco at the Bellekeno mine (i.e. Waste Rock Management Plan submitted for QML-0009, submitted Nov. 2009) is an appropriate management strategy at the Onek deposit.

2. METHODOLOGY

All data used in this study were provided by Alexco. Data were complied and for statistical analysis purposes, results below minimum limits of detection were assigned a value of one half of the detection limit. Results above the maximum limits of detection were assigned a value equal to the detection limit. Statistical analysis and data manipulation was carried out using Excel and XLStat software.

Samples in the 4437 sample Onek drillhole database were analyzed with aqua regia digestion via 27 element ICP-OES or 49 element mixed ICP-OES and ICP-MS finishes and included sulphur. The ABA testing was via the modified ABA method including sulphate via both sodium carbonate leach and HCl digestion, total inorganic carbon via coulometer, and paste pH at a 1:1 solid to water ratio. Chemical analyses were conducted by ALS Chemex Labs in North Vancouver, BC while samples from several drillholes from 2010 were analyzed by AGAT Labs in Mississauga, Ontario.

Lithological, mineralogical, and alteration data was determined by Alexco geologists during routine core logging and sampling. Specific lithologies (e.g. schists and quartzites) are intercalated with secondary lithologies over the scale of centimetres to meters. Thus, reported lithology over a specific interval is only the primary lithology and could contain a significant proportion of a secondary lithology. Two lithology codes including ICQS (Interbedded Carbonaceous Quartzite and Schist) and TQTZT (Thin Bedded Quartzite) are reported which reflect specific intervals of mixed lithology.

Determination of mineralized samples was conducted by using a geochemical query with criteria being as either Pb or Zn > 5000 ppm. The lithology code for mineralized vein or "VM" and mineralized stringer "SM" were consolidated with vein, or "VN" for ease of analysis. On an operational waste rock management level, vein or obviously mineralized material is assumed to either be ore or P-AML material; therefore all samples designated as "VN" were assumed to be mineralized even though a 8 samples did not contain >5000 ppm Pb or Zn. Two samples designated as breccia, or "BX" and 32 samples designated as fault, or "FLT" were not included in the analysis because their original lithology was unknown, leaving 4408 samples.

Analyses below detection limit were replaced with 0.5x detection limit for statistical analyses.

3. OVERVIEW OF ONEK ROCK

3.1 GEOLOGY AND MAJOR ROCK TYPES

The KHSD is comprised principally of Yukon Group metasedimentary rocks, which are described in the Keno Hill Silver District Environmental Conditions Report (Access Consulting Group, 2011).

In summary, the metasedimentary rocks have been divided locally into three formations; Upper Schist, Central Quartzite and Lower Schist. The Upper Schist (Hyland Group, pre-Cambrian to Cambrian age) consists of quartz-mica schist, quartzite, graphitic schist and minor limestone. The Central Quartzite (Keno Hill Quartzite, Mississippian age) contains thick-and thin-bedded quartzite, massive quartzite, graphitic phyllite, graphitic schist and calcareous schist. This unit is approximately 700 m (2300 ft) thick and hosts most of the major silver deposits in the area. The Lower Schist includes graphitic schist, argillite, thin-bedded quartzite, calcareous schist, phyllite, slate, sericite schist and minor thick-bedded quartzite. Conformable greenstone (altered diorite/gabbro) lenses and sills occur in places and narrow lamprophyre and quartz-feldspar porphyry dykes occur locally. Granite bodies have intruded the metasedimentary – greenstone package at several places to the north and south of the Keno Hill – Galena Hill area.

The Onek deposit is located on the south-western flank of Keno Hill directly to the northeast of the hamlet of Keno City. The deposit is hosted in an interbedded quartzite, carbonaceous schist and sericitic schist package containing conformable greenstone lenses on the south-western end and in more massive quartzites on the south-eastern end.

Principal rock units in order of predominance at the Onek deposit are quartzite, schist, and greenstone. Mineralogical and compositional variation is seen especially in the quartzites and schists, which is broken into sublithologies. A brief overview description of each major lithology type is summarized below from Boyle (1962), Altura (2008b) and Access (2011).

Quartzite (QTZT): Is the dominant unit at Onek, occurring both as thin and thickly bedded sequences with assemblages of schist. Quartzites are comprised primarily of quartz but also contain some mica carbonate minerals and carbonaceous material. Accessory minerals include leucoxene, tourmaline, zircon, apatite, and pyrite.

Schist (SCH): The majority of the schist within the Onek deposit is graphitic schist (GSCH), but some sericite schist (SSCH), chlorite schist (CHSCH) as well as undifferentiated schist is observed. As previously discussed, interbedded carbonaceous quartzite and schist (ICQS) and thin bedded quartzite (TQTZT) are also included as their own lithologies, but contain significant schist.

Graphitic schists are black or dark gray due to their significant carbon content, and occur in beds from millimetre to many meters in scale intercalated with quartzites and other lithologies. In addition to graphite, quartz, mica, carbonates, feldspar, chlorite, isotropic colloidal material and pyrite metacrysts have been identified in thin sections.

Sericite and chlorite schist are usually pale and dark green, respectively. Thin sections of sericite schists show primarily quartz and sericite with trace carbonate minerals and leucoxene. Accessory minerals include apatite, zircon, tourmaline and pyrite metacrysts.

Greenstone (GNST): Greenstones vary from massive to schistose and vary in color from greyish green to dark green. Greenstones occur in conformable elongated lenses and sills as a result of boudinage, particularly within the more ductile schist units. Greenstones units are generally more resistant than the quartzites and schists and appear geomorphologically as prominent hills in the KHSD. Thin sections show significant variety in mineral composition and texture but generally show a high degree of alteration. Primary mineralogy of the greenstones are hornblende, actinolite, saussurite (zoisite, epidote, albite, sericite, carbonate), plagioclase (oligoclase to andesine), chlorite, stilpnomelane, biotite, sericite, leucoxene, and carbonate minerals. Quartz, K-feldspar, ilmenite, magnetite, limonite and apatite are minor constituents with some pyrite. Chlorite is also generally present, which is primarily responsible for the rock's color.

Vein (VN): Economic mineralization in the Keno Hill District occurs in irregular shoots within vein fault systems. Dilation and subsequent development of economic mineralization is favoured in the more brittle (quartzite and greenstone) units, and where there is a contrasting rheology on each side of the vein fault. Dilation and economic mineralization is usually not well developed in the more ductile schists and phyllites.

At least two stages of mineralization have been identified in the KHSD. The first stage is associated with quartz, pyrite and arsenopyrite and sulphosalts. This earlier stage is associated with elevated gold concentrations. The second stage of mineralization (which comprises the majority of the economic mineralization in the district) is associated with deposition of siderite galena, sphalerite, pyrite, freibergite and pyrargyrite, quartz, pyrite and small amounts of other sulphides (e.g. chalcopyrite).

The Onek vein system comprises at least three individual vein faults occurring within a broad northeast striking, southeast dipping structural zone. The vein faults occur over a strike length of at least 600 m and are characterized by brittle fractured zones, locally containing massive sulphide vein material, consisting of sphalerite, galena and siderite along with minor pyrite, arsenopyrite and quartz.

3.2 ELEMENTAL CHARACTERIZATION

ICP metals data from the 4,408 sample drillhole database were characterized and described according to the major lithologic units. Table 1 shows the distribution of samples according to lithology in the Lucky Queen drillhole database. Lithologies with less than 1% relative frequency (phyllite, and calcareous schist) were deemed to be insignificant and were not included in the subsequent analysis, leaving 4,385 samples.

Table 1. Distribution of Samples in the Onek Drillhole Database

Lithology		Number of Samples		
Description	**Code**	**Non-Mineralized (Waste Rock)**	**Mineralized (>5000 ppm Pb or Zn)**	**Total**
Chloritic Schist	CHSCH	46	2	48
Calcareous Quartzite	CQTZT	169	10	179
Calcareous Schist	CSCH	19	1	20
Greenstone	GNST	176	17	193
Graphitic Schist	GSCH	433	39	472
Interbedded Carbonaceous Quartzite and Schist	ICQS	125	45	170
Phyllite	PHY	3	0	3
Quartzite	QTZT	1894	546	2440
Schist	SCH	126	10	136
Sericite Schist	SSCH	128	10	138
Thin Bedded Quartzite	TQTZT	206	137	343
Vein (Mineralized)	VN	0	266	266
	Totals	3325	1083	4408

A number of elements exceeded the method detection limit (MDL) for the standard ICP metals suite and were not run for ore grade or overlimit analyses. Samples over the method detection limits of As >10,000 ppm, Cd > 1000 ppm and Mn > 100,000 ppm were present mainly in samples assigned as VN, but also appear in a few other lithologies for As and Cd. A total of 36 samples exceed the MDL for As, with all but two of these samples falling into the VN or QTZT lithologies. All but 5 samples fall into the mineralized category, and all were identified as P-AML. A total of 268 samples exceed the MDL for Cd with all but one sample identified as mineralized and P-AML. The presence of these samples in the dataset will have a minor effect of underestimating the true statistical measurements for these elements, but will not have any effect on the efficacy of the geochemical screening criteria in indentifying samples with high Cd and As as P-AML.

3.2.1 Results

Summary statistics of Onek geochemistry are contained in Appendix A1. The results of the metals analysis for selected elements of interest in the Onek drillhole database are summarized below. Box plots of these selected elements are shown according to lithology and according to mineralized/unmineralized designation in Appendix A2.

Aluminum (Al)

The first-third quartile range for aluminum were lowest in VN (< 2%) and highest in the schist lithologies and greenstone (2-8%). The more siliceous quartzite lithologies had the fairly low values, generally less than 3%. Of the schist species, sericite schist showed the lowest values. These values reflect the respective mineralogy of each lithology, where aluminum is likely contained mostly within aluminosilicate minerals such as micas and clays in schist and amphiboles (as in greenstone).

Arsenic (As)

Arsenic was observed to be highest in VN, but also showed some elevated levels in other lithologies. A significantly higher (approximately 2-10x) mean than median value for arsenic shows that significantly elevated levels are observed in a small subset of the samples most likely due to the occurrence of arsenopyrite mineralization in these samples. This divergence between mean and median values was most pronounced in QTZT, CQTZT and VN. Although statistical measurements of As concentrations were approximately an order of magnitude higher in mineralized samples compared with non-mineralized, the large discrepancy between mean and median values was seen in both.

Barium (Ba)

Barium was lowest in VN and is highest in the schist units except for GSCH with elevated concentrations particularly associated with SSCH, CHSCH and PHY. Ba concentrations are significantly higher in non-mineralized samples compared with mineralized samples.

Calcium (Ca)

Calcium contents were lowest in VN and highest in GNST and generally lower in quartzites (except for CQTZT) and slightly higher in the schist units. Except for GNST, other lithologies had Ca concentrations of generally less than 5% with mean and median values of between 0.2-2%. Ca concentrations are significantly higher in non-mineralized samples compared with mineralized samples.

Magnesium (Mg)

Magnesium concentrations were generally less than 1% for all lithologies except GNST, in which most of the population was between 2.5-3.75%. The higher Mg concentration in GNST is due to the gabbroic concentration of the parent rock and the corresponding Mg bearing ferromagnesian minerals. Of the other lithologies, SSCH and CHSCH have slightly higher Mg contents which are likely contained within the phylosillicates (i.e. chlorite). Non-mineralized samples contained slightly higher Mg contents than mineralized samples.

Iron (Fe)

Iron concentrations were much higher in VN than other lithologies and much higher in mineralized as compared with non-mineralized samples. The main Fe bearing minerals encountered within and near the veins are siderite and pyrite. Among the other lithologies, GNST had the highest iron concentrations (mainly in the 6-8% range) due to its gabbroic composition and consequent mineralogy, which includes Fe bearing aluminosilicates such as chlorite, biotite and amphiboles.

Manganese (Mn)

Manganese concentrations were fairly uniform among all lithologies except for VN and unmineralized samples generally contained less than 5000 ppm. Mineralized and VN samples exhibited first to third quartile ranges between 20,000-30,000 ppm with some samples over the 100,000 (10%) method detection limit. Although the amount of substitution and precise carbonate composition is unknown at the site, Mn is known to substitute significantly for Fe in siderite.

Lead (Pb)

Median values for lead for most units is relatively low for most units, in the 10-100 ppm range, however, anomalously high values in thousands of ppm was noted to occur in all units. QTZT shows the greatest variation, which is likely an effect of a greater sample size. VN shows significantly higher values with a median of 2370 and maximum value of over 48% Pb, reflecting the presence of massive galena. Mineralized samples show much higher Pb contents (median of 10 ppm in non-mineralized compared with a median of 447 ppm for mineralized samples).

Sulphur (S)

Sulphur via ICP values for rock lithologies (all except VN) show median values of between 0.09 and 0.32% with means approximately 2x the median value, showing that a small number of samples with significantly elevated levels are skewing the population. There is no distinction between quartzites and schists and GNST has the lowest median value. VN has a median of 6.14% S. S is significantly higher in mineralized samples (median of 1.5%) compared with non-mineralized samples (0.2%).

Zinc (Zn)

Median zinc levels showed significant elevation in rock lithologies of between 147 to 3380 ppm. Lithologies with highest Zn were TQTZT and ICQS with significant elevation in QTZT. A significant divergence between mean and median values was also exhibited for Zn for all lithologies indicating that a subset of anomalously high values exists over the strong zinc overprint. The first to third quartile range for the non-mineralized samples was approximately 100-1000 ppm while the mineralized samples were between 8000-100,000.

3.2.2 Discussion

Analysis of data from the 4,385 samples of major lithologies from the Onek drillhole database show that the rock units (not including VN or mineralized category) tend to have generally low sulphur (less than 0.5%). No clear distinction in S contents exists between the quartzose and schistose rock units, but greenstones have the lowest sulphur contents. Occasional anomalous concentrations of some metals exist across all lithologies. Most notably, Zn is significantly elevated within rock lithologies with all median values > 147 ppm.

Vein lithology and mineralized samples show significantly higher concentrations of economic elements (Pb, Zn) as well as other metals associated with gangue mineralogy such as Fe, As, and Mn. Sulphur contents in VN and mineralized samples are significantly higher than other rock lithologies owing the presence of significant sulphide mineralization.

3.3 ACID BASE ACCOUNTING

The principal objective of ABA testing is to provide quantitative determination of the balance between acid producing and acid consuming minerals of materials. The ratio of neutralizing potential (NP) to maximum potential acidity (MPA) is expressed as NP/MPA. NP/MPA values reported from bulk ABA testing data (N=50) represented 7 of the 12 original lithologies. Alternative methods to calculate other types of ABA data can be employed if relationships can be established between parameters and mineralogy is understood. NP can be calculated based on such as inorganic carbonate, calcium, or calcium + magnesium, if the majority of the neutralizing potential is known to be from carbonate minerals. MPA is reported in ABA results as the calculated difference between total sulphur via Leco with total sulphate (via carbonate or HCl leach) subtracted. This remainder, assumed to be sulphur as sulphide, is multiplied by 31.25 in order to determine MPA in kg $CaCO_3$/tonne. Total sulphur as measured by ICP, can also be used to calculate MPA, which is discussed further in Section 3.3.1. These relationships allow for extension of ABA data to include samples for which only ICP analysis exist, and have allowed calculation of ABA data to include all lithologies except for GNST and VN and samples identified as mineralized. A summary table of the distribution of ABA samples including those calculated using ICP data for Onek is shown in Table 2.

Table 2. Distribution of ABA Samples in Onek Dataset

Lithology		# of ABA samples	# of calculated ABA samples
Description	**Code**		
Chloritic Schist	CHSCH	1	46
Greenstone	GNST	3	0
Calcareous Quartzite	CQTZT	0	169
Graphitic Schist	GSCH	5	432
Interbedded Carbonaceous Quartzite and Schist	ICQS	0	125
Quartzite	QTZT	14	1894
Schist	SCH	6	126
Sericite Schist	SSCH	8	128
Thin Bedded Quartzite	TQTZT	0	206
Mineralized Vein	VN	13	0
	Total	**50**	**3126**

3.3.1 Results

Acid base accounting summary statistics are presented in Appendix B1. Relationships between lithologies and between mineralized/unmineralized samples for ABA results are shown in Appendix B2.

Neutralization Potential

A strong correlation between %Ca and %CO_2 versus NP was noted in the Bellekeno geochemical characterization (Altura, 2008b) especially when considering only unmineralized samples, and excluding VN and GNST lithologies. In the case where significant dolomite or Mg bearing carbonates are known to exist, the correlation can be improved by comparing [Ca+Mg] with NP. Plots showing the relationships between bulk NP and a number of potential ICP data correlations (Ca, Mg, [Ca+Mg]) for the Onek dataset are shown in Figure 1a and 1b.

The best observed correlation was between Ca and NP in which the data was filtered to exclude VN and GNST (Figure 1). This allowed for calculation of neutralization potential based on Ca% [NP_{Ca}]. The derived relationship between Ca and NP was:

$$[NP_{Ca}] = 25.763[Ca\%] + 7.0008$$
$$R^2 = 0.921$$

Similar to the results described in Altura 2008b for the Bellekeno data, this correlation did not work for mineralized (VN) samples because the bulk NP was higher than the linear correlation due to the abundance of siderite (Fe_2CO_3) in vein material. In the case of GNST, bulk NP was much lower than the linear correlation because significant non-neutralizing Ca exists within calcic silicates such as hornblende, actinolite and other amphiboles. This relationship indicates that calcium carbonate is likely the primary source of neutralizing potential, and was used to calculate NP_{Ca} for the ICP data for all lithologies except VN and GNST. Box plots showing bulk NP and NP_{Ca} per lithology are shown in Figure 2.

The 50 sample bulk NP dataset showed that mineralized samples (as represented by VN lithology) had a higher neutralizing potential (median of 124 kg CaCO3/t) than non- mineralized lithologies and is attributed to the significant siderite content known to exist in the mineralized areas. Two lithologies (GNST and CHSCH) were represented by less than 5 samples.

Figure 1a. Relationship of Calcium, Magnesium and Carbonate with NP

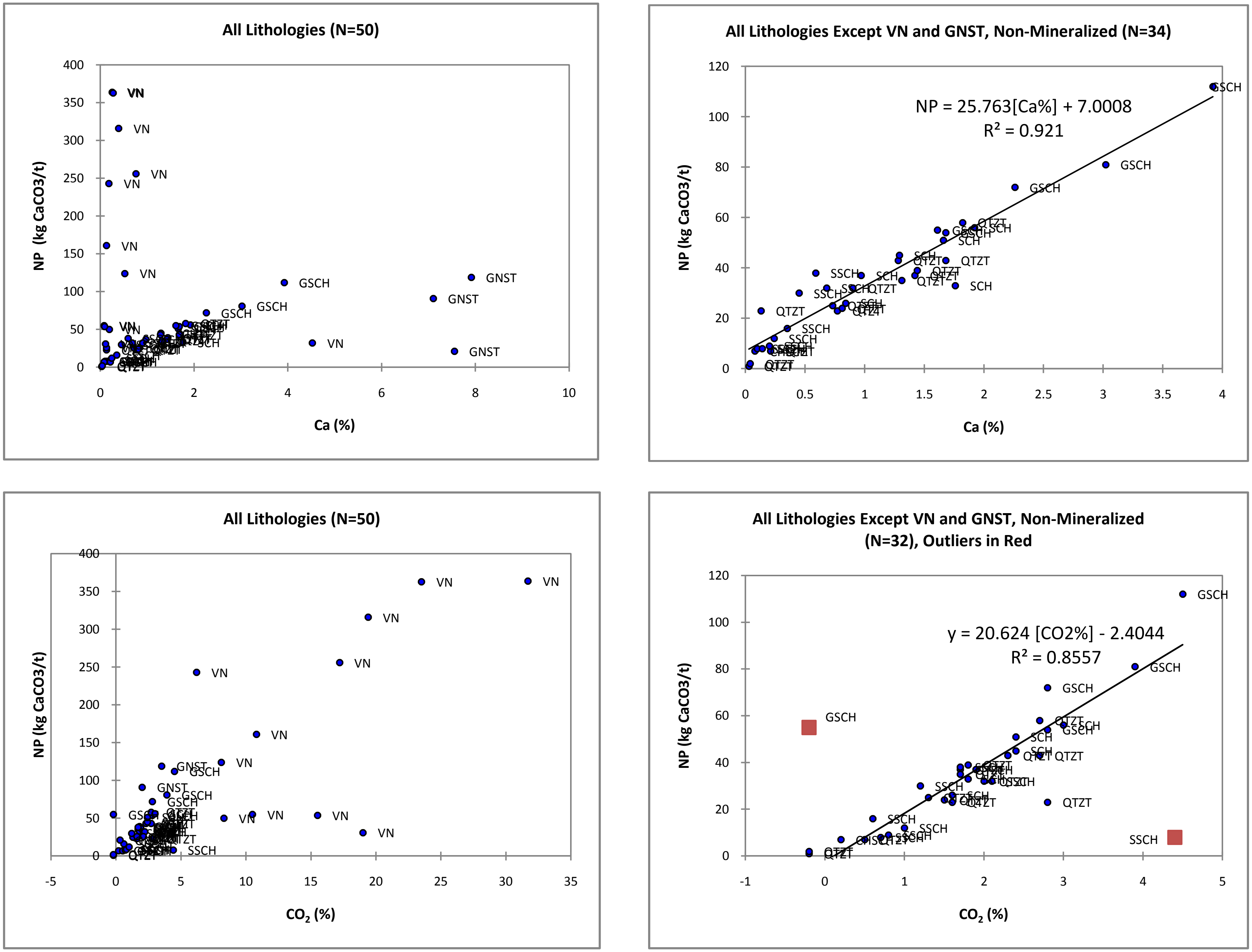


Figure 1b. Relationship of Calcium, Magnesium and Carbonate with NP

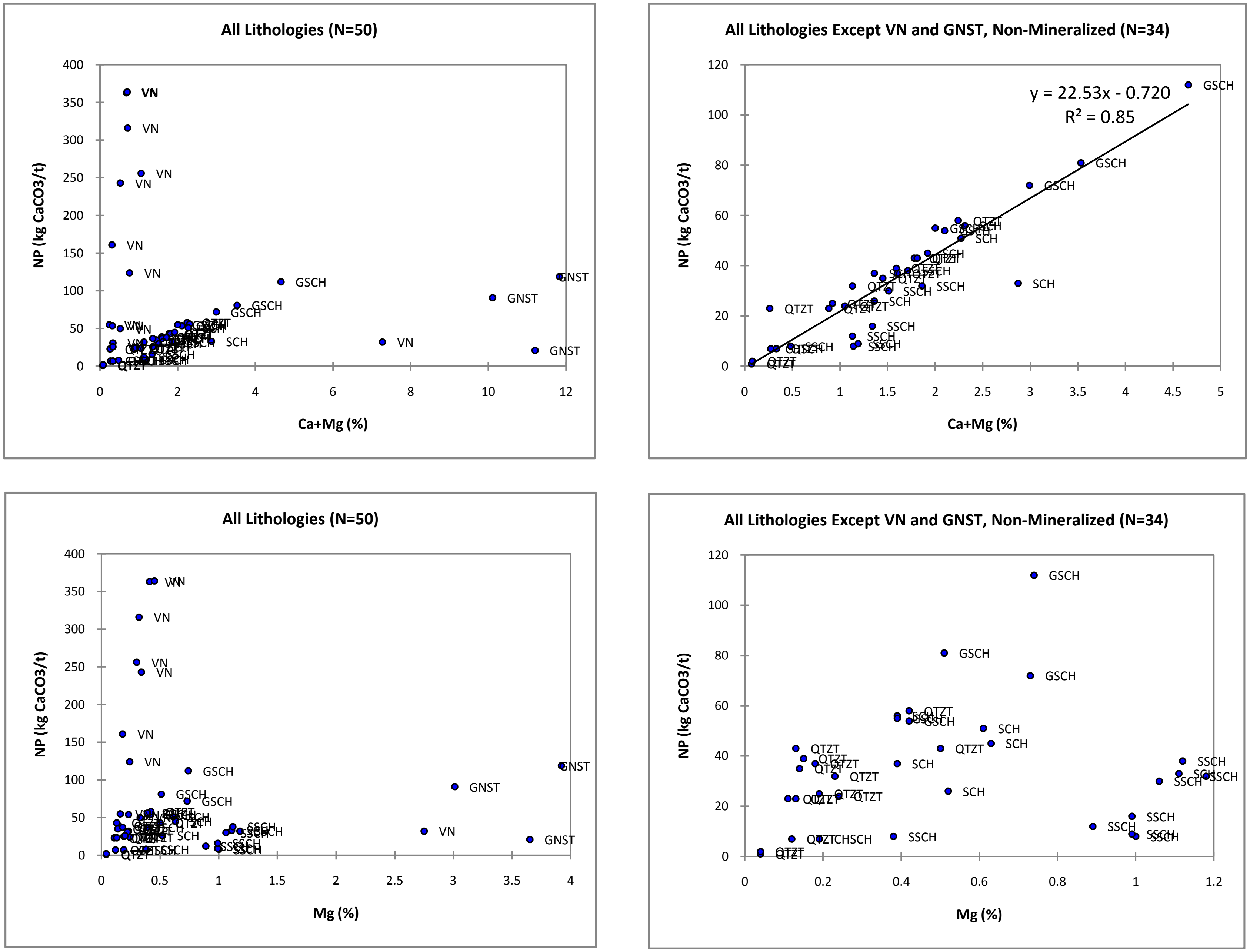
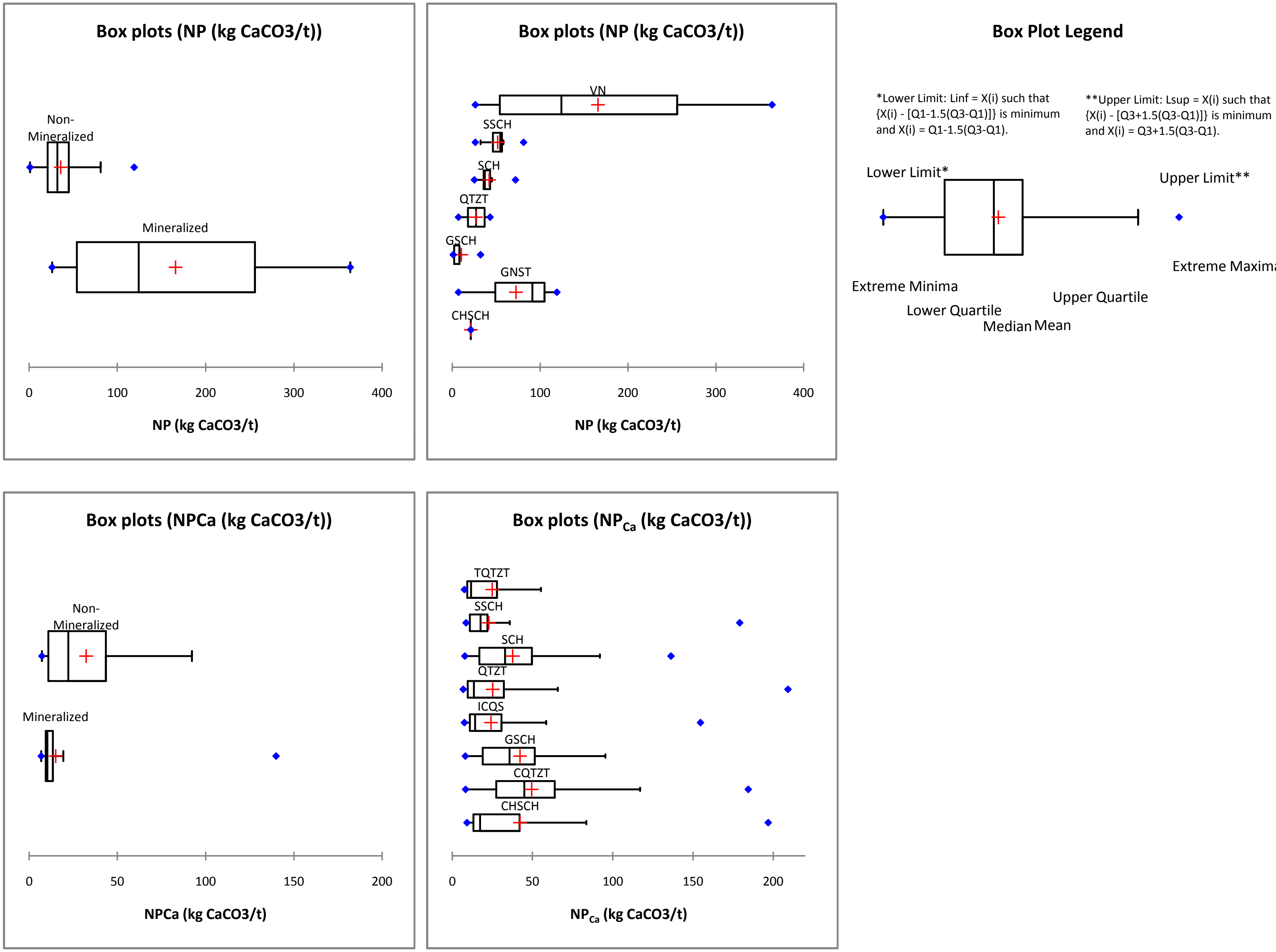


Figure 2. Measurd NP and calculated NP from ABA database



Lithologies represented by larger numbers of samples generally exhibit greater variability. The lowest bulk NP of 1 kg CaCO3/t was exhibited by a quartzite sample. Median values for waste rock lithologies varied between 7 and 91 kg CaCO3/t.

The 3926 calculated NP_{Ca} samples showed similar ranges but less variability among lithologies than the bulk NP data. Median values for comparable lithologies (QTZT, GSCH, SCH, but with the exception of SSCH and CHSCH) were generally lower in the larger NP_{Ca} dataset, most significantly in QTZT and GSCH. CQTZT, or calcareous quartzite predictably had the highest median value of the NP_{Ca} dataset.

Sulphur Species and Maximum Potential Acidity

Sulphur content and speciation is an important determining factor affecting the potential for generation of acidity. Sulphur occurs in various forms in rock including potentially acid generating sulphide, and sulphate which is generally not acid generating. MPA in the ABA dataset was calculated by multiplying the % sulphur as sulphide by 31.25.

From the 50 sample ABA data set, total sulphur ranged between 1.0% and 24.7% in the 13 VN samples, while the remainder of the rock lithologies varied between 0.05% and 1%. Sulphate sulphur via carbonate leach varied between below detection limit (0.01%) and 0.12% for rock lithologies and up to 0.16% in VN. The median value for mineralized samples was significantly higher at 0.6% compared with 0.2% for non-mineralized samples. Although results are similar between the two methods sulphate via HCl leach seemed to be less sensitive than the carbonate leach, with significantly more samples below detection limit. This was also noted by Altura 2008b for Bellekeno.

Sulphate via carbonate leach as a percentage of total sulphur has a median of 11% in non-mineralized rock lithologies and a median of 0.65% in VN and mineralized samples. By lithology, sulphate via carbonate leach is 100% of total S for the single sample of CHSCH, and has a mean of 62.5% for GNST. GSCH shows a median of 25%, while the remaining rock lithologies have median values of between 6 and 13%. VN has a median value of 0.65%.

Insoluble sulphate minerals such as barite ($BaSO_4$) and anglesite ($PbSO_4$) can interfere with the results of procedures that calculate forms of sulphur from the difference between total sulphur and extractable sulphur. Because of the low solubility of barite and anglesite, sulphur in these minerals will report as sulphide S if hydrochloric acid is used to predict the % sulphide S. This partially explains the greater sensitivity of the carbonate leach when compared with the HCl leach for measuring % sulphate S. However, according to Lapakko (2002), sodium carbonate will not dissolve barite. The sodium carbonate leach also may not effectively dissolving anglesite. In order to determine whether the concentrations of barite and anglesite will impact the measurements, MEND (2009) suggests the estimation of the concentrations of barite and anglesite and their potential interference on analytical procedures and results by calculation of the maximum potential concentrations of sulphur in barite + anglesite by calculating based on the ratio of their molecular weight to that of sulphur and assume that these minerals are the only source for these elements. Box plots showing selected results for sulphur speciation are shown in Figure 3.

Significant barium concentrations observed in some rock lithologies (notably the schist lithologies, except for CHSCH) which results in the potential for sulphate S in barite (S_{Ba})to be up to 0.07%. Maximum potential sulphate S in anglesite (S_{ang}) is contained almost exclusively in VN and mineralized samples, which contain a much higher concentration of Pb, and reach over 0.12% with a median of 0.019%. When combined, the potential sulphate S in both anglesite and barite is highest in SSCH with a median value of 0.06% followed by VN, SCH and GSCH. Four lithologies show that maximum potential (S_{Ba}) and (S_{ang}) can significantly exceed the percentage of sulphate measured by carbonate leach. This indicates that for these lithologies, especially SSCH and GSCH which have median values of approximately 150%), sulphide S, and consequently MPA, may be overestimated if (S_{Ba}) and (S_{ang}) is not being measured in these samples. The sensitivity to this potential effect can be estimated by increasing the sulphate in these lithologies and examining the effect on NP/MPA ratios. For example, a SSCH sample with a NP/MPA ratio of 8.5 was increased to 10.2 when sulphate was multiplied by 150%, demonstrating that this effect can be significant. However, since the lithologies in which insoluble sulphate may be underestimated appears to be most pronounced are relatively minor and generally have significant NP, the overall effect is likely minor. Since VN and mineralized samples are identified as P-AML and generally have low NP/MPA ratios and high MPAs, the effect on these samples will be negligible.

Figure 3. Select Sulphur Speciation

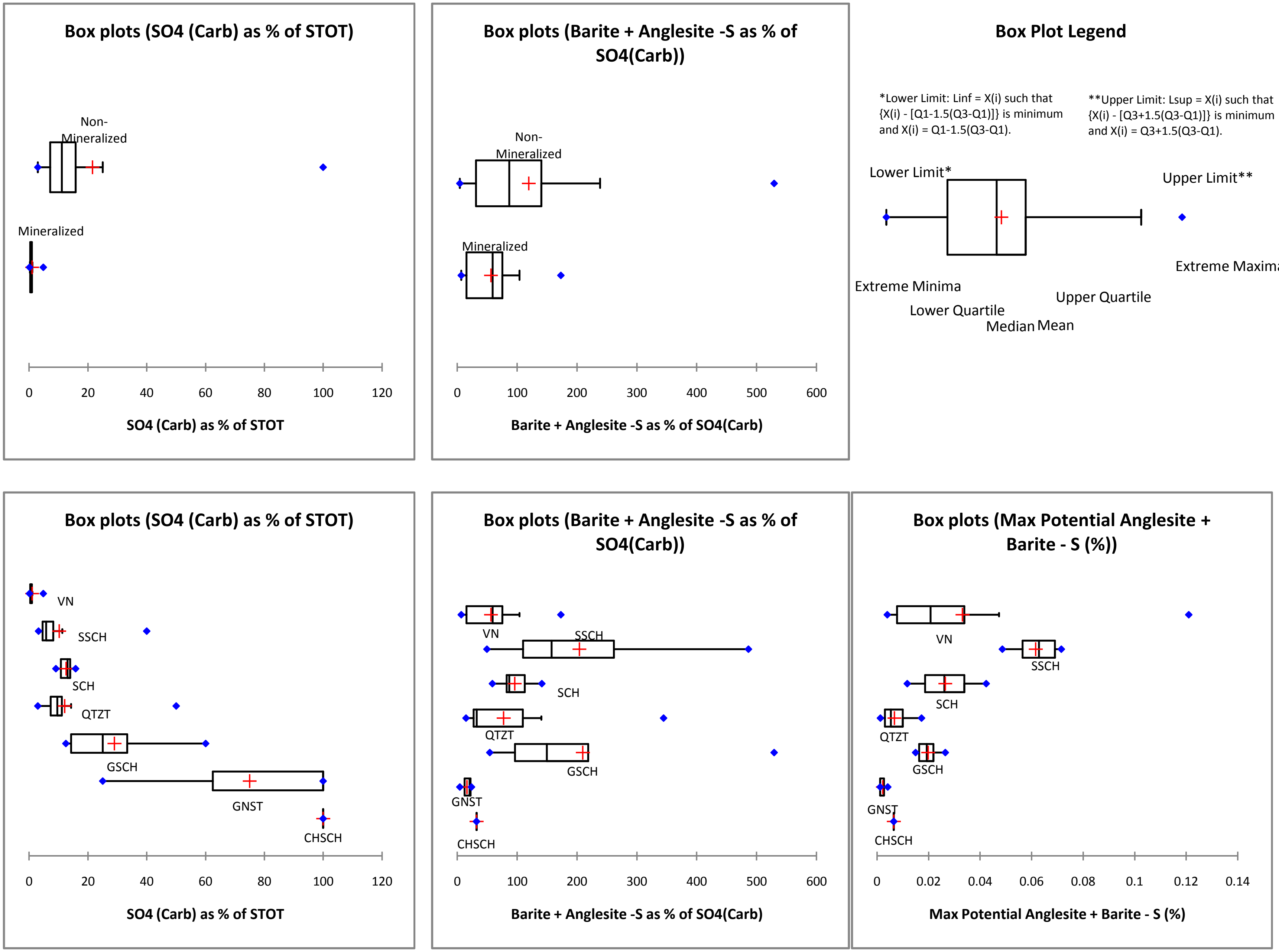
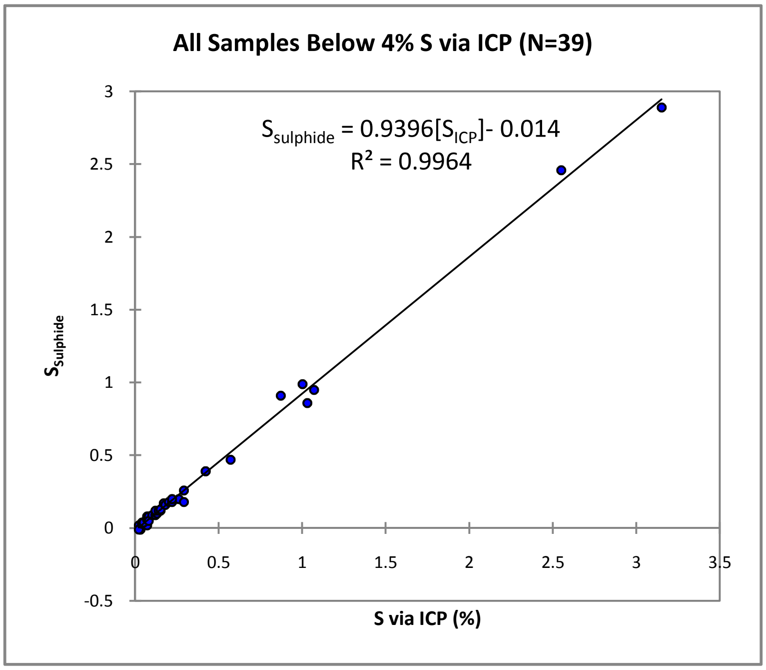
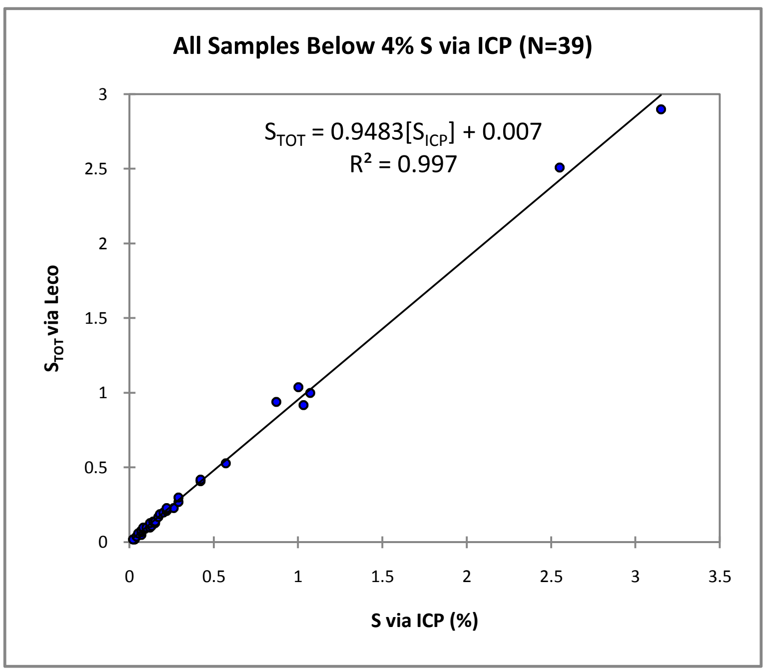


Figure 4. Sulphur Correlations





As noted by Altura 2008b, a very good correlation between total sulphur via Leco and sulphur via ICP was observed at Bellekeno.

Plots showing the relationship between sulphur measurements for Onek are shown in Figure 4 and agree with the observations made for Bellekeno. The correlation coefficient in the relationship between S via ICP and Total S via Leco is 0.997, which is higher than the relationship observed in the Bellekeno data.

As discussed in Section 3.3, MPA is determined based on the calculated difference between total sulphur via Leco and total sulphate (via carbonate or HCl leach). This is assumed to be sulphide sulphur and is multiplied by 31.25 in order to determine MPA in kg $CaCO_3$/tonne. In order to extend the MPA data to the ICP sulphur measured values, S via ICP was compared with the available calculated S as sulphide from the ABA database. Although a significant percentage of the total sulphur measured in the S via ICP can be expected to be present as non potential acid generating sulphate, MPA values were conservatively calculated assuming that S via ICP was present as 100% S as sulphide.

Neutralization Potential Ratio (NP/MPA)

A common industry practice is to infer that samples with NP/MPA of greater than 3:1 are unlikely to produce net acidity with no further testwork or study. MEND (2009) suggests that samples with NP/MPA greater than 2 are non-potentially acid generating if there are provided no significant errors have been made in the estimation of effective NP and AP. Box Plots showing NP/MPA ratios are shown in Figure 5.

NP/MPA ratios from the ABA dataset show GNST with a median of 146 and minimum of 11.2, which is significantly higher than all other lithologies, indicating GNST has a minimal potential for the generation of net acidity. Of the remaining lithologies in the ABA dataset, NP/MPA first quartiles for QTZT and SCH and CHSCH exceed 3, while it is lower than 3 for GSCH, SSCH. VN showed a median of 0.42, indicating high potential for generation of net acidity. Mineralized samples showed a median NP/MPA of 0.42 compared with a median of 5.9 for unmineralized samples.

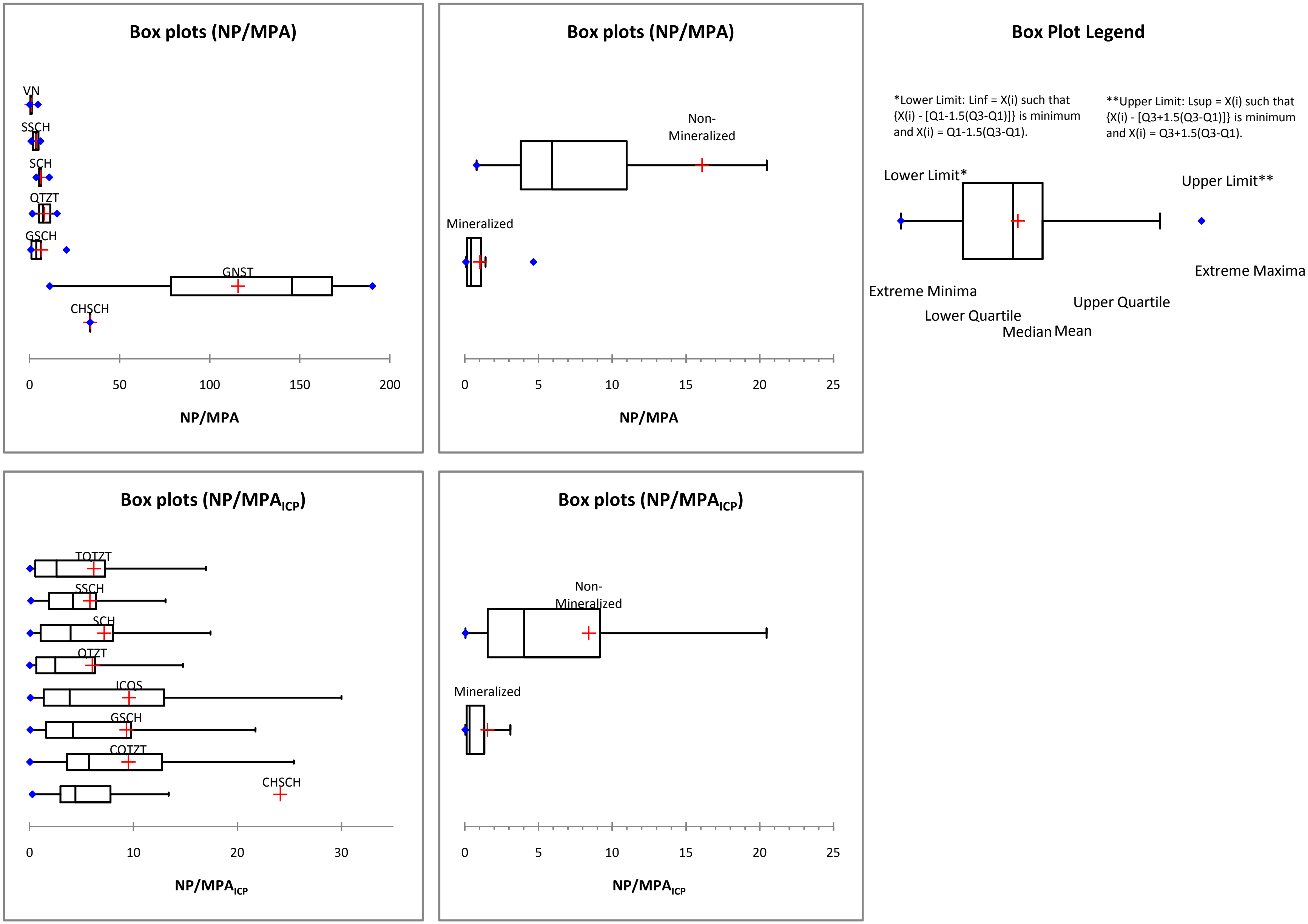
NP/MPA ratios calculated using the 3926 sample ICP dataset showed median values of over 3:1 for all lithologies except for QTZT and TQTZT, while first quartile values were over 3 only in CQTZT and TQTZT.

Table 3 and Table 4 show the distribution of samples from Onek according to NP/MPA range from the ABA and calculated ABA datasets, respectively. A total of 33 of the 50 samples from the ABA dataset have NP/MPA ratios of >3, indicating minimal potential for net acidity. Zero samples were had a NP/MPA ratio of between 2 and 3. Considering only the rock lithologies in the ABA dataset and excluding the VN lithology, 31 of 37 samples, or 84% of samples had NP/MPA ratios of >3.

A total of 1859 of 3126 samples, or 59% of the calculated ABA database had NP/MPA ratios of >3. 69% of samples have NP/MPA of >2.

The discrepancy in proportions of NP/MPA between the results from the ABA sampling compared with the calculated ABA data based on the ICP dataset is based in part in that 193 greenstone (which is assumed to exhibit NP/MPA ratios all >3) samples were not included because of the difficulty calculating NP based on calcium. If GNST is included in the calculation assuming 100% of the values have NP/MPA >3, the proportion of samples in the calculated ABA database increase to 66% with NP/MPA >3 and 75% with NP/MPA>2. In addition, the higher proportion of samples with NP/MPA ratios of <3 observed in the calculated ABA data can also be attributed in part to the conservative assumption that all sulphur as measured by ICP was in sulphide, or potentially acid generating form. If prior to calculation of MPA_{SICP}, S via ICP is reduced by the 11% indicated by the median value of sulphate S via carbonate leach as a percentage of total S, the proportion of samples with NP/MPA ratios above and below 3 are similar between the ABA results and the calculated ABA results based on the ICP data. The higher proportion of NP/MPA <3 in the calculated ABA dataset demonstrates that the method is conservative.

Figure 5. Measured NP/MPA and Calculated NP/MPA from ABA database



Note: Max value not shown in some cases for better perspective of the central tendency

Table 3. Distribution of NP/MPA Samples in Onek Dataset

Lithology		NP/MPA				
Description	**Code**	**< 1**	**1 to 2**	**2 to 3**	**>3**	**Total**
Chloritic Schist	CHSCH	0	1	0	0	1
Greenstone	GNST	0		0	3	3
Graphitic Schist	GSCH	0	1	0	4	5
Quartzite	QTZT	1	1	0	12	14
Schist	SCH	1	1	0	4	6
Sericitic Schist	SSCH	0	0	0	8	8
Mineralized Vein	VN	9	2	0	2	13
	Total	**11**	**6**	**0**	**33**	**50**

Table 4. Distribution of $NP_{Ca}/MPA_{S,ICP}$ Samples

Lithology		$NP_{Ca}/MPA_{S,ICP}$				
Description	**Code**	**< 1**	**1 to 2**	**2 to 3**	**> 3**	**Total**
Chloritic Schist	CHSCH	4	3	6	35	48
Calcareous Quartzite	CQTZT	19	9	7	144	179
Graphitic Schist	GSCH	84	57	55	276	472
Interbedded Carbonaceous Quartzite and Schist	ICQS	33	28	11	98	170
Quartzite	QTZT	794	326	218	1102	2440
Schist	SCH	32	16	13	75	136
Sericite Schist	SSCH	20	18	15	85	138
Thin Bedded Quartzite	TQTZT	112	40	30	161	343
	Total	**1098**	**497**	**355**	**1976**	**3926**

Paste pH

The 37 rock samples (excluding VN) ranged in paste pH from 6.5 to 9.0 with median values of between 8 and 9 except for GSCH, which had a median of 7.5. This indicates that none of the rock lithologies excluding VN were producing net acidity (assuming a cut off of pH 5.5) at the time of analysis. VN showed and mineralized samples showed considerably lower minimum of 6.2 and a maximum of 8.9 with a median of 6.6.

Fizz Rating

The fizz rating used in ABA testing is a ranking system between 1 and 4 to rate the degree of effervescence observed when 25% HCl is added to a pulverized sample. This rating is used to determine the strength of acid to utilize for the neutralizing potential titration. The limited number of samples showed that the median value for most lithologies was 2 except for VN and GNST which had a median of 3 and GSCH, which had a median of 1.

4. DISCUSSION

4.1 GEOCHEMICAL SCREENING CRITERIA

Altura (2008b) conducted geochemical testwork including shake flask extraction tests on 47 samples from waste rock dumps and pit wall dumps from over the KHSD. These samples were collected in 1995-1996 with an excavator but have been at the surface for up to 80 years. This study showed that net acidity and/or Pb and Zn metal leaching (AML) was associated with the following geochemical characteristics:

- Net Acidity: The two key aspects of samples demonstrating leacheate pH ≤ 5.5 are either a calcium level in the rock of ≤ 0.51% or a CO_2 level of ≤ 0.6% coupled with an ICP sulphur level of ≥ 0.25%.
- Zinc Leaching: leaching of zinc to levels ≥ 10 mg/kg appears to occur under two differing conditions: i) solubilisation of zinc under net acidic conditions independent of zinc concentration in rock, and ii) solubilisation of zinc under overall neutral to alkaline conditions where Zn concentrations in rock exceed 5000 ppm.
- Lead Leaching: leaching of lead to levels ≥ 3 mg/kg occurs only under neutral pH conditions where Pb concentrations in rock exceed 5000 ppm.

Altura 2008b indicates that direct application of the factors of ≤0.51% Ca and ≥ S via ICP results in a few samples with NP/MPA marginally above the 1 being classified into the category of having low potential for net acidity. The lower calcium threshold in the weathered site-wide dump samples was attributed to solubilisation and flushing of calcium under ambient site conditions. An adjustment factor for fresh rock samples of 1.5 was applied to the calcium criteria, increasing the threshold to 0.75% Ca. A 1.5% upper threshold for sulphur was also recommended to ensure that high sulphur samples are classified as being P-AML regardless of calcium content.

Geochemical screening criteria to identify P-AML rock, based on review of the Bellekeno ABA dataset and the district wide AML study were presented in Altura 2008b:

a) Ca% ≤ 0.75% and S via ICP ≥ 0.25%
b) Or S via ICP ≥ 1.5%

c) Or Pb ≥ 5000 ppm
d) Or Zn ≥ 5000 ppm

These criteria form the basis for the predictive waste rock classification system and geochemical verification which forms the basis of the Waste Rock Management Plan. The assumptions used in determination of these criteria are equally applicable to Onek. Specifically, the site wide ARD/ML correlation study included samples from Onek waste rock, and the ARD/ML controlling and correlating factors derived therein also apply to Onek. In addition, the conservative adjustment factor of increasing the Ca% by a factor of 1.5 to 0.75% for fresh rock samples is also valid for Onek.

4.2 ESTIMATED PROPORTIONS OF P-AML AND N-AML WASTE ROCK AT ONEK

The geochemical screening criteria are applied to the Onek ICP 4119 sample database in order to identify P-AML samples. Results are shown in Table 5.

GNST, CHSCH, and CQTZT show the lowest percentage of samples indicated as P-AML all at 16% or lower. GSCH, SCH, and SSCH are between 26 and 29% P-AML. The lithologies with the highest proportions of P-AML samples are ICQS (39%), QTZT (44%) and TQTZT (55%).

Table 5. Results of WRMP Geochemical Screening Criteria Applied to Onek Database

Lithology		Number of Samples	# of P-AML Samples	% of P-AML Samples
Description	Code			
Chloritic Schist	CHSCH	48	7	15%
Calcareous Quartzite	CQTZT	179	29	16%
Greenstone	GNST	193	25	13%
Graphitic Schist	GSCH	472	122	26%
Interbedded Carbonaceous Quartzite and Schist	ICQS	170	66	39%
Quartzite	QTZT	2440	1071	44%
Schist	SCH	136	39	29%
Sericite Schist	SSCH	138	39	28%
Thin Bedded Quartzite	TQTZT	343	189	55%

Note: Lithology units with less than 40 samples not included in calculation (CSCH and PHY)

These estimated proportions of P-AML material vary significantly from Bellekeno where QTZT was 22% P-AML and GSCH was 65% P-AML. In general, the schist lithologies at Onek exhibit smaller proportions of P-AML and the QTZT lithologies exhibit greater proportions of P-AML rock. At

Bellekeno, the opposite is generally true. This distinction is explained primarily by the observation that the median sulphur value for GSCH at Onek is significantly lower than the median value observed at Bellekeno.

4.3 FIELD SCREENING CRITERIA

Field screening criteria to identify P-AML waste rock derived from both the Bellekeno geoenvironmental characterization study (Altura 2008b) and the site wide ARD/ML correlation study (Altura 2008a) were presented as follows:

a) Slight or no effervescence of pulverized sample with 25% HCl (e.g. presence of none or only a few bubbles), and visual estimated pyrite >0.5%, or;
b) Any sample with one or more of the following:
    a. Visual estimated sphalerite >0.75%
    b. Visual estimated galena > 0.5%
    c. Visual estimated pyrite >2%
    d. Any vein material not deemed to be "mineralized"
    e. Paste pH ≤ 6.0

These field screening criteria were incorporated into the Waste Rock Management Plan and demonstrated to be effective operationally at the Bellekeno Mine since approximately July 2008 and is currently ongoing. These field screening criteria are also valid for Onek. Field screening criteria are subject to minor revision as necessary in response to routine geochemical (ICP and ABA) testing which is also part of the Waste Rock Management Plan

5. CONCLUSIONS

The relationships between ABA parameters and geochemical parameters included in the ICP metals database enabled extension of the database to included a much larger sample set and helped improve the understand the mineralogical controls on buffering and allow a robust verification of that the field screening parameters which help form the basis of the waste rock segregation program are appropriate for the Onek deposit.

The geology and style of mineralization at Onek shares a number of key similarities with the Bellekeno deposit. The deposits occur within the same major lithologic unit and share the same major rock lithologies, and while some differences exist, the style of mineralization is similar. As such, the geochemical and geoenvironmental characteristics of the rocks share a number of significant similarities. The Waste Rock Management Plan is anticipated to be effective for waste rock characterization and management at Onek.

Analysis of the Onek dataset indicated that while much of the rock is unlikely to produce net acidity and/or metal leaching, a significant proportion is indicated to be P-AML. The following key distinctions between Onek and Bellekeno are presented below:

- A higher overall proportion of samples at Onek are indicated by ABA testing and geochemical screening criteria as P-AML when compared with Bellekeno.
- Lithologic associations with P-AML characteristics are distinctly different between Onek and Bellekeno. Quartzites (except for calcareous quartzites) tend to have a greater proportion of samples with low (<2) NP/MPA ratios and a greater proportion of samples indicated by geochemical criteria as P-AML. This is in contrast with Bellekeno where quartzites had generally higher NP/MPA ratios than schist.
- A significantly higher Zn overprint is observed in samples from Onek when compared with Bellekeno which is a result of Onek being a higher zinc content deposit. This partially explains the higher proportion of samples which are indicated to be P-AML.

It is expected that aspects of the Waste Rock Management Plan may require minor modification in response to geochemical verification results and can be modified in response, if required.

6. CLOSURE

We trust this report meets your current needs. If you have any questions or if we can be of further assistance, please contact the undersigned at (867) 668-6463.

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8. ATTACHMENTS

Appendix A1 –A2
Appendix B1 – B2

Appendix A1
ICP Metals Summary Statistics

Selected Elements by Major Lithologies

Statistic	Pb (ppm) | CHSCH	Pb (ppm) | CQTZT	Pb (ppm) | GNST	Pb (ppm) | GSCH	Pb (ppm) | ICQS	Pb (ppm) | QTZT	Pb (ppm) | SCH	Pb (ppm) | SSCH	Pb (ppm) | TQTZT	Pb (ppm) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	5.0	-2.0	-2.0	-2.0	5.0	-2.0	4.0	-2.0	3.0	31.0
Maximum	1950.0	2240.0	1740.0	34700.0	2420.0	402600.0	33500.0	2510.0	113000.0	483600.0
1st Quartile	12.0	7.0	4.0	14.0	26.0	10.0	12.8	14.0	17.8	612.8
Median	19.0	12.0	8.0	21.0	100.0	38.0	21.5	26.5	123.0	2370.0
3rd Quartile	70.0	28.0	22.0	63.5	335.0	171.0	79.5	146.4	329.5	11962.5
Mean	102.6	89.2	65.8	208.9	262.6	1164.2	652.0	141.2	1019.2	23744.7
Variance (n-1)	84921.3	94175.6	37546.9	3269996.0	171080.1	181335566.0	13883116.6	81326.7	59306422.7	4226565848.4
Standard deviation (n-1)	291.4	306.9	193.8	1808.3	413.6	13466.1	3726.0	285.2	7701.1	65012.0

Statistic	Zn (ppm) | CHSCH	Zn (ppm) | CQTZT	Zn (ppm) | GNST	Zn (ppm) | GSCH	Zn (ppm) | ICQS	Zn (ppm) | QTZT	Zn (ppm) | SCH	Zn (ppm) | SSCH	Zn (ppm) | TQTZT	Zn (ppm) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	17.0	20.0	24.0	-2.0	90.9	5.0	17.0	37.0	51.0	71.0
Maximum	13300.0	181000.0	43100.0	141500.0	33900.0	555000.0	55900.0	42900.0	330900.0	559200.0
1st Quartile	187.8	101.0	106.0	114.8	461.5	153.8	82.0	200.5	1015.0	31225.0
Median	338.0	256.0	147.0	214.0	2410.0	805.0	160.5	475.5	3380.0	87050.0
3rd Quartile	1057.5	1430.0	439.0	1105.0	5345.0	4115.0	692.0	1515.0	7900.0	211750.0
Mean	1049.3	2854.6	1720.4	2389.7	3794.1	13460.6	2051.6	1812.6	8539.1	141887.7
Variance (n-1)	4442961.9	243790714.8	29644160.2	111387583.7	24688465.8	2660197628.9	58274385.4	21469069.9	520597641.2	19170093944.2
Standard deviation (n-1)	2107.8	15613.8	5444.6	10554.0	4968.7	51577.1	7633.8	4633.5	22816.6	138456.1

Statistic	Al_pct | CHSCH	Al_pct | CQTZT	Al_pct | GNST	Al_pct | GSCH	Al_pct | ICQS	Al_pct | QTZT	Al_pct | SCH	Al_pct | SSCH	Al_pct | TQTZT	Al_pct | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	1.1	0.3	0.2	0.2	0.5	0.0	0.2	2.3	0.3	0.0
Maximum	8.3	8.7	9.8	11.6	10.9	10.2	9.4	7.8	8.9	7.9
1st Quartile	4.8	0.9	6.7	3.6	3.8	0.7	2.0	4.1	1.2	0.1
Median	5.2	1.5	7.4	5.6	5.1	1.3	4.1	4.7	2.0	0.4
3rd Quartile	5.6	2.5	7.9	7.2	6.8	2.6	5.7	5.3	3.1	1.5
Mean	5.0	1.9	6.9	5.4	5.3	1.9	4.1	4.7	2.3	1.0
Variance (n-1)	2.0	2.1	2.8	5.7	4.4	2.7	6.5	0.9	2.0	1.8
Standard deviation (n-1)	1.4	1.5	1.7	2.4	2.1	1.6	2.6	1.0	1.4	1.3

Selected Elements by Major Lithologies

Statistic	As (ppm) | CHSCH	As (ppm) | CQTZT	As (ppm) | GNST	As (ppm) | GSCH	As (ppm) | ICQS	As (ppm) | QTZT	As (ppm) | SCH	As (ppm) | SSCH	As (ppm) | TQTZT	As (ppm) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	-5.0	-5.0	-5.0	-5.0	4.0	-5.0	-5.0	-5.0	1.0	-5.0
Maximum	304.0	8950.0	10000.0	6690.0	1250.0	10000.0	1635.0	2200.0	10000.0	10000.0
1st Quartile	-5.0	5.0	-1.0	10.0	20.0	7.0	9.0	6.0	13.0	46.3
Median	8.0	9.0	7.0	19.0	37.5	19.0	16.0	16.5	34.0	183.5
3rd Quartile	17.3	14.0	16.0	47.0	85.0	77.0	31.3	46.7	123.0	743.5
Mean	16.5	146.2	67.5	68.6	91.7	326.7	47.0	58.2	293.8	1245.6
Variance (n-1)	2147.8	820277.1	517972.5	116842.3	27582.5	1709855.6	27500.2	40868.5	1241487.0	6376835.6
Standard deviation (n-1)	46.3	905.7	719.7	341.8	166.1	1307.6	165.8	202.2	1114.2	2525.2

Statistic	Ba_ppm | CHSCH	Ba_ppm | CQTZT	Ba_ppm | GNST	Ba_ppm | GSCH	Ba_ppm | ICQS	Ba_ppm | QTZT	Ba_ppm | SCH	Ba_ppm | SSCH	Ba_ppm | TQTZT	Ba_ppm | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	20.0	-10.0	10.0	10.0	50.0	-10.0	30.0	50.0	-10.0	-10.0
Maximum	4960.0	2320.0	6700.0	3820.0	2430.0	6970.0	2820.0	6470.0	3100.0	2750.0
1st Quartile	547.5	145.0	95.0	480.0	600.0	70.0	250.0	1712.5	120.0	-10.0
Median	2280.0	240.0	170.0	740.0	858.5	180.0	495.0	2625.0	260.0	10.0
3rd Quartile	3215.0	410.0	320.0	982.5	1047.5	370.0	790.0	3397.5	518.0	40.0
Mean	2030.6	329.5	433.8	766.5	852.8	255.0	572.7	2557.7	364.6	55.5
Variance (n-1)	2002631.5	89600.3	906123.2	207665.4	157427.9	82898.5	201277.7	1904655.4	114393.8	40035.5
Standard deviation (n-1)	1415.1	299.3	951.9	455.7	396.8	287.9	448.6	1380.1	338.2	200.1

Statistic	Ca (%) | CHSCH	Ca (%) | CQTZT	Ca (%) | GNST	Ca (%) | GSCH	Ca (%) | ICQS	Ca (%) | QTZT	Ca (%) | SCH	Ca (%) | SSCH	Ca (%) | TQTZT	Ca (%) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	0.1	0.1	0.0	0.0	0.0	0.0	0.0	0.1	0.0	0.0
Maximum	7.4	6.9	11.0	37.9	5.7	7.9	5.0	6.7	10.4	4.5
1st Quartile	0.2	0.8	4.1	0.5	0.2	0.1	0.4	0.2	0.1	0.1
Median	0.4	1.5	6.2	1.1	0.3	0.3	1.0	0.4	0.2	0.1
3rd Quartile	1.4	2.2	7.4	1.7	0.9	1.0	1.7	0.6	0.8	0.1
Mean	1.4	1.6	5.4	1.4	0.7	0.7	1.2	0.6	0.7	0.1
Variance (n-1)	4.1	1.5	6.7	4.1	0.8	0.9	1.0	1.0	1.4	0.1
Standard deviation (n-1)	2.0	1.2	2.6	2.0	0.9	1.0	1.0	1.0	1.2	0.3

Selected Elements by Major Lithologies

Statistic	Cd_ppm | CHSCH	Cd_ppm | CQTZT	Cd_ppm | GNST	Cd_ppm | GSCH	Cd_ppm | ICQS	Cd_ppm | QTZT	Cd_ppm | SCH	Cd_ppm | SSCH	Cd_ppm | TQTZT	Cd_ppm | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	-0.5	0.7
Maximum	293.0	1000.0	452.0	1000.0	742.0	1000.0	540.0	524.0	1000.0	1000.0
1st Quartile	-0.5	0.5	-0.5	-0.5	2.9	0.7	-0.5	0.5	6.0	476.3
Median	1.7	1.3	-0.5	0.8	20.9	5.3	0.6	1.6	32.2	1000.0
3rd Quartile	8.1	5.6	1.6	6.4	58.1	37.5	4.2	9.5	87.8	1000.0
Mean	12.6	18.6	13.9	22.0	54.6	89.5	18.4	18.9	96.1	747.3
Variance (n-1)	1869.0	10551.2	2592.5	9510.3	10953.3	53248.6	5711.1	3254.3	36031.2	117008.6
Standard deviation (n-1)	43.2	102.7	50.9	97.5	104.7	230.8	75.6	57.0	189.8	342.1

Statistic	Fe (%) | CHSCH	Fe (%) | CQTZT	Fe (%) | GNST	Fe (%) | GSCH	Fe (%) | ICQS	Fe (%) | QTZT	Fe (%) | SCH	Fe (%) | SSCH	Fe (%) | TQTZT	Fe (%) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	1.2	0.5	0.8	0.2	1.1	0.2	0.5	1.4	0.5	1.4
Maximum	12.1	19.8	16.9	22.4	20.6	34.0	23.2	12.1	27.8	38.4
1st Quartile	2.9	0.9	7.2	2.4	3.1	1.1	1.8	2.9	1.7	11.4
Median	3.2	1.3	7.9	3.2	3.9	1.8	2.8	3.3	2.7	16.2
3rd Quartile	4.8	1.9	8.9	4.0	4.9	3.2	3.6	3.9	4.2	23.0
Mean	3.9	1.9	7.8	3.4	4.4	3.3	3.0	3.9	3.6	17.1
Variance (n-1)	4.4	6.1	6.2	4.6	5.4	22.4	4.9	3.2	9.1	69.6
Standard deviation (n-1)	2.1	2.5	2.5	2.1	2.3	4.7	2.2	1.8	3.0	8.3

Statistic	Mg (%) | CHSCH	Mg (%) | CQTZT	Mg (%) | GNST	Mg (%) | GSCH	Mg (%) | ICQS	Mg (%) | QTZT	Mg (%) | SCH	Mg (%) | SSCH	Mg (%) | TQTZT	Mg (%) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	0.1	0.0	0.1	0.0	0.0	0.0	0.0	0.2	0.0	0.0
Maximum	3.7	1.4	4.6	4.1	1.7	3.8	2.0	3.5	1.3	2.8
1st Quartile	0.9	0.1	2.6	0.3	0.2	0.1	0.2	0.6	0.1	0.2
Median	1.0	0.2	3.1	0.4	0.3	0.2	0.3	0.9	0.2	0.3
3rd Quartile	1.2	0.3	3.6	0.6	0.5	0.3	0.5	1.1	0.3	0.4
Mean	1.2	0.3	2.9	0.5	0.4	0.2	0.4	0.9	0.2	0.3
Variance (n-1)	0.5	0.0	1.0	0.2	0.1	0.1	0.1	0.3	0.0	0.0
Standard deviation (n-1)	0.7	0.2	1.0	0.4	0.3	0.3	0.3	0.5	0.2	0.2

Selected Elements by Major Lithologies

Statistic	Mn (ppm) | CHSCH	Mn (ppm) | CQTZT	Mn (ppm) | GNST	Mn (ppm) | GSCH	Mn (ppm) | ICQS	Mn (ppm) | QTZT	Mn (ppm) | SCH	Mn (ppm) | SSCH	Mn (ppm) | TQTZT	Mn (ppm) | VN
No. of observations	48	179	193	472	170	2440	136	138	343	266
Minimum	105.0	49.0	151.0	29.0	79.0	9.0	94.0	116.0	84.0	108.0
Maximum	12000.0	71000.0	13450.0	69900.0	33600.0	100000.0	72400.0	30400.0	65900.0	100000.0
1st Quartile	1027.5	155.0	1270.0	210.8	616.3	268.8	209.8	1347.5	1165.0	18625.0
Median	1237.5	268.0	1430.0	330.5	1817.5	1155.0	348.5	2430.0	3600.0	33850.0
3rd Quartile	1987.5	992.5	2160.0	1471.3	5132.5	4680.0	2682.5	4277.5	7960.0	58200.0
Mean	1843.6	2083.1	2353.2	2240.5	3812.1	5825.5	2542.3	3828.8	6133.4	38577.0
Variance (n-1)	3944523.5	51754733.0	6305775.3	34061260.1	25027350.5	168407718.7	48949157.6	19381231.5	63047584.9	657428101.8
Standard deviation (n-1)	1986.1	7194.1	2511.1	5836.2	5002.7	12977.2	6996.4	4402.4	7940.3	25640.4

Statistic	S (%) | CHSCH	S (%) | CQTZT	S (%) | GNST	S (%) | GSCH	S (%) | ICQS	S (%) | QTZT	S (%) | SCH	S (%) | SSCH	S (%) | TQTZT	S (%) | VN
No. of observations	48.00	179.00	193.00	472.00	170.00	2440.00	136.00	138.00	343.00	266.00
Minimum	0.01	0.04	-0.01	0.01	0.01	0.01	0.01	0.02	0.01	0.02
Maximum	1.32	10.00	5.32	6.81	5.44	10.00	4.90	2.14	10.00	10.00
1st Quartile	0.10	0.14	0.03	0.13	0.05	0.12	0.14	0.09	0.11	2.20
Median	0.14	0.21	0.09	0.29	0.14	0.29	0.32	0.14	0.23	6.14
3rd Quartile	0.29	0.36	0.20	0.64	0.43	0.70	0.63	0.33	0.65	10.00
Mean	0.24	0.45	0.21	0.51	0.34	0.92	0.53	0.29	0.64	5.90
Variance (n-1)	0.06	1.19	0.22	0.56	0.32	3.55	0.44	0.14	1.40	14.52
Standard deviation (n-1)	0.25	1.09	0.47	0.75	0.56	1.88	0.66	0.37	1.18	3.81

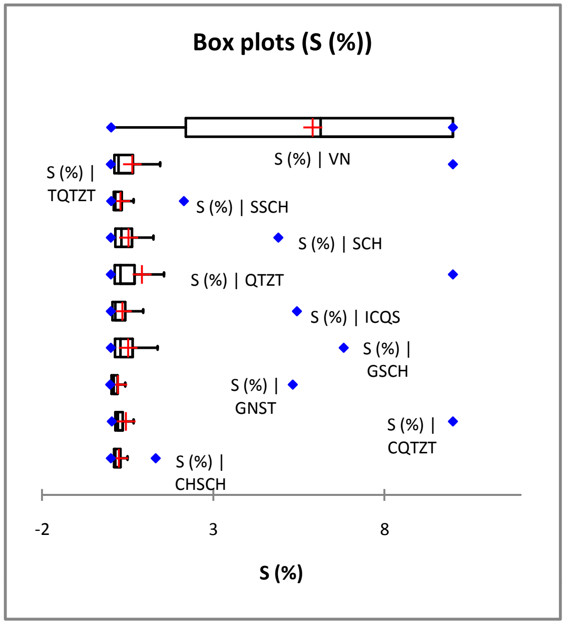
Selected Elements by Mineralized/Non-Mineralized

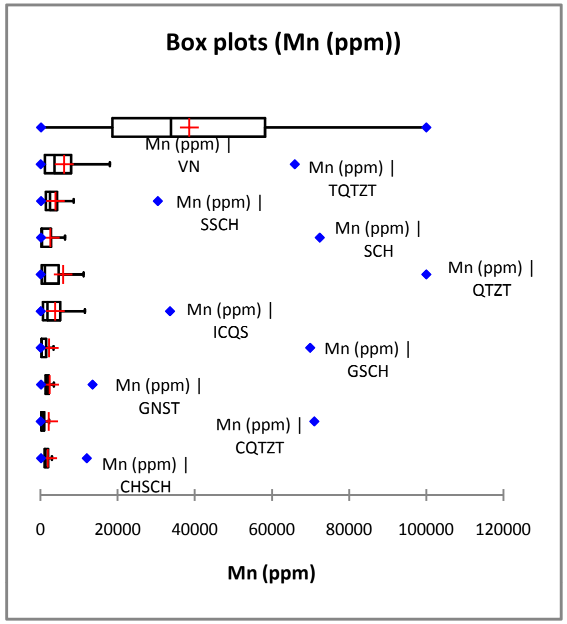
Statistic	S (%) | Mineralized	S (%) | Non-Mineralized	Mn (ppm) | Mineralized	Mn (ppm) | Non-Mineralized	Mg (%) | Mineralized	Mg (%) | Non-Mineralized	Fe (%) | Mineralized	Fe (%) | Non-Mineralized	Cd (ppm) | Mineralized	Cd (ppm) | Non-Mineralized
No. of observations	1075.0	3310.0	1075.0	3310.0	1075.0	3310.0	1075.0	3310.0	1075.0	3310.0
Minimum	0.0	0.0	118.0	9.0	0.0	0.0	0.6	0.2	1.8	-0.5
Maximum	10.0	10.0	100000.0	84800.0	4.1	4.6	38.4	31.1	1000.0	1000.0
1st Quartile	0.5	0.1	5050.0	229.0	0.1	0.1	3.3	1.2	79.7	-0.5
Median	1.5	0.2	12200.0	681.5	0.2	0.2	7.0	2.0	217.0	1.6
3rd Quartile	5.0	0.4	30450.0	2150.0	0.3	0.5	14.4	3.3	959.5	9.4
Mean	3.2	0.4	21850.5	1989.5	0.3	0.5	9.9	2.6	420.4	8.9
Variance (n-1)	12.2	0.3	525652047	17250928	0.2	0.5	68.5	4.9	151840.4	640.9
Standard deviation (n-1)	3.5	0.5	22927.1	4153.4	0.4	0.7	8.3	2.2	389.7	25.3

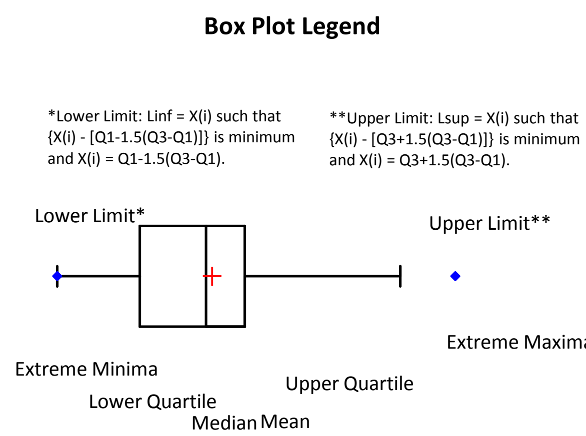
Statistic	Ca (%) | Mineralized	Ca (%) | Non-Mineralized	Ba (ppm) | Mineralized	Ba (ppm) | Non-Mineralized	As (ppm) | Mineralized	As (ppm) | Non-Mineralized	Al (%) | Mineralized	Al (%) | Non-Mineralized	Zn (ppm) | Mineralized	Zn (ppm) | Non-Mineralized
No. of observations	1075.0	3310.0	1075.0	3310.0	1075.0	3310.0	1075.0	3310.0	1075.0	3310.0
Minimum	0.0	0.0	-10.0	-10.0	-5.0	-5.0	0.0	0.2	1240.0	-2.0
Maximum	7.3	37.9	3100.0	6970.0	10000.0	10000.0	9.6	11.6	559200.0	4990.0
1st Quartile	0.1	0.2	10.0	140.0	40.0	6.6	0.5	1.0	7865.0	116.0
Median	0.1	0.7	70.0	310.0	125.0	14.0	1.2	2.4	17400.0	329.0
3rd Quartile	0.2	1.6	230.0	640.0	513.0	33.0	2.4	4.8	70150.0	1370.0
Mean	0.3	1.2	175.6	529.0	924.4	102.1	1.8	3.1	68481.4	934.4
Variance (n-1)	0.3	3.1	84909	515239	4599269	428664.2	3.6	5.9	11773299779	1432608.0
Standard deviation (n-1)	0.6	1.7	291.4	717.8	2144.6	654.7	1.9	2.4	108504.8	1196.9

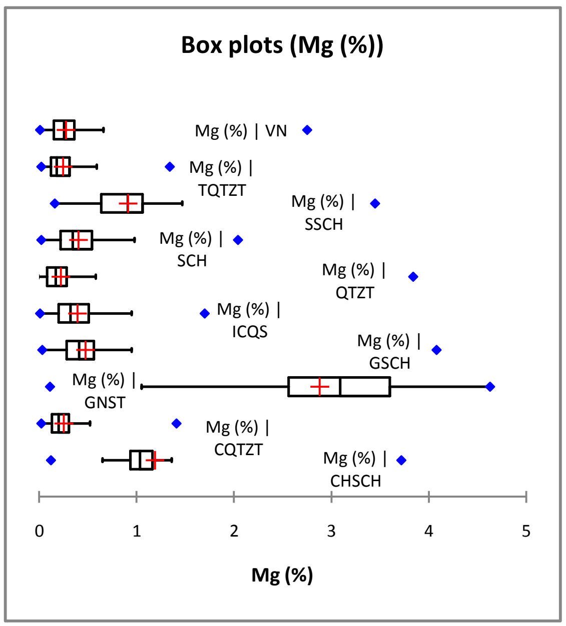
Statistic	Pb (ppm) | Mineralized	Pb (ppm) | Non-Mineralized
No. of observations	1075.0	3310.0
Minimum	3.0	-2.0
Maximum	483600.0	3740.0
1st Quartile	165.0	9.0
Median	447.0	19.0
3rd Quartile	1740.0	78.0
Mean	8843.8	85.9
Variance (n-1)	1541498599	43131.6
Standard deviation (n-1)	39261.9	207.7

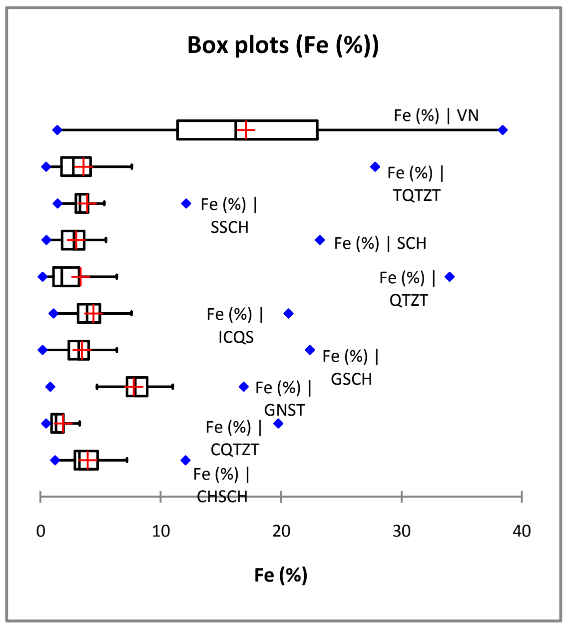
By Lithology

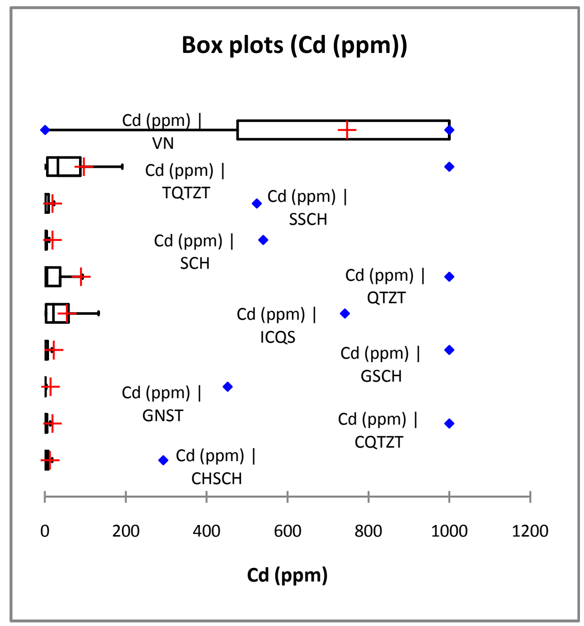




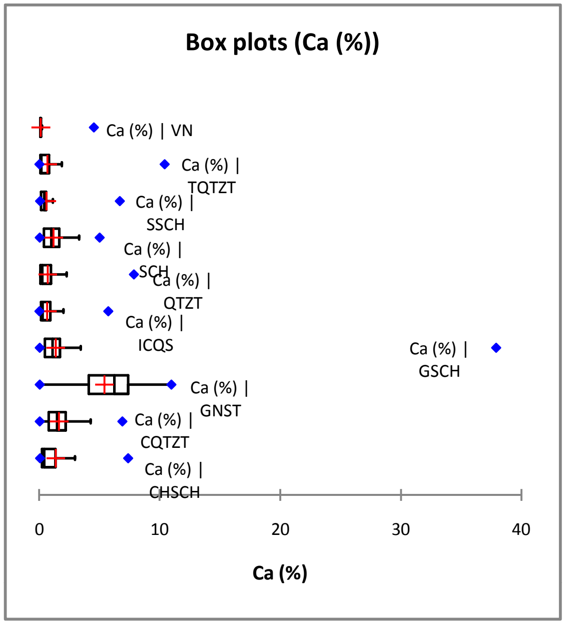


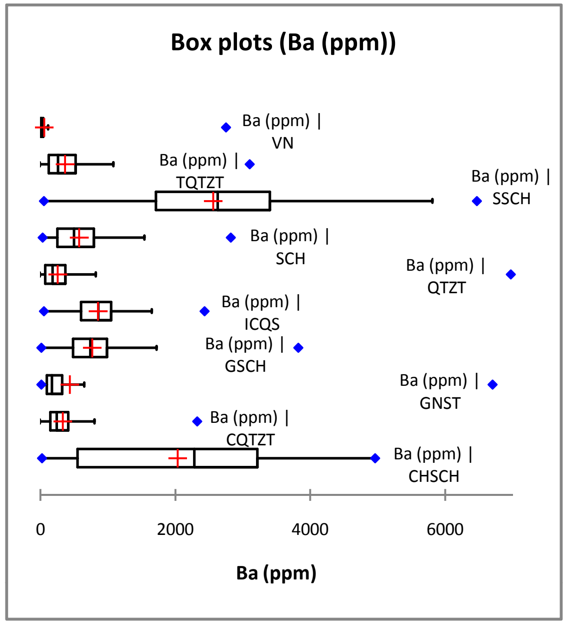


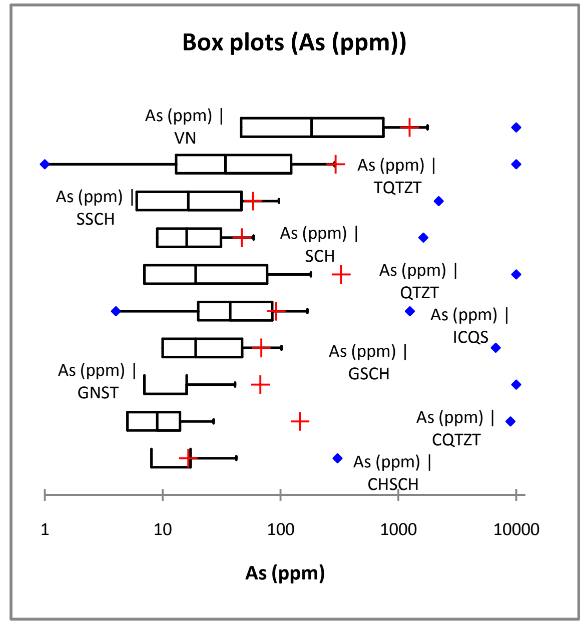


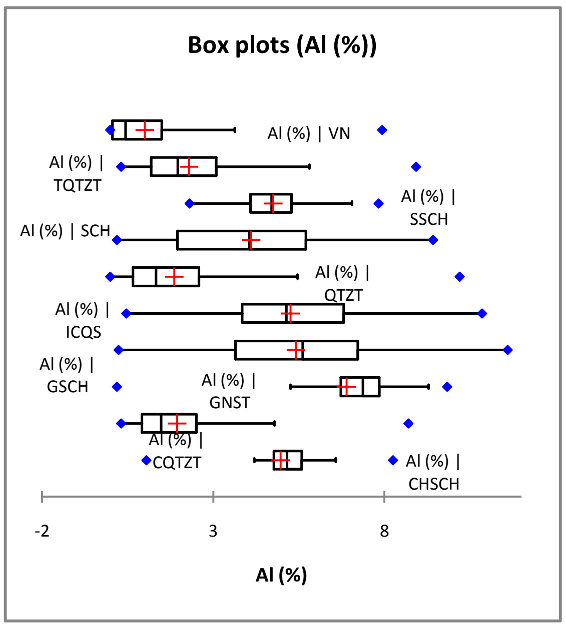


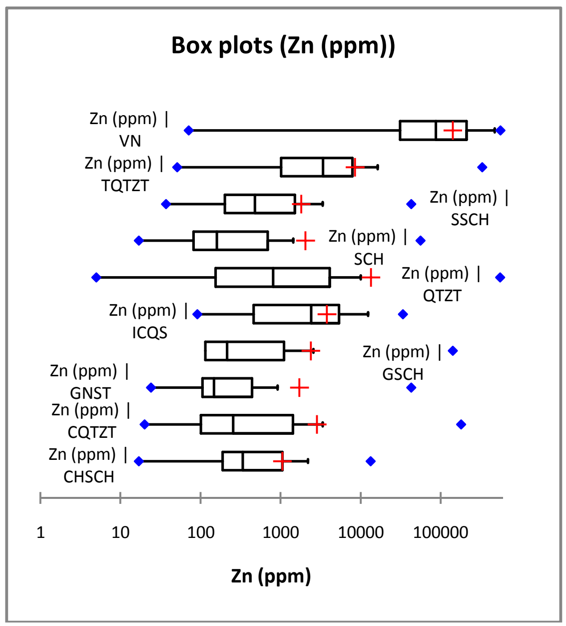
By Lithology

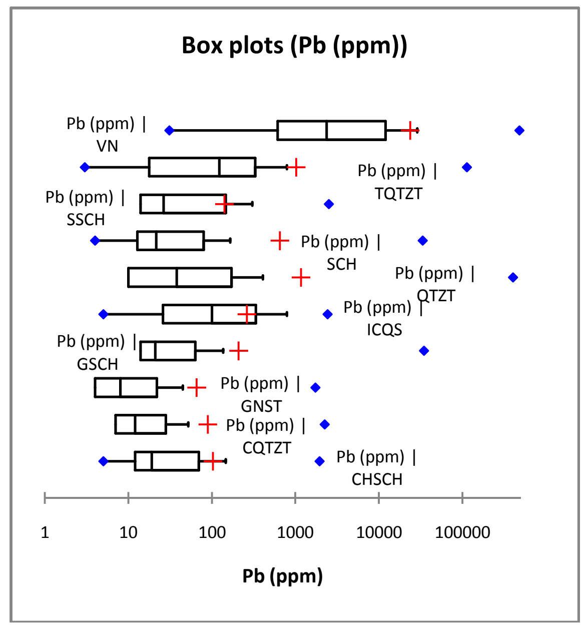




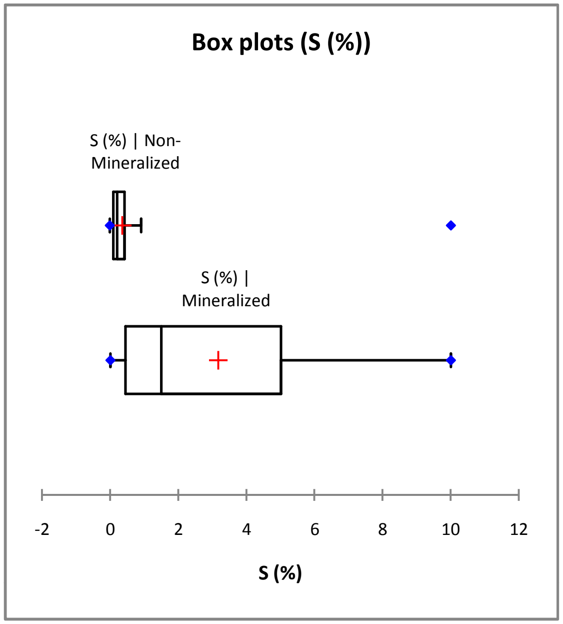


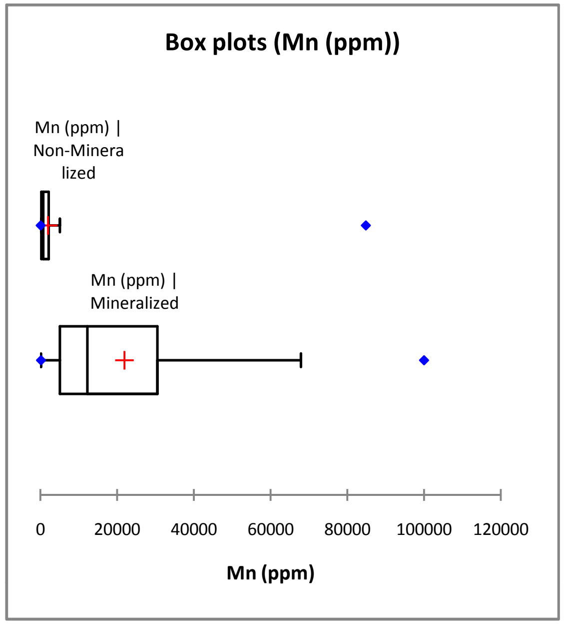


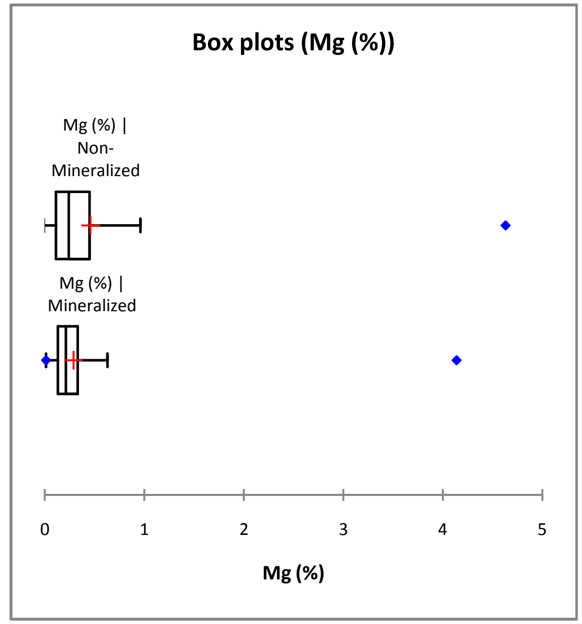


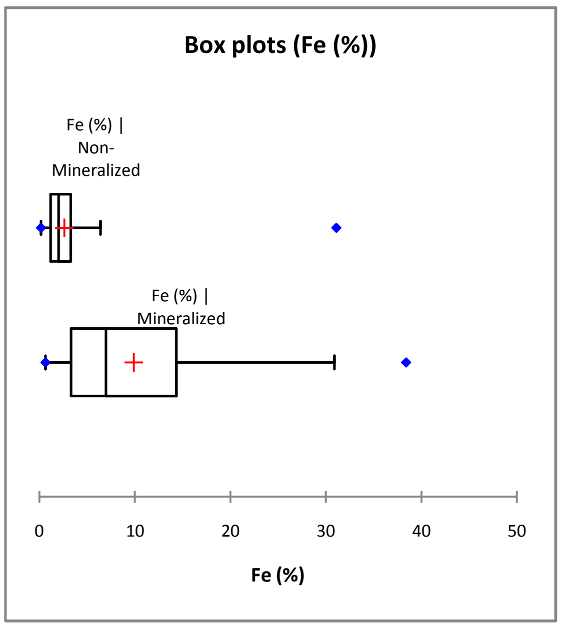


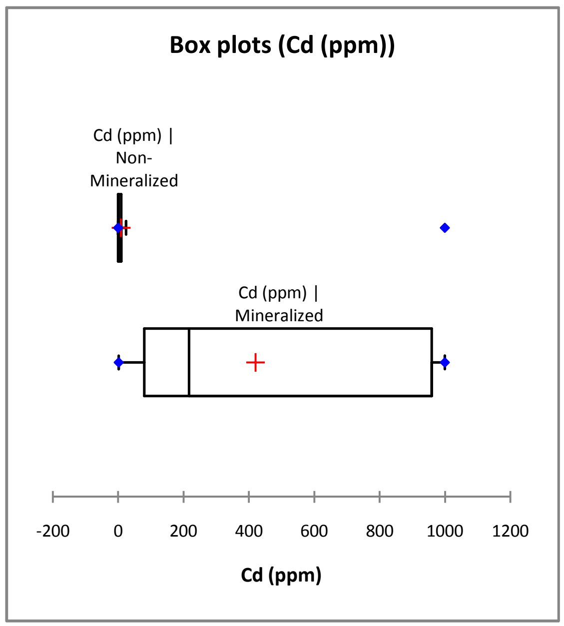
By Mineralized/Non-Mineralized

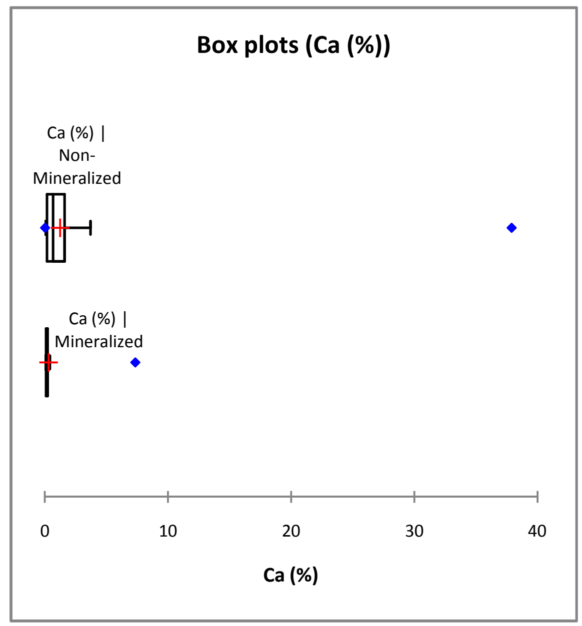




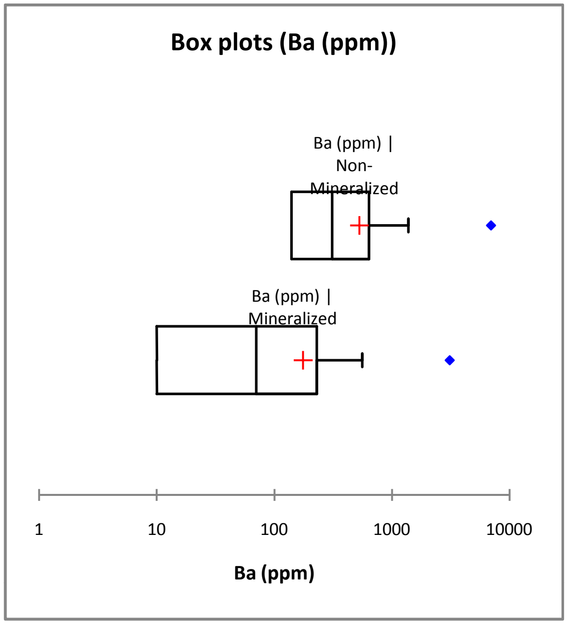


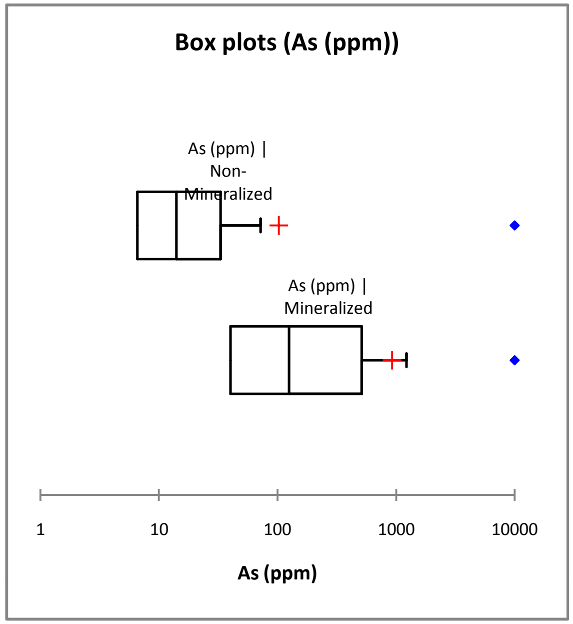


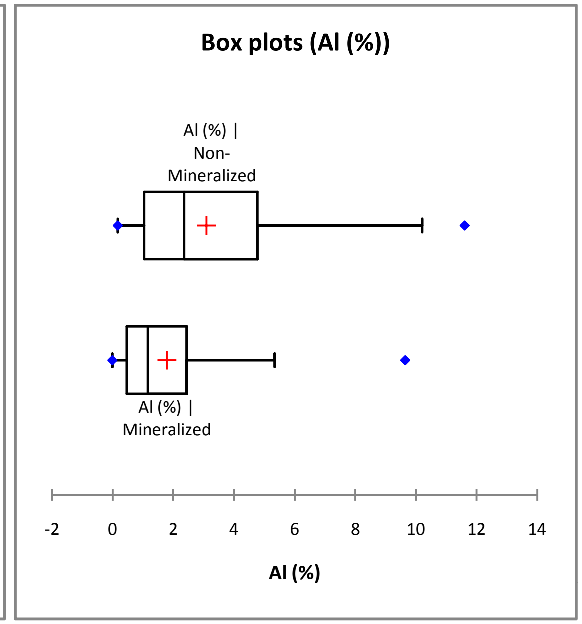


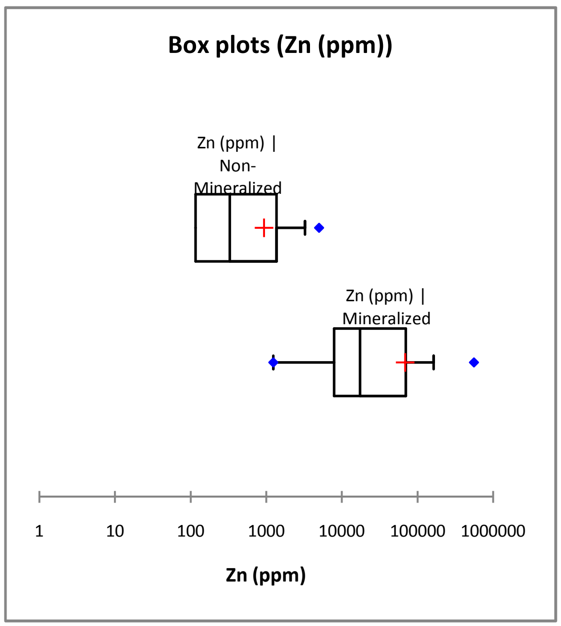


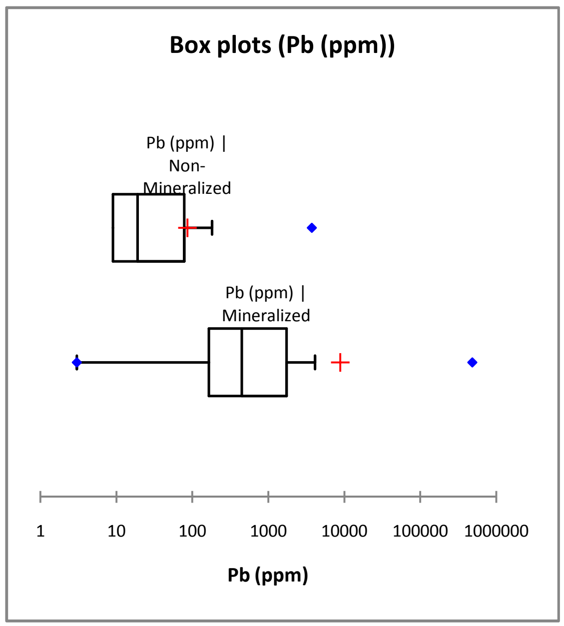
By Mineralized/Non-Mineralized











Summary Statistics by Lithology

Statistic	MPA (kg CaCO3/t) | CHSCH	MPA (kg CaCO3/t) | GNST	MPA (kg CaCO3/t) | GSCH	MPA (kg CaCO3/t) | QTZT	MPA (kg CaCO3/t) | SCH	MPA (kg CaCO3/t) | SSCH	MPA (kg CaCO3/t) | VN	FIZ_RATE | CHSCH	FIZ_RATE | GNST	FIZ_RATE | GSCH	FIZ_RATE | QTZT
No. of observations	1	3	5	14	6	8	13	1	3	5	14
Minimum	0.000	0.000	0.625	1.563	5.000	5.625	30.938	2.000	2.000	1.000	1.000
Maximum	0.000	0.469	1.875	5.156	6.250	29.688	768.750	2.000	3.000	2.000	2.000
1st Quartile	0.000	0.000	0.938	2.383	5.625	11.172	128.750	2.000	2.500	1.000	2.000
Median	0.000	0.000	1.094	2.813	5.938	13.438	332.188	2.000	3.000	1.000	2.000
3rd Quartile	0.000	0.234	1.250	3.750	6.250	27.266	530.938	2.000	3.000	1.000	2.000
Mean	0.000	0.156	1.156	3.002	5.833	17.227	350.433	350.433	2.667	1.200	1.786
Variance (n-1)		0.073	0.215	0.981	0.260	92.674	59200.448		0.333	0.200	0.181
Standard deviation (n-1)		0.271	0.464	0.990	0.510	9.627	243.311		0.577	0.447	0.426

Statistic	FIZ_RATE | SCH	FIZ_RATE | SSCH	FIZ_RATE | VN	NNP (kg CaCO3/t) | CHSCH	NNP (kg CaCO3/t) | GNST	NNP (kg CaCO3/t) | GSCH	NNP (kg CaCO3/t) | QTZT	NNP (kg CaCO3/t) | SCH	NNP (kg CaCO3/t) | SSCH	NNP (kg CaCO3/t) | VN	NP (kg CaCO3/t) | CHSCH
No. of observations	6	8	13	1	3	5	14	6	8	13	1
Minimum	2.000	2.000	2.000	21.000	7.000	-0.094	3.250	18.750	-3.688	-644.750	21.000
Maximum	2.000	2.000	3.000	21.000	118.531	31.375	40.500	66.375	68.813	287.125	21.000
1st Quartile	2.000	2.000	2.000	21.000	49.000	0.750	14.352	29.719	24.063	-369.938	21.000
Median	2.000	2.000	3.000	21.000	91.000	6.125	23.563	31.375	32.938	-106.813	21.000
3rd Quartile	2.000	2.000	3.000	21.000	104.766	7.063	34.367	37.063	46.953	30.813	21.000
Mean	2.000	2.000	2.615	2.615	72.177	9.044	23.569	36.000	34.398	-184.663	-184.663
Variance (n-1)	0.000	0.000	0.256		3375.532	165.852	154.132	263.044	474.605	80175.893	
Standard deviation (n-1)	0.000	0.000	0.506		58.099	12.878	12.415	16.219	21.785	283.153	

Statistic	NP (kg CaCO3/t) | GNST	NP (kg CaCO3/t) | GSCH	NP (kg CaCO3/t) | QTZT	NP (kg CaCO3/t) | SCH	NP (kg CaCO3/t) | SSCH	NP (kg CaCO3/t) | VN	pH | CHSCH	pH | GNST	pH | GSCH	pH | QTZT	pH | SCH
No. of observations	3	5	14	6	8	13	1	3	5	14	6
Minimum	7.000	1.000	7.000	25.000	26.000	26.000	8.900	8.400	6.500	7.400	7.800
Maximum	119.000	32.000	43.000	72.000	81.000	364.000	8.900	9.000	9.000	9.000	9.000
1st Quartile	49.000	2.000	17.750	35.500	46.250	54.000	8.900	8.450	7.100	8.425	8.700
Median	91.000	8.000	27.000	37.000	54.500	124.000	8.900	8.500	7.500	8.600	8.750
3rd Quartile	105.000	8.000	36.750	43.000	56.500	256.000	8.900	8.750	8.000	8.850	8.875
Mean	72.333	10.200	26.571	41.833	51.625	165.769	165.769	8.633	7.620	8.479	8.650
Variance (n-1)	3397.333	159.200	150.418	259.367	283.125	16282.692		0.103	0.897	0.234	0.187
Standard deviation (n-1)	58.287	12.617	12.264	16.105	16.826	127.604		0.321	0.947	0.484	0.432

Summary Statistics by Lithology

Statistic	pH | SSCH	pH | VN	NP/MPA | CHSCH	NP/MPA | GNST	NP/MPA | GSCH	NP/MPA | QTZT	NP/MPA | SCH	NP/MPA | SSCH	NP/MPA | VN	STOT | CHSCH	STOT | GNST
No. of observations	8	13	1	3	5	14	6	8	13	1	3
Minimum	8.100	6.200	33.600	11.200	0.800	1.600	3.640	0.830	0.070	0.020	0.020
Maximum	9.000	8.900	33.600	190.400	20.480	15.290	10.970	6.170	4.640	0.020	0.020
1st Quartile	8.550	6.600	33.600	78.400	1.070	5.155	5.263	1.845	0.160	0.020	0.020
Median	8.600	6.600	33.600	145.600	3.660	7.320	5.915	3.525	0.420	0.020	0.020
3rd Quartile	8.800	7.000	33.600	168.000	6.400	11.443	6.253	4.890	1.090	0.020	0.020
Mean	8.613	6.900	6.900	115.733	6.482	8.291	6.308	3.524	1.021	1.021	0.020
Variance (n-1)	0.076	0.437		8697.173	66.372	18.925	6.141	3.887	2.020		0.000
Standard deviation (n-1)	0.275	0.661		93.259	8.147	4.350	2.478	1.971	1.421		0.000

Statistic	STOT | GSCH	STOT | QTZT	STOT | SCH	STOT | SSCH	STOT | VN	SO4(Carb) | CHSCH	SO4(Carb) | GNST	SO4(Carb) | GSCH	SO4(Carb) | QTZT	SO4(Carb) | SCH	SO4(Carb) | SSCH
No. of observations	5	14	6	8	13	1	3	5	14	6	8
Minimum	0.040	0.070	0.190	0.270	1.040	0.020	0.005	0.005	0.005	0.020	0.010
Maximum	0.070	0.170	0.230	1.000	24.700	0.020	0.030	0.030	0.050	0.030	0.120
1st Quartile	0.040	0.090	0.203	0.383	4.140	0.020	0.013	0.010	0.010	0.023	0.028
Median	0.050	0.100	0.215	0.475	10.700	0.020	0.020	0.010	0.010	0.030	0.040
3rd Quartile	0.060	0.130	0.228	0.925	17.150	0.020	0.025	0.020	0.010	0.030	0.060
Mean	0.052	0.109	0.213	0.599	11.282	11.282	0.018	0.015	0.013	0.027	0.048
Variance (n-1)	0.000	0.001	0.000	0.093	60.959		0.000	0.000	0.000	0.000	0.001
Standard deviation (n-1)	0.013	0.030	0.016	0.305	7.808		0.013	0.010	0.011	0.005	0.035

Statistic	SO4(Carb) | VN	SO4(HCl) | CHSCH	SO4(HCl) | GNST	SO4(HCl) | GSCH	SO4(HCl) | QTZT	SO4(HCl) | SCH	SO4(HCl) | SSCH	SO4(HCl) | VN	SSulphide | CHSCH	SSulphide | GNST	SSulphide | GSCH
No. of observations	13	1	3	5	14	6	8	13	1	3	5
Minimum	0.010	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.000	0.000	0.020
Maximum	0.160	0.005	0.010	0.020	0.010	0.020	0.100	0.120	0.000	0.015	0.060
1st Quartile	0.050	0.005	0.005	0.005	0.005	0.005	0.005	0.005	0.000	0.000	0.030
Median	0.060	0.005	0.005	0.005	0.005	0.005	0.005	0.010	0.000	0.000	0.035
3rd Quartile	0.090	0.005	0.008	0.010	0.010	0.009	0.010	0.060	0.000	0.008	0.040
Mean	0.068	0.068	0.007	0.009	0.007	0.008	0.018	0.033	0.033	0.005	0.037
Variance (n-1)	0.002		0.000	0.000	0.000	0.000	0.001	0.002		0.000	0.000
Standard deviation (n-1)	0.043		0.003	0.007	0.003	0.006	0.033	0.042		0.009	0.015

Summary Statistics by Lithology

Statistic	SSulphide | QTZT	SSulphide | SCH	SSulphide | SSCH	SSulphide | VN	CTOT | CHSCH	CTOT | GNST	CTOT | GSCH	CTOT | QTZT	CTOT | SCH	CTOT | SSCH	CTOT | VN
No. of observations	14	6	8	13	1	3	5	14	6	8	13
Minimum	0.050	0.160	0.180	0.990	0.090	0.120	0.025	0.060	0.340	0.025	0.590
Maximum	0.165	0.200	0.950	24.600	0.090	0.960	1.190	0.780	0.770	1.060	8.650
1st Quartile	0.076	0.180	0.358	4.120	0.090	0.335	0.025	0.278	0.470	0.515	2.200
Median	0.090	0.190	0.430	10.630	0.090	0.550	0.190	0.455	0.490	0.705	2.950
3rd Quartile	0.120	0.200	0.873	16.990	0.090	0.755	0.600	0.560	0.630	0.783	5.200
Mean	0.096	0.187	0.551	11.214	11.214	0.543	0.406	0.431	0.538	0.633	3.713
Variance (n-1)	0.001	0.000	0.095	60.621		0.176	0.247	0.045	0.024	0.095	5.262
Standard deviation (n-1)	0.032	0.016	0.308	7.786		0.420	0.497	0.212	0.155	0.308	2.294

Statistic	CO2TOT | CHSCH	CO2TOT | GNST	CO2TOT | GSCH	CO2TOT | QTZT	CO2TOT | SCH	CO2TOT | SSCH	CO2TOT | VN
No. of observations	1	3	5	14	6	8	13
Minimum	0.300	0.500	0.100	0.200	1.300	0.100	2.100
Maximum	0.300	3.500	4.400	2.800	2.800	3.900	31.700
1st Quartile	0.300	1.250	0.100	1.050	1.700	1.900	8.100
Median	0.300	2.000	0.700	1.650	1.800	2.550	10.800
3rd Quartile	0.300	2.750	2.200	2.025	2.275	2.850	19.000
Mean	3.713	2.000	1.500	1.579	1.967	2.313	13.600
Variance (n-1)		2.250	3.365	0.585	0.295	1.270	70.883
Standard deviation (n-1)		1.500	1.834	0.765	0.543	1.127	8.419

Summary Statistics by Mineralized/Non-Mineralized

Statistic	MPA (kg CaCO3/t) | Mineralized	MPA (kg CaCO3/t) | Non-Mineralized	FIZ_RATE | Mineralized	FIZ_RATE | Non-Mineralized	NNP (kg CaCO3/t) | Mineralized	NNP (kg CaCO3/t) | Non-Mineralized	NP (kg CaCO3/t) | Mineralized	NP (kg CaCO3/t) | Non-Mineralized	pH | Mineralized	pH | Non-Mineralized	NP/MPA | Mineralized
No. of observations	13	37	13	37	13	37	13	37	13	37	13
Minimum	30.938	0.000	2.000	1.000	-644.750	-3.688	26.000	1.000	6.200	6.500	0.070
Maximum	768.750	29.688	3.000	3.000	287.125	118.531	364.000	119.000	8.900	9.000	4.640
1st Quartile	128.750	1.875	2.000	2.000	-369.938	13.188	54.000	21.000	6.600	8.400	0.160
Median	332.188	3.750	3.000	2.000	-106.813	26.875	124.000	32.000	6.600	8.600	0.420
3rd Quartile	530.938	6.250	3.000	2.000	30.813	38.750	256.000	45.000	7.000	8.900	1.090
Mean	350.433	5.976	2.615	1.865	-184.663	29.835	165.769	35.811	6.900	8.443	1.021
Variance (n-1)	59200.448	57.049	0.256	0.231	80175.893	628.276	16282.692	654.991	0.437	0.348	2.020
Standard deviation (n-1)	243.311	7.553	0.506	0.481	283.153	25.065	127.604	25.593	0.661	0.590	1.421

Statistic	NP/MPA | Non-Mineralized	STOT | Mineralized	STOT | Non-Mineralized	SO4(Carb) | Mineralized	SO4(Carb) | Non-Mineralized	SO4(HCl) | Mineralized	SO4(HCl) | Non-Mineralized	SSulphide | Mineralized	SSulphide | Non-Mineralized	CTOT | Mineralized	CTOT | Non-Mineralized
No. of observations	37	13	37	13	37	13	37	13	37	13	37
Minimum	0.800	1.040	0.020	0.010	0.005	0.005	0.005	0.990	0.000	0.590	0.025
Maximum	190.400	24.700	1.000	0.160	0.120	0.120	0.100	24.600	0.950	8.650	1.190
1st Quartile	3.790	4.140	0.070	0.050	0.010	0.005	0.005	4.120	0.060	2.200	0.260
Median	5.910	10.700	0.130	0.060	0.020	0.010	0.005	10.630	0.120	2.950	0.500
3rd Quartile	10.970	17.150	0.230	0.090	0.030	0.060	0.010	16.990	0.200	5.200	0.670
Mean	16.090	11.282	0.214	0.068	0.023	0.033	0.010	11.214	0.191	3.713	0.489
Variance (n-1)	1422.425	60.959	0.063	0.002	0.000	0.002	0.000	60.621	0.058	5.262	0.087
Standard deviation (n-1)	37.715	7.808	0.252	0.043	0.022	0.042	0.016	7.786	0.242	2.294	0.295

Statistic	CO2TOT | Mineralized	CO2TOT | Non-Mineralized
No. of observations	13	37
Minimum	2.100	0.100
Maximum	31.700	4.400
1st Quartile	8.100	1.000
Median	10.800	1.800
3rd Quartile	19.000	2.400
Mean	13.600	1.789
Variance (n-1)	70.883	1.158
Standard deviation (n-1)	8.419	1.076

Calculated ABA Parameters via ICP, by Lithology

Statistic	MPAS(kg CaCO3/t) | CHSCH	MPAS(kg CaCO3/t) | CQTZT	MPAS(kg CaCO3/t) | GSCH	MPAS(kg CaCO3/t) | ICQS	MPAS(kg CaCO3/t) | QTZT	MPAS(kg CaCO3/t) | SCH	MPAS(kg CaCO3/t) | SSCH	MPAS(kg CaCO3/t) | TQTZT	NNPICP(kg CaCO3/t) | CHSCH	NNPICP(kg CaCO3/t) | CQTZT	NNPICP(kg CaCO3/t) | GSCH
No. of observations	46	169	432	125	1894	126	128	206	46	169	432
Minimum	0.313	1.250	0.313	0.156	0.156	0.313	0.625	0.250	-30.642	-241.673	-98.911
Maximum	41.250	251.250	113.125	45.625	312.500	55.625	49.688	90.938	196.562	171.383	974.669
1st Quartile	3.125	4.063	3.750	1.250	3.125	4.063	2.836	2.500	8.894	20.841	10.544
Median	4.375	6.250	8.438	2.500	6.875	9.375	4.063	5.328	14.496	36.802	29.170
3rd Quartile	6.172	10.313	17.813	10.656	13.438	18.672	8.906	10.234	37.818	57.775	42.940
Mean	6.848	10.925	13.041	7.342	11.513	13.462	7.566	10.367	36.720	39.604	31.367
Variance (n-1)	52.877	519.780	193.982	86.458	345.683	150.895	74.599	218.475	2845.739	1722.188	3165.742
Standard deviation (n-1)	7.272	22.799	13.928	9.298	18.593	12.284	8.637	14.781	53.345	41.499	56.265

Statistic	NNPICP(kg CaCO3/t) | ICQS	NNPICP(kg CaCO3/t) | QTZT	NNPICP(kg CaCO3/t) | SCH	NNPICP(kg CaCO3/t) | SSCH	NNPICP(kg CaCO3/t) | TQTZT	NPCa (kg CaCO3/t) | CHSCH	NPCa (kg CaCO3/t) | CQTZT	NPCa (kg CaCO3/t) | GSCH	NPCa (kg CaCO3/t) | ICQS	NPCa (kg CaCO3/t) | QTZT	NPCa (kg CaCO3/t) | SCH
No. of observations	125	1894	126	128	206	46	169	432	125	1894	126
Minimum	-33.729	-296.997	-39.371	-39.853	-82.133	9.062	8.289	8.031	7.516	7.258	7.774
Maximum	149.717	207.990	121.491	175.973	266.186	196.874	184.508	983.419	154.623	209.240	136.331
1st Quartile	7.664	3.179	3.072	7.304	4.320	14.214	29.157	23.425	11.381	9.835	21.299
Median	11.855	9.879	26.579	12.353	10.207	17.821	45.903	37.916	17.821	17.306	35.340
3rd Quartile	28.033	28.230	39.274	17.150	31.698	49.381	65.225	52.859	33.794	37.852	50.540
Mean	19.779	16.672	25.575	15.810	21.254	43.567	50.528	44.407	27.121	28.185	39.037
Variance (n-1)	679.822	1049.967	775.524	744.484	1692.236	2814.639	1013.394	2871.100	615.112	692.880	633.784
Standard deviation (n-1)	26.073	32.403	27.848	27.285	41.137	53.053	31.834	53.583	24.801	26.323	25.175

Statistic	NPCa (kg CaCO3/t) | SSCH	NPCa (kg CaCO3/t) | TQTZT	NP/MPAICP | CHSCH	NP/MPAICP | CQTZT	NP/MPAICP | GSCH	NP/MPAICP | ICQS	NP/MPAICP | QTZT	NP/MPAICP | SCH	NP/MPAICP | SSCH	NP/MPAICP | TQTZT
No. of observations	128	206	46	169	432	125	1894	126	128	206
Minimum	8.547	7.516	0.257	0.038	0.126	0.261	0.035	0.255	0.198	0.097
Maximum	179.098	274.936	629.997	52.180	659.676	63.425	263.956	127.103	83.863	63.102
1st Quartile	11.123	9.577	3.170	3.777	1.910	1.882	1.353	1.226	2.205	1.505
Median	18.337	15.760	4.497	6.271	4.850	9.063	3.419	4.639	4.309	4.752
3rd Quartile	22.265	38.818	7.976	13.244	10.353	18.040	8.017	8.792	6.468	12.485
Mean	23.376	31.621	25.143	9.904	9.972	12.113	7.456	7.641	6.074	8.579
Variance (n-1)	660.779	1342.344	9023.887	88.983	1124.055	168.013	236.045	180.838	93.256	97.634
Standard deviation (n-1)	25.706	36.638	94.994	9.433	33.527	12.962	15.364	13.448	9.657	9.881

Sulphur Speciation

Statistic	SO4 (Carb) as % of STOT | Mineralized	SO4 (Carb) as % of STOT | Non-Mineralized	Max Potential Barite-S (%) | Mineralized	Max Potential Barite-S (%) | Non-Mineralized	Max Potential Anglesite-S (%) | Mineralized	Max Potential Anglesite-S (%) | Non-Mineralized	Max Potential Anglesite + Barite - S (%) | Mineralized	Max Potential Anglesite + Barite - S (%) | Non-Mineralized	Barite + Anglesite -S as % of SO4(Carb) | Mineralized	Barite + Anglesite -S as % of SO4(Carb) | Non-Mineralized
No. of observations	13	37	13	37	13	37	13	37	13	37
Minimum	0.144	2.941	0.000	0.000	0.003	0.000	0.004	0.001	6.559	3.995
Maximum	4.808	100.000	0.006	0.071	0.121	0.003	0.121	0.072	172.863	529.250
1st Quartile	0.405	7.143	0.000	0.005	0.007	0.000	0.008	0.005	15.453	31.130
Median	0.654	11.111	0.000	0.015	0.019	0.000	0.021	0.015	59.158	86.910
3rd Quartile	0.933	15.789	0.001	0.036	0.034	0.001	0.034	0.036	75.321	140.246
Mean	1.022	21.510	0.001	0.023	0.032	0.001	0.033	0.023	56.214	119.416
Variance (n-1)	1.527	716.070	0.000	0.001	0.001	0.000	0.001	0.001	2247.494	15640.821
Standard deviation (n-1)	1.236	26.759	0.002	0.023	0.037	0.001	0.036	0.023	47.408	125.063

Statistic	SO4 (Carb) as % of STOT | CHSCH	SO4 (Carb) as % of STOT | GNST	SO4 (Carb) as % of STOT | GSCH	SO4 (Carb) as % of STOT | QTZT	SO4 (Carb) as % of STOT | SCH	SO4 (Carb) as % of STOT | SSCH	SO4 (Carb) as % of STOT | VN	Max Potential Barite-S (%) | CHSCH	Max Potential Barite-S (%) | GNST	Max Potential Barite-S (%) | GSCH	Max Potential Barite-S (%) | QTZT
No. of observations	1	3	5	14	6	8	13	1	3	5	14
Minimum	100.000	25.000	12.500	2.941	9.091	3.191	0.144	0.005	0.001	0.015	0.000
Maximum	100.000	100.000	60.000	50.000	15.789	40.000	4.808	0.005	0.004	0.026	0.017
1st Quartile	100.000	62.500	14.286	7.280	10.761	4.584	0.405	0.005	0.001	0.016	0.003
Median	100.000	100.000	25.000	9.545	13.043	5.761	0.654	0.005	0.001	0.018	0.005
3rd Quartile	100.000	100.000	33.333	11.111	13.975	8.187	0.933	0.005	0.003	0.021	0.009
Mean	0.000	75.000	29.024	12.053	12.542	10.220	1.022	1.022	0.002	0.019	0.006
Variance (n-1)		1875.000	371.134	128.606	6.492	151.265	1.527		0.000	0.000	0.000
Standard deviation (n-1)		43.301	19.265	11.340	2.548	12.299	1.236		0.002	0.005	0.005

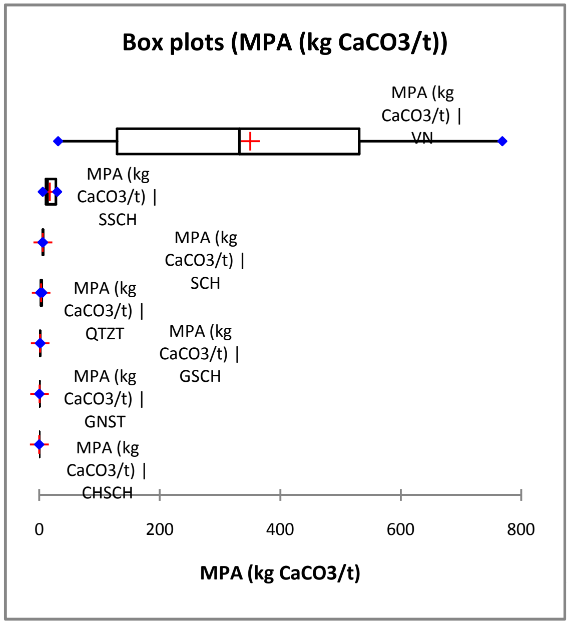
Sulphur Speciation

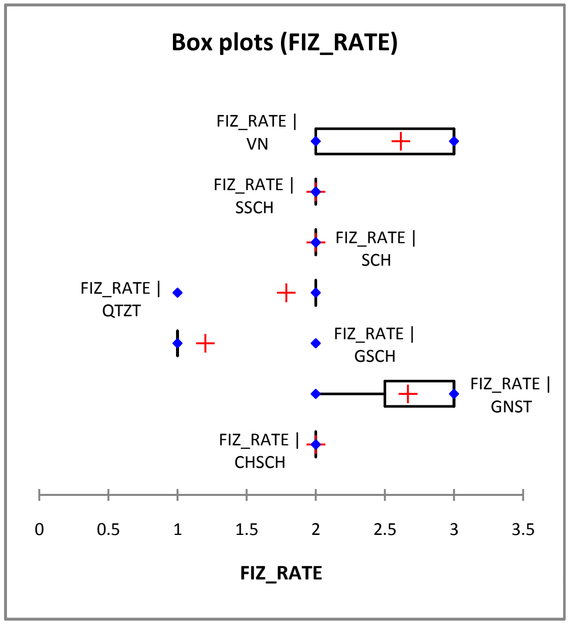
Statistic	Max Potential Barite-S (%) | SCH	Max Potential Barite-S (%) | SSCH	Max Potential Barite-S (%) | VN	Max Potential Anglesite-S (%) | CHSCH	Max Potential Anglesite-S (%) | GNST	Max Potential Anglesite-S (%) | GSCH	Max Potential Anglesite-S (%) | QTZT	Max Potential Anglesite-S (%) | SCH	Max Potential Anglesite-S (%) | SSCH	Max Potential Anglesite-S (%) | VN	Max Potential Anglesite + Barite - S (%) | CHSCH
No. of observations	6	8	13	1	3	5	14	6	8	13	1
Minimum	0.0114	0.0469	0.0001	0.0013	0.0000	0.0002	0.0000	0.0001	0.0002	0.0032	0.0064
Maximum	0.0423	0.0708	0.0061	0.0013	0.0005	0.0011	0.0028	0.0004	0.0025	0.1209	0.0064
1st Quartile	0.0183	0.0548	0.0001	0.0013	0.0001	0.0003	0.0001	0.0003	0.0004	0.0073	0.0064
Median	0.0257	0.0619	0.0001	0.0013	0.0001	0.0004	0.0001	0.0003	0.0009	0.0191	0.0064
3rd Quartile	0.0334	0.0680	0.0007	0.0013	0.0003	0.0004	0.0002	0.0004	0.0014	0.0337	0.0064
Mean	0.0262	0.0605	0.0010	0.0010	0.0002	0.0005	0.0004	0.0003	0.0010	0.0321	0.0321
Variance (n-1)	0.0001	0.0001	0.0000		0.0000	0.0000	0.0000	0.0000	0.0000	0.0013	
Standard deviation (n-1)	0.0116	0.0094	0.0018		0.0002	0.0003	0.0008	0.0001	0.0008	0.0365	

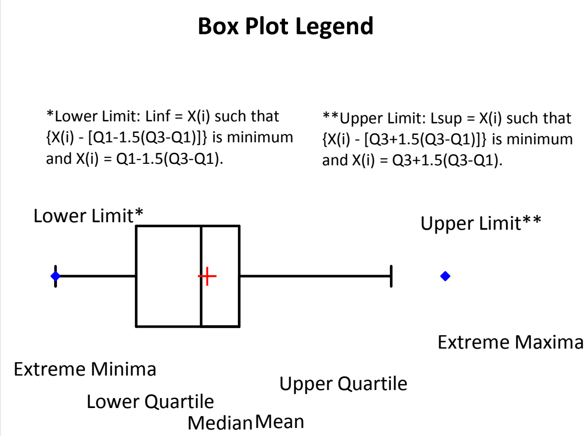
Statistic	Max Potential Anglesite + Barite - S (%) | GNST	Max Potential Anglesite + Barite - S (%) | GSCH	Max Potential Anglesite + Barite - S (%) | QTZT	Max Potential Anglesite + Barite - S (%) | SCH	Max Potential Anglesite + Barite - S (%) | SSCH	Max Potential Anglesite + Barite - S (%) | VN	Barite + Anglesite -S as % of SO4(Carb) | CHSCH	Barite + Anglesite -S as % of SO4(Carb) | GNST	Barite + Anglesite -S as % of SO4(Carb) | GSCH	Barite + Anglesite -S as % of SO4(Carb) | QTZT	Barite + Anglesite -S as % of SO4(Carb) | SCH
No. of observations	3	5	14	6	8	13	1	3	5	14	6
Minimum	0.001	0.015	0.001	0.012	0.049	0.004	32.187	3.995	54.270	14.630	58.44776382
Maximum	0.004	0.026	0.017	0.042	0.072	0.121	32.187	23.607	529.250	344.637	141.1927805
1st Quartile	0.001	0.016	0.003	0.019	0.057	0.008	32.187	12.231	96.486	27.179	82.27804369
Median	0.001	0.019	0.005	0.026	0.063	0.021	32.187	20.467	149.432	32.452	86.83211624
3rd Quartile	0.003	0.022	0.010	0.034	0.069	0.034	32.187	22.037	218.697	109.473	112.6727907
Mean	0.002	0.020	0.007	0.026	0.062	0.033	0.033	16.023	209.627	77.385	95.89185753
Variance (n-1)	0.000	0.000	0.000	0.000	0.000	0.001		110.972	35700.262	7854.666	898.033332
Standard deviation (n-1)	0.002	0.005	0.005	0.012	0.009	0.036		10.534	188.945	88.627	29.96720427

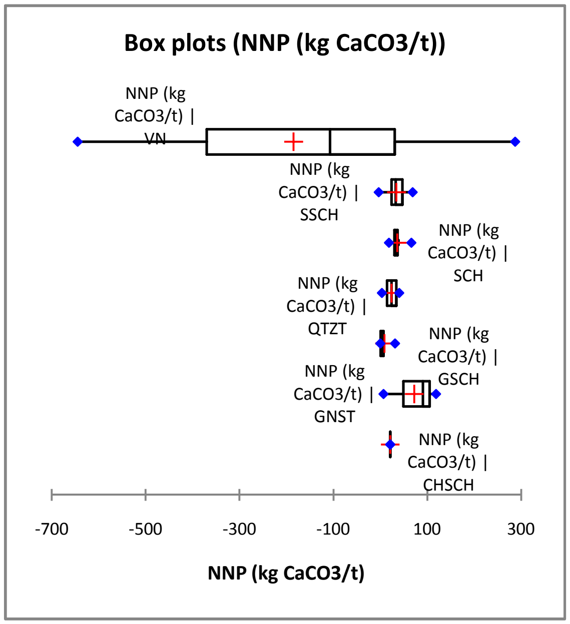
Statistic	Barite + Anglesite -S as % of SO4(Carb) | SSCH	Barite + Anglesite -S as % of SO4(Carb) | VN
No. of observations	8	13
Minimum	49.570	6.559
Maximum	486.532	172.863
1st Quartile	109.961	15.453
Median	157.301	59.158
3rd Quartile	261.530	75.321
Mean	203.908	56.214
Variance (n-1)	21130.227	2247.494
Standard deviation (n-1)	145.362	47.408

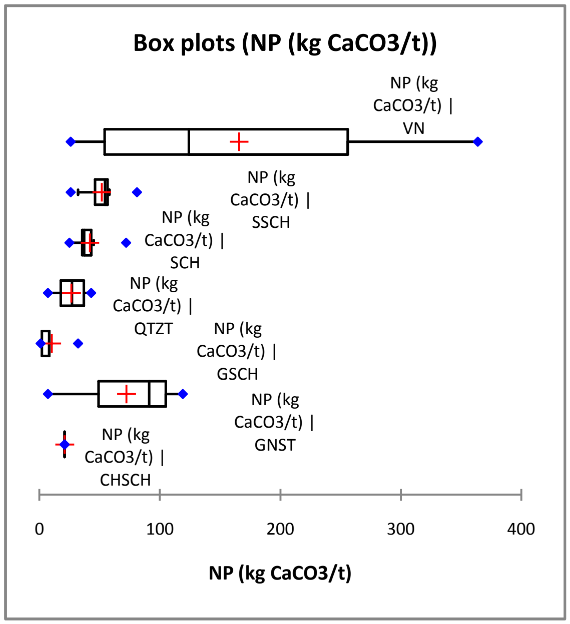
By Lithology

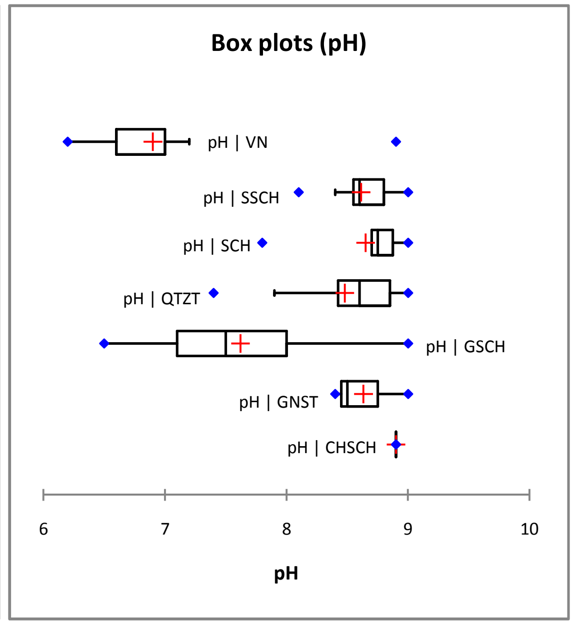












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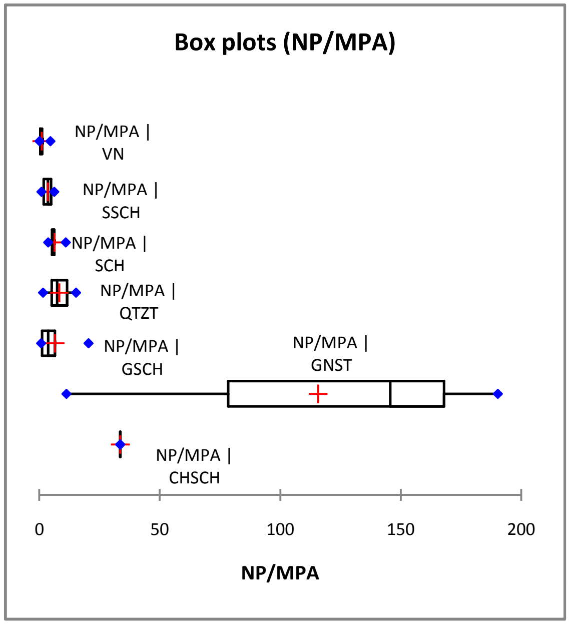

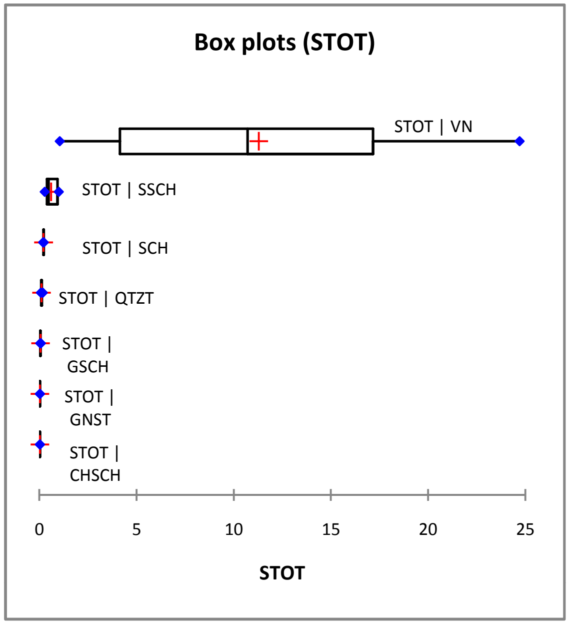

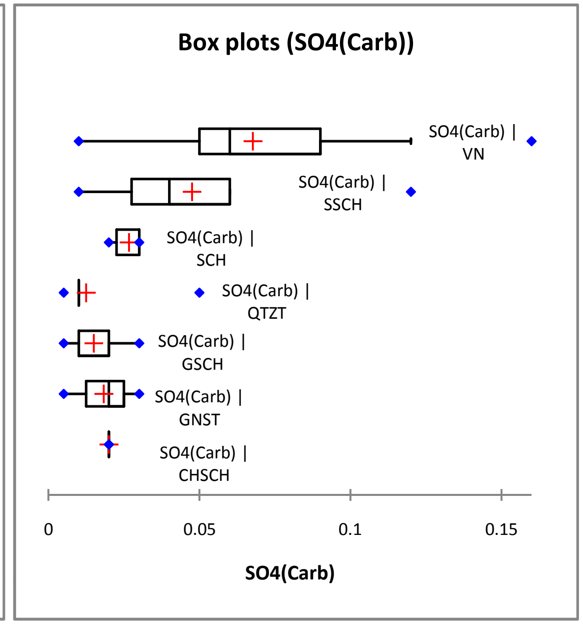

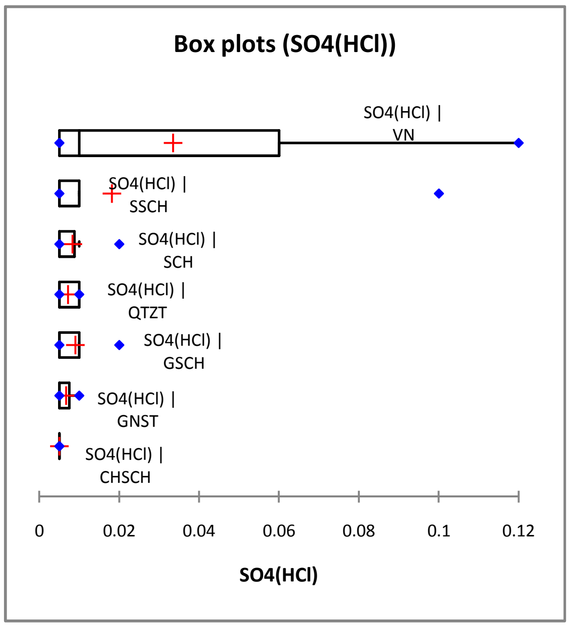

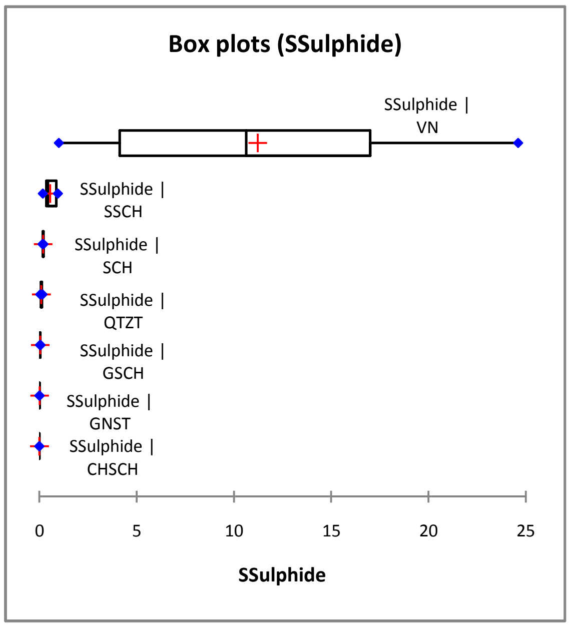

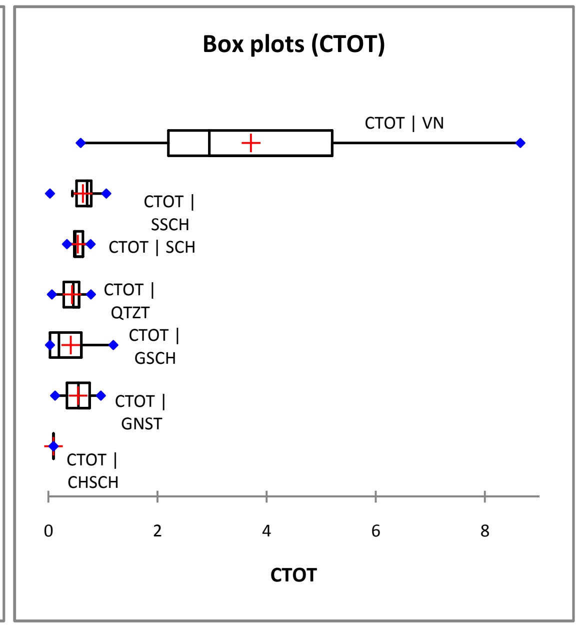

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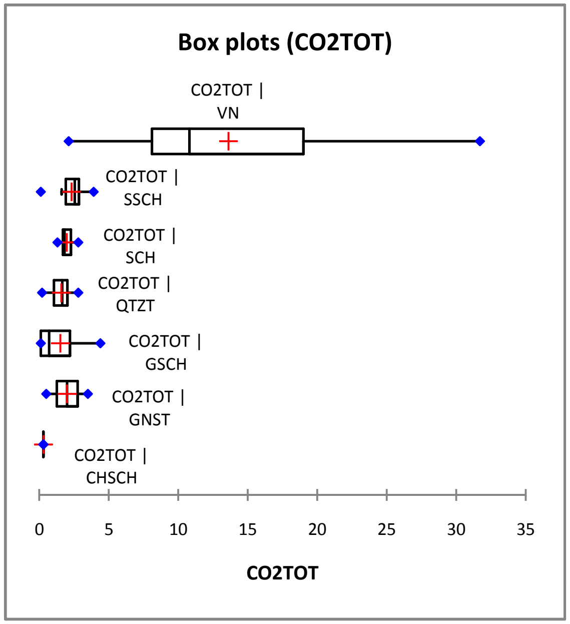

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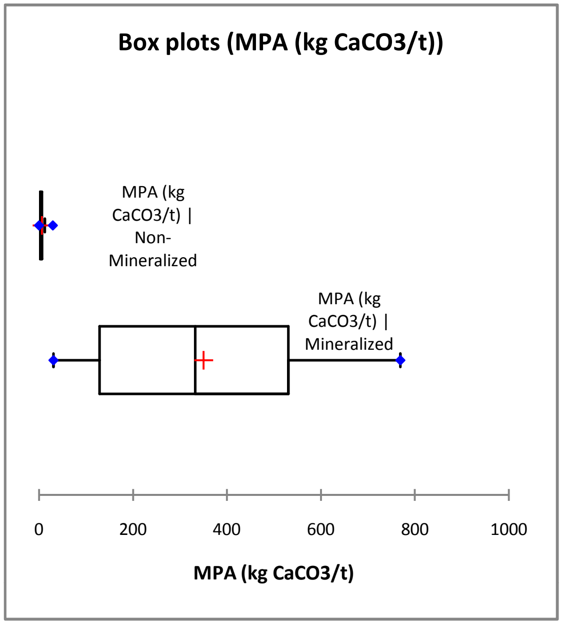
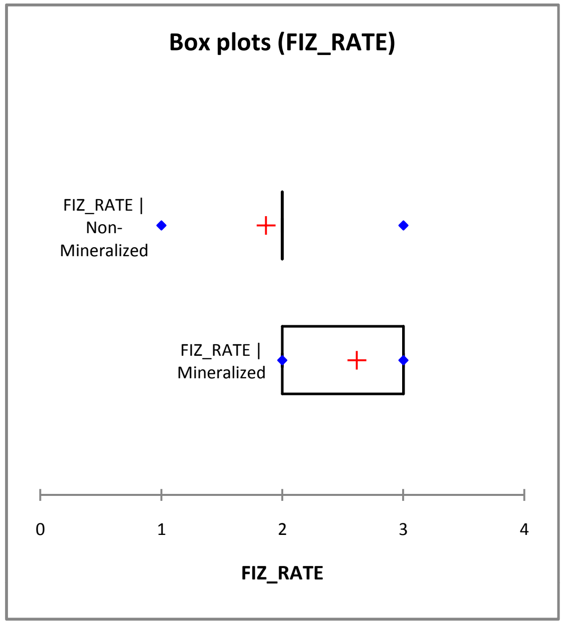
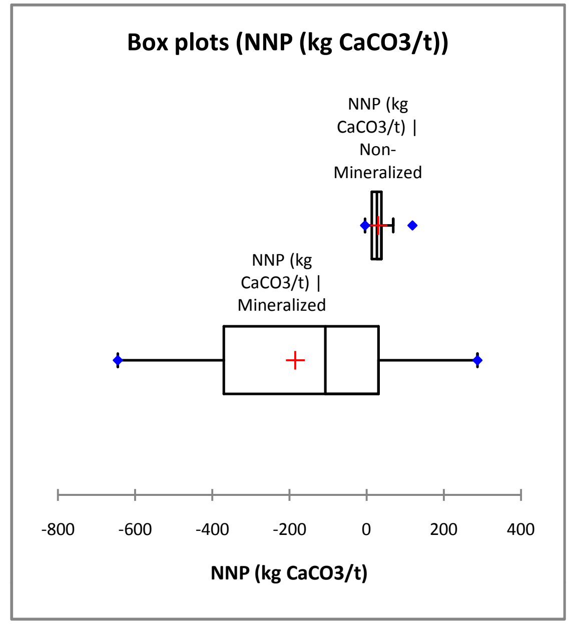
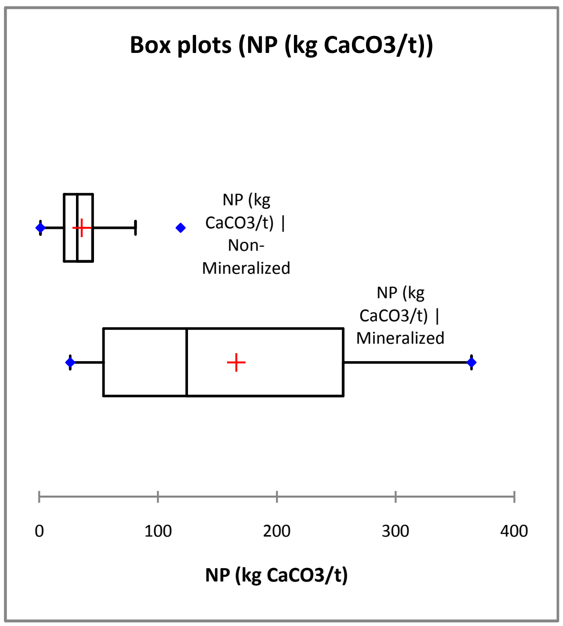
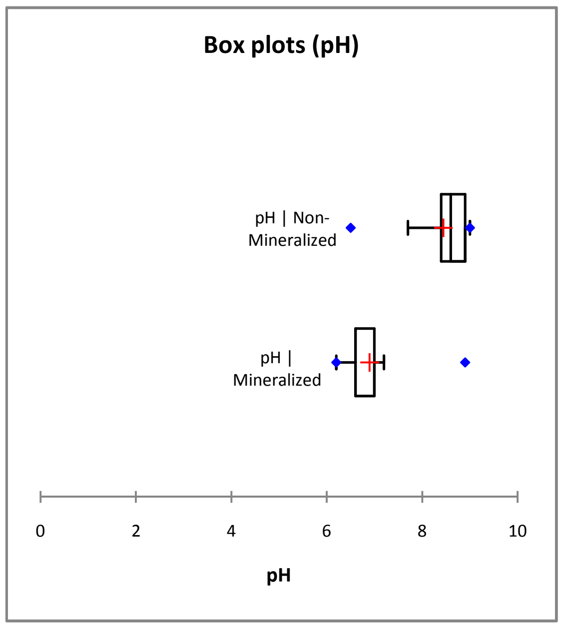
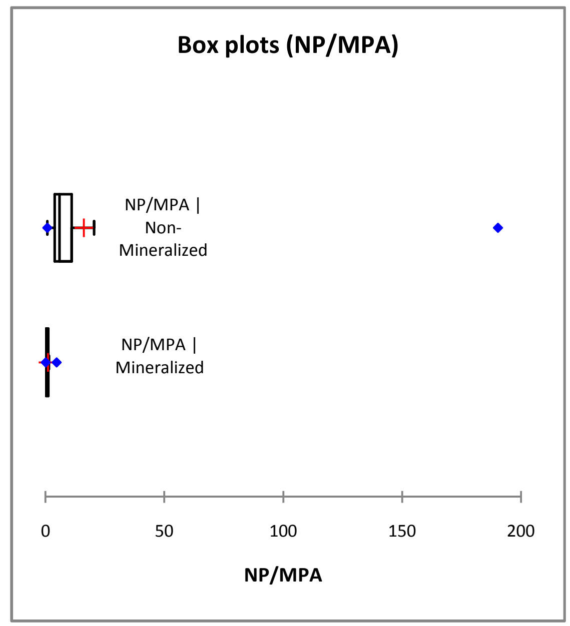


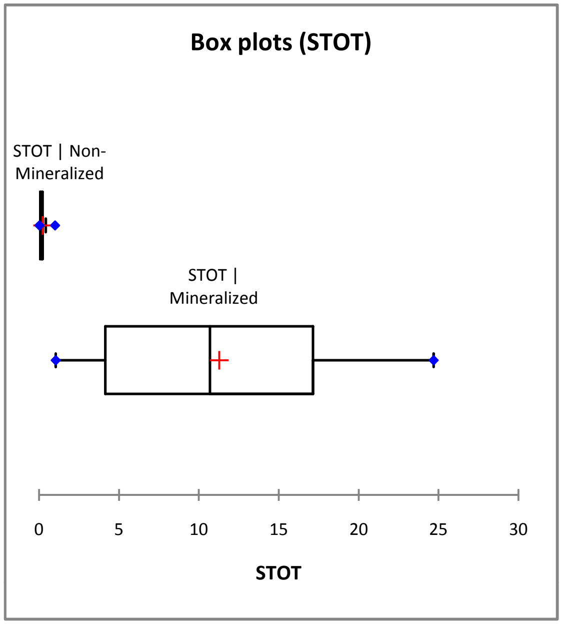


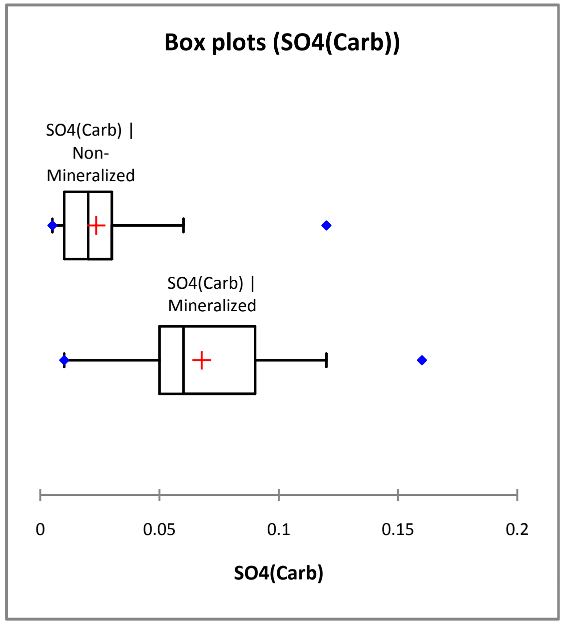


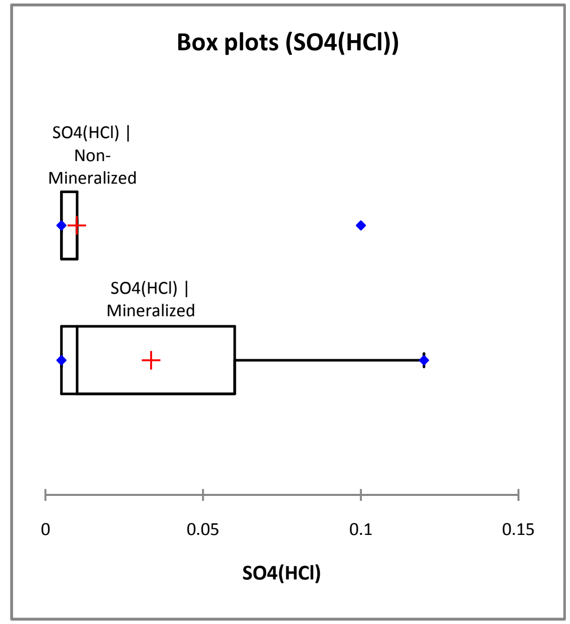


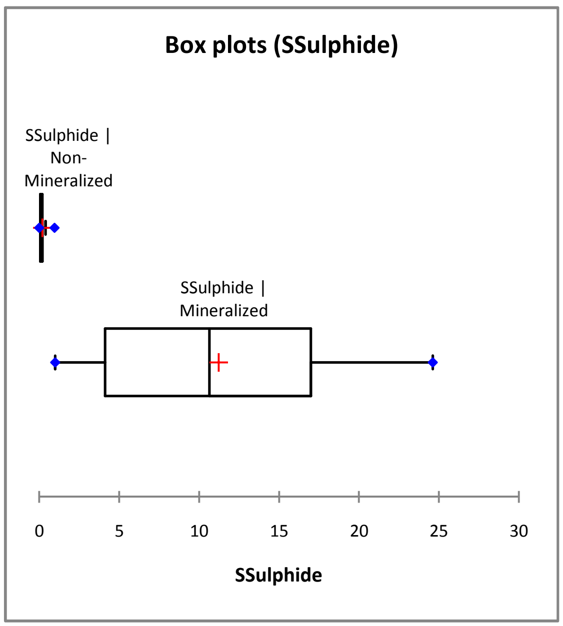


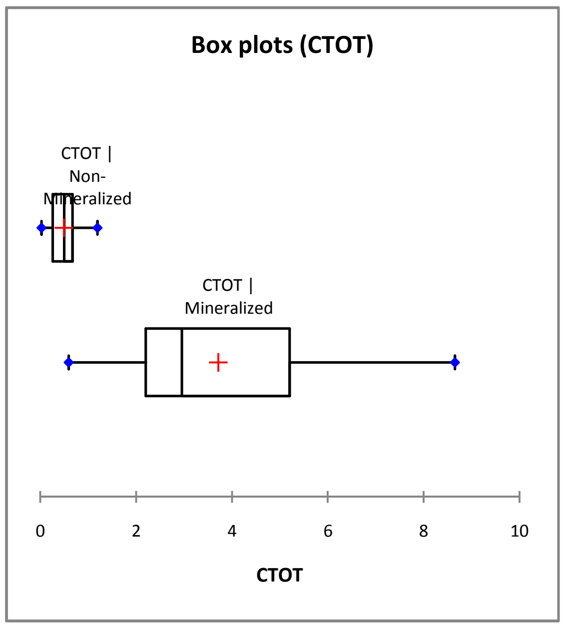



Box plots (STOT)
STOT | Non-Mineralized
STOT | Mineralized
0
5
10
15
20
25
30
STOT


Box plots (SO4(Carb))
SO4(Carb) | Non-Mineralized
SO4(Carb) | Mineralized
0
0.05
0.1
0.15
0.2
SO4(Carb)


Box plots (SO4(HCl))
SO4(HCl) | Non-Mineralized
SO4(HCl) | Mineralized
0
0.05
0.1
0.15
SO4(HCl)


Box plots (SSulphide)
SSulphide | Non-Mineralized
SSulphide | Mineralized
0
5
10
15
20
25
30
SSulphide


Box plots (CTOT)
CTOT | Non-Mineralized
CTOT | Mineralized
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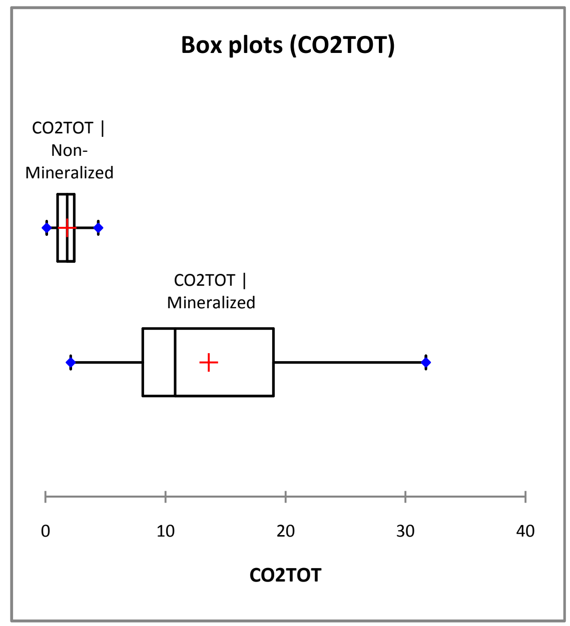
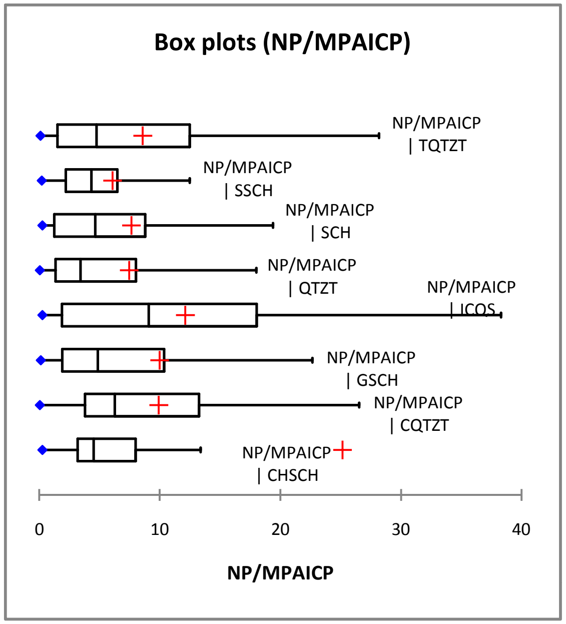
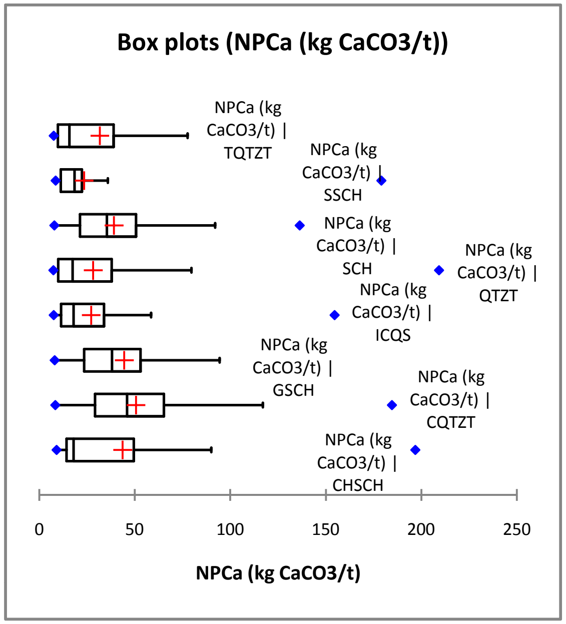
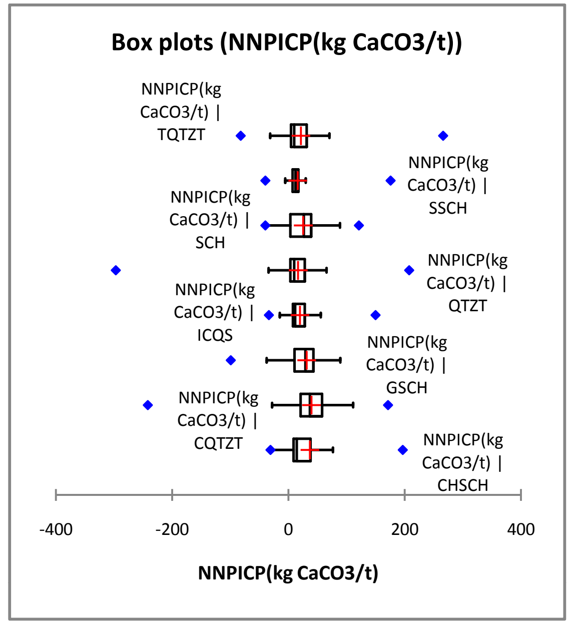
2
4
6
8
10
CTOT

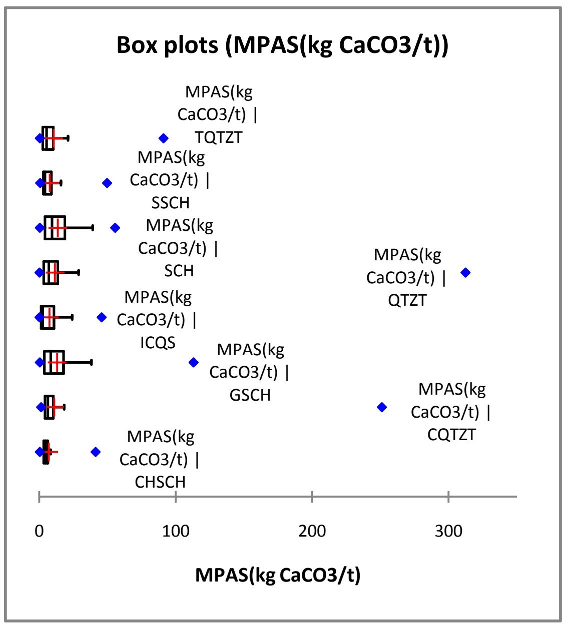

Box plots (CO2TOT)
CO2TOT | Non-Mineralized
CO2TOT | Mineralized
0
10
20
30
40
CO2TOT

Calculated ABA Parameters via ICP, by Lithology



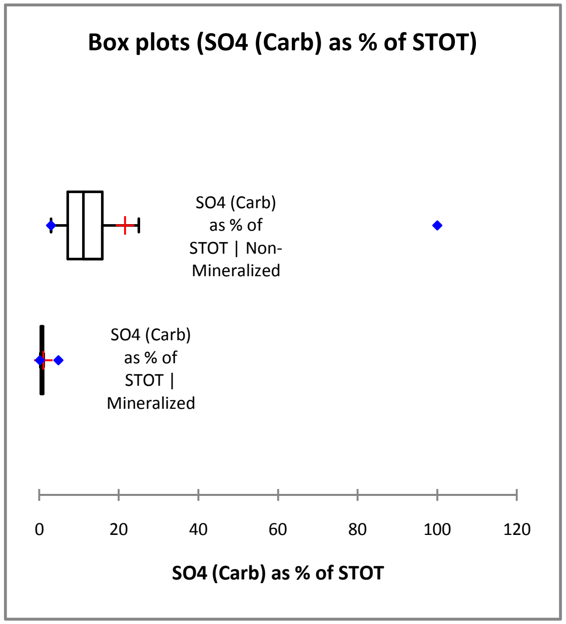


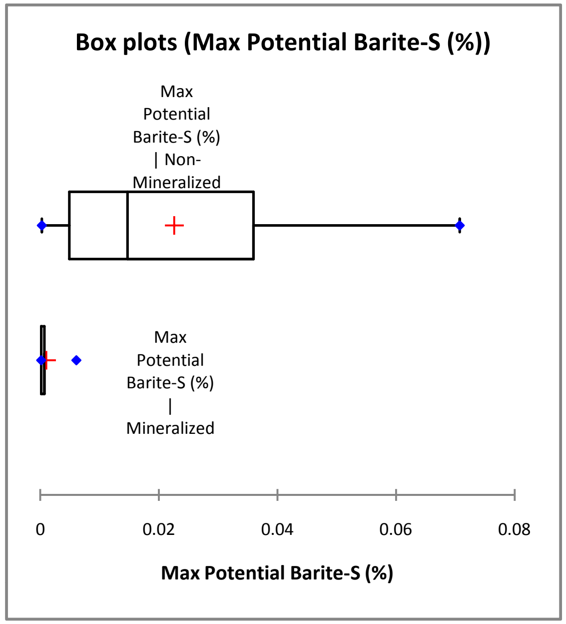


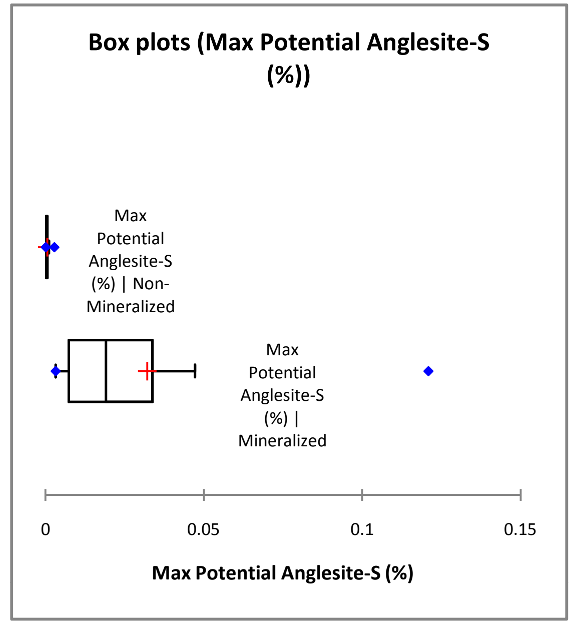


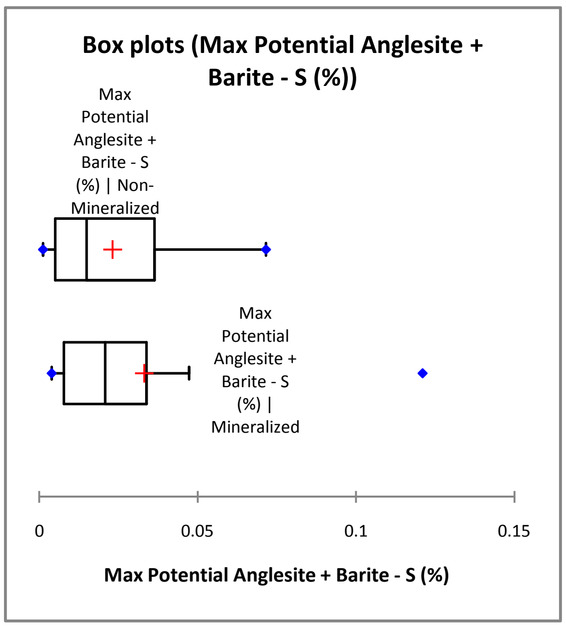
ACCESS CONSULTING GROUP

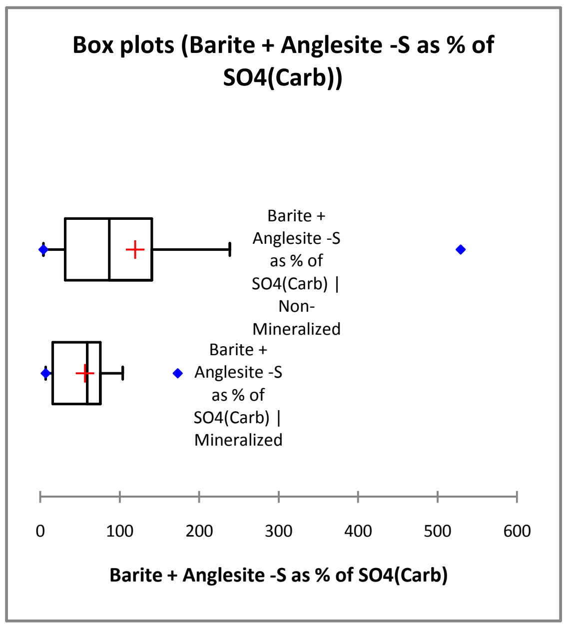
Sulphur Speciation

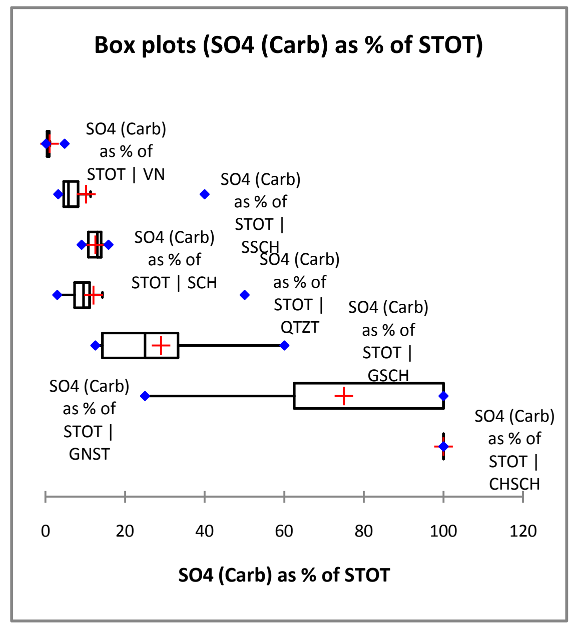




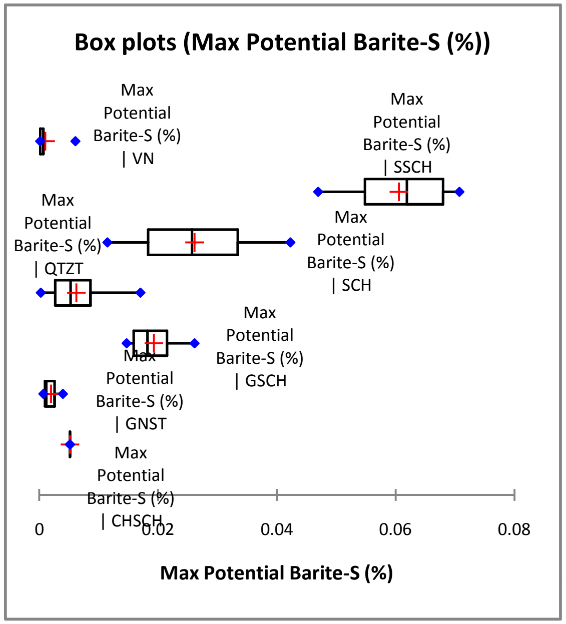


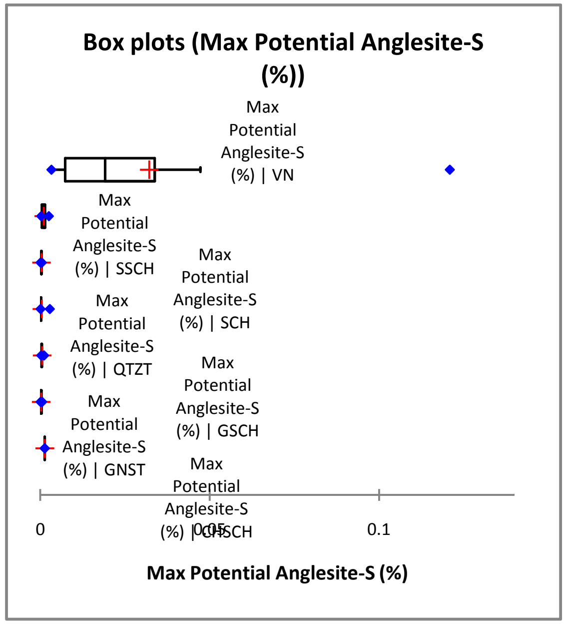


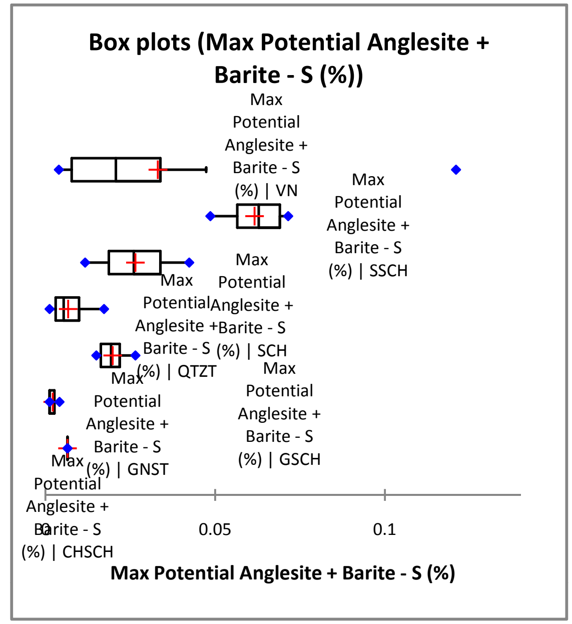


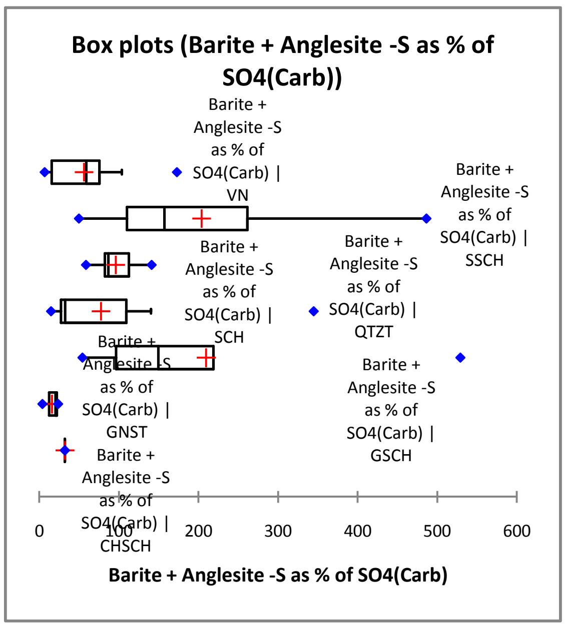


Sulphur Speciation









Appendix D

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mail@accessconsulting.ca

Memorandum

To: Jim Harrington, Brad Thrall, Alexco Keno Hill Mining Corp.

From: Ethan Allen, Scott Davidson, Access Consulting Group

Date: December 7, 2011

Subject: Geochemical Rock Characterization, Lucky Queen
Keno Hill District, Yukon

1. PURPOSE AND SCOPE

This report summarizes results of a geochemical characterization of geologic materials from the Lucky Queen deposit area within the Keno Hill Silver District (KHSD), Yukon.

1.1 PURPOSE

The purpose of this memorandum is to review the geochemical characteristics of rock in the Lucky Queen (LQ) area especially with regard to its potential for the generation of acidic drainage and/or metal leaching (AML). The objective is to provide technical basis to support management of rock to be excavated from LQ during Alexco Keno Hill Mining Corporation's (AHKM) proposed underground development and mining program.

1.2 STUDY APPROACH

This evaluation consists of data analysis and integration of two sources of data: 1) acid base accounting of 2006-2010 LQ drill core (24 samples) and 2) multi-element ICP metals and lithology database from LQ drill core (3070 samples)

This analysis builds on prior geochemical characterization studies conducted in order to define AML controlling and correlating factors for the KHSD as a whole (Altura 2008a). Altura conducted a review of static testing data from site-wide geochemical sampling conducted during 1995 to 1996 on weathered rock dump and pit samples. Key geochemical and field diagnostic factors that appear to either control or correlate to the generation of net acidity and/or metal leaching in the Keno Hill rock suite were applied in order to predict the relative proportions of potentially AML (P-AML) and non-AML (N-AML) rock. The available ABA and ICP geochemistry data were reviewed to assess the applicability of existing waste rock segregation and management protocol are appropriate for the LQ deposit. This study employed similar methodologies and is compared with, and builds on, the geochemical characterization of the Bellekeno Zone (Altura 2008b) in order to confirm that the waste rock management system currently used by Alexco at the Bellekeno mine (QML-0009 Waste

Rock Management Plan, submitted Nov. 2009) is an appropriate management strategy at the LQ deposit.

2. METHODOLOGY

All data for this report were provided by AKHM. Data was complied and, for statistical analysis purposes, results below minimum limits of detection were assigned a value of one half of the detection limit. Results above the maximum limits of detection were assigned a value equal to the detection limit. Statistical analysis and data manipulation was carried out using Excel and XLStat software.

Samples in the 3070 sample waste rock drillhole database were analyzed via 27 element ICP-OES or 49 element mixed ICP-OES and ICP-MS methods and included sulphur. During 2009, 329 samples were analyzed by Ecometrix Incorporated of Mississauga, Ontario and were not analyzed for sulphur. Acid base accounting (ABA) samples were tested via modified ABA methods including sulphate via both sodium carbonate leach and HCl digestion, total inorganic carbon via coulometer, and paste pH at a 1:1 solid to water ratio. All other chemical analyses were conducted by ALS Chemex Labs in North Vancouver, BC or AGAT Labs of Mississauga, Ontario.

Lithologies for each sample were determined by AHKM geologists during routine core logging and sampling. Specific lithologies (schists and quartzites) are intercalated with secondary lithologies over the scale of centimeters to meters. Thus, reported lithology over a specific interval represents only the primary lithology and could contain a significant proportion of a secondary lithology. Two lithology codes including ICQS (Interbedded Carbonaceous Quartzite and Schist) and TQTZT (Thin Bedded Quartzite) are reported which reflect specific intervals of mixed lithology.

Determination of mineralized samples, which were assigned the lithology code "VN" (Vein) was conducted by using a geochemical query with a criteria based on a metal content for either Pb or Zn > 5000 ppm. Samples which were designated as mineralized vein or "VM" in the lithology log had Pb and Zn less than 5000 ppm but were redesignated as VN for ease of analysis. A single sample designated in the lithology log as mineralized stringer, or "SM" but having < 5000 ppm Pb and Zn was also redesignated as VN. Three samples designated as fault, or "FLT" were not mineralized by the Pb/Zn criteria, and because original lithology was unknown, these samples were not included in the analysis.

3. OVERVIEW OF LUCKY QUEEN ROCK

3.1 GEOLOGY AND MAJOR ROCK TYPES

The KHSD is comprised principally of Yukon Group metasedimentary rocks, which are described in the Keno Hill Silver District Environmental Conditions Report (Access Consulting Group, 2011).

In summary, the metasedimentary rocks have been divided locally into three formations; Upper Schist, Central Quartzite and Lower Schist. The Upper Schist (Hyland Group, pre-Cambrian to Cambrian age) consists of quartz-mica schist, quartzite, graphitic schist and minor limestone. The

Central Quartzite (Keno Hill Quartzite, Mississippian age) contains thick-and thin-bedded quartzite, massive quartzite, graphitic phyllite, graphitic schist and calcareous schist. This unit is approximately 700 m (2300 ft) thick and hosts most of the major silver deposits in the area. The Lower Schist includes graphitic schist, argillite, thin-bedded quartzite, calcareous schist, phyllite, slate, sericite schist and minor thick-bedded quartzite. Conformable greenstone (altered diorite/gabbro) lenses and sills occur in places and narrow lamprophyre and quartz-feldspar porphyry dykes occur locally. Granite bodies have intruded the metasedimentary – greenstone package at several places to the north and south of the Keno Hill – Galena Hill area.

The LQ deposit is located on the northern side of Keno Hill near to the top. It is hosted within massive quartzites and interbedded carbonaceous schists and quartzites sitting stratigraphically immediately above the Lower Schist contact. Stratigraphic units correlative across the structure show a dip-normal separation of approximately 30-35 m.

Principal rock units in order of predominance at the LQ deposit are quartzite, schist, and thin bedded quartzite. Mineralogical and compositional variation is seen especially in the quartzites and schists, which is broken into sublithologies. Although more significant at other deposits within the district, greenstones form only a very minor part of the LQ deposit being represented by less than 1% of total samples. A brief overview description of the major lithology types is summarized below from Boyle (1962), Altura (2008b) and Access (2011).

Quartzite (QTZT): Is the dominant unit at LQ, occurs both as thin and thickly bedded sequences with assemblages of schist. Quartzites are comprised primarily of quartz but also contain some mica carbonate minerals and carbonaceous material. Accessory minerals include leucoxene, tourmaline, zircon, apatite, and pyrite.

Schist (SCH): The majority of the schist within LQ is graphitic schist (GSCH), but trace sericite schist (SSCH), chlorite schist (CHSCH) as well as undifferentiated schist have also been observed. As previously discussed, interbedded carbonaceous quartzite and schist (ICQS) and thin bedded quartzite (TQTZT) are also included as their own lithologies, but are predominantly composed of schist.

Graphitic schists are black or dark gray due to their significant carbon content, and occur in beds from millimetre to many meters in scale intercalated with quartzites and other lithologies. In addition to graphite, quartz, mica, carbonates, feldspar, chlorite, isotropic colloidal material and pyrite metacrysts have been identified in thin sections.

Sericite and chlorite schist are usually pale and dark green, respectively. Thin sections of sericite schists show primarily quartz and sericite with trace carbonate minerals and leucoxene. Accessory minerals include apatite, zircon, tourmaline and pyrite metacrysts.

Vein (VN): Economic mineralization in LQ occurs in irregular shoots within vein fault systems. Dilation and subsequent development of economic mineralization is favoured in the more brittle (quartzite and greenstone) units, and where there is a contrasting rheology on each side of the vein fault. Dilation and economic mineralization is usually not well developed in the more ductile schists and phyllites.

At least two stages of mineralization have been identified in the KHSD. The first stage is associated with quartz, pyrite and arsenopyrite and sulphosalts. This earlier stage is associated with elevated gold concentrations. The second stage of mineralization (which comprises the majority of the economic mineralization in the KHSD) is associated with deposition of siderite galena, sphalerite, pyrite, freibergite and pyrargyrite, quartz, pyrite and small amounts of other sulphides (e.g. chalcopyrite).

The LQ vein structure has an average strike of approximately 43 degrees azimuth, with local variations ranging from 25 to 60 degrees, and an average dip of around 45 degrees to the south. The main structure has a strike length, as defined by drilling, of approximately 650 m and is open along the strike to both the northeast and southwest. Mineralized zones are largely composed of brecciated wallrock, siderite (± limonite), vein quartz and ore minerals including, silver sulphosalts, galena, sphalerite and native silver. Minor primary minerals present include arsenopyrite and pyrite.

3.2 ELEMENTAL CHARACTERIZATION.

ICP metals data from the 3,070 samples in the drillhole database were characterized and described according to the major lithologic units. Table 1 shows the distribution of samples according to lithology in the LQ drillhole database. Only three lithologies (quartzite, graphitic schist, and thin-bedded quartzite) represent 1% or greater of the total samples. Lithologies represented by less than 1% of the total samples were deemed to be insignificant and were not included subsequent analysis.

Table 1. Samples in the Lucky Queen Drillhole Database by Lithology

Lithology		Number of Samples	Rel. Freq. per Category (%)
Description	Code		
Calcareous Quartzite	CQTZT	28	0.9
Chloritic Schist	CHSCH	9	0.3
Graphitic Schist	GSCH	398	13.0
Greenstone	GNST	29	0.9
Interbedded Carbonaceous Quartzite and Schist	ICQS	29	0.9
Phyllite	PHY	21	0.7
Quartzite	QTZT	2110	68.7
Schist, Undifferentiated	SCH	24	0.8
Sericitic Schist	SSCH	11	0.4
Thin-bedded Quartzite	TQTZT	279	9.0
Vein	VN	132	4.3
	Total	3070	100

The three primary lithologies mentioned above account for almost 91% of all the LQ database samples. The remaining lithologies represent less than 1% each of all the samples, with the exception of vein (4.3%) which is already assumed to be mineralized and will be mined. Lithologies with less than 30 samples (or 1% of total) were not included in subsequent analysis.

The distribution of the remaining three major rock lithologies (GSCH, QTZT, TQTZT) and VN according to mineralized/non-mineralized designation are shown in Table 2.

Table 2. Distribution of Selected Samples by Mineralized/Non-Mineralized

Lithology				
Description	**Code**	**Number of Non-Mineralized Samples**	**Number of Mineralized Samples (>5000 ppm Pb or Zn)**	**Total**
Graphitic Schist	GSCH	377	5	382
Quartzite	QTZT	1812	22	1834
Thin-bedded Quartzite	TQTZT	275	4	279
Vein	VN	80	28	108
	Total	2544	59	2603

A number of elements exceeded the method detection limit (MDL) for the standard ICP metals suite and were not run for ore grade or overlimit analyses. Samples over the method detection limits of As >10,000 ppm, Cd > 1000 ppm and Mn > 100,000 ppm were present mainly in samples assigned as VN, but also appear in a few other lithologies for As and Cd. Three samples exceeded MDL for Cd and were designated as mineralized. Six samples exceeded MDL for As, with 5 of these samples VN and one QTZT. The presence of these samples in the dataset will have a minor effect of underestimating the true statistical measurements for these elements, but will not have any effect on the efficacy of the geochemical screening criteria in identifying samples with high Cd and As as P-AML.

3.2.1 Results

Statistical measures of geochemistry are contained in Appendix A1. Analysis for selected elements of interest in the LQ drillhole database are summarized below. Box plots of these selected elements are shown according to lithology and mineralized versus non-mineralized in Appendix A2.

Quartzite makes up 68.7% of all the samples in the LQ database. Within the quartzite samples the concentrations of the elements of interest are as follows:

- Aluminum content in QTZT ranges from 0.1% to 10.45% with a mean of 1.56% and median of 0.83%. The 25th percentile is 0.43% and the 75th percentile is 2.03%.

- Arsenic content of the samples ranges from below the detection limit (<1 ppm) to a single value exceeding the MDL of 10,000 ppm. The next highest As content value was 7020 ppm. The median value is 8 ppm with a 25th percentile at 2.5 ppm and a 75th percentile at 17 ppm.
- Barium ranged from a minimum of 10 to maximum of 2000 ppm, with a median of 130 and mean of 243. The 25th percentile is 70 and the 75th percentile is 319.
- Calcium content ranges from below the detection limit of <0.01% (per 100g) to the maximum value 18.2%. The 25th percentile is at 0.1% and the 75th percentile is 0.9%, while the median value is 0.3%
- The amount of cadmium within the samples ranged from below the lowest detection limit of <0.02 ppm to six samples with contents exceeding the MDL of 1000 ppm. The 25th percentile for cadmium is 0.25 ppm and the median is 0.5 ppm[1]. The 75th percentile is 2.5 ppm.
- Magnesium content ranged between below detection limit (> 0.01%) up to a maximum value of 9.7%. The median value of the samples is 0.1% with the 25th percentile at 0.04% and the 75th percentile at 0.3%.
- The amount of manganese ranged from 20 ppm to 100,000 ppm with a 25th percentile of 112 ppm and a 75th percentile of 826 ppm. The median value is 206 ppm.
- Iron content ranged from a minimum value of 0.21% to a maximum value 25.7%. The 25th percentile is 0.66% and the 75th percentile is 1.78% with a median value of 1.1%
- Lead content within the samples ranged from below the detection limit of >2 ppm and the maximum concentration was 302,900 ppm. The 25th percentile is 6 ppm and the 75th percentile is 82 ppm, with median value of 16 ppm.
- As previously discussed sulphur was not analyzed on all of the samples. There are 1834 sulphur results of the 2110 quartzite samples. The amount of sulphur in the samples ranged from below the detection limit of >0.005% to a maximum value of 6.1%. The 25th percentile is 0.03% and the 75th percentile is 0.38% with a median value of 0.14%.
- Zinc content ranged from values that are below the detection limit of >2ppm to 96,300 ppm. The 25th percentile is 35 ppm and the 75th percentile is 221 ppm. The median value is 72 ppm.

Graphitic schist makes up 13% of all the samples in the LQ database. Within the graphitic schist samples the concentrations of the elements of interest are as follows:

- Aluminum content in GSCH varies between 0.19% and 11.15%. 25th percentile is 4.0% and third quartile is 7.1% with a mean of 5.5% and median of 5.8%.
- Arsenic content ranges from values below the detection limit of <2 ppm to a maximum value of 2330 ppm. The 25th percentile is 11 ppm and 75th percentile is 28 ppm with a median value of 18 ppm.
- Barium varies between a minimum of 30 ppm and a maximum of 8470. Mean and median Ba values are 814 ppm and 730 ppm, respectively, with 25th percentile of 500 ppm and 75th percentile of 978 ppm.

[1] Detection limits for cadmium ranged from <0.02 ppm to <1.0 ppm, which means both the 25th percentile and the median values are below detection values. 45% of all the cadmium samples were below a detection limit with 94% of those having a detection limit of <0.5 ppm. For the purposes of calculating statistics all values reported as below detection limit were considered to equal half the detection limit.

- The minimum value for the element calcium is 0.02% and the maximum value is 6.9%. The 25th percentile is 0.37% and the 75th percentile 1.35%. The median value for calcium is at 0.73%.
- Cadmium content had a minimum value that is below the detection limit, <0.5 ppm, and a maximum of 658 ppm. The 25th percentile and the median value are both 0.25ppm[2] with a 75th percentile value of 104 ppm.
- The percentage of magnesium per 100g in the samples ranged from values below the detection limit of <0.01% to a maximum value of 1.98%. The median value is 0.41%. The 25th percentile is 0.26% and the 75th percentile is 0.63%.
- Manganese content ranges from 49 ppm to 54,400 ppm with a median value of 252 ppm. The 25th percentile is 167 ppm and the 75th percentile is 998 ppm.
- Iron content ranges from 0.31% to 12.4% with the 25th percentile at 2.3% and the 75th percentile at 3.7%. The median value is at 3.0%.
- Lead content ranges from below the detection limit of <1.0 ppm to the maximum value of 139,500 ppm. Lead samples have a 25th percentile of 13 ppm and a 75th percentile of 38 ppm. The median value is 19 ppm.
- There are 382 graphitic schist samples with sulphur results of the 398 total graphitic schist samples. The sulphur content in this lithology ranges from below the detection limit <0.1% to a maximum value of 3.6%. The 25th percentile is 0.13% and the 75th percentile is 1.3% with a median value of 0.6%.
- Zinc content ranges from 13 ppm to 57,300 ppm with the 25th percentile at 77 ppm and the 75th percentile at 170 ppm. The median value is 109 ppm.

Thin bedded quartzite makes up 9% of all the samples in the LQ database. Within the thin bedded quartzite samples the concentrations of the elements of interest are as follows:

- Aluminum in TQTZT varies between a minimum of 0.3% and a maximum of 7.4%. Mean and median values for Al are 1.6 % and 0.8%, respectively with 25th percentile of 0.8% and 2.0%.
- Arsenic content ranges from below the detection limit of <5.0 ppm to a maximum value of 445 ppm. The 25th percentile is 4 ppm and 75th percentile is 21 ppm with a median value of 8 ppm.
- Barium ranged between 20 and 2380 ppm with a median of 130 and mean of 244 ppm. 25th percentile was 70 and 75th percentile value was 470.
- Calcium content within the samples ranges from below the detection limit of <0.01% to a maximum value of 8.3%. The 25th percentile is 0.1% and the 75th percentile is 1.0% with a median value for calcium at 0.4%
- Cadmium content had a minimum value that is below the detection limit, <0.5 ppm, and a maximum of 210 ppm. The 25th percentile is 0.25ppm[3]. The median value is 0.7 ppm and the 75th percentile is 3.65 ppm.

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[2] Detection limits for cadmium for all the graphitic schist samples is <0.5 ppm and 50% of all the graphitic schist samples have values that were below this detection limit. For this reason the 25th percentile and the median are both half the value of the detection limit. For the purposes of calculating statistics all values reported as below detection limit were considered to equal half the detection limit.

[3] Detection limits for cadmium for all the thin bedded quartzite is <0.5 ppm and 31% of all the thin bedded quartzite samples have values that were below this detection limit. For this reason the 25th percentile is half the value of the detection limit. For the purposes of calculating statistics all values reported as below detection limit were considered to equal half the value of that samples detection limit.

- Magnesium content ranges from below values below the detection limit of <0.01% to a maximum value of 2.1%. The median value is 0.2% with a 25th percentile of 0.1% and a 75th of 0.3%.
- The amount of manganese in the samples ranges from 26 ppm to 30,000 ppm with a 25th percentile of 167 ppm and a 75th percentile of 1065 ppm. The median value is 285 ppm.
- Iron content ranges from 0.27% to 7.0% with a 25th percentile of 1.0% and a 75th percentile of 2.0%. The median value is at 1.5%.
- Lead content ranged from values below the detection limit of <1.0 ppm and the maximum concentration of 2600 ppm. The 25th percentile is 10 ppm and the 75th percentile is 112 ppm with a median value of 18 ppm.
- Sulphur was analyzed for all thin bedded quartzite samples. The content range was between a minimum value that was below the detection limit of <0.005% to a maximum value of 3.5%. The 25th percentile is 0.01% and the 75th percentile is 0.6% with a median value of 0.3%.
- Zinc ranged from values that were below detection limit of 6 ppm to a maximum value 14,494 ppm. The 25th percentile is 50 ppm and the 75th percentile is 323 ppm. The median value is 91 ppm.

Vein makes up 4.2% of the total samples. Within the VN lithology samples, the concentrations of the elements of interest are as follows:

- Aluminum in VN ranges between 0.16% and 6.64% with 25th percentile of 0.34% and 75th percentile of 1.2%. Mean and median values area 0.99% and 0.50%, respectively.
- Arsenic varies between a below detection limit of less than 1 ppm to 5 samples exceeding the maximum MDL of 10,000 ppm. Mean and median values are 617 ppm and 22 ppm, respectively. 25th percentile is 7 ppm and 75th percentile 94 ppm.
- Barium ranges between a minimum of 20 ppm and a maximum of 1280 ppm. The median value for Ba in VN is 105 ppm and the mean value is 198 ppm. The first and third quartile range is between 70 ppm and 265 ppm.
- Calcium varies in VN between 0.02% and a maximum of 8.74%. The median value is 0.33% with a first to third quartile range of 0.14% to 0.94%.
- Cadmium ranged between a minimum of 0.01 ppm with 2 samples exceeding a maximum MDL of 1000 ppm. The first quartile value was 4.55 ppm and third quartile was 41.55 ppm with a median of 11.05 ppm.
- Iron content varied between 0.37% and 19.5%. The first to third quartile range was 1.38% to 6.26% with a median of 2.86%.
- Magnesium in VN varied between 0.01% and 2.21%. The first to third quartile range was between 0.10% and 0.38% with a median of 0.20%.
- Manganese content ranges between a minimum of 43 ppm and a maximum of 82,800 ppm. The first quartile is 2,470 ppm and the third quartile is 19,200 ppm. Mean is 14,136 ppm and median is 6,580 ppm.
- Sulphur varies between a minimum of 0.008% and a maximum of 10.0%. The first quartile is 0.32% and the 3rd quartile is 1.05% with a median of 0.588% and a mean of 1.163%.

When categorized by mineralized versus non-mineralized samples, the following elemental patterns are observed:

- Aluminum varies between 0.1% and 11.1 % in non-mineralized samples and between 0.14% and 6.6% in mineralized samples. The first to third quartile range was between 0.5% and 3.03% in non-mineralized samples and between 0.30% and 0.66%. Median values were 1.24% in non-mineralized and 0.36% in mineralized samples.
- Arsenic was between 1 ppm to 5 samples exceeding the MDL of 10,000 ppm in non-mineralized samples. The first to third quartile range was between 4 ppm and 21 ppm in non-mineralized samples and between 13 ppm and 61 ppm in mineralized samples. Median values were 10 ppm in non-mineralized and 22 in mineralized samples, respectively.
- Barium ranged between 20 ppm and 1280 ppm in mineralized samples, and between 10 ppm and 8470 ppm in non-mineralized samples. The first to third quartile range for non-mineralized samples was between 88 ppm and 480 ppm in non-mineralized samples and between 50 ppm and 110 ppm in mineralized samples. The median Ba value for non-mineralized samples was 199 ppm and 80 ppm in mineralized samples.
- Calcium showed a minimum of 0.005% and maximum of 18.2% in non-mineralized samples and a minimum of 0.01% and maximum of 8.74% in mineralized samples. The first to third quartile range was between 0.05% and 0.31% in mineralized samples and between 0.1% and 0.94% in non-mineralized samples. Median values were 0.31% in mineralized samples and 0.36% in non-mineralized samples, respectively.

3.2.2 Discussion

Aluminum content is lowest in VN and highest in GSCH. Aluminum is likely contained primarily within aluminosilicate sheet silicates such as muscovite and other micas. As expected of a lithology composed of the two end members, the population of TQTZT samples have aluminum contents which are between GSCH and QTZT but are closer to QTZT since QTZT is the dominant lithology.

Arsenic content within the thin bedded quartzite and quartzite samples have similar medians and quartile ranges, while graphitic schist has a higher median with a narrower quartile range. The mineralized population of arsenic samples had a higher arsenic content than non-mineralized but had similar quartile ranges. The source of the higher arsenic within the VN is believed to be due to the presence of arsenopyrite within the mineralized vein material, while the slightly elevated median As within GSCH is part of a broader pattern of slight elevation of metals observed within the carbon rich reducing depositional basin environment in which the GSCH formed.

A number of VN lithology samples (5) exceeded MDL for As (>10,000 ppm) were identified as non-mineralized because of their only moderately elevated base metal contents. These samples considerably skewed the As concentrations in the non-mineralized samples, which results in a higher mean than the mineralized samples.

Barium shows a similar pattern to aluminum with VN having the lowest concentrations, GSCH the highest and TQTZT having intermediate concentrations between QTZT and GSCH. This pattern suggests an association between Barium and organic carbon, or possibly an association with the aluminosilicates (micas).

Calcium content for all three lithologies has a similar distribution as the medians and quartile ranges are similar. Similar results are seen when calcium is spilt into mineralized and non-mineralized. Samples that are mineralized have a slightly lower median percentage and narrower range compared to non-mineralized samples. This is in contrast to Bellekeno and Onek where calcium is generally more abundant away from the veins and mineralized areas.

Cadmium within the three lithologies tended to be low, as 47% of all the samples were below detection limit. 25th quartile values for all three lithologies were below the detection limit and median values were either below the detection limit or just above. Mineralized and VN samples have much higher cadmium content that those samples that are non-mineralized. This is explained by the association of cadmium with sphalerite which is found almost exclusively within VN and in samples identified as mineralized.

Magnesium content in all lithologies including VN is very similar as the medians and quartile ranges are all within a very narrow spread. Graphitic Schist tends to be slightly higher that thin bedded quartzite and quartzite. Classification of magnesium for mineralization found that the mineralized and non-mineralized populations had similar quartile ranges and medians.

Similar to magnesium, manganese contents in all three lithologies have very similar medians and quartile ranges for the three rock lithologies. However, samples classified as mineralized and VN lithology have much higher manganese content than non-mineralized. The manganese in these units is primarily believed to be associated with siderite which forms a major portion of the gangue mineralogy.

Graphitic Schist generally has a higher iron content that the thin bedded quartzite and quartzite lithologies. The median and quartile range of iron in graphitic schist is higher than those of thin bedded quartzite and quartzite both of which have very similar medians and ranges. Mineralized and VN samples have a higher median value of iron content and wider distribution of quartile values compared to those that are non-mineralized. Within the non-mineralized and non VN lithologies, iron is likely associated with minor disseminated pyrite and may also be associated with some iron containing micas (e.g. chlorite). As with the manganese, the iron in VN and mineralized samples is likely associated with siderite and to a lesser degree, iron sulphides (pyrite, arsenopyrite).

The median lead content for all three rock lithologies is very similar (range 16 ppm to 19 ppm) but quartzite and thin bedded quartzite lead contents have wider range of results compared to graphitic schist. 50% of the quartzite samples are between (6 to 82 ppm) contrasted to graphitic schist, which has a much smaller range (13 to 38 ppm). Mineralized samples and VN have a significantly higher median and quartile range compared to non-mineralized samples due to the association with galena in the mineralized fault zones.

The content of sulphur within thin bedded quartzite and quartzite were very similar as the median values and quartile ranges are very close to each other. Graphitic schist samples had a wider quartile range and higher median value compared to the other lithologies. Mineralized and VN samples showed a higher median and wider range quartile for the mineralized population while non-mineralized samples had a low median value and smaller quartile range. The presence of VN samples which are not designated as mineralized and contain low sulphur concentrations is somewhat distinct from the data observed for Onek and Bellekeno, where the sulphur in VN and mineralized samples are always distinctly higher than in unmineralized rock lithologies.

The median zinc values for the three lithologies are similar however the quartile ranges for quartzite and thin bedded quartzite are larger than that for graphitic schist. The population of samples that are mineralized and VN have a significantly higher median and quartile values for zinc content compared to those that are non-mineralized. A uniform zinc overprint of approximately 100 ppm is observed over all non vein lithologies. A number of elements show a significantly higher mean than median values because of a few samples with extremely anomalous results. These elements include Cd, Mn, As, Zn and Pb. These elements are all strongly associated with mineralized zones (as opposed to unmineralized country rock) and it is thought that the highly anomalous samples might be associated with mineralized stringers in country rock at some distance from the major vein structures.

The analysis of data from two of the major LQ rock units (quartzite, and thin bedded quartzite) show that these units have generally low sulphur (<0.5%). GSCH has slightly higher sulphur values relative to the quartzite dominated units. Despite having generally low sulphur and generally low metal contents, non mineralized and non-VN rock lithologies nonetheless show occasional anomalous results.

3.3 ACID BASE ACCOUNTING

The principal object of ABA testing is to provide quantitative determination of the balance between acid producing and acid consuming minerals contained within geologic materials. The ratio of neutralization potential to maximum potential acidity (NP/MPA) values reported from ABA testing data (N=24) was available the three major lithologies present at Lucky Queen. The distribution of ABA samples according to lithology is shown in Table 3.

Table 3. Distribution of ABA Samples in the Lucky Queen Dataset

Lithology		Number of ABA Samples	# of Calculated ABA Samples
Description	Code		
Graphitic Schist	GSCH	2	382
Quartzite	QTZT	13	1834
Thin-bedded Quartzite	TQTZT	9	279
	Total	24	2495

3.3.1 Results

Acid base accounting summary statistics are presented in Appendix B1 and in Appendix B2. relationships between lithologies and between mineralized/unmineralized samples for ABA results are shown.

Neutralizing Potential

A strong correlation between %Ca and %CO_2 versus NP was noted in the Bellekeno geoenvironmental characterization (Altura, 2008b) especially when considering only unmineralized samples, and excluding VN and GNST lithologies. In the case where significant dolomite or Mg bearing carbonates are known to exist, the correlation can be improved by comparing [Ca+Mg] with NP. Plots showing the relationships between bulk NP and a number of potential ICP data correlations (Ca, Mg, [Ca+Mg], and CO_2) for the Lucky Queen dataset are shown on Figure 1.

The best correlation observed correlation was between Ca and NP (Figure 1). This allowed calculation of neutralizing potential based on Ca% [NP_{Ca}]. The derived relationship between Ca and NP was:

$$NP_{Ca} = 28.523(\%\ Ca) + 2.603$$

In the data presented by Altura 2008b for Bellekeno, and in the accompanying geochemical characterization study for Onek (Access 2011a) the correlation with calcium did not work for mineralized (VN) samples because the bulk NP was higher than the linear correlation due to the abundance of siderite (Fe_2CO_3) in vein material. In the case of GNST, bulk NP was much lower than the linear correlation because significant non-neutralizing Ca exists within calcic silicates such as hornblende, actinolite and other amphiboles. None of the ABA samples at LQ were either VN or GNST, but the experience from Bellekeno and Onek recommends against applying the calcium-NP correlation on these lithologies. As previously mentioned GNST is a minor lithology consisting of less than 1% of total samples so was not included in the analyses, and all vein material, even if not the host of economic mineralization is assumed to be P-AML.

This relationship indicates that calcium carbonate is likely the primary source of neutralizing potential, and was used to calculate NP_{Ca} for the ICP data for all three major rock lithologies. Box plots showing bulk NP and NP_{Ca} per lithology are shown in Figure 2.

Figure 1. Relationship between Calcium, Magnesium and Carbonate with NP

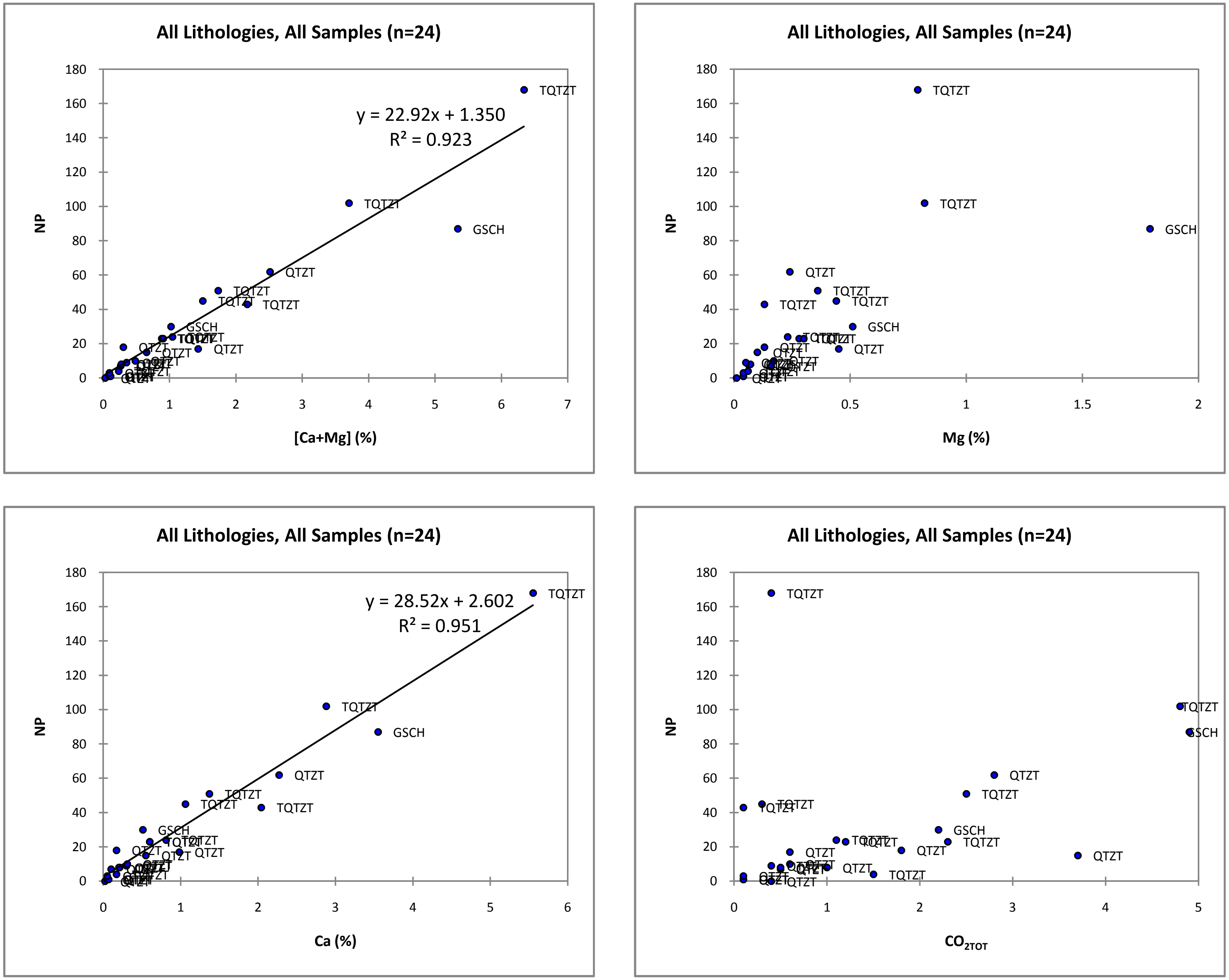
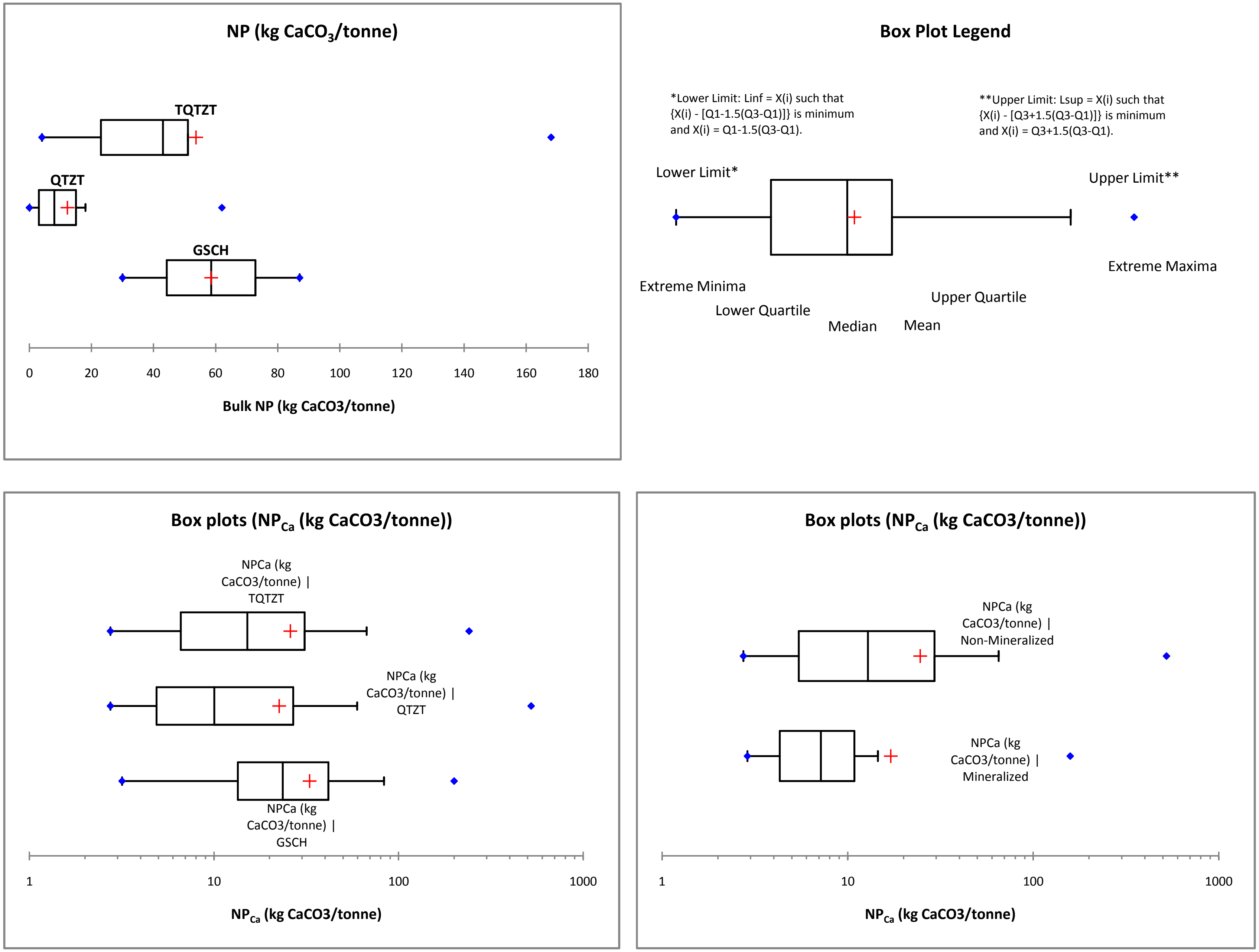


Figure 2. NP Box Plots



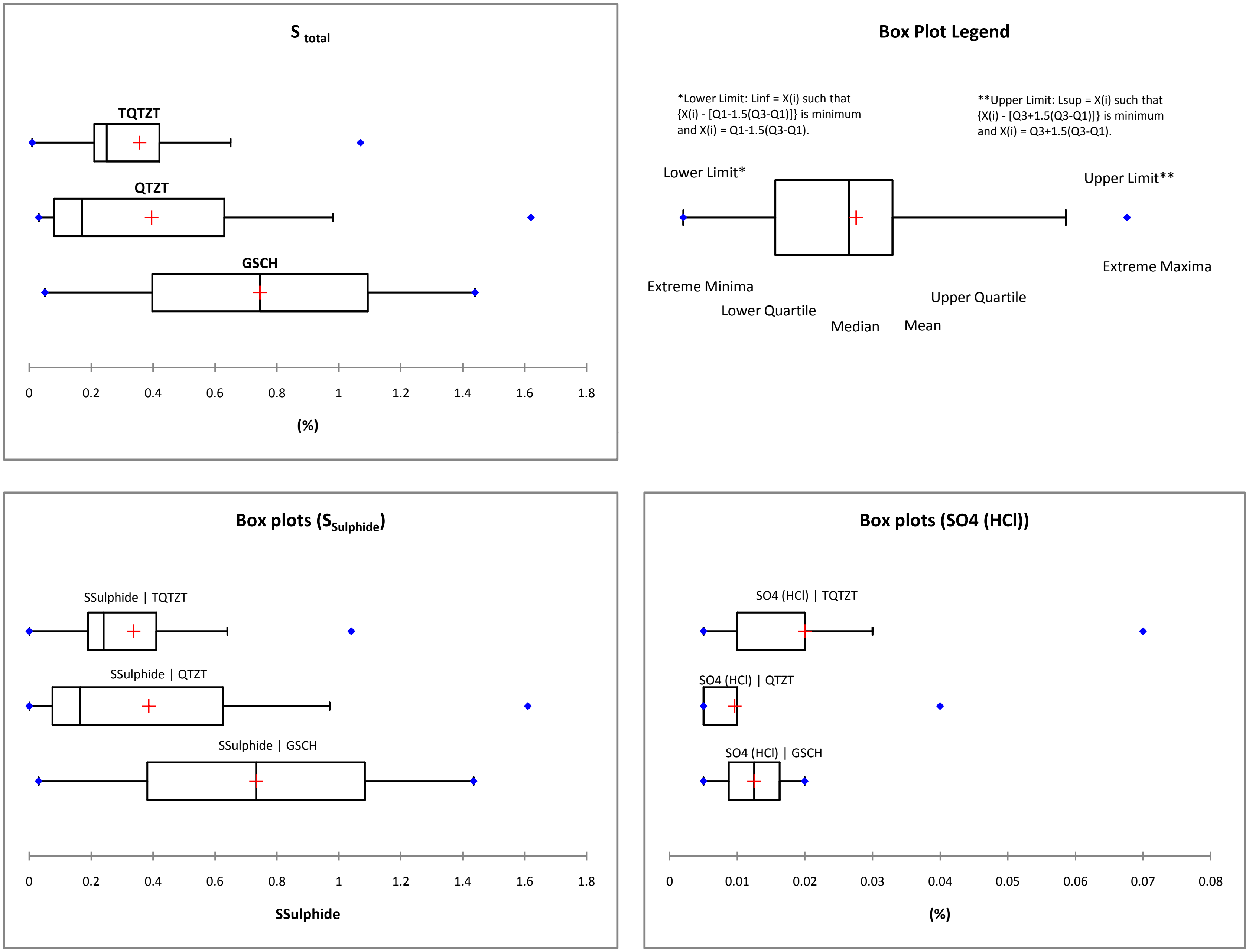
The 2495 calculated NP_{Ca} samples showed a greater minimum-maximum range by lithology as expected in a much larger sample set. First to third quartile ranges were generally similar but there were some distinct differences from the bulk NP data. QTZT, which showed the lowest first to third quartile range of between 3 and 15 in the bulk NP data, was higher in NP_{Ca} with a first to third quartile range of between 4.9 and 26.9. In contrast, both GSCH and TQTZT showed lower first to third quartile ranges in the NP_{Ca} data. The general pattern in both datasets showed GSCH with the highest NP values and QTZT with the lowest with TQTZT between the QTZT and GSCH. VN was not represented in the bulk NP dataset and could not be calculated using the correlation because of the previously discussed issue with siderite.

Sulphur Species and Maximum Potential Acidity (MPA)

Sulphur content and speciation is an important determining factor affecting the potential for generation of acidity. Sulphur occurs in various forms in rock including potentially acid generating sulphide, and sulphate which is generally not acid generating. MPA in the ABA dataset was calculated by multiplying the % sulphur as sulphide by 31.25. Box plots showing selected results for sulphur speciation are shown in Figure 3.

From the 24 sample ABA data set, total sulphur ranged between 0.01% and 1.62% in the rock lithologies. The highest median total sulphur value was observed in GSCH, the lowest in QTZT with TQTZT in between. Sulphate sulphur via HCl leach (sulphate via sodium carbonate leach was not conducted on any of the LQ data) varied from between below detection limit (0.01%) and 0.07% for rock lithologies. The median value was highest in GSCH, lowest in QTZT and intermediate in TQTZT. It was noted that at Onek (Access 2011b) and at Bellekeno (Altura 2008b), the sulphate via HCl leach seemed to be less sensitive than the carbonate leach, with significantly more samples below detection limit. The use of only HCl leach will result in greater underestimation of the % sulphur as sulphate at LQ, which will in turn overestimate the % sulphur as sulphide, as sulphide sulphur is calculated as the total sulphur – sulphate sulphur. This effect results in potentially over-estimated MPA values in the ABA dataset, assuming sulphate sulphur is non-acid generating and is considered to be conservative for determining the actual MPA.

Figure 3. Selected Sulphur Speciation Box Plots

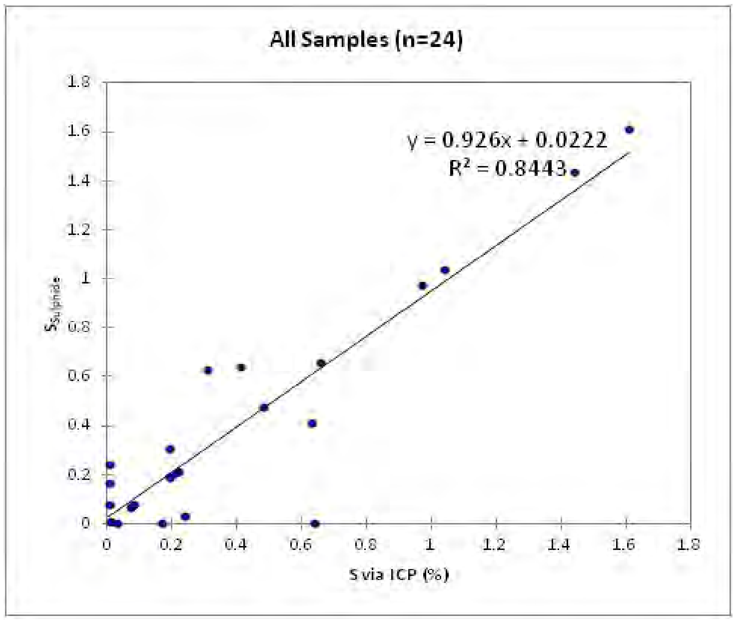


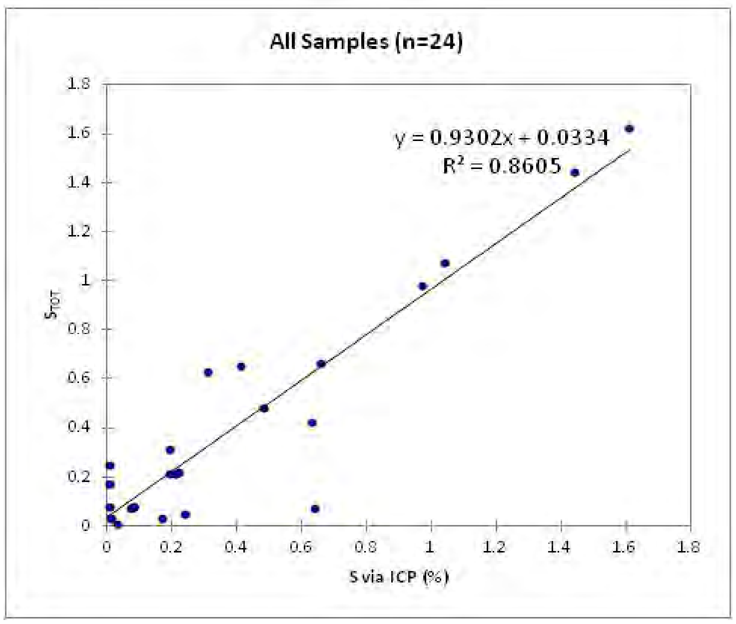
As a percentage of total sulphur, sulphate via HCl leach as a percentage of total sulphur has a median of 3% QTZT, a median of 4% in TQTZT, a median of 20% in GSCH. Maximum percentages exceeded 100%, especially in GSCH, indicating that more sulphur was measured as sulphate by the HCl leach than was measured as total sulphur via the Leco furnace. Although the data did not allow comparison between mineralized and unmineralized samples because all ABA samples were non-mineralized, data from Bellekeno and Onek show the total percentage of sulphate is much lower (<1% of total sulphur) in vein material and mineralized rock.

The significance of insoluble barite ($BaSO_4$) and anglesite ($PbSO_4$) was considered in the Onek geochemical characterization (Access 2011b) for the potential of these minerals, if present, to interfere with the results. This investigation concluded that in spite of fairly significant barium and lead contents, the effect that this might have on underestimating sulphate in these minerals is conservative (correcting for this effect would decrease MPA) and the effect would likely not be significant. LQ has similar to slightly lower levels of barium and significantly lower base metals than Onek, indicating that this effect would also not be significant at LQ.

As noted by Altura 2008b for Bellekeno and by Access 2011b at Onek, a very good correlation between total sulphur via Leco and sulphur via ICP was observed. Plots showing the relationship between sulphur measurements for LQ are shown in Figure 4 and agree with the observations made for Bellekeno and Onek. The correlation coefficient in the relationship between S via ICP and Total S via Leco is 0.861, which is lower than the relationship observed in the Bellekeno and Onek data, but is also based on fewer samples. As discussed in Section 3.3, MPA is determined based on the calculated difference between total sulphur via Leco and total sulphate (via carbonate or HCl leach). This is assumed to be sulphide sulphur and is multiplied by 31.25 in order to determine MPA in kg $CaCO_3$/tonne. In order to extend the MPA data to the ICP sulphur measured values, S via ICP was compared with the available calculated S as sulphide from the ABA database. Although a significant percentage of the total sulphur measured in the S via ICP can be expected to be present as non potential acid generating sulphate, MPA values were conservatively calculated assuming that S via ICP was present as 100% S as sulphide.

Figure 4. Sulphur Correlations





Neutralization Potential Ratio (NP/MPA)

Box Plots showing NP/MPA ratios are shown in Figure 5. NP/MPA ratios from the ABA dataset show QTZT with the lowest median of 1.2 (N=13). GSCH has the highest median NP/MPA ratio of 10.6 (N=2) with TQTZT at 3.2 (N=9). When considering the NP/MPA ratios calculated from the ICP data, the opposite order is observed. Median NP/MPA_{ICP} values are lowest for GSCH at 1.66 and highest in QTZT at 3.31 with TQTZT intermediate at 2.25. In addition to the limitations imposed by the small number of ABA samples available for some lithologies (particularly GSCH), a significant reason for this large discrepancy is explained by the much larger proportion of S_{TOT} as $S_{sulphate}$ observed in GSCH even though MPA values were calculated for the ICP data without any correction factor for sulphate.

MEND (2009) suggests that samples with NP/MPA greater than 2 are non-potentially acid generating provided no significant errors have been made in the estimation of effective NP and AP. Altura (2008b) states that it is common industry practice to infer that samples with NP/MPA of greater than 3:1 are unlikely to produce net acidity with no further testwork or study. It is felt that the usage of an NP/MPA ratio of >3:1 for geologic materials as being unlikely to produce net acidity represents a conservative means of classification for the KHSD.

Table 3 and Table 4 show the distribution of samples from LQ according to NP/MPA range from the ABA and calculated ABA datasets, respectively. A total of 9 of the 24 or 37.5% of samples from the ABA dataset have NP/MPA ratios of >3, indicating minimal potential for net acidity. Three samples had a NP/MPA ratio of between 2 and 3, so 50% of samples have NP/MPA ratios of >3. A total of 1178 of 2495 samples, or 47% of the calculated ABA database had NP/MPA ratios of >3. 60% of samples have NP/MPA of >2.

As was observed in the Onek dataset, slightly higher NP/MPA ratios are expected in the ABA dataset because of the conservative usage of total S via ICP to calculate MPA without any sulphate subtraction factor. The opposite is observed at LQ, which is thought to be a result of skewing by insufficient sample numbers, particularly for GSCH.

Figure 5. Box Plots for NPNP/MPA

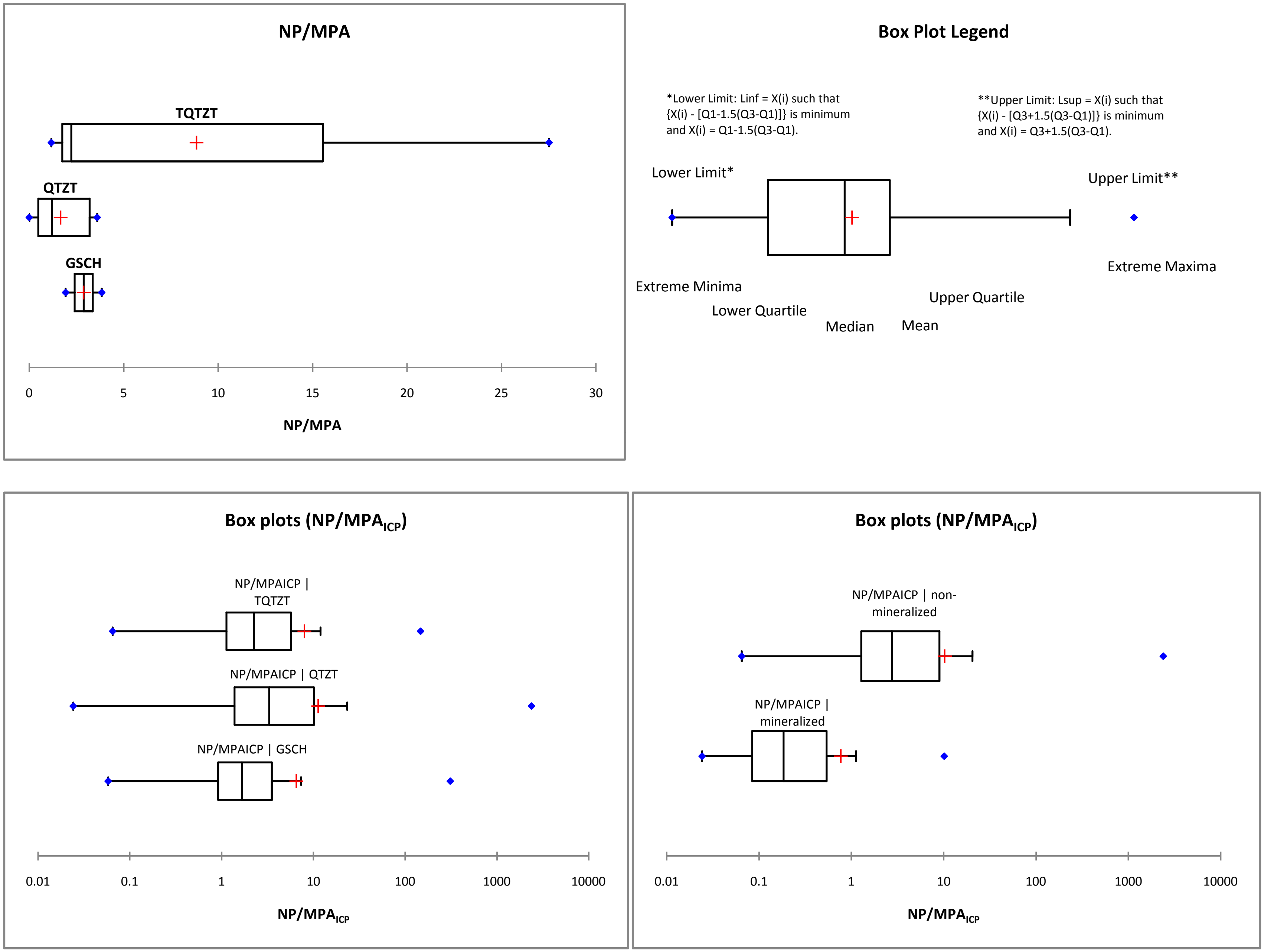


Table 4. Distribution of NP/MPA Samples in Lucky Queen Dataset

Lithology		NP/MPA				
Description	**Code**	**< 1**	**1 to 2**	**2 to 3**	**> 3**	**Total**
Graphitic Schist	GSCH	-	1	-	1	2
Quartzite	QTZT	5	2	2	4	13
Thin-bedded Quartzite	TQTZT	-	4	1	4	9
	Total	5	7	3	9	24

Table 5. Distribution of Calculated NP/MPA Samples in Lucky Queen Dataset

Lithology		NP_{Ca}/MPA_S				
Description	**Code**	**< 1**	**1 to 2**	**2 to 3**	**> 3**	**Total**
Graphitic Schist	GSCH	108	110	55	109	382
Quartzite	QTZT	303	359	218	954	1834
Thin-bedded Quartzite	TQTZT	65	61	37	115	279
	Total	476	530	310	1178	2495

Paste pH

The 24 ABA samples ranged in paste pH from 6.7 to 8.7 with median values above 8 except for QTZT, which had a median of 7.2. This indicates that none of the rock lithologies excluding VN were producing net acidity (assuming a cut off of pH 5.5) at the time of analysis.

Fizz Rating

The fizz rating used in ABA testing is a ranking system between 1 and 4 to rate the degree of effervescence observed when 25% HCl is added to a pulverized sample. This rating is used to determine the strength of acid to utilize for the neutralizing potential titration. The limited number of samples showed that the median value for most lithologies was 2 except for TQTZT which had a median of 3.

4. DISCUSSION

4.1 EXISTING GEOCHEMICAL SCREENING CRITERIA

Altura (2008b) conducted geochemical testwork including shake flask extraction tests on 47 samples from waste rock dumps and pit wall dumps from over the KHSD. These samples were collected in 1995-1996 with an excavator but have been at the surface for up to 80 years. This study showed that net acidity and/or Pb and Zn metal leaching (AML) was associated with the following geochemical characteristics:

- Net Acidity: The two key aspects of samples demonstrating leacheate pH ≤ 5.5 are either a calcium level in the rock of ≤ 0.51% or a CO_2 level of ≤ 0.6% coupled with an ICP sulphur level of ≥ 0.25%.
- Zinc Leaching: leaching of zinc to levels ≥ 10 mg/kg appears to occur under two differing conditions: i) solubilisation of zinc under net acidic conditions independent of zinc concentration in rock, and ii) solubilisation of zinc under overall neutral to alkaline conditions where Zn concentrations in rock exceed 5000 ppm.
- Lead Leaching: leaching of lead to levels ≥ 3 mg/kg occurs only under neutral pH conditions where Pb concentrations in rock exceed 5000 ppm.

Altura 2008b indicates that direct application of the factors of ≤0.51% Ca and ≥ S via ICP results in a few samples with NP/MPA marginally above the 1 being classified into the category of having low potential for net acidity. The lower calcium threshold in the weathered site-wide dump samples was attributed to solubilisation and flushing of calcium under ambient site conditions. Altura used an adjustment factor for fresh rock samples of 1.5 to the calcium criteria increasing the Ca threshold to 0.75%. An upper threshold for sulphur of 1.5% was also recommended to ensure that high sulphur samples are classified as being P-AML regardless of calcium content.

The geochemical screening criteria to identify P-AML rock, based on review of the Bellekeno ABA dataset and the district wide AML study were presented in Altura 2008b:

a) Ca% ≤ 0.75% and S via ICP ≥ 0.25%
b) Or S via ICP ≥ 1.5%
c) Or Pb ≥ 5000 ppm
d) Or Zn ≥ 5000 ppm

These criteria form the basis for the predictive waste rock classification system and geochemical verification which forms the basis of the Waste Rock Management Plan. Due to the generally similar stratigraphy and style of mineralization present at LQ the ARD/ML controlling and correlating factors derived therein should be applicable, even though the site wide ARD/ML correlation study did not include samples from LQ waste rock. The conservative adjustment used in the WRMP to increase the Ca% by a factor of 1.5 (from 0.5 to 0.75%) for fresh rock samples should also be valid for Lucky Queen.

4.2 ESTIMATED PROPORTIONS OF P-AML AND N-AML WASTE ROCK AND REVISED SCREENING CRITERIA FOR LUCKY QUEEN

The geochemical screening criteria were applied to the Lucky Queen ICP 2495 sample database in order to identify P-AML samples. QTZT shows the lowest percentage of samples indicated as P-AML at 20%, while GSCH, is 38% P-AML and TQTZT is intermediate at 30%.

The estimated proportions of P-AML material are somewhat similar to Bellekeno where QTZT was 22% P-AML and GSCH was much higher at 65% P-AML. In contrast with Onek, the schist lithologies at LQ exhibit higher proportions of P-AML and the QTZT lithologies exhibit lesser proportions of P-AML rock. This is explained partly at LQ in that in spite of higher median calcium levels, median sulphur levels in GSCH is significantly higher than QTZT. Median MPA in the non-mineralized LQ dataset (6.7 kg CaCO3/23one) is similar to that observed at Bellekeno in non-mineralized samples (5.6 kg CaCO3/23one) but median NP is much lower (17.5 kg CaCO3/23one compared with 55 kg CaCO3/23one at Bellekeno).

A reasonable similarity is expected between the proportion of samples identified using NP/MPA ratios as having minimal potential for the generation of net acidity and the proportion of samples identified as non-AML. At LQ, significantly greater percentage samples are identified as non-AML than percentage of samples above an NP/MPA ratio of 3, or even 2. This means that the application of the geochemical screening criteria would result in a significant number of samples identified as non-AML would have NP/MPA ratios below 2 or be in the "uncertain" range in terms of the potential for the generation of net acidity. The dissimilar proportions can be explained primarily by the generally lower NP observed at LQ, where samples which have S via ICP of less than 0.25 and also have minimal NP are not flagged as P-AML but have NP/MPA ratios of less than 2.

Although the district wide AML controlling and correlating factors and screening criteria derived by Altura (2008a) are believed to be effective at LQ, site specific minor modifications to make the screening criteria more conservative are deemed necessary. The rationale for these changes includes:

1. The district wide AML controlling and correlation factors study (Altura 2008a) did not include samples from Lucky Queen;
2. the significant discrepancy between percentage of samples identified as P-AML and identified as "uncertain" with respect the potential to generate net acidity as indicated by NP/MPA ratios; and,
3. uncertainty associated with the limited number of existing available ABA data from LQ.

It was found that lowering maximum % S via ICP in criterion (a) of the P-AML geochemical screening criteria from 0.25% to 0.15% resulted in an effective capture of samples which had low sulphur but also low calcium and identified these samples as P-AML. Based on this adjustment to the District WRMP the revised geochemical screening criteria proposed for LQ are as follows:

a) Ca% ≤ 0.75% and S via ICP ≥ 0.15%
b) Or S via ICP ≥ 1.5%
c) Or Pb ≥ 5000 ppm
d) Or Zn ≥ 5000 ppm

The proportion of samples identified as P-AML according to the revised geochemical screening criteria is shown in Table 7.

Table 6. Lucky Queen P-AML Samples Identified using Revised Geochemical Screening Criteria

Lithology		Number of Samples	# of P-AML Samples	% of P-AML Samples
Description	Code			
Graphitic Schist	GSCH	382	163	43%
Quartzite	QTZT	1834	633	35%
Thin Bedded Quartzite	TQTZT	279	115	41%

4.3 LUCKY QUEEN SITE SPECIFIC FIELD SCREENING CRITERIA

Field screening criteria to identify P-AML waste rock derived from both the Bellekeno geoenvironmental characterization study (Altura 2008b). Based on the revised geochemical screening criteria for identifying LQ P-AML rock presented above the maximum visual pyrite should be reduced to > 0.3% in samples with low neutralizing potential. The revised LQ field screening criteria for P-AML rock would then be as follows:

a) Slight or no effervescence of pulverized sample with 25% HCl (e.g. presence of none or only a few bubbles), and visual estimated pyrite >0.3%, or;

b) Any sample with one or more of the following:
   a. Visual estimated sphalerite >0.75%
   b. Visual estimated galena > 0.5%
   c. Visual estimated pyrite >2%
   d. Any vein material not deemed to be "mineralized"
   e. Paste pH ≤ 6.0

Subject to this change, the field screening criteria are considered to be valid for LQ. Field screening criteria are subject to minor revision as necessary in response to routine geochemical (ICP and ABA) testing which is also part of the Waste Rock Management Plan.

5. CONCLUSIONS

The relationships between ABA parameters and geochemical parameters included in the ICP metals database enabled extension of the database to included a much larger sample set and helped improve the understand the mineralogical controls on buffering and allow a more robust verification and minor modification of geochemical and field screening parameters which help form the basis of the waste rock segregation program.

The geology and style of mineralization at Lucky Queen shares a number of key similarities with the Bellekeno deposit. The deposits occur within the same major lithologic unit and share the same major rock lithologies, and while some differences exist, the style of mineralization is similar. As such, the geochemical and geoenvironmental characteristics of the rocks share a number of significant similarities. The WRMP, subject to the minor changes to geochemical and field screening criteria, is anticipated to be effective for waste rock characterization and management at Lucky Queen.

Analysis of the Lucky Queen dataset indicated that while much of the rock is unlikely to produce net acidity and/or metal leaching, a significant proportion is indicated to be P-AML. The following key distinctions between Lucky Queen and Bellekeno are presented below:

- A higher overall proportion of samples at LQ are indicated by ABA testing and geochemical screening criteria as P-AML when compared with Bellekeno.
- The Lucky Queen deposit contains generally lower base metal concentrations (especially zinc) than the Bellekeno deposit, both within the veins and in the surrounding country rock, leading to less likelihood of metal leaching from these materials.
- While sulphur content and NPA is similar at Lucky Queen, calcium content and NP is significantly lower than Bellekeno.

Additional ABA sampling will be conducted as part of the geochemical verification of the WRMP will help to refine the understanding of sulphur speciation and MPA where the existing sampling is not well represented. Alexco may also wish to collect additional ABA samples during early phases of development and initial operations in order to better understand sulphur speciation and MPA potential especially within the graphitic schist unit. This additional information may allow the geochemical and field screening criteria for identifying P-AML to be relaxed at LQ.

The WRMP has demonstrated effectiveness at the Bellekeno mine for accurate identification, segregation, operational management and geochemical verification of waste rock. The site specific modifications to the screening criteria proposed herein are expected to ensure its efficacy at LQ. It is expected that aspects of the Waste Rock Management Plan may require minor modification in response to the feedback mechanisms featured within the WRMP. This operational responsiveness will assist with the efficacy of waste rock management at LQ and other mines within the district.

6. CLOSURE

We trust this report meets your current needs. If you have any questions or if we can be of further assistance, please contact the undersigned at (867) 668-6463.

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8. ATTACHMENTS

Appendix A1 – A2

Appendix B1 – B2

By Lithology

Statistic	Pb (ppm) | GSCH	Pb (ppm) | QTZT	Pb (ppm) | TQTZT	Pb (ppm) | VN	Zn (ppm) | GSCH	Zn (ppm) | QTZT	Zn (ppm) | TQTZT	Zn (ppm) | VN	Al (%) | GSCH	Al (%) | QTZT	Al (%) | TQTZT
No. of observations	382	1834	279	108	382	1834	279	108	382	1834	279
Minimum	1.000	1.000	1.000	6.000	13.000	2.000	6.000	13.300	0.190	0.100	0.270
Maximum	139500.000	302900.000	2600.000	238500.000	57300.000	96300.000	14500.000	84700.000	11.150	10.450	7.400
1st Quartile	13.000	6.000	10.000	183.000	77.000	33.000	49.500	405.750	3.993	0.433	0.815
Median	19.000	12.000	18.000	598.500	107.500	63.450	90.700	977.000	5.755	0.830	1.450
3rd Quartile	35.000	53.000	111.500	2517.500	159.000	175.500	322.500	2450.000	7.050	2.030	2.290
Mean	659.124	622.554	129.831	9023.635	506.007	363.218	461.990	5033.821	5.520	1.567	1.769
Variance (n-1)	64233747	104246192	90669	1131587246	10799422	7286633	1983311	159544964	5	3	2
Standard deviation (n-1)	8014.596	10210.102	301.112	33639.073	3286.247	2699.376	1408.301	12631.111	2.307	1.689	1.248

Statistic	Al (%) | QTZT	Al (%) | TQTZT	Al (%) | VN	As (ppm) | GSCH	As (ppm) | QTZT	As (ppm) | TQTZT	As (ppm) | VN	Ba (ppm) | GSCH	Ba (ppm) | QTZT	Ba (ppm) | TQTZT	Ba (ppm) | VN
No. of observations	1834	279	108	382	1834	279	108	382	1834	279	108
Minimum	0.100	0.270	0.160	2.000	0.500	0.500	0.500	30.000	10.000	20.000	20.000
Maximum	10.450	7.400	6.640	2330.000	10000.000	445.000	10000.000	8470.000	2000.000	2380.000	1280.000
1st Quartile	0.433	0.815	0.340	12.000	2.500	4.000	7.000	500.000	70.000	150.500	70.000
Median	0.830	1.450	0.500	18.000	8.000	8.000	22.000	730.000	130.000	290.000	104.500
3rd Quartile	2.030	2.290	1.205	28.000	18.300	20.500	94.000	977.500	319.250	470.000	265.000
Mean	1.567	1.769	0.985	39.423	65.533	24.655	617.216	814.039	243.761	354.104	197.593
Variance (n-1)	2.852	1.557	1.174	22206.793	206071.832	2946.554	4576840.794	553094.206	66346.514	78523.899	48848.262
Standard deviation (n-1)	1.689	1.248	1.083	149.019	453.951	54.282	2139.355	743.703	257.578	280.221	221.016

Statistic	Al (%) | VN	As (ppm) | GSCH	As (ppm) | QTZT	As (ppm) | TQTZT	As (ppm) | VN	Ba (ppm) | GSCH	Ba (ppm) | QTZT	Ba (ppm) | TQTZT	Ba (ppm) | VN	Ca (%) | GSCH	Ca (%) | QTZT
No. of observations	108	382	1834	279	108	382	1834	279	108	382	1834
Minimum	0.160	2.000	0.500	0.500	0.500	30.000	10.000	20.000	20.000	0.020	0.005
Maximum	6.640	2330.000	10000.000	445.000	10000.000	8470.000	2000.000	2380.000	1280.000	6.920	18.200
1st Quartile	0.340	12.000	2.500	4.000	7.000	500.000	70.000	150.500	70.000	0.380	0.080
Median	0.500	18.000	8.000	8.000	22.000	730.000	130.000	290.000	104.500	0.735	0.260
3rd Quartile	1.205	28.000	18.300	20.500	94.000	977.500	319.250	470.000	265.000	1.368	0.850
Mean	0.985	39.423	65.533	24.655	617.216	814.039	243.761	354.104	197.593	1.063	0.698
Variance (n-1)	1	22207	206072	2947	4576841	553094	66347	78524	48848	1	1
Standard deviation (n-1)	1.083	149.019	453.951	54.282	2139.355	743.703	257.578	280.221	221.016	1.051	1.151

By Lithology

Statistic	Ca (%) | TQTZT	Ca (%) | VN	Cd (ppm) | GSCH	Cd (ppm) | QTZT	Cd (ppm) | TQTZT	Cd (ppm) | VN	Fe (%) | GSCH	Fe (%) | QTZT	Fe (%) | TQTZT	Fe (%) | VN	Mg (%) | GSCH
No. of observations	279	108	382	1834	279	108	382	1834	279	108	382
Minimum	0.005	0.020	0.140	0.010	0.030	0.250	0.310	0.210	0.270	0.370	0.010
Maximum	8.340	8.740	658.000	1000.000	210.000	1000.000	12.400	25.700	6.960	19.500	1.980
1st Quartile	0.140	0.140	0.250	0.250	0.250	4.550	2.293	0.630	1.015	1.383	0.263
Median	0.440	0.330	0.250	0.250	0.700	11.050	3.020	1.050	1.460	2.860	0.420
3rd Quartile	0.995	0.938	1.000	1.800	3.650	41.550	3.718	1.690	1.990	6.258	0.650
Mean	0.816	0.874	5.767	4.354	5.965	69.505	3.045	1.399	1.628	4.666	0.565
Variance (n-1)	1	2	1624	960	422	30765	2	2	1	22	0
Standard deviation (n-1)	1.127	1.361	40.296	30.981	20.545	175.399	1.247	1.452	0.928	4.718	0.451

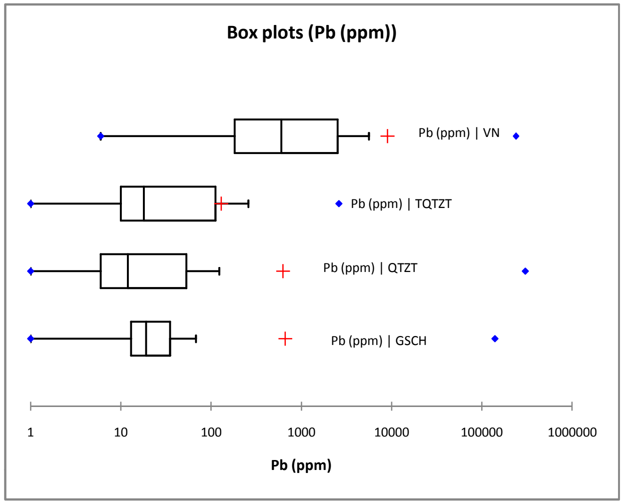
Statistic	Mg (%) | QTZT	Mg (%) | TQTZT	Mg (%) | VN	Mn (ppm) | GSCH	Mn (ppm) | QTZT	Mn (ppm) | TQTZT	Mn (ppm) | VN	S (%) | GSCH	S (%) | QTZT	S (%) | TQTZT	S (%) | VN
No. of observations	1834	279	108	382	1834	279	108	382	1834	279	108
Minimum	0.005	0.005	0.010	49.000	20.000	26.000	43.000	0.003	0.003	0.003	0.008
Maximum	9.730	2.090	2.210	54400.000	100000.000	30000.000	82800.000	3.640	6.090	3.540	10.000
1st Quartile	0.040	0.090	0.100	165.500	108.250	166.500	2470.000	0.133	0.030	0.097	0.318
Median	0.100	0.160	0.200	248.500	189.500	285.000	6580.000	0.631	0.140	0.266	0.588
3rd Quartile	0.240	0.260	0.378	910.250	601.500	1065.000	19200.000	1.298	0.380	0.587	1.050
Mean	0.212	0.225	0.353	1143.254	1462.605	1669.065	14136.926	0.793	0.281	0.409	1.163
Variance (n-1)	0	0	0	15833466	27688073	15339060	318128669	1	0	0	3
Standard deviation (n-1)	0.381	0.258	0.442	3979.129	5261.946	3916.511	17836.162	0.718	0.409	0.462	1.820

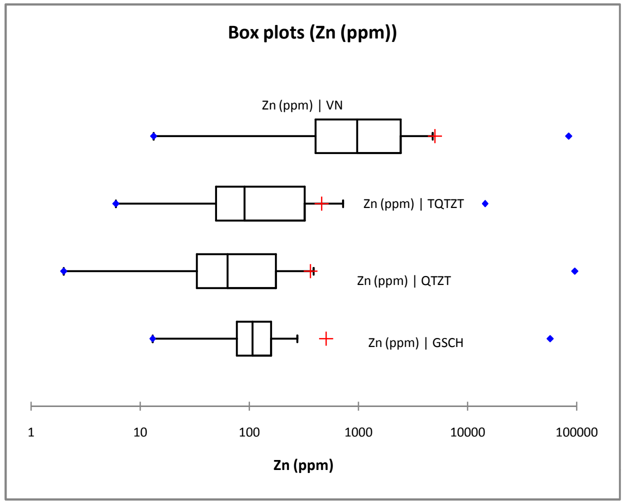
By Mineralized/Non-Mineralized

Statistic	Pb (ppm) | Mineralized	Pb (ppm) | Non-Mineralized	Zn (ppm) | Mineralized	Zn (ppm) | Non-Mineralized	Al (%) | Mineralized	Al (%) | Non-Mineralized	As (ppm) | Mineralized	As (ppm) | Non-Mineralized	Ba (ppm) | Mineralized	Ba (ppm) | Non-Mineralized	Ca (%) | Mineralized
No. of observations	59	2544	59	2544	59	2544	59	2544	59	2544	59
Minimum	58.000	1.000	129.000	2.000	0.140	0.100	1	1	30	10	0.010
Maximum	302900	4560	96300	4990	6.640	11.150	585	10000	1280	8470	8.740
1st Quartile	1485	7	2615	40	0.295	0.500	13	4	50	88	0.050
Median	6290	15	6970	78	0.360	1.240	22	10	80	199	0.140
3rd Quartile	23460	55	15250	191	0.660	3.030	61	21	110	480	0.310
Mean	36136	107	15068	253	0.800	2.176	66	81	131	342	0.687
Variance (n-1)	4637750324	108849	413217327	276982	1.414	5.023	11525	357486	35864	180811	2.247
Standard deviation (n-1)	68101	330	20328	526	1.189	2.241	107	598	189	425	1.499

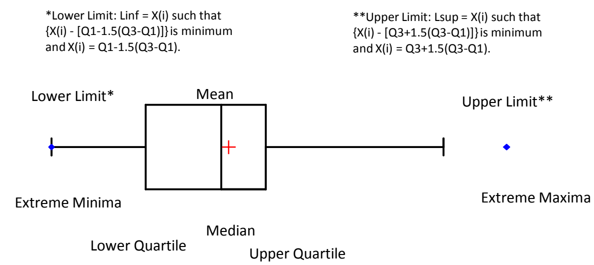
Statistic	Ca (%) | Non-Mineralized	Cd (ppm) | Mineralized	Cd (ppm) | Non-Mineralized	Fe (%) | Mineralized	Fe (%) | Non-Mineralized	Mg (%) | Mineralized	Mg (%) | Non-Mineralized	Mn (ppm) | Mineralized	Mn (ppm) | Non-Mineralized	S (%) | Mineralized	S (%) | Non-Mineralized
No. of observations	2544	59	2544	59	2544	59	2544	59	2544	59	2544
Minimum	0.005	3.200	0.010	0.600	0.210	0.010	0	459	20	0.240	0.003
Maximum	18.200	1000.000	120.000	23.100	25.700	2.200	10	96000	100000	8.510	10.000
1st Quartile	0.100	49.300	0.250	2.295	0.730	0.055	0	5515	122	0.620	0.040
Median	0.360	101.000	0.500	3.740	1.290	0.190	0	11600	215	0.960	0.180
3rd Quartile	0.940	235.000	1.900	8.470	2.210	0.420	0	27750	745	2.330	0.510
Mean	0.774	203.046	2.901	5.928	1.705	0.343	0	20227	1540	1.787	0.374
Variance (n-1)	1.303	65065.420	54.545	28.671	2.424	0.195	0	420539253	26467518	3.176	0.301
Standard deviation (n-1)	1.141	255.079	7.385	5.355	1.557	0.441	0	20507	5145	1.782	0.548

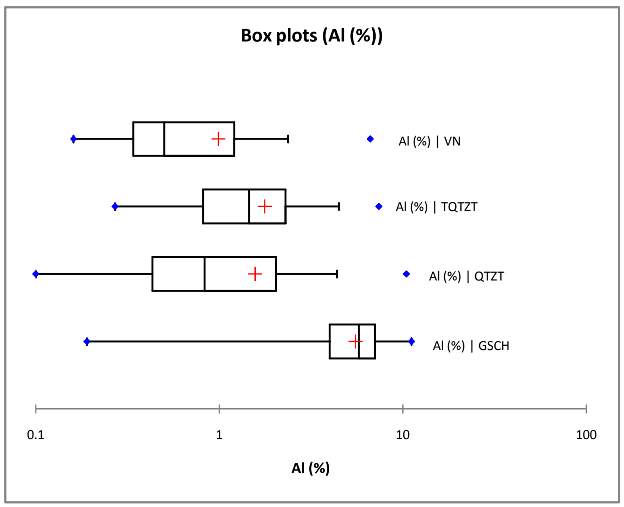
By Lithology

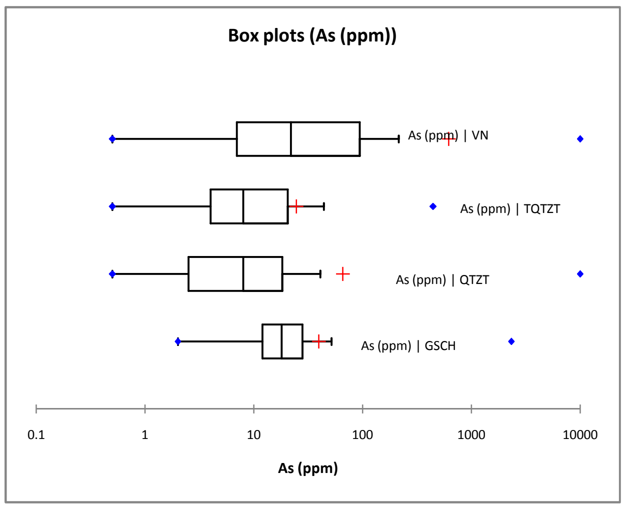


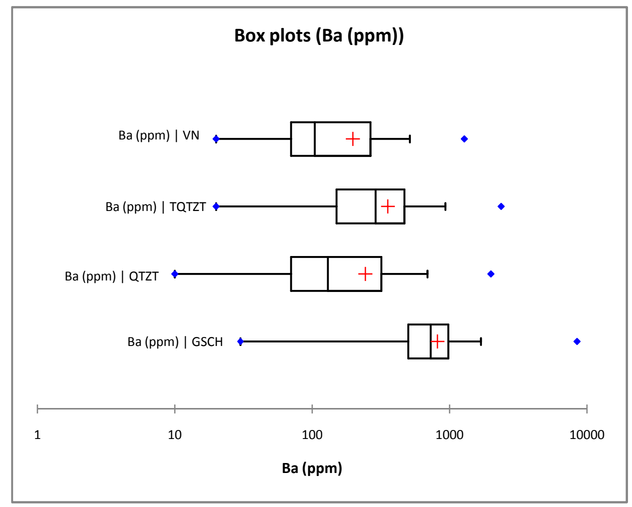


Box Plot Legend









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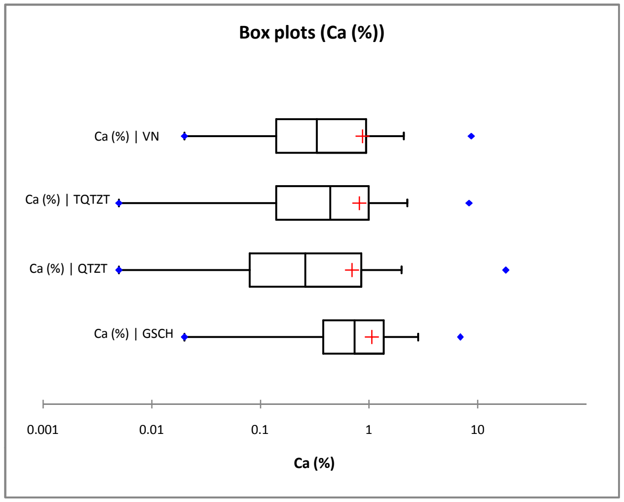
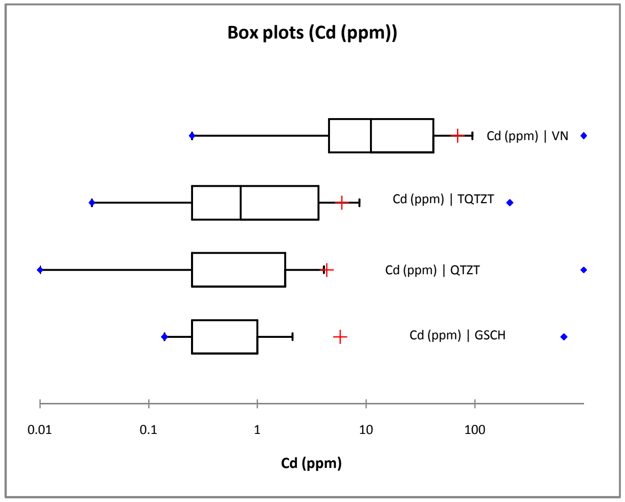
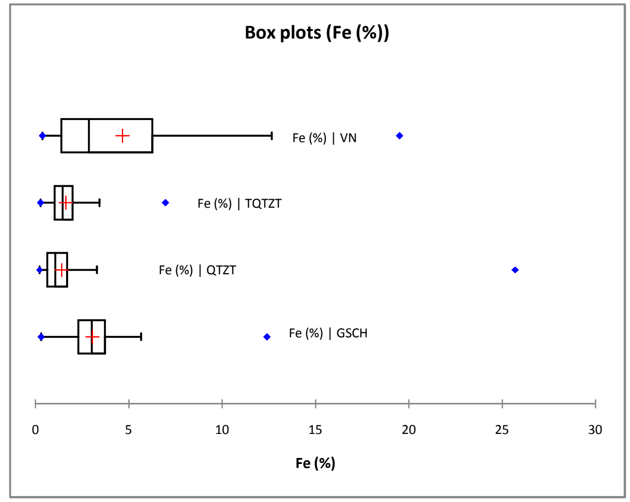
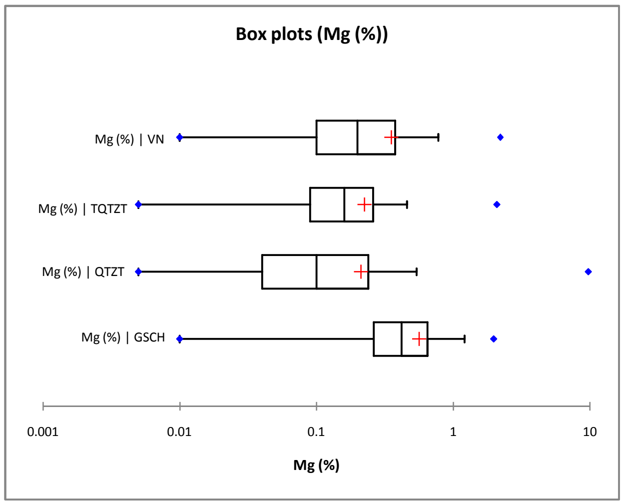
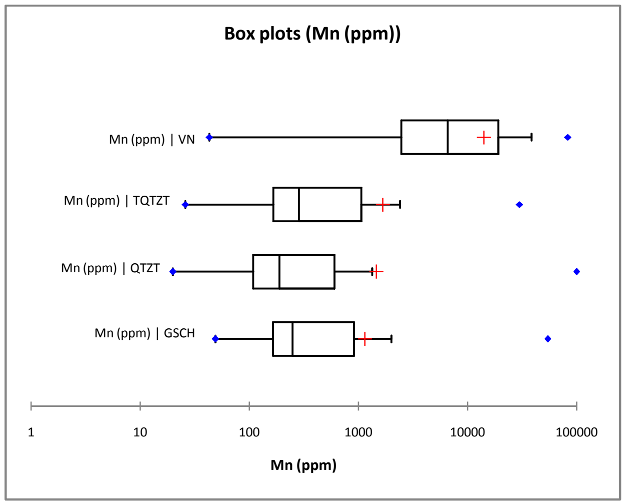
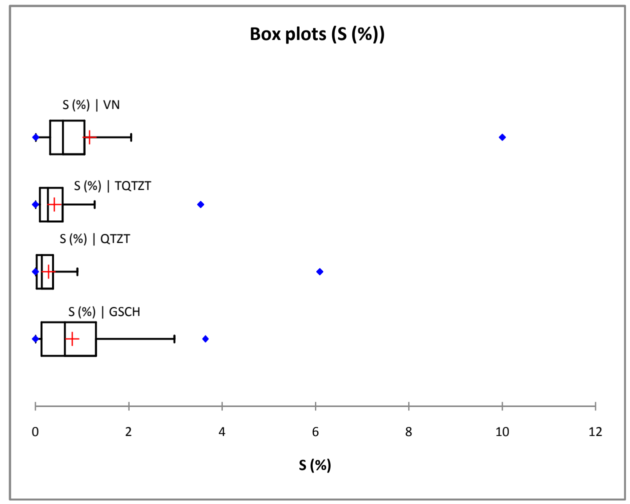




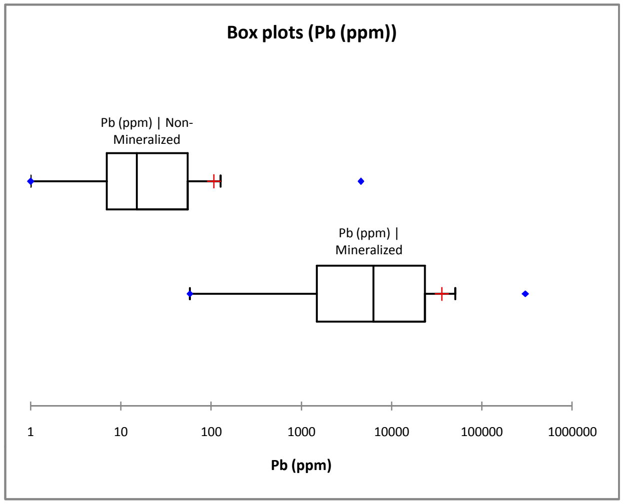


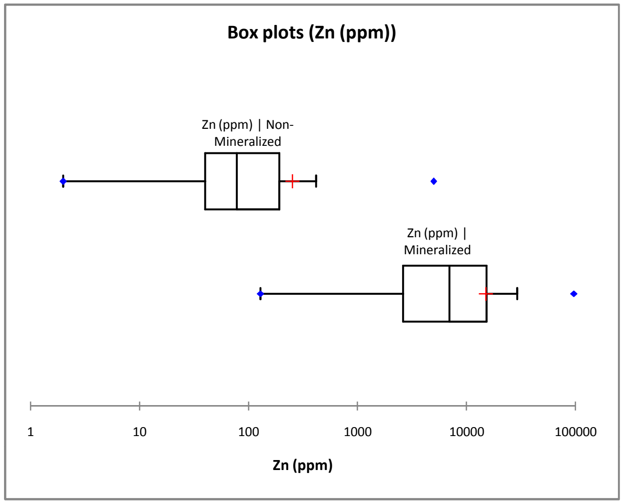


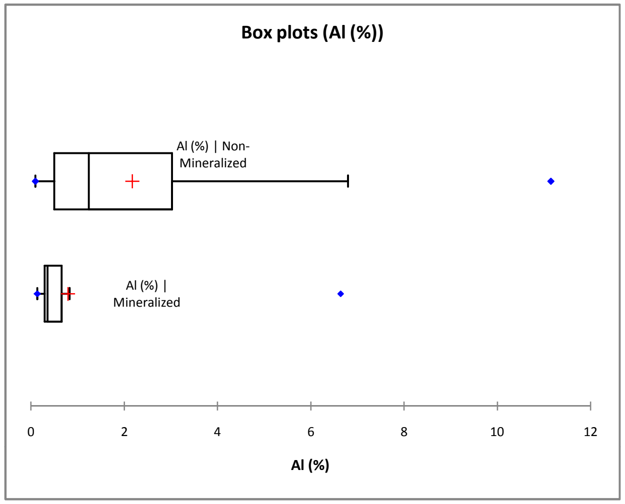


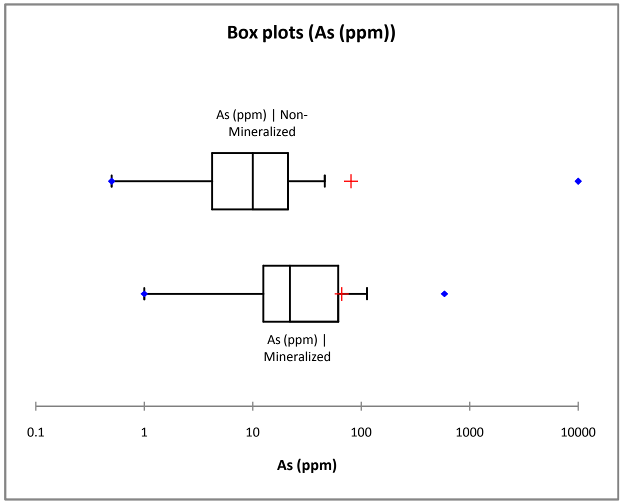


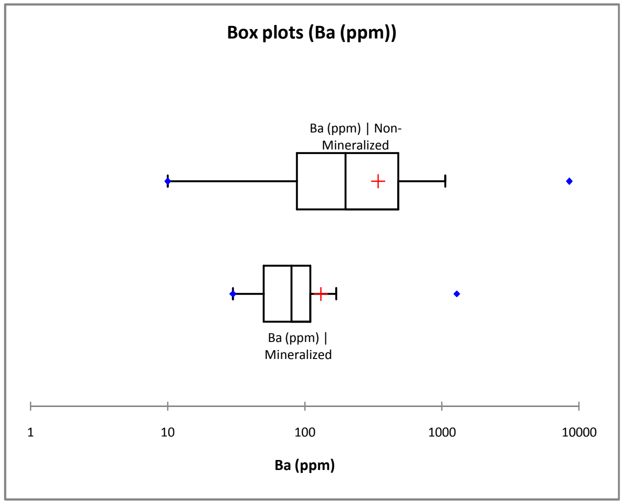
By Mineralized/Non-Mineralized

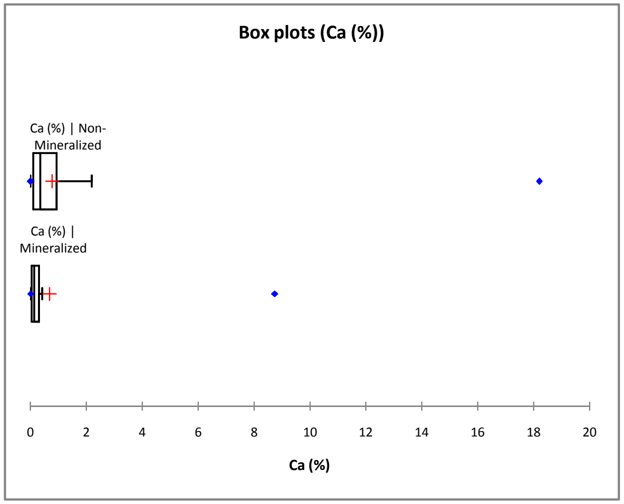




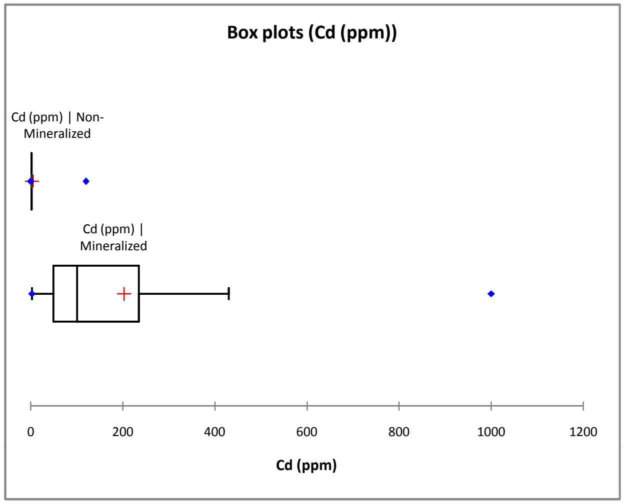


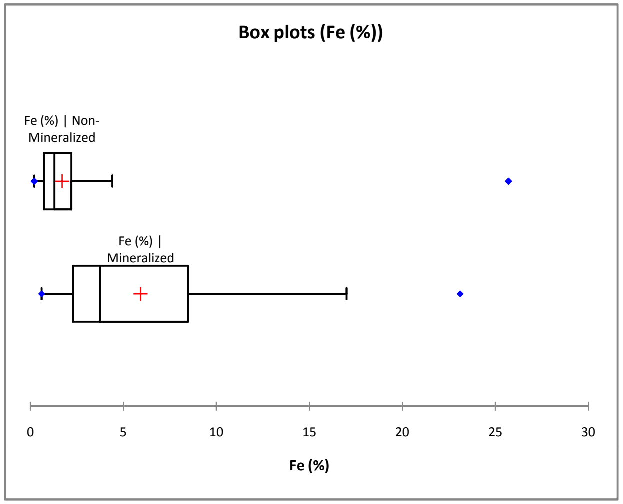


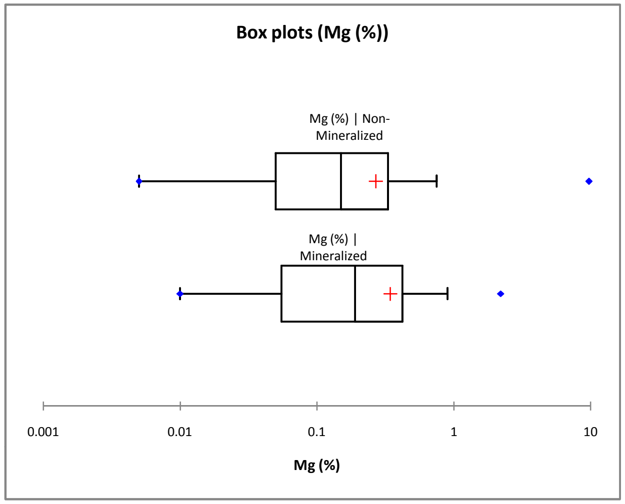


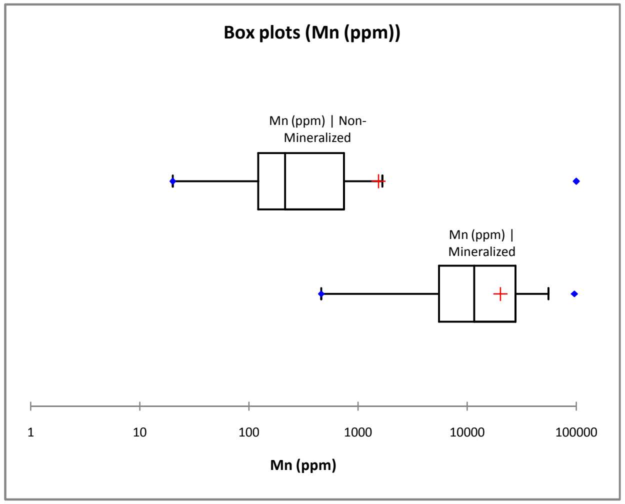


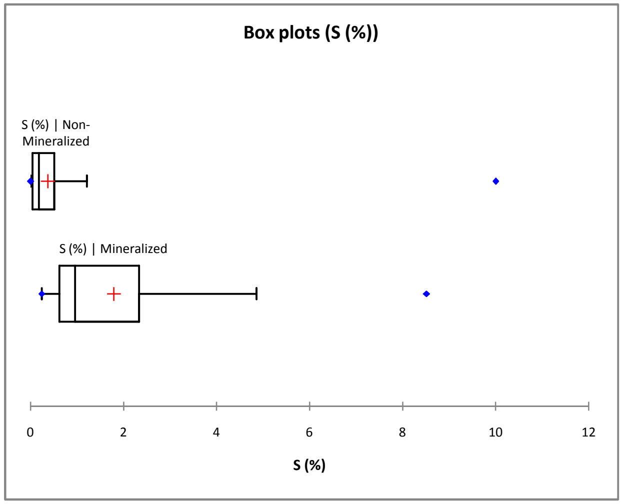
By Mineralized/Non-Mineralized











ABA Summary Statistics - By Lithology

Statistic	SO4 (HCl) | GSCH	SO4 (HCl) | QTZT	SO4 (HCl) | TQTZT	SSulphide | GSCH	SSulphide | QTZT	SSulphide | TQTZT	C_TOT | GSCH	C_TOT | QTZT	C_TOT | TQTZT	CO2TOT | GSCH	CO2TOT | QTZT	CO2TOT | TQTZT	S_TOT | GSCH	S_TOT | QTZT	S_TOT | TQTZT	NP/MPA | GSCH	NP/MPA | QTZT	NP/MPA | TQTZT	pH | GSCH	pH | QTZT	pH | TQTZT
No. of observations	2	13	9	2	13	9	2	13	9	2	13	9	2	13	9	2	13	9	2	13	9
Minimum	0.005	0.005	0.005	0.030	0.000	0.000	0.600	0.025	0.025	2.200	0.100	0.100	0.050	0.030	0.010	1.933	0.000	0.512	8.100	6.700	7.800
Maximum	0.020	0.040	0.070	1.435	1.610	1.040	1.340	1.010	1.300	4.900	3.700	4.800	1.440	1.620	1.070	19.200	3.600	137.600	8.200	8.500	8.700
1st Quartile	0.009	0.005	0.010	0.381	0.075	0.190	0.785	0.100	0.100	2.875	0.400	0.400	0.398	0.080	0.210	6.250	0.406	1.525	8.125	7.200	8.100
Median	0.013	0.005	0.010	0.733	0.165	0.240	0.970	0.140	0.330	3.550	0.500	1.200	0.745	0.170	0.250	10.567	1.200	3.657	8.150	7.600	8.300
3rd Quartile	0.016	0.010	0.020	1.084	0.625	0.410	1.155	0.260	0.620	4.225	1.000	2.300	1.093	0.630	0.420	14.883	3.200	17.342	8.175	8.200	8.600
Mean	0.013	0.010	0.020	0.733	0.386	0.337	0.970	0.260	0.427	3.550	0.969	1.578	0.745	0.395	0.356	10.567	1.622	22.182	8.150	7.669	8.311
Variance (n-1)	0	0	0	1	0	0	0	0	0	4	1	2	1	0	0	149	2	1936	0	0	0
Standard deviation (n-1)	0.011	0.010	0.020	0.993	0.478	0.329	0.523	0.307	0.401	1.909	1.123	1.472	0.983	0.477	0.327	12.209	1.337	44.005	0.071	0.560	0.302

Statistic	NP | GSCH	NP | QTZT	NP | TQTZT	NNP | GSCH	NNP | QTZT	NNP | TQTZT	FIZ_RATE | GSCH	FIZ_RATE | QTZT	FIZ_RATE | TQTZT	MPA | GSCH	MPA | QTZT	MPA | TQTZT
No. of observations	2	13	9	2	13	9	2	13	9	2	13	9
Minimum	30.000	0.000	4.000	28.438	-33.625	-3.813	2.000	1.000	1.000	1.563	0.938	0.313
Maximum	87.000	62.000	168.000	42.000	31.375	158.313	2.000	2.000	3.000	45.000	50.625	33.438
1st Quartile	44.250	3.000	23.000	31.828	-4.313	9.875	2.000	1.000	2.000	12.422	2.500	6.563
Median	58.500	8.000	43.000	35.219	2.063	17.563	2.000	2.000	2.000	23.281	5.313	7.813
3rd Quartile	72.750	15.000	51.000	38.609	5.500	42.813	2.000	2.000	2.000	34.141	19.688	13.125
Mean	58.500	12.231	53.667	35.219	-0.101	42.556	2.000	1.538	2.111	23.281	12.332	11.111
Variance (n-1)	1625	259	2604	92	214	2782	0	0	0	943	222	105
Standard deviation (n-1)	40.305	16.089	51.029	9.590	14.618	52.749	0.000	0.519	0.601	30.715	14.896	10.233

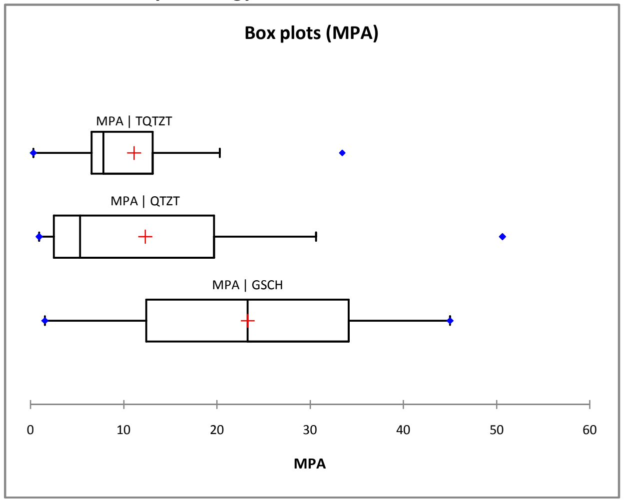
Calculated ABA Summary Statistics - By Lithology

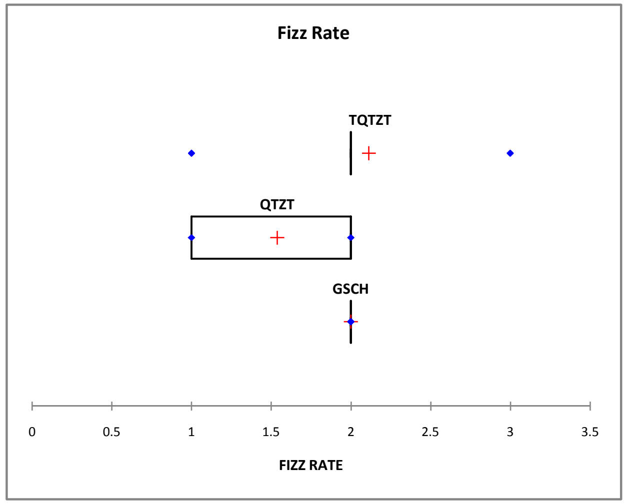
Statistic	MPAS | GSCH	MPAS | QTZT	MPAS | TQTZT	NPCa | GSCH	NPCa | QTZT	NPCa | TQTZT	NP/MPAI CP | GSCH	NP/MPAI CP | QTZT	NP/MPAI CP | TQTZT	NNPICP | GSCH	NNPICP | QTZT	NNPICP | TQTZT
No. of observations	382	1834	279	382	1834	279	382	1834	279	382	1834	279
Minimum	0.078	0.078	0.078	3.173	2.745	2.745	0.058	0.024	0.065	-107.154	-185.713	-91.764
Maximum	113.75	190.31	110.63	199.98	521.72	240.48	309.53	2385.01	147.18	150.92	521.50	228.20
1st Quartile	4.141	0.938	3.016	13.441	4.884	6.596	0.917	1.379	1.130	-2.213	2.130	1.337
Median	19.719	4.375	8.313	23.567	10.019	15.153	1.658	3.309	2.248	6.110	4.287	5.244
3rd Quartile	40.547	11.875	18.344	41.608	26.847	30.983	3.529	10.151	5.697	17.639	14.394	18.357
Mean	24.766	8.781	12.778	32.916	22.523	25.880	6.506	11.242	7.956	8.150	13.743	13.101
Variance (n-1)	504	163	209	898	1078	1034	383	4241	303	798	1113	1167
Standard deviation (n-1)	22.445	12.773	14.444	29.968	32.830	32.157	19.579	65.121	17.393	28.245	33.364	34.155

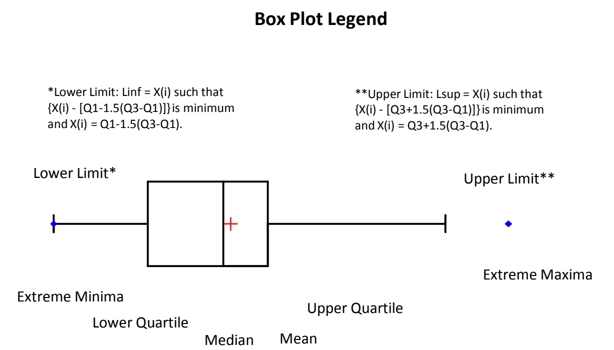
Calculated ABA Summary Statistics - By Mineralized vs Non-Mineralized

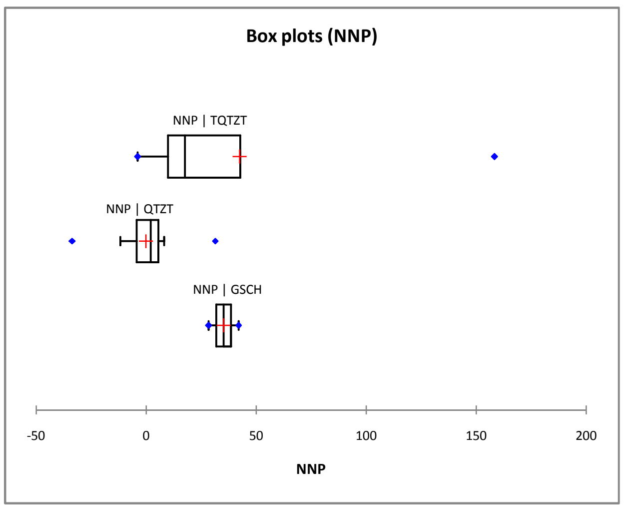
Statistic	MPAS | mineralized	MPAS | non-mineralized	NPCa | mineralized	NPCa | non-mineralized	NP/MPAI CP | mineralized	NP/MPAI CP | non-mineralized	NNPICP | mineralized	NNPICP | non-mineralized
No. of observations	31	2464	31	2464	31	2464	31	2464
Minimum	7.500	0.078	2.888	2.745	0.024	0.065	-185.713	-91.764
Maximum	190.31	110.63	158.05	521.72	10.12	2385.01	142.43	521.50
1st Quartile	18.516	1.250	4.314	5.455	0.084	1.280	-62.962	1.877
Median	35.313	5.625	7.166	12.871	0.184	2.749	-23.580	4.803
3rd Quartile	72.813	15.391	10.874	29.414	0.537	8.991	-6.938	15.624
Mean	52.918	11.156	17.076	24.583	0.768	10.268	-35.843	13.427
Variance (n-1)	2262	207	938	1060	3	3252	3629	1013
Standard deviation (n-1)	47.566	14.374	30.630	32.554	1.837	57.025	60.245	31.830

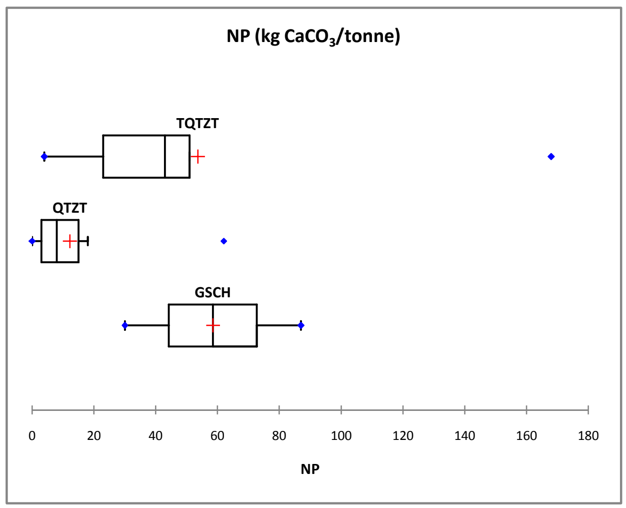
ABA Box Plots by Lithology

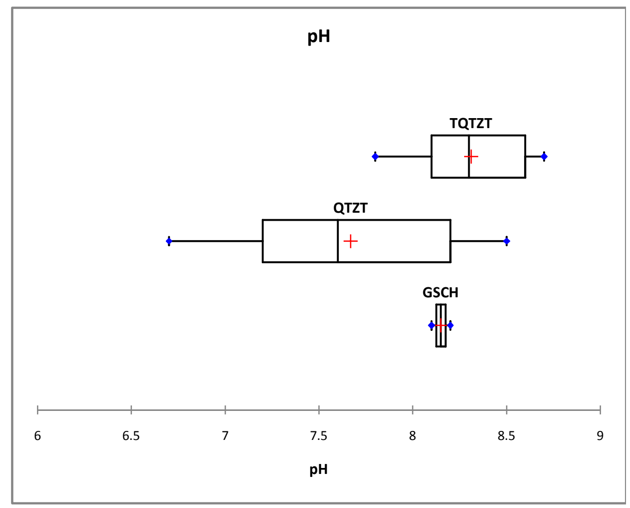




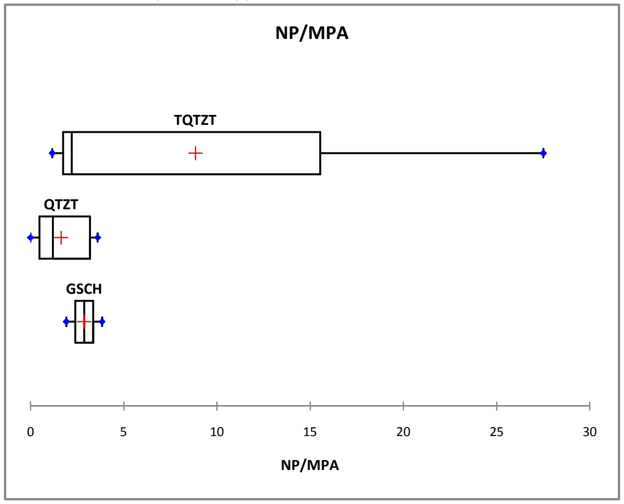


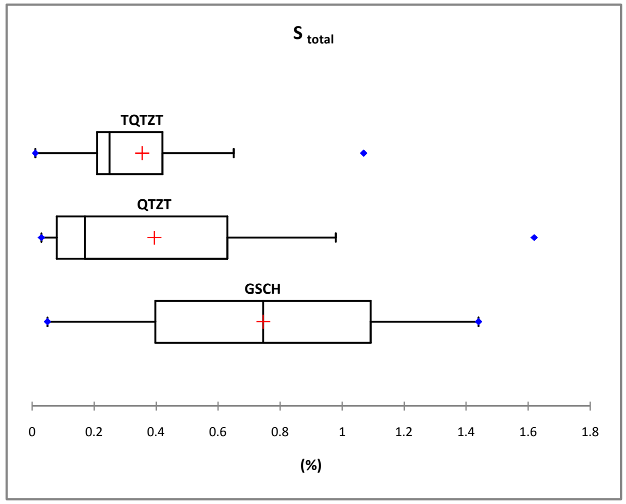


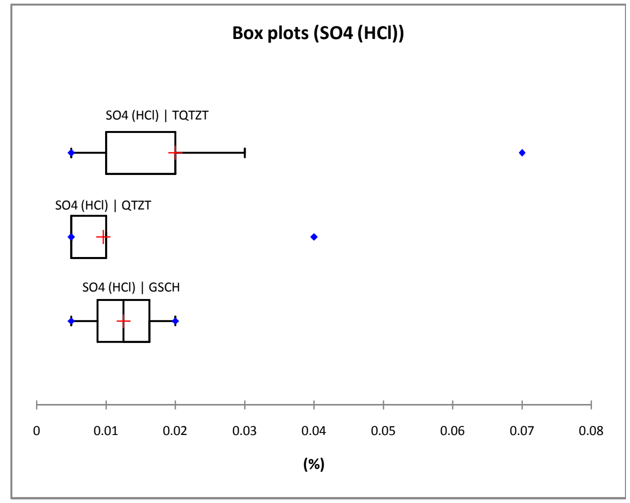


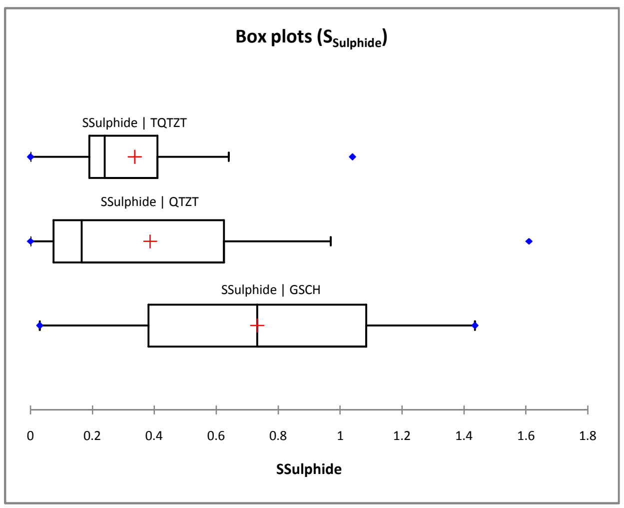


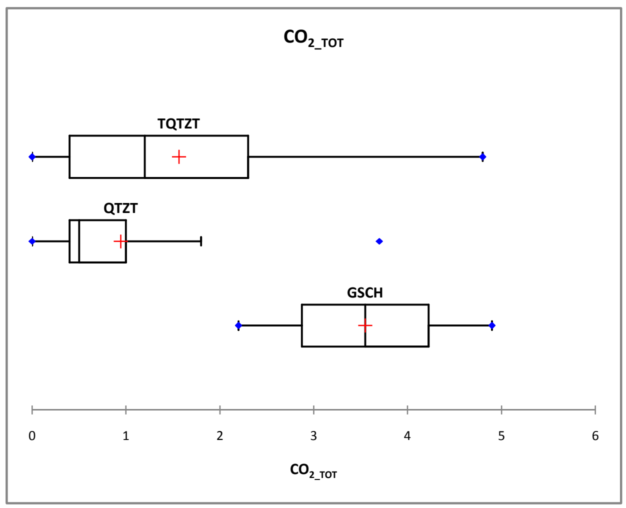
ABA Box Plots by Lithology

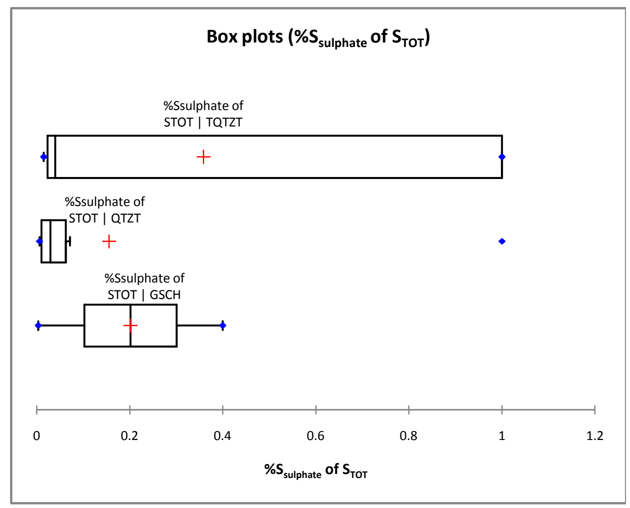




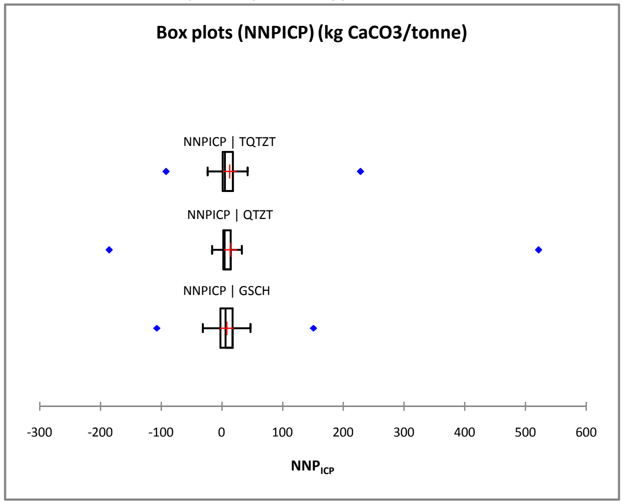


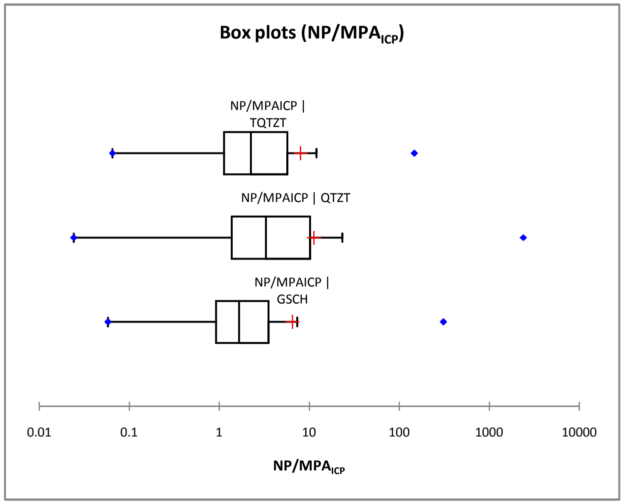


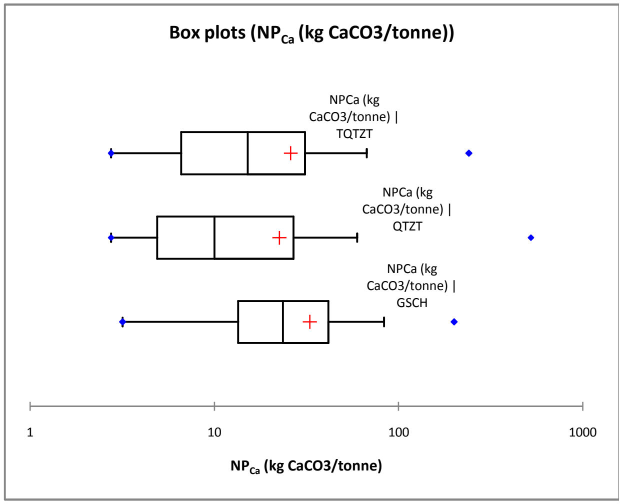


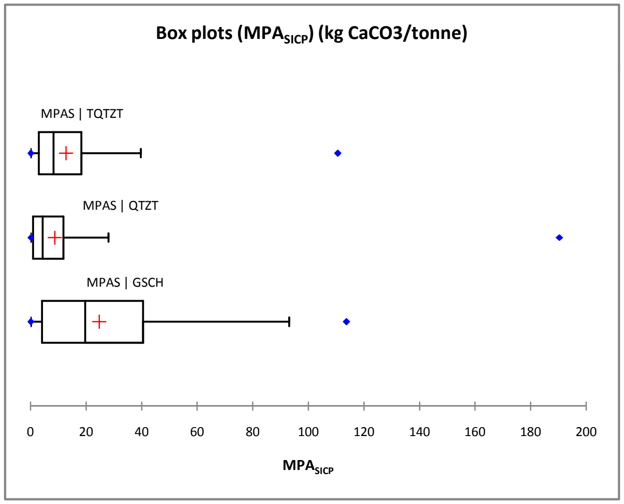


Calculated ABA Boxplots by Lithology

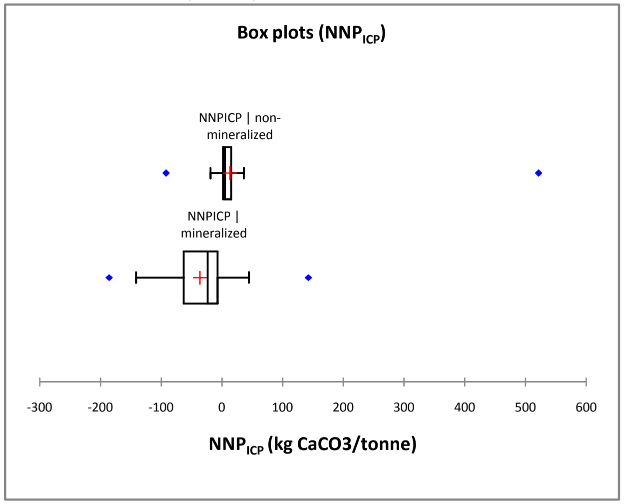


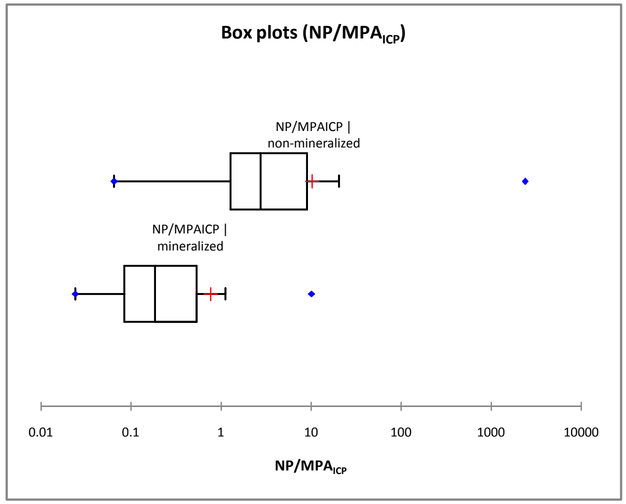


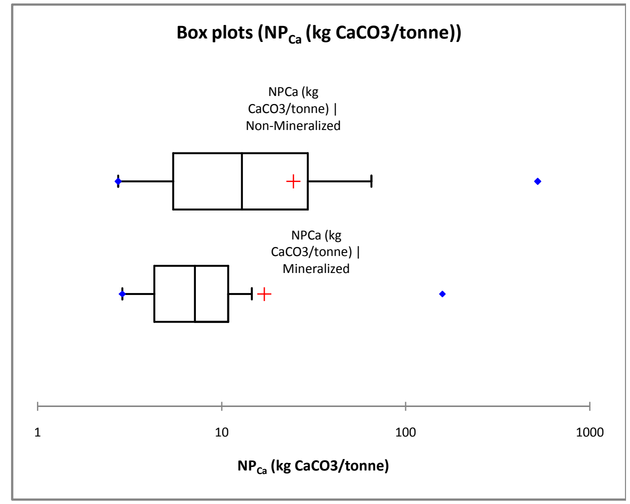


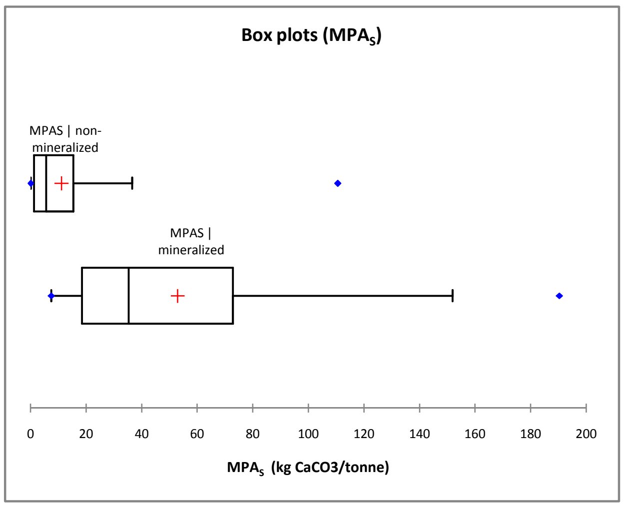


Calculated ABA Boxplots by Mineralized vs Non-Mineralized









Appendix E

A TETRA TECH COMPANY

November 29, 2011

ISSUED FOR REVIEW
EBA FILE: W14101656
Via Email: lhaney@alexcoresource.com

Access Consulting Group
3-151 Industrial Road
Whitehorse, YT Y1A 2V3

Attention: Lauren Haney – Manager, Environmental Permitting

Subject: Lucky Queen Waste Rock Extension – Conceptual Design
Keno City, Yukon

This "Issued for Review" document is provided solely for the purpose of client review and presents our findings and recommendations to date. Our findings and recommendations are provided only through an "Issued for Use" document, which will be issued subsequent to this review. You should not rely on the interim recommendations made herein. Once our report is issued for use, the "Issued for Review" document should be either returned to EBA or destroyed.

1.0 INTRODUCTION

Alexco Resource Corporation (Alexco) retained EBA, A Tetra Tech Company (EBA), to complete a conceptual design of the proposed waste rock extension at their Lucky Queen property near Keno City, Yukon.

This report summarizes the subsurface conditions encountered during a site investigation, design assumptions, stability calculations and the conceptual design for the Lucky Queen waste rock extension. For additional conditions regarding this report, please refer to EBA's General Conditions included in Appendix A.

Authorization to proceed with this work was received from Ms. Lauren Haney in an email dated November 7, 2011.

1.1 Scope of Services

As per the email proposal sent to Ms. Lauren Haney on November 4, 2011, EBA's scope of services for this project is as follows:

- Review existing information and figures from Alexco;
- Excavate two (2) testpits on the subject site to determine the subsurface conditions;
- Prepare a preliminary model of the waste rock extension using estimated volumes provided by Alexco;
- Conduct preliminary slope stability modeling of the waste rock extension; and
- Prepare a conceptual engineering design report for permitting submission.

EBA, A Tetra Tech Company
Calcite Business Centre, Unit 6, 151 Industrial Road
Whitehorse, YT Y1A 2V3 CANADA
p. 867.668.3068 f. 867.668.4349

2.0 SITE INVESTIGATION

EBA conducted a site investigation to determine the subsurface soil conditions at the subject site. The approximate UTM (NAD 83 datum) coordinates of the site are 7,090,600 N and 486,500 E in Zone 8 on the mapsheet 105 M/14. The site location is shown on Figure 1, the proposed extension footprint, and testpit locations are shown on Figure 2.

Two testpits were excavated on September 30, 2011 using a CAT 325 excavator. EBA's representative on site was Mr. Justin Pigage, EIT. The testpits were excavated in the accessible southern portion of the proposed footprint and are assumed to be representative of conditions throughout the site. Disturbed grab samples from the testpit walls and excavator bucket were collected and returned to EBA's Whitehorse laboratory for moisture content testing. Test results are presented on the testpit logs in Appendix B.

3.0 SITE CONDITIONS

3.1 Subsurface Conditions

The subsurface conditions were determined from the two testpits excavated on the southern portion of the site. A summary of subsurface conditions is presented in Table 1.

Table 1: Subsurface Soil Conditions – Lucky Queen Waste Rock Extension

Soil Type	Strata Depth Range (m)	
	TP-01	TP-02
Organic Cover	0.0 – 0.1	0.0 – 0.1
Sand and Gravel – silty	0.1 – 4.5	0.1 – 2.0
Bedrock – fractured	–	2.0 – 3.0
End of Testpit	4.5	3.0

General subsurface conditions consist of a thin organic layer underlain by a silty sand and gravel layer underlain by bedrock. Bedrock was not encountered in TP-01 and the testpit was terminated at the extent of the excavator, approximately 4.5 m. Bedrock was encountered in TP-02 at a depth of 2.0 m. The bedrock was fractured near its surface but became competent forcing refusal at 3.0 m. Detailed testpit logs are presented in Appendix B.

3.2 Groundwater

Groundwater was not encountered during the investigation.

3.3 Permafrost

Permafrost was not encountered during the investigation.

3.4 Bedrock

Fractured bedrock was encountered in TP-02 at a depth of 2.0 m. The bedrock became competent forcing refusal at 3.0 m.

4.0 LUCKY QUEEN WASTE ROCK EXTENSION

Alexco is proposing to extend the existing waste rock pile at their Lucky Queen property. This section summarizes the design assumptions, stability calculations, and conceptual design of the waste rock extension.

4.1 Waste Rock Extension Design Assumptions

Alexco provided the following assumptions to EBA for use in the conceptual design of the waste rock extension:

- Total volume of waste rock to be stored is 30,000 m^3

EBA's conceptual design assumptions are as follows:

- Placed density of waste rock will be 1,800 kg/m^3;
- Internal friction angle of 36 degrees for waste rock;
- Waste rock is cohesionless;
- Foundation soils for the waste rock are 4.5 m of silty sand and gravel with a bulk unit weight of 2,150 kg/m^3 and an internal friction angle of 32 degrees underlain by bedrock;
- Shear failure will not occur through the bedrock; and
- Design seismic event is 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).

4.2 Waste Rock Extension Stability Calculations

The stability of the waste rock extension was checked using Geostudio 2007 – SlopeW. The factors of safety calculated for the waste rock extension and the guidelines set forth by the BC Mine Waste Rock Pile Research Committee (1991) are summarized in Table 2.

Table 2: Lucky Queen Waste Rock Extension – Slope Stability Factor of Safety Summary

Stability Condition	Factor of Safety	
	Suggested Minimum[1]	Calculated
Stability of Surface		
Short Term (during construction)	1.0	1.4
Long-Term (reclamation – abandonment)	1.1	1.4
Deep-Seated Stability		
Short Term (static)	1.1 – 1.3	1.4
Long-Term (static)	1.3	1.4
Pseudo-Static	1.0	1.0

1. Suggested minimum from the BC Mine Waste Rock Pile Research Committee (1991)

4.3 Waste Rock Extension Conceptual Design

The conceptual design footprint and a cross-section used for slope stability modeling are presented in Figure 2. The waste rock extension will be constructed as a benched dump; the lower bench will be constructed first with a crest elevation of 1320 m and a slope to existing ground surface of 2.5H:1V. The toe of the upper bench will be set back at least 14 m from the crest of the lower bench. The upper bench will have a maximum height of 10 m (crest elevation approximately matching existing structure at 1330 m). The upper bench will be constructed with a 1.4H:1V slope, similar to the natural angle of repose of the waste rock.

5.0 LIMITATIONS OF REPORT

This report and its contents are intended for the sole use of Alexco Resource Corporation and their agents. EBA, A Tetra Tech Company, 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 Corporation, 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 General Conditions provided in Appendix A of this report.

6.0 CLOSURE

We trust this report meets your present requirements. Should you have any questions or comments, please contact the undersigned.

Sincerely,
EBA, A Tetra Tech Company

Justin Pigage, EIT
Geotechnical Engineer, Arctic Region
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Project Director – Yukon, Arctic Region
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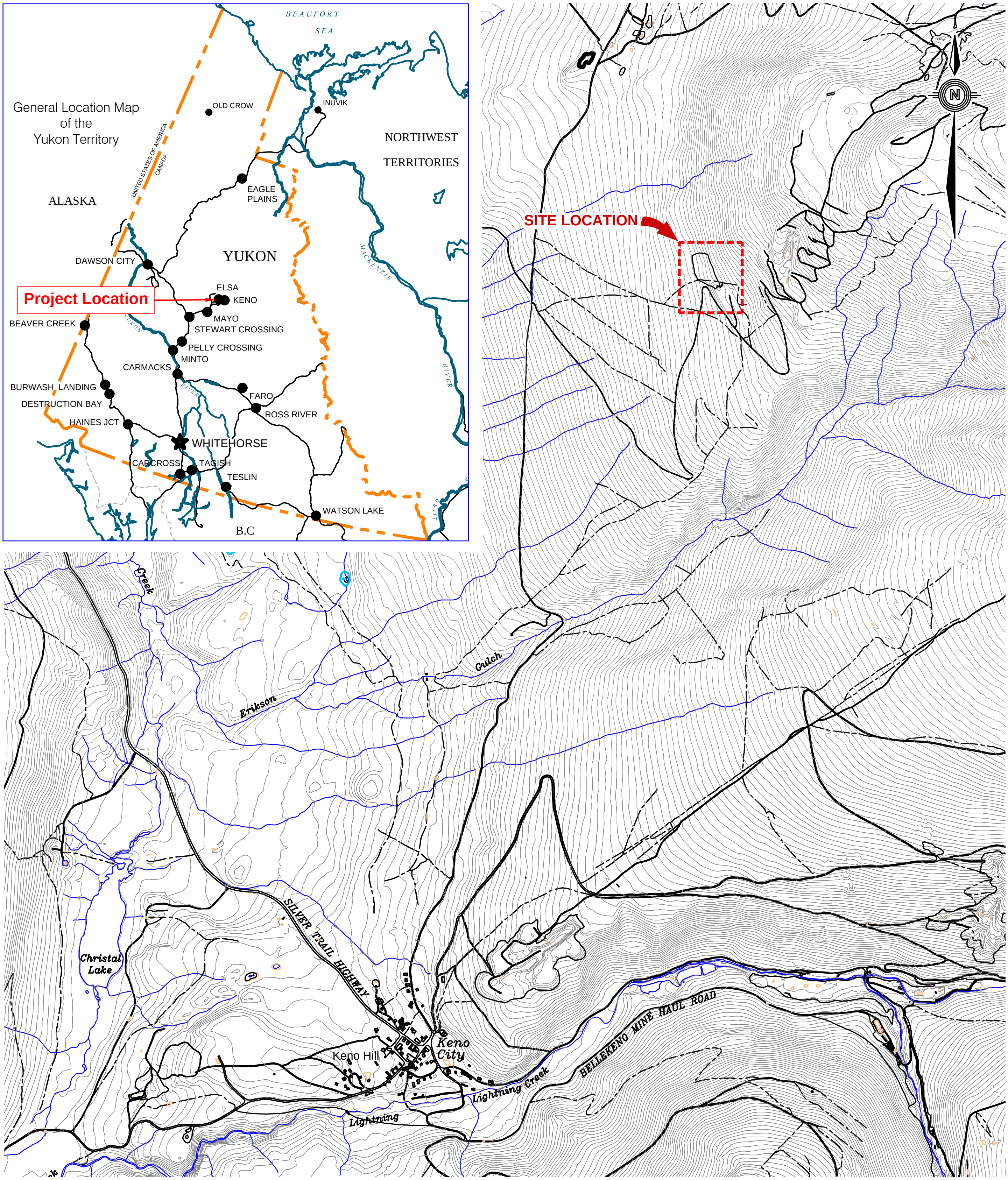
FIGURES



0 1 000

Scale: 1: 25 000 (metres)

CLIENT

ALEXCO

A TETRA TECH COMPANY

WASTE ROCK EXTENSION - CONCEPTUAL DESIGN
LUCKY QUEEN - NEAR KENO CITY, YUKON

LOCATION PLAN

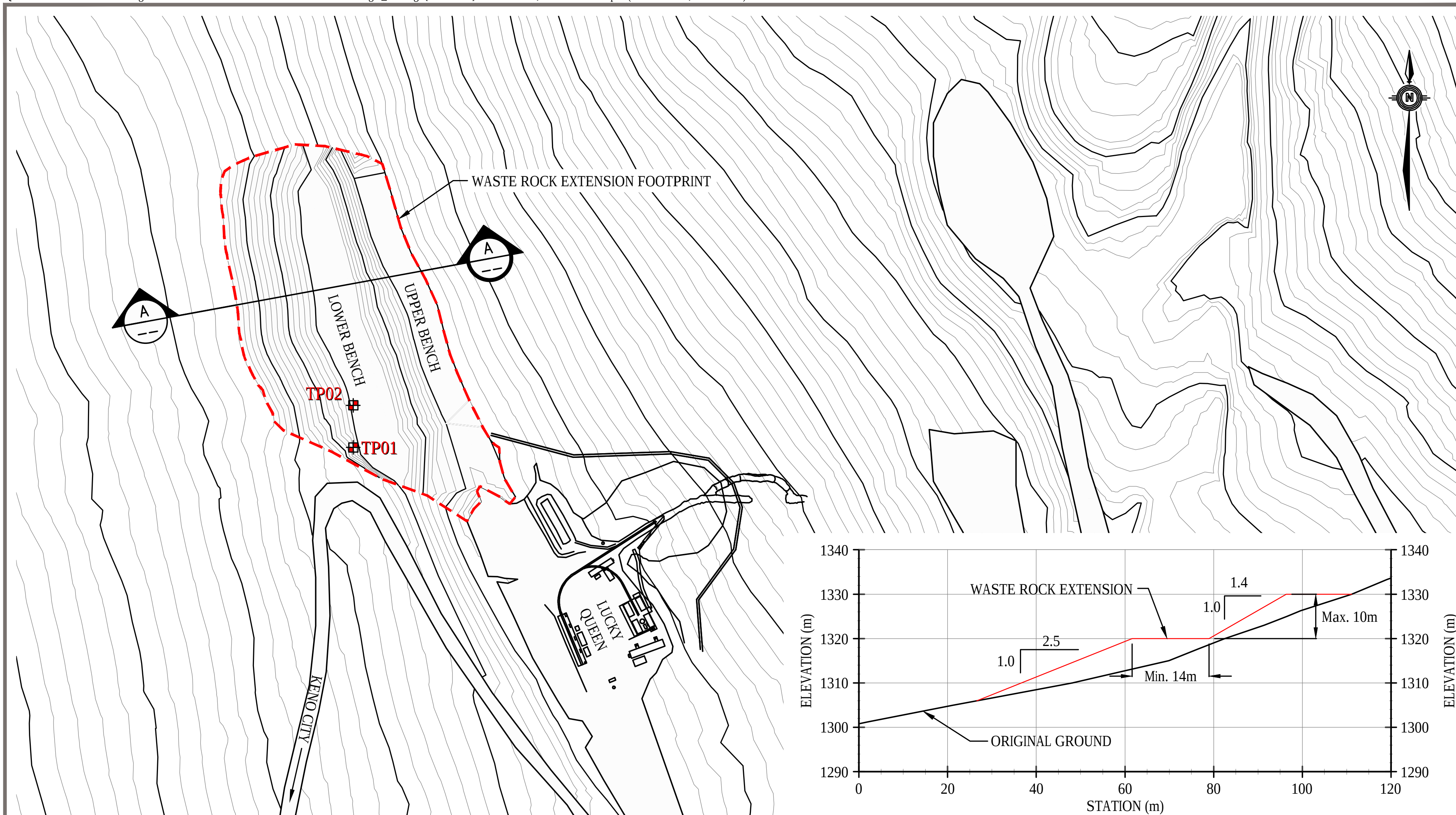
PROJECT NO.	DWN	CKD	REV
W14101656	CB	JTP	0

OFFICE	DATE
EBA-WHSE	November 23, 2011

Figure 1

Q:\Whitehorse\Data\0201\drawings\Elsa\W14101656 Onek Portal Bench\W14101656 Fig_1_R1.dwg [FIGURE 1] November 29, 2011 - 12:02:21 pm (BY: BUCHAN, CAMERON)

Q:\Whitehorse\Data\0201drawings\Elsa\W14101656 Onek Portal Bench\W14101656 Fig.2_R1.dwg [FIGURE 2] November 29, 2011 - 12:01:19 pm (BY: BUCHAN, CAMERON)



A
--
WASTE ROCK EXTENSION PROFILE
SCALE 1 : 1250

LEGEND:

- DESIGN FOOTPRINT
- TESTPIT LOCATION

0 100

Scale: 1: 2 500 (metres)

CLIENT

ALEXCO

eba A TETRA TECH COMPANY

WASTE ROCK EXTENSION - CONCEPTUAL DESIGN
LUCKY QUEEN - NEAR KENO CITY, YUKON

SITE PLAN SHOWING
DESIGN FOOTPRINT AND TESTPIT LOCATIONS

PROJECT NO.	DWN	CKD	REV
W14101656	CB	JTP	0

OFFICE	DATE
EBA-WHSE	November 23, 2011

Figure 2

APPENDIX A

APPENDIX A EBA'S GENERAL CONDITIONS

GENERAL CONDITIONS

GEOTECHNICAL REPORT

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 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.

8.0 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.

9.0 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.

10.0 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.

11.0 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.

12.0 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.

13.0 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.

14.0 INFORMATION PROVIDED TO EBA BY OTHERS

During the performance of the work and the preparation of the report, EBA may rely on information provided by persons other than the Client. While EBA endeavours to verify the accuracy of such information when instructed to do so by the Client, EBA accepts no responsibility for the accuracy or the reliability of such information which may affect the report.

APPENDIX B

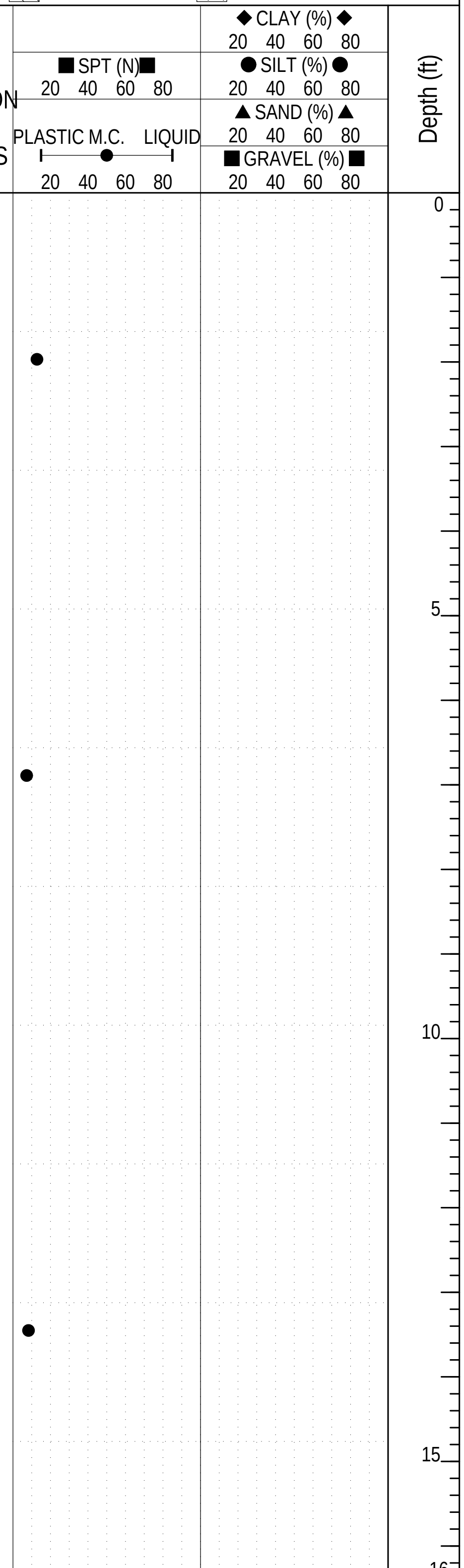
APPENDIX B TESTPIT LOGS

Geotechnical Investigation	CLIENT: Alexco Resource Corporation	TESTPIT NO: W14101656-TP01
Lucky Queen Waste Rock Extension	EXCAVATOR: CAT 325 Excavator	PROJECT NO: W14101656
Keno City, YT	7090597N; 486509E; Zone 8	

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 AND COMMENTS
0	ORGANIC COVER			UNFROZEN
	SAND and GRAVEL - some silt, damp, loose (est.), brown, organics throughout			
		DISTURBED	SA01	
1	- organics end, cobbles throughout			
	- hard digging, sub-angular cobbles, occasional boulders			
2		DISTURBED	SA02	
3	- becomes dry			
4		DISTURBED	SA03	
	END OF TESTPIT @ 4.5 m (Machine Extent)			
5				



LOGGED BY: JTP	COMPLETION DEPTH: 4.5m
REVIEWED BY: JRT	COMPLETE: 9/30/2011
DRAWING NO: Figure 1	Page 1 of 1

eba A TETRA TECH COMPANY

Geotechnical Investigation	CLIENT: Alexco Resource Corporation	TESTPIT NO: W14101656-TP02
Lucky Queen Waste Rock Extension	EXCAVATOR: CAT 325 Excavator	PROJECT NO: W14101656
Keno City, YT	7090616N; 486509E; Zone 8	

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 AND COMMENTS	■ SPT (N) ■ 20 40 60 80 / PLASTIC M.C. LIQUID 20 40 60 80	◆ CLAY (%) ◆ / ● SILT (%) ● / ▲ SAND (%) ▲ / ■ GRAVEL (%) ■ 20 40 60 80	Depth (ft)
0	ORGANIC COVER			UNFROZEN			0
	SAND and GRAVEL - silty, moist, loose (est.), brown, occasional cobble						
1		DISTURBED	SA04		●		
	- becomes some silt, cobbles throughout						5
2	BEDROCK - fractured, dry, grey						
		DISTURBED	SA05		●		
	- hard digging, becomes competent						
3	END OF TESTPIT @ 3.0 m (Refusal)						10
4							
							15
5							16

eba A TETRA TECH COMPANY	LOGGED BY: JTP	COMPLETION DEPTH: 3m
	REVIEWED BY: JRT	COMPLETE: 9/30/2011
	DRAWING NO: Figure 1	Page 1 of 1

Appendix F

Elsa Reclamation and Development Corp.

Onek 400 Proposed Water Treatment System

Water Use Licence QZ06-074

December 2011

Prepared by:

Alexco Environmental Group

TABLE OF CONTENTS

LIST OF FIGURES

LIST OF APPENDICES

1.0 INTRODUCTION

1.1 *Adaptive Management Framework*

Water Use Licence (WUL) QZ06-074 clause 22 requires the development and implementation of an Adaptive Management Plan (AMP) which addresses contingent events not explicitly covered in the Licence. In its Reasons for Decision, the Yukon Water Board (YWB) explains that it allowed water to remain untreated at several adits in the district only on the condition that continued monitoring of the adits take place, and an adaptive management plan is developed that will establish a path for active treatment at a currently untreated adit, such as Onek 400, based on receipt of surface water or groundwater quality data that shows environmental degradation from the adit discharge in surface water or groundwater.

In the AMP (ERDC, 2008) section 3.1.5.2, the appropriate responses to be followed when groundwater or surface water data shows a degradation of water quality that requires a response is described. Two relevant paragraphs are excerpted which describe follow up actions to be taken when data are received that show environmental degradation from adit drainage:

> The next step will be to perform a comprehensive analysis of samples taken at the sampling stations in the drainage area down gradient of the site in question. At certain old mine workings (No Cash 500 adit and Onek adit), down gradient piezometers have been installed to track effects to the local receiving environment. Additional drive point piezometers could be installed at other locations based on continued tracking of adit discharge flow paths. Results of 2007 monitoring of adit flow paths tracked most flows to receiving waters, however, if flow goes to ground and is not observed to enter receiving waters, additional piezometers may be installed. Results from piezometers would be analysed to determine the extent of the groundwater contamination, if any. The purpose of this analysis will be to aid in the identification of potential down gradient environmental effects. This will also allow a determination of the extent of the higher contamination levels and will dictate the extent of the response measures. If deemed necessary, monitoring frequency will be increased to help pinpoint the cause of the trigger in the effluent discharge and include additional groundwater, seepage or surface water sampling in the receiving environment.

Technical experts and regulatory agencies will be consulted to determine temporary mitigation measures which can be implemented to control the flow of contaminants, if occurring, into nearby watercourses or groundwater while a mitigation plan is developed. Once a mitigation or treatment plan is developed, construction of any required facilities and implementation of any required work plans will then proceed according to any directives returned by the Yukon Water Board. These plans should allow water quality to return to normal levels by securely preventing the noted contaminants from proceeding any further past the treatment point, much like the treatment sites at Galkeno 300 or Bellekeno 625. The water treatment plans will be designed such that treatment can proceed for an undetermined length of time until the final Closure Plan can be implemented.

1.2 *Recent Investigations and Regulatory Discussion*

A study of the Onek 400 adit area has been performed in several phases over the last several years. A draft report from Interralogic (October 27, 2011) summarizes information from a flow path investigation of water from the adit, as well as data from new wells installed in the area of the Onek adit on the northern side of Keno City. Recent water quality information has shown two metals, cadmium and zinc, which are elevated in the adit drainage, are also elevated in a well downgradient of the adit, and somewhat elevated compared to nearby wells in other wells further downgradient of the adit toward Christal Lake and Christal Creek. Other water quality modeling mass balance analysis that is ongoing has indicated that Onek adit drainage is the largest untreated source of metals in the Christal Creek watershed.

Consequently, Alexco Environmental Group (AEG), on behalf of Elsa Reclamation and Development Corp., has described both the current status of the investigation in the area, and the preliminary modeling results, to Canada (Aboriginal Affairs and Northern Development Canada) and the following Yukon Government (YG) departments: Environment (Water Resources and, Water Inspections Branch), Department of Health and Social Services, and Energy, Mines and Resources (Assessment and Abandoned Mines). Plans for community consultation are being finalized for January 2012. Subsequent discussions with the Water Inspections Branch have indicated that the AMP has been reviewed by the Water Inspector and Yukon Water Board, and that based on the preliminary data and the AMP triggers, it is a high priority to establish water treatment plans for the existing Onek 400 adit drainage. At this time, AEG is following the direction of the Water Inspections Branch to develop water treatment approaches for the Onek 400 adit to eliminate to the extent possible the ongoing groundwater (and likely surface water) impacts in the Christal Creek watershed. This Preliminary Onek 400 Water Treatment Plan is being developed to enable effective further discussions with Canada, YG, the First Nation of Nacho Nyak Dun (NND) and community consultation prior to finalization of a treatment plan for this site.

2.0 Onek 400 Water Treatment Requirements

In planning for water treatment, an assessment of water chemistry and flow quantity must be performed.

2.1 *Adit Drainage Flow Quantity*

Due to the nature of the Onek mine, where an open pit provides direct recharge pathways through a shaft and open vein structures in the bottom of the open pit, widely variable flow rates from the mine have been observed. The Interralogic investigation determined infiltration into ground is occurring in the first 100 meters from the adit. Prior investigations in earlier seasons have shown that during conditions of frozen or partially frozen ground (early summer) that flow can continue near surface discontinuously as far as 1 km or further from the adit. Due to the collapsed adit structures, it is not possible to determine with certainty that some amount of infiltration is occurring prior to what is visible and measurable a few meters below the collapse area. However, based on what is observable, flow ranges from 0.5 L/s to over 5 L/s during freshet. During conditions related to late summer storms or sustained wet periods, flow over 2 L/s in late summer has been observed.

Conservative plans for the treatment plant are planned to be 4 L/s, as well as pretreatment storage in the mine adit level or in an equalization pond to be located upgradient of the treatment plant.

2.2 *Adit Drainage Water Chemistry*

Evaluation of recent (2009-present) water chemistry shows the following exceedences when compared with standards contained in WUL QZ06-074:

Table 1. Water quality constituents exceeding WUL QZ06-074 discharge standards.

Analyte	Mean Concentration (mg/L)	Standard Deviation (mg/L)	WUL QZ06-074 Effluent Quality Standards(mg/L)
Cadmium	1.67	1.92	0.05

Zinc	71.3	51.5	0.5
TSS	20.6	13	25

Onek adit is fairly extreme in the Keno Hills Silver District (KHSD), with concentrations of zinc similar to Galkeno 300 adit, and the highest cadmium concentration in the KHSD, approximately 5 times higher than the average at Galkeno 300, which is the second highest concentration of cadmium in the KHSD. Thus treatment requirements will focus on cadmium and zinc, with the recognition that suspended solids will also periodically require treatment.

Other metals are below discharge standards, but are also reviewed to determine the potential effects on reagent consumption in the treatment process. For purposes of this discussion, a lime treatment process is assumed, as it is the most extensively tested process and is the basis of water treatment at 5 other sites in the KHSD.

Water pH

The pH of the adit has only rarely been measured below pH 7, typically pH 7.5. Alkalinity averages 124 mg/L, indicating mildly buffered water chemistry. Thus lime requirements to raise the pH to over 9 to cause cadmium and zinc precipitation as metal hydroxides will not require consumption of free H^+ acidity.

Iron

Iron is an important constituent in that it aids the treatment process by sorbing and coprecipitating both cadmium and zinc, as well as other heavy metals. Iron is low in the dissolved fraction (0.01 mg/L) and present as a suspended solid (0.84 mg/L average). Thus the addition of iron as a coagulation aid and to coprecipitate metals during lime treatment is recommended.

Manganese

Manganese is present in unusually high concentrations in KHSD adit drainages, due to the presence of manganiferous siderite in the vein mineralization. For example, at Galkeno 300, similar concentrations of manganese and zinc occur, and at Galkeno 900, approximately 4 times higher manganese to zinc ratios are observed. However, in the Onek drainage, zinc exceeds manganese on average 9 times. In a water treatment process, manganese precipitation will, similar to iron, aid in the removal of heavy metals including cadmium and zinc. However, this beneficial effect that is observed at both Galkeno 300 and Galkeno 900 treatment plants is not expected at Onek.

Other Trace Metals

Arsenic (0.04 mg/L), copper (0.02 mg/L), lead (0.007 mg/L), and nickel (0.02 mg/L) average concentrations are present in the Onek drainage, but should only minimally affect reagent consumption, and are all already below the WUL QZ06-074 discharge standards.

3.0 Preliminary Proposed Onek 400 Treatment Process

The treatment process at Onek has some unique aspects that require special consideration compared to other sites in the KHSD.

3.1 *Lime Treatment Considerations*

As mentioned above, lime treatment has been used extensively in the KHSD and is considered the default process for active treatment in the KHSD due to its successful application at five other sites (Bellekeno 625, Galkeno 300, Galkeno 900, Silver King 100, and Valley Tailings seasonal treatment).

Lime treatment should be successful at Onek, with the following additions and caveats:

1. Due to the relatively low levels of iron and manganese in the mine drainage, substantially higher pH will have to be achieved to remove cadmium and zinc as primary metal hydroxides $Cd(OH)_2$ and $Zn(OH)_2$. Alternatively, ferric iron could be added to the treatment process to cause sufficient metals removal at pH levels that allow direct discharge without acidification of the treated water.
2. Iron addition will also benefit the clarification/settling process by enhancing floc formation.
3. Addition of a flocculent, as is done at the Bellekeno 625 and Galkeno 300 treatment sites, is also recommended due to the low initial levels of iron and manganese in the mine drainage.
4. Due to the very high initial concentrations of metals compared to discharge standards (33 times standard for cadmium, 151 times standard for zinc), the settling process should be enhanced by clarification or similar active separation steps.
5. The stability of the sludge produced by the treatment process is dependent on the excess lime present in the sludge, as well as secondary stable mineral formation as the sludge ages. Due to the very high initial concentrations of metals in the adit drainage, consideration of production of a dry sludge product and landfilling should be further investigated.

3.2 *Adit Preparation*

The Onek 400 adit is currently collapsed and has periodically had ice plugs form, water impound as a result, and with uncontrolled blowouts that have affected downgradient areas. Any treatment system will require adit preparation, which will involve water collection while still contained in competent rock, and steps to prevent ice plug formation in the adit. A weir to allow more accurate adit flow will also need to be established.

3.3 *Proposed Treatment System Components*

Appendix 1 shows a preliminary proposed treatment system process flow sheet, with several components shown as optional:

- Equalization pond (optional): Due to the highly variable flow rates observed in the Onek Adit, a conservatively sized treatment system is recommended at 4 L/s rated capacity. For the few times in the year where this rated capacity may be exceeded, such as during freshet or summer storm periods, addition of a equalization pond or adit storage system should be considered.
- Lime addition: A lime slurry storage tank and lime addition system are required to raise the pH to a level to precipitate cadmium and zinc as metal hydroxides.
- Iron addition (optional): An iron reagent storage tank and iron solution addition system will likely be required to achieve treatment standards.
- Flocculent addition (optional): A flocculent similar to what is used at Bellekeno 625 and Galkeno 300 will likely be required to achieve timely settling.
- Rapid mix tank: Contact of adit water with lime and settling aids iron and flocculent must be done in a mechanically mixed system, which will be done under active mixing in a small tank prior to the clarification/settling system.
- Clarification/Settling System: A clarifier unit similar to what is used at Galkeno 300 is recommended due to the high initial concentrations of metals in the adit drainage. An alternative that could be used but is not recommended would be a settling pond such as is used at Galkeno 900 or Silver King 100.
- Sludge Thickener (optional): Sludge from the initial clarification/settling process is likely to be low (0.5% to 2%) solids. A thickener will allow this sludge to be thickened prior to transport to a liquid storage site (such as is available at Valley Tailings) or prior to a sludge press which would produce a dry sludge cake.

- Filter Press (optional): A thickened sludge can be further dewatered to produce a dry filter cake which would be amenable to placement in a dry landfill or similar disposal approach.
- Post-Treatment Equalization Pond: Variability of treatment effectiveness can be observed in a system such as Onek that has highly variable influent chemistry. An equalization pond at the end of the treatment system allows for a more uniform treatment result, increasing compliance certainty.
- Discharge flow measurement: It is recommended that any system be built with an installed flow meter and data logger that allows for real-time and historical flow rate tracking.

4.0 Design Finalization

Additional discussion will be facilitated by ERDC with Canada, YG, NND, and Keno City regarding the treatment approach. A final treatment approach will result from that discussion, which will likely be the subject of a water licence amendment.

5.0 References

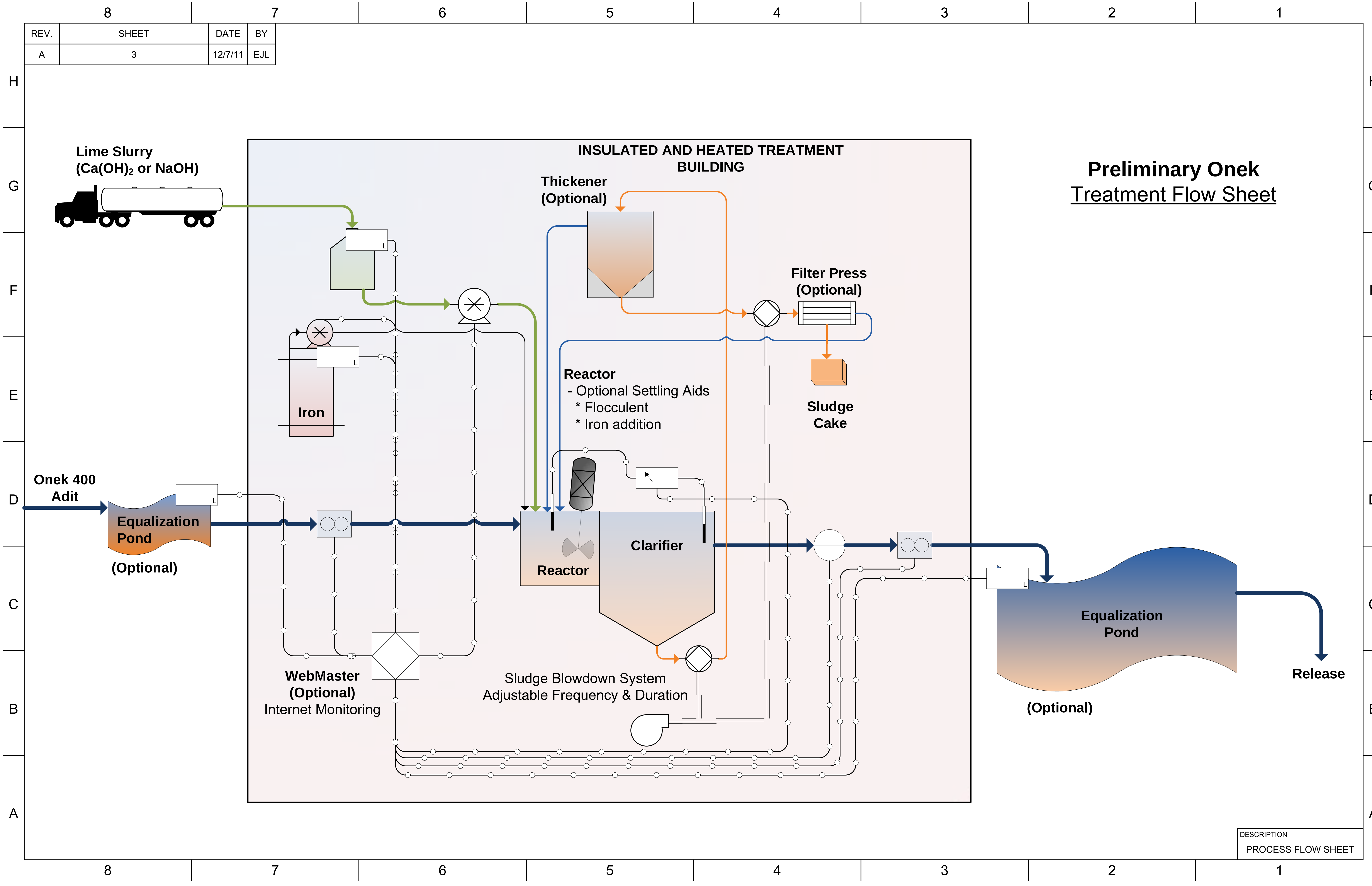
Alexco Resource US Corp, June 2009. Underground Hydrologic Preliminary Evaluation.

Elsa Reclamation and Development Corporation. 2008. Adaptive Management Plan.

Interralogic Inc. 2011. Draft Keno City Groundwater Evaluation.

REV.	SHEET	DATE	BY
A	3	12/7/11	EJL

Preliminary Onek
Treatment Flow Sheet



DESCRIPTION
PROCESS FLOW SHEET

REV.	SHEET	DATE	BY
A	4	12/7/11	EJL

PRIME MOVERS FOR
MOTOR DRIVEN EQUIPMENT

PUMP

AGITATOR OR MIXER

METERING PUMP

AIR COMPRESSOR

CENTRIFUGAL PUMP

AIR DIAPHRAGM PUMP

COMBO – VACUUM BREAK/
AIR RELEASE VALVE

INSTRUMENT LINE SYMBOLS

DATA LINE

120V A/C 1-PHASE

PNEUMATIC LINE

575V A/C 3-PHASE

PIPE LINE DESIGNATIONS

= IRON ADDITION TUBE

= 3" PIPE

= LIME SLURRY

= REGENERATIVE BRINE

= SLUDGE LINE

SYMBOLS FOR VALVE
ACTION IN THE EVENT OF
ACTUATOR POWER FAILURE

FO

SYMBOL LOCATED BY VALVE – USED ONLY WHERE NECESSARY TO INCREASE UNDERSTANDING OF THE SYSTEM.

FO = FAIL OPEN

FC = FAIL CLOSED

INSTRUMENTATION

LEVEL SENSOR/
FLOAT SWITCH

FLOW METER

PROGRAMMABLE
LOGIC CONTROLLER

TURBIDIMETER

VALVE SYMBOLS

GATE

GLOBE

BALL

BUTTERFLY

CHECK

ADDITIONAL COMPONENTS

LIME SLURRY STORAGE TANK

FILTER PRESS

DESCRIPTION
PIPING & INSTRUMENTATION LEGEND

Appendix G

Memorandum

Date: June 20, 2011

To: Vanessa Benwood, Alexco Keno Hill Mining Corp (AKHM)

C: Jim Harrington, Alexco Resource Corp.

From: Ethan Allen, Access Consulting Group

Subject: Keno District Mill Preliminary Dustfall Monitoring Results

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1. INTRODUCTION

In accordance with Clause 69 of the Decision Document for the assessment for the Bellekeno Mine Project (YESAB File Number 2009-0030), dustfall monitoring was installed at two locations near the Keno District mill site. Samples have been collected on an approximately monthly basis at two locations near the mill site continuously since March 6, 2011. The dust monitoring program is described in the Monitoring and Surveillance Plan Revision 1 (June, 2011).

1.1 Purpose

At the request of Yukon Government, Alexco and Access Consulting Group met with representatives of Yukon Government on May 17, 2011 to discuss the implementation of the dust monitoring program for the Bellekeno Project. A commitment to provide results of initial sampling to Yukon Government was made by Alexco at this meeting.

This memorandum summarizes the results of initial dustfall monitoring undertaken by AKHM for the period between March 6, 2011 and May 10, 2011.

2. METHODS

Mill site layout and infrastructure and locations of Bergerhoff dust monitoring gauges currently in place at two locations at the edge of the mill site are shown on Figure 1.

National Topographic Data Base (NTDB) compiled by Natural Resources Canada at a scale of 1:50,000. Cadastral data compiled by Natural Resources Canada. Reproduced underlicense from Her Majesty the Queen in Right of Canada, Department of Natural Resources Canada. All rights reserved.

Datum: NAD 83; Map Projection: UTM Zone 8N

Main Map: 1:2,500 Inset Map: 1:60,000

(when printed on 11 x17 inch paper)

△ Dust Monitor Station

Mill Access Road

Haul Road

Local Road

ALEXCO

ACCESS
CONSULTING GROUP

MONITORING AND SURVEILLANCE PLAN QML - 0009

FIGURE 1
PRELIMINARY DUST MONITORING RESULTS

DRAWN BY MD	JUNE 2011	VERIFIED BY EA

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(Last edited by: mducharme;03/06/2011/14:32 PM)

2.1 Site sampling procedure

Two samples were collected for the period between March 6, 2011, and May 10, 2011 at each sampling location on approximately monthly intervals. Because of the prevailing winter/spring conditions during collection of these two initial samples, no special procedure was undertaken with respect to ensuring maintenance of water in the collection bottle. All samples contained a significant amount of water (or snow) at the time of collection. Samples were emptied and rinsed with deionized water into secondary sample bottles and sent to Maxxam Analytical Laboratories of Burnaby, BC for analysis.

2.2 Laboratory Analytical Procedure

The following samples were subjected to the following procedure upon receipt by Maxxam:

- Samples were split into two portions of 60 mL.
- One aliquot was run for Total Suspended Solids.
- The second aliquot for Total Solids, fixed and volatile.

Total Suspended Solids (TSS) Aliquot

- Extraneous material was removed prior to filtering.
- Samples were filtered using a Whatman 934AH 12.5 cm 1.5um filter to determine TSS.

Total Solids Aliquot

- Samples were dried overnight at 105 degrees C.

Loss on Ignition (LOI)

- LOI was conducted on both aliquots at 600 degrees C on the filtrate from the total and suspended solids aliquots in order to determine total weight of the fixed and volatile portions. The volatile fraction, which was burned off during LOI was assumed to be organic material.

Moving forward, Maxxam has been instructed to run the sample for only TSS. Also, Maxxam has been instructed to keep the solids from the Total Solids and if enough sample is available (at least 1 gram) to proceed with a ICP metals analysis.

3. RESULTS

The results of preliminary dust monitoring for DM1 and DM2 are summarized in Table 1 below. A summary table and calculated deposition rate for each sample and for the two sample periods is included in Table 2. Analytical certificates for these samples are included as Attachment 1.

Table 1 Summary of Results

		Total Solids Aliquot			Total Suspended Solids Aliquot		
Station #	Units	Total	Fixed	Volatile	Total	Fixed	Volatile
DM1	mg/sample[1]	18	<10	18	<10	<1	<1
DM2	mg/sample[1]	22	<10	18	<10	7	<1
DM1	mg/sample[1]	19	<10	19	<10	2	<1
DM2	mg/sample[1]	13	<10	12	<10	2	<1
	RDL[2]	10	10	10	10[3]	1	1

Notes: [1]All measurements calculated to represent the entire sample (both aliquots)
[2]RDL = Reportable Detection Limit
[3] The RDL was raised to from 1 to 10 due to insufficient sample volume

Table 2 Dust Deposition Summary Table

Station #	Collection Period	Days	Surface Area of Sample Bottle (dm^2)	Deposition Based on TSS Fixed (mg/[dm^2*d])
DM1	March 6 - April 3	29	1.46	0.012*
DM2	March 6 - April 3	29	1.46	0.165
DM1	April 3 - May 10	38	1.46	0.036
DM2	April 3 - May 10	38	1.46	0.036

*Assuming below detection result was 0.5x RDL

Dust deposition was calculated based on the TSS fixed. RDL for the Total Solids was too high, resulting in all of the measurements being below detection. The TSS fixed value was divided by the surface area of the sample bottle mouth and the number of days over each sample was collected. The resultant dust deposition values are reported in mg/(dm^2*d), which is comparable to the Ambient Air Control Objectives in the *Pollution Control Objectives for the Mining, Smelting and Related Industries of BC* (1979), which provides an acceptable range of between 1.7 to 2.9 mg/(dm^2*d). The use of only the fixed solids measurements is deemed the most appropriate representation of dust which may originate from the site, and is expected to consist wholly of minerals, which would not be significantly volatilized by LOI.

4. DISCUSSION AND RECCOMENDATIONS

A number of observations and interpretations are made from these data:

- RDL for the TSS measurement is an order of magnitude lower that the Total Solids measurement (1 mg compared with 10 mg) which enabled a measurable result for all but one sample.
- The highest calculated dust deposition rate was over an order of magnitude below the lowest value of 1.7 mg/(dm^2*d) listed under the *Ambient Air Control Objectives*, which is the trigger for Phase 2 (TSP) sampling.
- The highest observed deposition (0.165 mg/(dm^2*d) was recorded at DM1 for the period between March 6 – April 3, but still over and order of magnitude lower than the Phase 2 trigger. This dust may be attributable to dust emanating from the crushers during periods of cold weather. This interpretation is supported by the observation that the crushers are located directly upwind according to the modeled and observed predominant winds at the site and that some cold weather was experienced in March.
- The majority of the Total Solids fraction (between 82% and 100%) was volatile (organic) and lost during ignition.

Potential dust sources at the mill site have been identified as the Dry Stack Tailings Facility (DSTF), the tailings and concentrate loadout areas, the fine ore stockpile, the primary and secondary crushers, and fugitive dust from mill site area roads. Based on the dust modeling conducted and submitted as part of the DSTF Construction and Operation Plan and preliminary data collected to date, these potential dust sources are expected to be more likely to produce dust at different times of the year. Dust from crushing activity is most likely during periods of cold weather during the winter months, when natural water in ore is too frozen to provide natural dust suppression. Dust from other sources (DSTF, loadout areas, stockpiles, and roads) is considered more likely to be produced during the summer months during periods of dry weather.

Based on the preliminary monitoring period summarized in this memo, the following recommendations are made relating to future dust monitoring activities as described

- These preliminary results justify continuation of the Phase 1 (dustfall) monitoring program as there were no exceedences of the trigger of 1.7 mg/(dm^2*d) for the second phase (TSP) monitoring.
- Two additional monitoring Bergerhoff dust monitoring stations are recommended along the northwest and southeast margins of the mill site. These additional stations will provide additional confidence that windblown dust resulting from any predominant wind direction is adequately sampled.
- Only TSS should be measured for future dust samples by the laboratory, because of its more sensitive RDL.
- A sampling period length of approximately 1 month is recommended during the spring and summer months as other potential dust sources are exposed.
- A longer sampling period (e.g. 60 days) during winter/spring months may be warranted in order to attempt to collect a greater (measurable) sample weight which will provide a greater margin above RDLs.
- Implementation of more sophisticated field sampling procedures (including the periodic addition of deionized water to sampling jars) as described in the Monitoring and Surveillance Plan Revision 1 is warranted during the summer months in order to prevent potentially drying out of the sample jars, which could cause loss of sample.

Continuation of pre-emptive and reactive dust control procedures as outlined in the DSTF Construction and Operation Plan, Traffic Management Plan, and Monitoring and Surveillance Plan is recommended to help ensure that fugitive dusting does not become an issue.

5. CLOSURE

Should you have any questions, please contact the undersigned at (867)-668-6463.

E. Allen, M.Sc.
Environmental Geoscientist

Attachments:

1. Dust Monitoring Analytical Certificates from Maxxam Analytical