TECHNICAL MEMORANDUM

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REVIEWED BY	Steve Atkin and Don Chorley		
RE:	**ASSESSMENT OF THE ACID ROCK DRAINAGE AND METAL LEACHING POTENTIAL OF ROCK FFROM POTENTIAL QUARRY SITE PIT 6, MEADOWBANK PROJECT, NUNAVUT**		

1.0 INTRODUCTION

This memorandum presents an assessment of the acid rock drainage (ARD) and metal leaching (ML) potential of samples collected from a potential quarry site along the Tehek Lake access road to the Meadowbank Gold Project (Meadowbank), in Nunavut. This site, labelled Pit 6, was investigated for quarrying suitability as part of the road alignment inspection, conducted by Golder Associates Ltd. (Golder), between August 18 and September 3, 2006. During the investigation, samples of rock were collected from Pit 6 for ARD/ML testing. The purpose of conducting ARD/ML tests on these samples was to evaluate the potential for the excavated rock to produce acidic drainage and leach metals to the receiving environmentF

2.0 METHODOLOGY

2.1 Sample Collection

Three rock samples were collected from rock outcrops at the Pit 6 site for the purpose of ARD/ML testing. Figure 2-1 shows the location of Pit 6 and the location of the Tehek Lake access road. The samples were described in detail in terms of geology and mineralogy, labelled, bagged and submitted to Canadian Environmental and Metallurgical Inc. (CEMI) for chemical analyses.

2.2 Analyses

The suite of chemical analyses performed by CEMI included whole rock and elemental solid phase chemistry, acid-base accounting (ABA), and analysis of metal leaching potential via shake flask extraction (SFE). These analyses are described in the following sections.

2.3 Rock Chemistry

The chemical composition of the three samples was determined by a) whole rock analysis (via lithium metaborate fusion and nitric acid digestion) and by b) multi-acid digestion. Arsenic, mercury, selenium, and thallium were analyzed by a separate assay. All analyses were completed through ICP-OES scans of the digested solutions.

Whole rock analysis provides total elemental weight percent compositions as oxides of major rock-forming elements (*e.g.*, Na_2O, CaO, SiO_2, etc.) and is used to determine the general characteristics of different lithologies.

Multi-acid digestion provides elemental concentrations of trace metals. Although multi-acid digestion of samples prior to ICP analysis is aggressive, the process may leave trace amounts of solids undissolved and therefore not analyzed. Whole rock analytical results are thus considered to be more representative of the actual concentration of major elements.

2.3.1 Acid Base Accounting

ABA tests were performed on each of the three samples to evaluate the ARD potential of the rock. These tests included determination of the following parameters: paste pH; acid potential (AP) through sulphur species analysis (analysis of total sulphur, sulphate sulphur and sulphide sulphur by difference); bulk neutralization potential (bulk NP) by the modified Sobek Method; and carbonate neutralization potential (CaNP) through total inorganic carbon (TIC) analysis. CaNP is used to assess the amount of acid neutralization that can be attributed to reactive carbonate minerals, relative to the amount of acid neutralization from silicate minerals.

2.3.2 Metal Leaching

SFE tests were performed on each of the three samples to evaluate the amount of readily soluble metals that can leach from the rock in concentrations exceeding the Canadian Council of Ministers of the Environment's (CCME) Canadian Environmental Quality

Guidelines (CEQG) (updated 2003) for the protection of freshwater aquatic life. The samples were crushed to minus 5 mm and subjected to a 24-hour shake flask extraction using de-ionized water at a liquid to solid ratio of 3 to 1 (*i.e.,* 750 ml distilled water to 250 g of sample). The resulting leachate was filtered and analyzed for; pH, conductivity, acidity, alkalinity, sulphate, and low-level metals (by ICP-MS).

2.4 Comparative Guidelines

2.4.1 ARD Potential

The ARD potential of the three samples was evaluated using the Indian and Northern AFFAIRS Canada (INAC) guidelines for northern minesites (INAC, 1992). The potential of a geologic material to generate ARD is described by comparing the buffering capacity of the rock provided by neutralizing minerals, expressed as neutralization potential (bulk NP in units of equivalent kg of calcium carbonate per tonne of rock), to the amount of acidity that can be generated by the oxidation of sulphide minerals, expressed as the maximum acid potential (AP in the same units as NP), present in the rock. This ratio is referred to as the net potential ratio (NPR). The suggested guidelines are as follows:

TABLE 2-1: Acid Rock Drainage Screening Criteria for Rock (INAC, 1992)

Initial Screening Criteria	ARD Potential
NPR < 1	Likely Acid Generating (PAG)
1 < NPR < 3	Uncertain
3 < NPR	Acid Consuming Not Potentially Acid Generating (NPAG)

The relationship between paste pH and sulphide sulphur content was also considered. Materials with a sulphide sulphur content of less than 0.3 wt.% and a paste pH greater than 5.5 may be classified as non-acid generating (Price, 1997) except where the rock matrix consists of base poor minerals (*e.g.,* quartz), or where the sulphide minerals contain metals that may leach under weakly acidic to alkaline conditions. This criterion was considered as a screening tool rather than a definite indicator of the potential for acidification.

Bulk NP measures the maximum potential buffering capacity including that, which comes from less reactive silicate minerals such as micas and feldspars. For samples having a low carbonate mineral content, the bulk NP measurement can overestimate the effective NP of a sample. For samples with low carbonate content, CaNP may provide a better measure of available NP and NPR (ARD potential).

2.4.2 Metal Leaching Potential

Metal concentrations in leachate generated by SFE tests are compared to the CEQG (updated 2003) for the protection of freshwater aquatic life.

This set of criteria is used for screening purposes only, since true drainage and run-off quality generated by exposure of fresh rock surfaces to water depends on factors that cannot be simulated in static laboratory tests (*e.g.*, grain size distribution, frequency and volume of precipitation, rate of sulphide oxidation, etc.). Guideline exceedances of constituents in SFE leachates do not necessarily imply water quality exceedances on site; rather they provide an indication of potential constituents of environmental concern.

3.0 RESULTS

3.1 Geology

The following table summarizes the lithologies of the samples collected for ARD/ML analyses.

TABLE 3-1: Geological Sample Descriptions

Sample	Rock Type	Description
Sample - 1	Diorite	Medium grained intermediate/mafic igneous rock with trace to1% disseminated pyrite, foliation, chlorite and oxidation alteration of minerals
Sample - 2	Diabase	Fine grained Intermediate/mafic igneous rock with trace to1% disseminated pyrite, foliation of mineral grains, chlorite alteration of minerals
Sample - 3	Diorite	Medium grained intermediate/mafic igneous rock with trace disseminated pyrite, foliation, chlorite alteration of mafic minerals

In general, the samples collected were intermediate to mafic igneous rocks with trace (up to 1%) disseminated pyrite. Sample 1 and Sample 3 were coarse grained and exhibited foliation of common rock forming minerals, such as feldspars, amphiboles and pyroxenes. Sample 2 was finer grained and exhibited moderate foliation of mineral grains. All three of the samples were strongly chloritized.

The presence of iron-bearing sulphides, particularly pyrite, is noteworthy since their oxidation results in acid production. The following equation represents the oxidation of pyrite and generation of proton acidity:

$$FeS_2\,(s) + (7/2)\,H_2O + (15/4)\,O_2\,(g) \rightarrow Fe(OH)_3\,(s) + 2SO_4^{2-}\,(aq) + 4H^+\,(aq)$$

This equation shows that pyrite in contact with water and air will produce rust ($Fe(OH)_3$), sulphate (SO_4^{2-}) and acid (H+). Under acidic conditions, with a lack of buffering, the mobility of most metals in water is enhanced. Common acid buffering minerals include calcium-rich carbonates, such as calcite and dolomite, as well as aluminosilicate minerals, such as the chlorite noted in the sample descriptions in Table 3-1. These minerals dissolve at different rates to buffer the acidity generated by sulphide minerals; silicate minerals are less reactive than carbonate minerals (Blowes and Ptacek, 1994).

3.2 Rock Chemistry

Results of whole rock and elemental analyses are shown at the end of this report in Tables 3-2 and 3-3, respectively.

As shown in the results from the whole rock analysis, the samples report average silica, aluminium and iron concentrations as weight percents SiO_2, Al_2O_3 and total iron as Fe_2O_3 of 46.65 wt %, 18.15 wt %, and 10.18 wt %, respectively. This compares to 51.9 %, 16.4 wt%, and 11.2 wt % for silica, aluminium, and iron, respectively in average diorite (Price, 1997).

The concentration ranges of the CEQG-regulated constituents from the multi-acid digestion analyses for trace element concentrations in the three samples are: aluminium (8.68 to 8.95 %); arsenic (1 to 2 ppm); chromium (96 to 215 ppm); copper (21 to 59 ppm); iron (6.25 to 7.29 %); mercury (6 to 13 ppb); nickel (51 to 69 ppm); and zinc (101 to 131 ppm).

The following CEQG-regulated constituents were below laboratory detection limits in all three samples: cadmium (<1 ppm); lead (<2 ppm); molybdenum (<2 ppm); selenium (<0.1 ppm); silver (<1 ppm); and thallium (<0.1 ppm).

3.3 ARD Potential

Results of ABA analyses are shown in Table 3-4 at the end of this report. A summary of the ARD potential of the rock samples, based on bulk NPR compared to the INAC (1992) criteria, is presented in Table 3-5.

TABLE 3-5: Summary of ARD Potentials of the Pit 6 Samples

Potential for ARD	Initial Screening Criteria	Number of Results	NPR Range
PAG	NPR < 1	-	-
Uncertain	1 < NPR < 3	-	-
NPAG	NPR > 3	3	3.2 – 41.5

Based on the INAC guidelines for northern minesites (1992), none of the samples are considered to be potentially acid generating (NPAG). Bulk NP values range from 8.0 to 116.8 kg $CaCO_3$/tonne of rock and AP values range from 1.88 to 2.81 kg $CaCO_3$/tonne of rock. The NPR values range from 3.20 to 41.5.

The three samples report strongly alkaline paste pH values, ranging from 9.20 to 9.69 indicating readily available buffering capacity. The three samples also report low sulphide sulphur contents, ranging from 0.06 to 0.09 % and sulphate sulphur concentrations at or below the detection limit (0.01 wt %).

The three samples report CaNPR values that range from 2.67 to 37.0 compared with a bulk NPR range of 3.20 to 41.5. The $CaCO_3$ NP values range from 6.67 to 104.2 kg $CaCO_3$/tonne of rock. Comparing the NPR and CaNPR values indicates that the majority of the neutralization potential of each of the three samples is provided by reactive carbonate minerals, with some proportion attributed to aluminosilicate minerals.

3.4 Metal Leaching

Results of static metal leaching tests are shown in Table 3-6 at the end of this report and are compared to the CEQG for freshwater aquatic life. Table 3-7 summarizes guideline exceedances noted in leachates from the three samples.

TABLE 3-7: Summary of CEQG and MMER Exceedances in Pit 6 Sample Leachates

Sample ID	CEQG Exceedances
Sample-01	Aluminium, Copper
Sample-02	Aluminium, Copper
Sample-03	Aluminium, Copper

Sample-01 reports slightly alkaline pH values of 7.79. The SFE leachate aluminium for this sample is 0.149 mg/L, which is in excess of the CEQG for aluminium (0.1 mg/L). The SFE leachate copper for this sample is 0.0208 mg/L, which is in excess of the CEQG for copper (0.003 mg/L).

Sample-02 reports slightly alkaline pH values of 7.92. The SFE leachate aluminium for this sample is 0.188 mg/L, which is in excess of the CEQG for aluminium (0.1 mg/L). The SFE leachate copper for this sample is 0.0072 mg/L, which is in excess of the CEQG for copper (0.003 mg/L).

Sample-03 reports slightly alkaline pH values of 7.78. The SFE leachate aluminium for this sample is 0.156 mg/L, which is in excess of the CEQG for aluminium (0.1 mg/L). The SFE leachate copper for this sample is 0.0183 mg/L, which is in excess of the CEQG for copper (0.003 mg/L)

The aluminium leaching exhibited by each of the samples is likely due to partial dissolution of the naturally occurring and abundant aluminosilicate minerals. The source mineral for the copper leaching may be due to trace concentrations of this element in either sulphide or rock forming mineral. Trace element analysis of the three samples presented in Table 3-3 show low copper concentrations (<59 ppm).

4.0 SUMMARY AND RECOMMENDATIONS

The objective of this assessment was to evaluate the ARD/ML potential of rock collected from the proposed Pit 6 quarry site. Three representative samples of the quarry material were collected by Golder personnel for ARD/ML testing. Quarry material from Pit 6 is potentially to be used in the construction of the Tehek Lake access road to Meadowbank.

The three samples have been described as chloritized, intermediate to mafic igneous rocks with trace (up to 1%) disseminated pyrite. The hand specimens of the samples varied in mineral grain texture (fine grained to coarse grained).

The results of whole rock analysis show an abundance of aluminosilicate minerals in the three samples. The rocks are also high in Fe_2O_3, which is likely due to the presence of mafic minerals (amphiboles, pyroxenes, etc.) in the rocks.

All three samples are considered to be NPAG, based on their NPR values compared to the INAC (1992) screening criteria. The samples also report low sulphide sulphur concentrations and alkaline paste pH values. CaNP values compared to bulk NP values indicate that the majority of the neutralization capacity of the samples is provided by carbonates, with some proportion attributed to aluminosilicate minerals.

SFE leachate pH values are alkaline for the three samples. The SFE leachate concentrations satisfy the CEQG guidelines except for aluminium and copper concentrations, which exceed the CEQG guidelines for the three samples. Aluminium leaching from the samples is likely due to partial dissolution of the exposed aluminosilicate minerals, which are naturally occurring and abundant in the rock. The source for copper leaching is unknown, however trace element analysis indicates that the concentration of copper in the samples is very low. Considering that samples are all non-acid generating and have very low sulphide content to oxidize, dissolved constituent concentrations are expected to attenuate with time, as fine particles settle within the fill. As noted above (refer to Section 2.4.2), results of the SFE are not directly applicable to field conditions, and exceedances in SFE analytes do not necessarily directly correlate to exceedances of the same analytes if the material is used for road construction

It is recommended that runoff contacting open quarry sites and excavated rock be monitored during the construction of the Tehek Lake access road, to document the quality of drainage and to verify the results of the testing described in this document.

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TABLE 3-2:
Whole Rock Analysis Results
Pit 6 Samples
Meadowbank, Nunavut

Sample ID	Location	Rock Type	SiO2 %	Al2O3 %	Fe2O3 %	CaO %	MgO %	Na2O %	K2O %	TiO2 %	P2O5 %	MnO %	BaO %	Cr2O3 %	LOI %	Total %	C %	S %
Sample-01	**Pit 6**	**Diorite**	48.59	18.1	9.25	7.29	5.57	4.93	0.55	1.02	0.41	0.14	0.03	0.04	3.28	99.19	0.48	0.06
Sample-02	**Pit 6**	**Diabase**	42.21	18.12	10.62	8.38	5.63	4.3	0.65	1.16	0.53	0.14	0.03	0.02	8.15	99.93	1.45	0.1
Sample-03	**Pit 6**	**Diorite**	49.14	18.24	10.68	7.11	4.82	4.4	0.6	0.91	0.24	0.14	0.04	0.04	3.29	99.64	0.26	0.08
		min	*42.21*	*18.10*	*9.25*	*7.11*	*4.82*	*4.30*	*0.55*	*0.91*	*0.24*	*0.14*	*0.03*	*0.02*	*3.28*	*99.19*	*0.26*	*0.06*
		max	*49.14*	*18.24*	*10.68*	*8.38*	*5.63*	*4.93*	*0.65*	*1.16*	*0.53*	*0.14*	*0.04*	*0.04*	*8.15*	*99.93*	*1.45*	*0.10*
		average	*46.65*	*18.15*	*10.18*	*7.59*	*5.34*	*4.54*	*0.60*	*1.03*	*0.39*	*0.14*	*0.03*	*0.03*	*4.91*	*99.59*	*0.73*	*0.08*
		median	*48.59*	*18.12*	*10.62*	*7.29*	*5.57*	*4.40*	*0.60*	*1.02*	*0.41*	*0.14*	*0.03*	*0.04*	*3.29*	*99.64*	*0.48*	*0.08*
		standard deviation	*3.85*	*0.08*	*0.81*	*0.69*	*0.45*	*0.34*	*0.05*	*0.13*	*0.15*	*0.00*	*0.01*	*0.01*	*2.81*	*0.37*	*0.63*	*0.02*

Notes:
< = less than detection limit
Non-detect values assumed to be equal to one half of the detection limit in calculations of average, median and standard deviation, where applicable.

TABLE 3-3:
Trace Element Analysis Results
Pit 6 Samples
Meadowbank, Nunavut

Sample ID	Location	Rock Type	Ag ppm	Al %	As ppm	Ba ppm	Be ppm	Bi ppm	Ca %	Cd ppm	Co ppm	Cr ppm	Cu ppm	Fe %	Hg ppb	K %	Mg %	Mn ppm
Sample-01	**Pit 6**	**Diorite**	<1	8.68	1	230	1.2	<5	4.69	<1	33	211	32	6.25	13	0.54	2.94	979
Sample-02	**Pit 6**	**Diabase**	<1	8.95	2	228	0.9	<5	5.54	<1	35	96	21	7.29	9	0.65	3.08	1029
Sample-03	**Pit 6**	**Diorite**	<1	8.82	2	355	1.2	<5	4.66	<1	36	215	59	6.98	6	0.56	2.59	1005
		min	*<1*	*8.68*	*1*	*228*	*0.90*	*<5*	*4.66*	*<1*	*33*	*96*	*21*	*6.25*	*6*	*0.54*	*2.59*	*979*
		max	*<1*	*8.95*	*2*	*355*	*1.20*	*<5*	*5.54*	*<1*	*36*	*215*	*59*	*7.29*	*13*	*0.65*	*3.08*	*1029*
		average	*<1*	*8.82*	*2*	*271*	*1.10*	*<5*	*4.96*	*<1*	*35*	*174*	*37*	*6.84*	*9*	*0.58*	*2.87*	*1004*
		median	*<1*	*8.82*	*2*	*230*	*1.20*	*<5*	*4.69*	*<1*	*35*	*211*	*32*	*6.98*	*9*	*0.56*	*2.94*	*1005*
		standard deviation	*n/a*	*0.14*	*0.6*	*73*	*0.17*	*n/a*	*0.50*	*n/a*	*1.5*	*68*	*20*	*0.53*	*4*	*0.06*	*0.25*	*25*

Sample ID	Location	Rock Type	Mo ppm	Na %	Ni ppm	P ppm	Pb ppm	Se ppm	Sr ppm	Ti %	Tl ppm	V ppm	W ppm	Zn ppm
Sample-01	**Pit 6**	**Diorite**	<2	3.19	69	1803	<2	<0.1	823	0.45	<0.1	160	<10	101
Sample-02	**Pit 6**	**Diabase**	<2	2.94	60	2287	<2	<0.1	727	0.27	<0.1	187	<10	131
Sample-03	**Pit 6**	**Diorite**	<2	2.85	51	1093	<2	<0.1	848	0.48	<0.1	173	<10	115
		min	*<2*	*2.85*	*51*	*1093*	*<2*	*<0.1*	*727*	*0.27*	*<0.1*	*160*	*<10*	*101*
		max	*<2*	*3.19*	*69*	*2287*	*<2*	*<0.1*	*848*	*0.48*	*<0.1*	*187*	*<10*	*131*
		average	*<2*	*2.99*	*60*	*1728*	*<2*	*<0.1*	*799*	*0.40*	*<0.1*	*173*	*<10*	*116*
		median	*<2*	*2.94*	*60*	*1803*	*<2*	*<0.1*	*823*	*0.45*	*<0.1*	*173*	*<10*	*115*
		standard deviation	*n/a*	*0.18*	*9*	*601*	*n/a*	*n/a*	*64*	*0.11*	*n/a*	*14*	*n/a*	*15*

Notes:

< = less than detection limit

Non-detect values assumed to be equal to one half of the detection limit in calculations of average, median and standard deviation, where applicable.

TABLE 3-4:
Acid Base Accounting Results
Pit 6 Samples
Meadowbank, Nunavut

Sample ID	Location	Rock type	Paste pH	S(T) %	S(SO4) %	S(S-2) %	AP	NP	TIC (%)	CaCO3 NP	Net NP	NPR	CaNPR	ARD Potential
Sample-01	**Pit 6**	**Diorite**	9.69	0.06	<0.01	0.06	1.88	25.5	0.21	17.5	23.6	13.6	9.33	NPAG
Sample-02	**Pit 6**	**Diabase**	9.20	0.1	0.01	0.09	2.81	116.8	1.25	104.2	114.0	41.5	37.04	NPAG
Sample-03	**Pit 6**	**Diorite**	9.42	0.08	<0.01	0.08	2.50	8.0	0.08	6.7	5.5	3.2	2.67	NPAG
		min	*9.20*	*0.06*	*0.01*	*0.06*	*1.88*	*8.0*	*0.08*	*6.67*	*5.50*	*3.20*	*2.67*	-
		max	*9.69*	*0.10*	*0.01*	*0.09*	*2.81*	*116.8*	*1.25*	*104.17*	*113.99*	*41.53*	*37.04*	-
		average	*9.39*	*0.08*	*0.01*	*0.08*	*2.40*	*50.1*	*0.51*	*42.78*	*47.70*	*19.44*	*16.35*	-
		median	*9.42*	*0.08*	*0.01*	*0.08*	*2.50*	*25.5*	*0.21*	*17.50*	*23.63*	*13.60*	*9.33*	-
		standard deviation	*0.25*	*0.02*	*0.003*	*0.02*	*0.48*	*58.4*	*0.64*	*53.44*	*58.11*	*19.82*	*18.23*	-

Notes:

< = less than detection limit

* S(S2-) sulphide sulphur calculated as S(T)total suphur - S(SO4)sulphate sulphur

Where S(SO4) is reported as <0.01%, it is assumed to be zero for the AP calculation.

TIC = Total inorganic carbon, used in calculation of CaNP

AP = Acid potential in kg CaCO3 equivalent per tonne of rock. AP is determined from calculated sulphide sulphur content: S(T) - S(SO4), assuming total conversion of sulphide to sulphate.

Bulk NP = Neutralization potential in kg CaCO3 equivalent per tonne of rock.

CaNP = Carbonate mineral neutralization potential in kg CaCO3 equivalent per tonne of rock

NET NP = Net neutralization potential in kg CaCO3 equivalent per tonne of rock. Calculated as the difference between NP and AP.

NPR = Neutralization potential ratio: NP/AP

CaNPR = Neutralization potential ratio calculated using CaNP: CaNP/AP

Non-detect values assumed to be equal to one half of the detection limit in calculations of average, median and standard deviation, where applicable.

TABLE 3-6:
Shake Flask Extraction Results
Pit 6 Samples
Meadowbank, Nunavut

CCME (CEQG) (freshwater aquatic life)* (mg/L)			6.5 - 9.0							0.005 - 0.1		0.005		
Sample ID	**Location**	**Rock type**	**pH s.u.**	**REDOX mV**	**Conductivity uS/cm**	**Acidity (pH 8.3) mg/L as CaCO3**	**Alkalinity mg/L as CaCO3**	**Hardness mg/L as CaCO3**	**Sulphate (mg/L)**	**Aluminum[2] (mg/L)**	**Antimony (mg/L)**	**Arsenic (mg/L)**	**Barium (mg/L)**	**Beryllium (mg/L)**
Sample-01	**Pit 6**	**Diorite**	7.79	293	149	2.6	66.2	78	10	**0.149**	0.00092	0.0007	0.0146	<0.00005
Sample-02	**Pit 6**	**Diabase**	7.92	303	152	2.4	74.6	82	3	**0.188**	0.00827	0.0006	0.00401	<0.00005
Sample-03	**Pit 6**	**Diorite**	7.78	316	111	2.3	55.0	59	2	**0.156**	0.00089	0.0008	0.00615	<0.00005
	min		*7.78*	*293*	*111*	*2.3*	*55.0*	*59*	*2*	*0.149*	*0.00089*	*0.0006*	*0.00401*	*<0.00005*
	max		*7.92*	*316*	*152*	*2.6*	*74.6*	*82*	*10*	*0.188*	*0.00827*	*0.0008*	*0.01460*	*<0.00005*
	average		*7.83*	*304*	*138*	*2.4*	*65.3*	*73*	*5*	*0.164*	*0.00336*	*0.0007*	*0.00825*	*<0.00005*
	median		*7.79*	*303*	*149*	*2.4*	*66.2*	*78*	*3*	*0.156*	*0.00092*	*0.0007*	*0.00615*	*<0.00005*
	standard deviation		*0.08*	*12*	*23*	*0.1*	*9.8*	*12*	*4*	*0.021*	*0.00425*	*0.0001*	*0.00560*	*n/a*

CCME (CEQG) (freshwater aquatic life)* (mg/L)						0.000026	0.073	0.025 - 0.15			0.001		0.0001	
Sample ID	**Location**	**Rock type**	**Lithium (mg/L)**	**Magnesium (mg/L)**	**Manganese (mg/L)**	**Mercury (mg/L)**	**Molybdenum (mg/L)**	**Nickel[4] (mg/L)**	**Phosphorus (mg/L)**	**Potassium (mg/L)**	**Selenium (mg/L)**	**Silicon (mg/L)**	**Silver (mg/L)**	**Sodium (mg/L)**
Sample-01	**Pit 6**	**Diorite**	0.0005	2.9	0.0121	<0.05	0.0018	0.0014	<0.1	1.86	<0.0005	1.69	<0.00001	4.98
Sample-02	**Pit 6**	**Diabase**	0.0004	2.24	0.0141	<0.05	0.00083	0.0006	<0.1	2.16	<0.0005	1.15	<0.00001	3.61
Sample-03	**Pit 6**	**Diorite**	0.0004	1.84	0.0137	<0.05	0.00154	<0.0005	<0.1	1.24	<0.0005	1.48	<0.00001	3.19
	min		*0.0004*	*1.84*	*0.0121*	*<0.05*	*0.0008*	*<0.0005*	*<0.1*	*1.24*	*<0.0005*	*1.15*	*<0.00001*	*3.19*
	max		*0.0005*	*2.90*	*0.0141*	*<0.05*	*0.0018*	*0.0014*	*<0.1*	*2.16*	*<0.0005*	*1.69*	*<0.00001*	*4.98*
	average		*0.0004*	*2.33*	*0.0133*	*<0.05*	*0.0014*	*0.0008*	*<0.1*	*1.75*	*<0.0005*	*1.44*	*<0.00001*	*3.93*
	median		*0.0004*	*2.24*	*0.0137*	*<0.05*	*0.0015*	*0.0006*	*<0.1*	*1.86*	*<0.0005*	*1.48*	*<0.00001*	*3.61*
	standard deviation		*0.0001*	*0.54*	*0.0011*	*n/a*	*0.0005*	*0.0006*	*n/a*	*0.47*	*n/a*	*0.27*	*n/a*	*0.94*

Notes:
1. CEQG freshwater guidelines and criteria are based on **total** metal concentrations, except for aluminum (dissolved aluminum criterion).
2. Freshwater aquatic life criterion for aluminum depends on pH, [Ca2+] and DOC. In this table, only the pH criterion has been applied to highlight exceedances.
3. Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.
4. Freshwater aquatic life criterion or guideline is hardness dependant.
< = less than the analytical detection limit.
* December 2003
Non-detect values assumed to be equal to one half the detection limit in calculations of average, median and standard deviation, where applicable.

TABLE 3-6:
Shake Flask Extraction Results
Pit 6 Samples
Meadowbank, Nunavut

Sample ID	Location	Rock type	Bismuth (mg/L)	Boron (mg/L)	Cadmium[4] (mg/L)	Calcium (mg/L)	Chromium[3] (mg/L)	Cobalt (mg/L)	Copper[4] (mg/L)	Iron (mg/L)	Lead[4] (mg/L)
CCME (CEQG) (freshwater aquatic life)* (mg/L)					**0.000017**		**0.001/0.0089**		**0.002 - 0.004**	**0.3**	**0.001 - 0.007**
Sample-01	**Pit 6**	**Diorite**	<0.00005	0.01	<0.00001	26.4	0.0003	0.00006	**0.0208**	0.018	0.00012
Sample-02	**Pit 6**	**Diabase**	<0.00005	<0.008	<0.00001	29.1	<0.0002	0.00002	**0.0072**	0.009	0.00006
Sample-03	**Pit 6**	**Diorite**	<0.00005	0.009	<0.00001	20.4	<0.0002	0.00005	**0.0183**	0.01	0.00013
	min		*<0.00005*	*<0.008*	*<0.00001*	*20.4*	*<0.0002*	*0.00002*	*0.0072*	*0.009*	*0.00006*
	max		*<0.00005*	*0.010*	*<0.00001*	*29.1*	*0.0003*	*0.00006*	*0.0208*	*0.018*	*0.00013*
	average		*<0.00005*	*0.008*	*<0.00001*	*25.3*	*0.0002*	*0.00004*	*0.0154*	*0.012*	*0.00010*
	median		*<0.00005*	*0.009*	*<0.00001*	*26.4*	*0.0001*	*0.00005*	*0.0183*	*0.010*	*0.00012*
	standard deviation		*na*	*0.003*	*n/a*	*4.5*	*0.0001*	*0.00002*	*0.0072*	*0.005*	*0.00004*

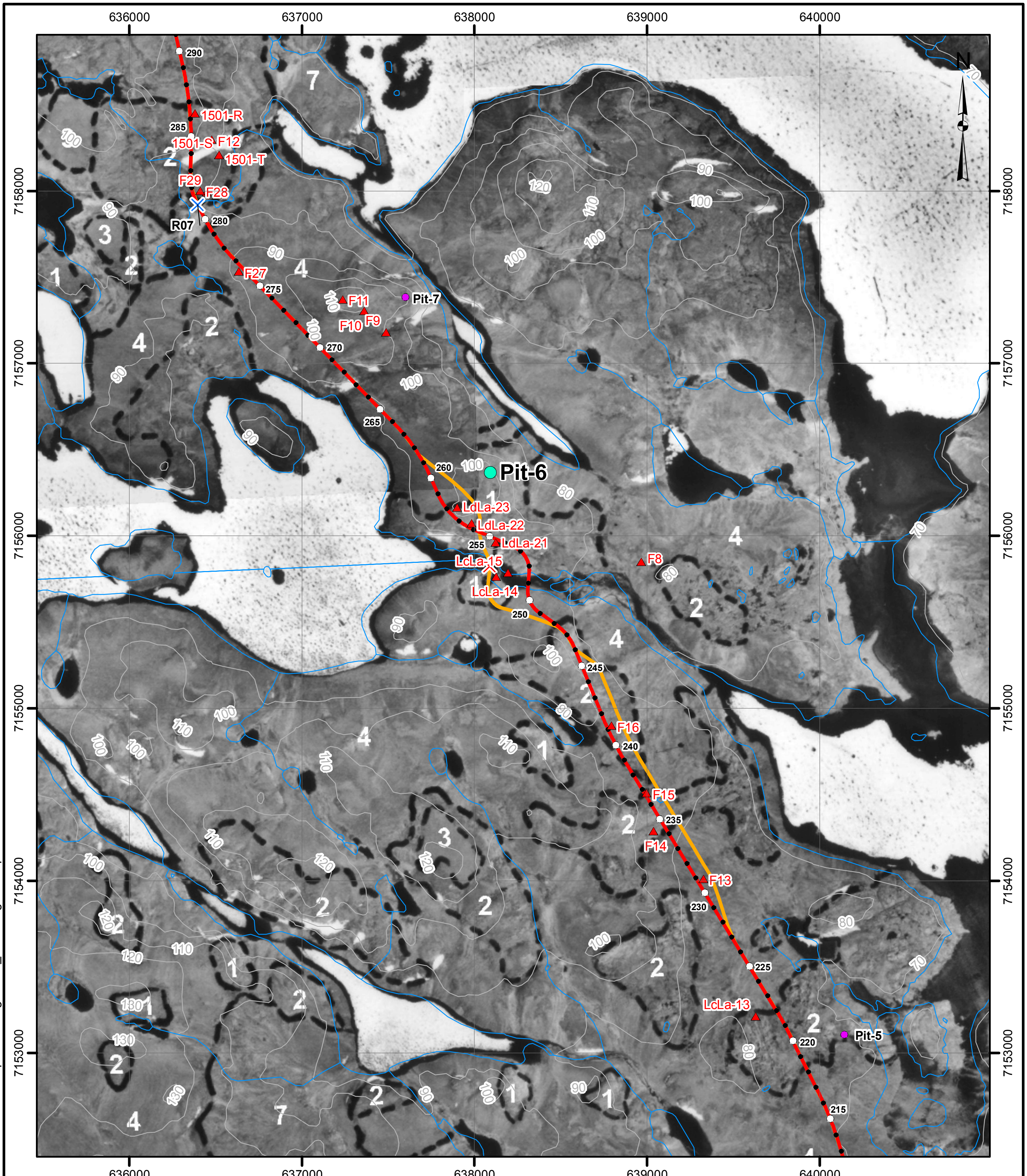
Sample ID	Location	Rock type	Strontium (mg/L)	Sulphur (mg/L)	Thallium (mg/L)	Tin (mg/L)	Titanium (mg/L)	Uranium (mg/L)	Vanadium (mg/L)	Zinc (mg/L)	Zirconium (mg/L)
CCME (CEQG) (freshwater aquatic life)* (mg/L)					**0.0008**					**0.03**	
Sample-01	**Pit 6**	**Diorite**	0.0739	3.6	<0.00005	<0.00005	0.0006	0.00006	0.00105	<0.0005	<0.005
Sample-02	**Pit 6**	**Diabase**	0.128	1.1	<0.00005	<0.00005	<0.0005	0.00002	0.00057	<0.0005	<0.005
Sample-03	**Pit 6**	**Diorite**	0.0434	0.8	<0.00005	<0.00005	0.0006	0.00003	0.00082	<0.0005	<0.005
	min		*0.0434*	*0.8*	*<0.00005*	*<0.00005*	*<0.0005*	*0.00002*	*0.0006*	*<0.0005*	*<0.005*
	max		*0.1280*	*3.6*	*<0.00005*	*<0.00005*	*0.0006*	*0.00006*	*0.0011*	*<0.0005*	*<0.005*
	average		*0.0818*	*1.8*	*<0.00005*	*<0.00005*	*0.0005*	*0.00004*	*0.0008*	*<0.0005*	*<0.005*
	median		*0.0739*	*1.1*	*<0.00005*	*<0.00005*	*0.0006*	*0.00003*	*0.0008*	*<0.0005*	*<0.005*
	standard deviation		*0.0428*	*1.5*	*n/a*	*n/a*	*0.0002*	*0.00002*	*0.0002*	*n/a*	*n/a*

Notes:
1. CEQG freshwater guidelines and criteria are based on **total** metal concentrations, except for aluminum (dissolved aluminum criterion).
2. Freshwater aquatic life criterion for aluminum depends on pH, [Ca2+] and DOC. In this table, only the pH criterion has been applied to highlight exceedances.
3. Freshwater aquatic life criteria for chromium depends on the valence of chromium ion. In the above table, the Cr(VI) criterion of 0.001 mg/L is shown.
4. Freshwater aquatic life criterion or guideline is hardness dependant.
5. Maximum authorized monthly mean concentration (based on **total** concentration).
6. < = less than the analytical detection limit.

* December 2003

** June 6, 2002

Non-detect values assumed to be equal to one half the detection limit in calculations of average, median and standard deviation, where applicable.



LEGEND

- Meadowbank Project
- Archaeological Site
- Rock Pit (investigated)
- Rock Pit (to be quarried)
- Chainage Marker
- Route
- Revised Route
- Watercourse
- Waterbody
- Contour (10 m interval)
- Stream Crossing (30 m bridge)
- Stream Crossing (12 m bridge)
- Stream Crossing (multiple culverts at bottom)
- Stream Crossing (single culvert at bottom)

600 300 0 600 Meters

Scale - 1:50,000

REFERENCE

Cumberland Resources Ltd.
Datum: NAD 83 Projection: UTM Zone 14

PROJECT

CUMBERLAND RESOURCES LTD.

TITLE

ROUTE ALIGNMENT SHOWING LOCATION OF PIT 6

Golder Associates
Burnaby, B.C.

PROJECT No. 06-1413-034			SCALE AS SHOWN	REV. 0
DESIGN	KD	15 Sep. 2006	FIGURE 2-1	
GIS	CDB	15 Sep. 2006		
CHECK	PA	12 Oct. 2006		
REVIEW				

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