GEOCHEMICAL AND GEOLOGICAL REPORT

ROD-STIR PROPERTY

Clinton Mining Division, British Columbia

Latitude 51°07' / Longitude 122°15'
UTM NAD 83 5663066 mN and 552495 mE.
NTS: Map 092O/019

Prepared by:
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December 17, 2011
Amended: May 30th, 2012

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ROD-STIR PROJECT

Location Map

Fig. 1

A.) PROPERTY DESCRIPTION

1) Location

The Rod-Stir Property is located, on the west side of the Fraser River, 92 kilometres north of the community of Lillooet. The property is centered at 51°07' north latitude and 122°15'west longitude, UTM NAD 83 5663066 mN and 552495 mE. (Figure 1)

2) Access and Physiography

The property is accessed from Lillooet via the West Pavilion Forestry road on the west side of the Fraser River. At kilometre 92 on the West Pavilion road a secondary mining road takes off to the west and at 9 kilometres bisects the property. The closest helicopter service is located in Lillooet.

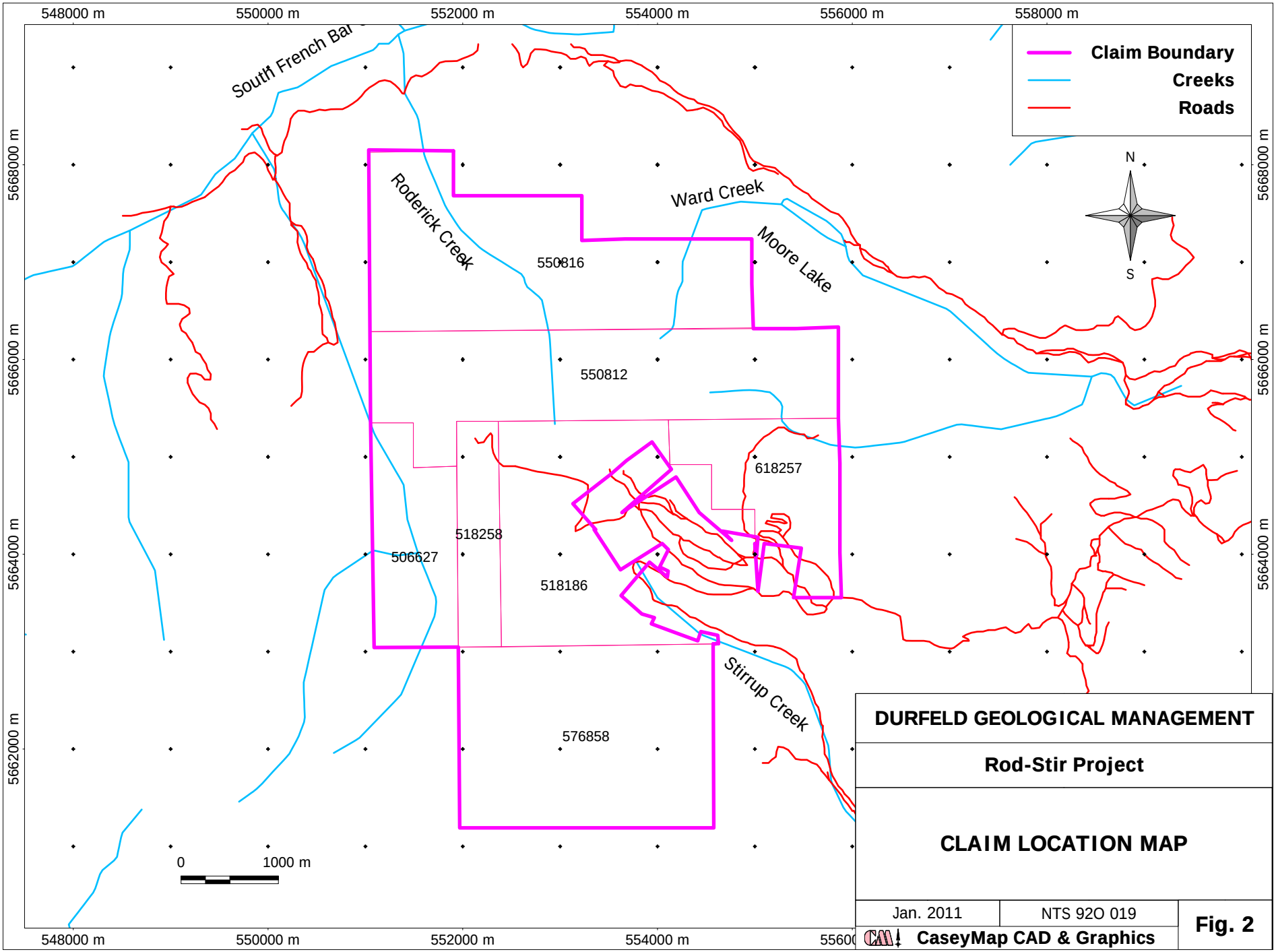
The property is on the Fraser Plateau in south central British Columbia. The topography of the property is dominated by the east-west trending 9-mile ridge with elevations ranging from 1600 to 2010 metres above sea level.

3) Claims

The Rod-Stir Property consists of 8 contiguous mineral tenures covering some 1804.9 hectares of mineral tenure in the Clinton Mining Division. (Figure 2)
The following table summarizes the current claim status. The Good To Date reflects work that was filed as SOWs Exploration and Development Work / Expiry Date Change Event Numbers (5010623) and is documented in this report. The excess exploration credit work will be filed to further advance the good to date. The claims are held in the name of JM (Mel) Stewart (FMC # 125752).

Claim Tenure as Roderick Claims

Tenure Number	Claim Name	Owner	Tenure Type	Map Number	Issue Date	Good To Date	Area (ha)
518186	DAVE	125752 (100%)	Mineral	092O	2005/jul/22	2011/sep/30	486.8
518257	DAVE 2	125752 (100%)	Mineral	092O	2005/jul/26	2011/sep/30	223.1
518258	DAVE 3	125752 (100%)	Mineral	092O	2005/jul/26	2011/sep/30	101.4
538455	GAP 1	125752 (100%)	Mineral	092O	2006/aug/01	2011/sep/30	40.6
538457	GAP 2	125752 (100%)	Mineral	092O	2006/aug/01	2011/sep/30	20.3
550812	JOAN	125752 (100%)	Mineral	092O	2007/jan/31	2011/sep/30	466.4
550816	DEB	125752 (100%)	Mineral	092O	2007/jan/31	2011/sep/30	283.8
596627	JM	125752 (100%)	Mineral	092O	2008/dec/26	2011/sep/30	182.6
					Property Area		**1804.9**



DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

CLAIM LOCATION MAP

Jan. 2011	NTS 92O 019	**Fig. 2**

CaseyMap CAD & Graphics

4.) Regional History (Stirrup / Roderick Creek)

Mineral claims owned by H.V. Warren and his associates, located on the ridge between the headwaters of Stirrup Creek and Roderick Creek in the Clinton Mining Division, have been investigated for the source of several thousand ounces of placer gold. Warren reports that placer gold was discovered at Stirrup Creek during World War 1 and over the following 25 years, some 3000 to 5000 ounces of gold were produced. Placer operations have continued intermittently since that time.

The 1933 B.C. Minister of Mines Report notes that a 100 foot cross-cut with an 80 foot winze and a connecting 12 foot drift were completed that year. A number of veins and lenses of stibnite were located in 1942.

Rio Tinto Explorations Ltd. optioned the property in 1969. That company carried out geochemical surveys and drilled nine percussion holes aggregating 494 metres (1622 feet). A piece of float found on the ridge saddle at this time assayed 0.66 opt gold. Placer Development Ltd. optioned the property in 1973 and undertook geochemical and trenching programs. Then Chevron optioned the property in 1974. Chevron also conducted geochemical and geological programs, trenching, and in 1975 drilled two 300 foot vertical core holes. Asarco made detailed examinations of the claims in 1980, and Placer Development are reported to have conducted a limited VLF-EM test in 1984. Interest in the property was again revived in 1986 when the high grade Blackdome gold deposit located about 30 kilometres north of Stirrup Creek was brought into production.

Chevron Canada Resources Limited again optioned the property in 1987 along with the adjacent Brent property to the west. The properties were acquired with a view to re-evaluating a number of known gold showings within the Warren claims, and in particular to determine whether smaller, structurally controlled deposits may be present. In June and July of 1987, a number of old trenches were cleaned, a limited amount of new trenching was completed and sampled. In October, four shallow drill tests were completed.

5.) 2011 Exploration Program

In the spring the author supervised compilation of all the available historic geological data. From August 24th to the 26th the author spent time on the project in the company of, Mel Stewart, the owner of the mineral tenure. Time was spent geological mapping and prospecting in the south central property area. Geological contacts were corrected to where they were observed in the field. The compiled data was used to identify areas for additional soil sampling and from September 28th to 30th, 2011 Steve Lehman collected 80 soil samples in the property area. The results of this sampling are documented in this report.

B.) GEOLOGY

1) Regional Geology

The claim area lies near the eastern margin of the Jackass Mountain Group, an early Cretaceous sedimentary unit. The assemblage is reported to be about 5300 metres thick consisting of volcanic-rich lithic wakes, shales and polymict boulder conglomerates that are dominantly of marine origin.

The claims lie close to the Trettin'D ' Fault, one of the major northwesterly splays of the Fraser River Fault Zone. Movement along the Fraser Fault and the Yalakom Fault further to the west has dissected the Jackass Group into several parts and has also resulted in a number of cross faults trending east to northeast between the two. A number of easterly trending parallel faults have been noted in the upper part of Stirrup Creek.

2) Property Geology

Much of the area of the 2007, 2008, 2009 and 2010 programs is lower on the hillside and covered by overburden. The contacts on the geology map were defined by mapping rubble in soil pits and outcrop where observed. The geology is given as the backdrop for all of the geochemical results (Figures 4, 5 and 6).

Within the claims and adjoining area to the northwest and south east, the sedimentary rocks dominated by sandstone (1), conglomerate (3) and lesser siltstone and argillite (2) have been intruded by dykes, sills and plugs of granodiorite (4), feldspar porphyry (5) and quartz-feldspar porphyry (6). Due to limited exposure, the nature of the intrusives are not defined but are believed to be part of the sill and Dyke system present at Stirrup Creek.

3) Mineralization

These intrusives are locally mineralized with fine pyrite / arsenopyrite. The mineralized intrusions form prominent gossans on the alpine open slopes. In the central claim area, small stibnite occurrences have been partly exposed in bulldozer trenches. The stibnite occurs as narrow seams near the contact of a quartz-feldspar porphyry sill that seems to trend west to northwest in an argillaceous siltstone host. Nearby rocks are locally highly altered, cream-coloured and clay rich with dark brown fractures. This setting and the geochemistry are similar to other occurrences on the adjacent Stirrup Creek property.

Two small hand pits reveal grey stibnite bearing quartz veins and stringers in a gossanous quartz-feldspar porphyry. The extent or trend of this zone is presently uncertain. Poorly defined quartz veins assaying up to 200 ppb gold are present near the northwest margin of the Shine claim. This material appears to mark a contact between quart-feldspar porphyry and Jackass sandstone.

4) Alteration

During the 2007 sampling program a series of float of altered sediment and intrusive rocks were selected and sent to Kim Heberlein in Vancouver for PIMA Spectral Analysis.

The results of her work showed an alteration suite of – phlogopite, illite/sericite, smectite, chlorite (Fe-Mg), weak kaolinite, probable epidote. A comparison of this alteration assemblage to the 'Temperature Stability of Hydrothermal Minerals in the Epithermal Environment' shows the alteration minerals defining a zone with potential for epithermal ore deposition.

C.) GEOCHEMISTRY

1) Sample Collection

During the 2011 field program 88 soil samples were collected for analysis. The sample sites were located using the Garmin GPS and recorded the UTM location in NAD 83.

Soil samples were collected with a grub hoe digging pits to a minimum of .7 metres to expose the soil profile. This profile showed a light grey volcanic ash that was up to .6 metres thick overlying a well developed rusty yellow to brown B-horizon soil. Samples were taken from the B-horizon, rock fragments removed and the sand silt and clay material placed in a pre-numbered kraft sample bag. Individual samples were described and the predominant lithology determined from local outcrops and rock fragments. The sample number and location were entered in an XL data base and later merged with the analytical results.

All equipment was cleaned between samples to avoid contamination.

2) Sample Analysis

Samples were shipped to SGS Canada Inc., Mineral Services, in Vancouver, BC for analysis by fire geochem for gold and 34 elements ICP. The labs detailed analytical procedures are given as Appendix III. Copies of analytical certificates are given as Appendix II.

D.) RESULTS

The soil results were merged with the field location data (UTM) and are given as appendix I.

The 2011 soil sample locations are shown on the property map figure 3 and colour coded 2011 soil results are plotted with the soil results from previous surveys with geology for gold, arsenic and antimony as figures 4, 5 and 6. The colour coded results for the 2011 sampling are shown with the geology as figures 4a, 5a and 6a. The anomalous values for gold and arsenic are also plotted.

The historic rock sampling has shown background gold values. A single sample of quartz-stibnite-arsenopyrite vein from the 2007 survey returned 586 ppm arsenic, 59 ppm mercury and greater than 10,000 ppm antimony. The high arsenic-stibnite suggests epithermal potential at depth. Otherwise the rock sampling has shown low arsenic and antimony values. The 2011 soil sampling continued to fill in and confirm the historic

western anomaly which is developing as a strong gold-arsenic-antimony in soil anomaly that is open to the north, south and west. Several prospecting and rock sampling traverses at the head of Ward Creek encountered relatively unaltered sandstones and conglomerate of the Jackass Mountain Group that were not anomalous in gold or pathfinder elements. A single 2008 traverse in the northern claim area showed a single gossanous soil sample strongly anomalous in gold (149 ppb) and arsenic (149 ppm). A small grid of 10 soil samples did not show any samples anomalous in gold and only a single sample with 143 ppm arsenic in an area underlain by gossanous weakly altered sandstone. Sampling of pyritic feldspar porphyry in the west property area showed the only rock sample of the 2009 work anomalous in gold (59 ppb).

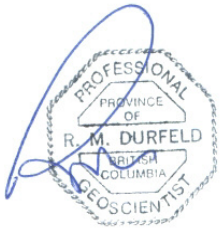
The 2010 rock sampling showed a quartz veined altered sandstone to be anomalous in arsenic (2522580) while the soil line to the northwest continues to define a coincident weak gold and arsenic anomaly.

The 2011 soil sampling confirmed the irregular historic strong gold and arsenic in soil anomaly in the western property area. While showing new potential as a single anomalous gold in soil sample at the most southeasterly soil sample site. This area is in the contact zone of sandstone (1) and feldspar porphyry (5). Additional soil sampling in conjunction with prospecting should be conducted in the area to evaluate the extent and full potential.

E.) COST STATEMENT

August 1 to October 15, 2011						
Soil Sampling, Prospecting and Geology						
Travel / Room / Board						
	Mob / Demob	20%		$8700 Project cost.	$1,740.00	
	Quad (2 for 3 days)	6	day	@ $70/day	$420.00	
	Room and Board	7	manday	@ $85/day	$595.00	
Wages						
Geologist	RM Durfeld, P.Geo					
	Aug 25 to 26	2	day	@ $700/day	$1,400.00	
Assistant	Compilation					
	K. Pocha			$1,600	$1,600.00	
Prospector	S Lehman					
	September 28 to 30	3	daty	@ $350	$1,050.00	
	Mel Stewart					
	Aug 23 to 27	4	day	@ $300/day	$1,200.00	
Analytical						
	2010 Sampling					
	Soil Samples	88	soil	@ $ 38.94	$3,426.72	
Reporting						
	Drafting and Plotting				$500.00	
	Report				$1,000.00	
	TOTAL 2009 PROJECT COST				**$12,931.72**	

Dated at Williams Lake, British Columbia this 17th day of December 2011.



R.M. Durfeld, B.Sc., P.Geo.

F.) STATEMENT OF QUALIFICATIONS

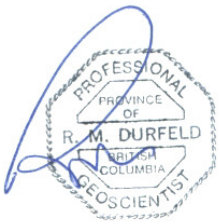
I, Rudolf M. Durfeld, do hereby certify that:
1.) I am a geologist with offices at 2029 South Lakeside Drive, Williams Lake, BC.
2.) I am a graduate of the University of British Columbia, B.Sc. Geology 1972, and have practiced my profession with various mining and/or exploration companies and as an independent geological consultant since graduation.
3.) I am a member Canadian Institute of Mining and Metallurgy.
4.) That I am registered as a Professional Geoscientist by the Association of Engineers and Geoscientists of B.C. (No. 18241).
5.) That this report is based on:

a.) my project supervision and project mapping conducted on the property on August 25 and 26, 2011.

b.) compilation of the 2011 and previous exploration data.

b.) my personal knowledge of the property area and a review of available government maps and assessment reports.

Dated at Williams Lake, British Columbia this 17th day of December 2011.



R.M. DURFELD, B.SC., P.GEO.

551000 m

552000 m

553000 m

5665000 m

550812

518186

518258

558218

N

LEGEND

Claim Boundaries

Creeks

Roads

Soils 2011 Samples

Points

0 500 m

3DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Soil Samples 2011

Date Nov 2009 | NTS 92O 019

CaseyMap CAD & Graphics

Fig. 3

552000 m

553000 m

5668000 m

5667000 m

5666000 m

5665000 m

5664000 m

Roderick Creek

LEGEND

Claim Boundaries

Creeks

Roads

2011 Soil Au

Points : Au

<30

30...60

60...140

>140

Historic Soils Au

Points : Au(ppb)

<30

30...60

60...140

>140

Geology

Areas : Lithology

1 Sandstone

2 Siltstone/Argillite

3 Conglomerate

4 Granodiorite

5 Feldspar Porphyry

6 Qtz.-Feldspar Porphyry

DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Soils Au/Geology

Date Nov 2009 | NTS 92O 019

CaseyMap CAD & Graphics

Fig. 4

552000 m

553000 m

5668000 m

5667000 m

5666000 m

5665000 m

5664000 m

Roderick Creek

LEGEND

Claim Boundaries

Creeks

Roads

Historic Soils As

Points : As(ppm)

<50

50...130

130...240

>240

2011 Soils As

Points : As(ppm)

<50

50...130

130...240

>240

Geology

Areas : Lithology

1 Sandstone

2 Siltstone/Argillite

3 Conglomerate

4 Granodiorite

5 Feldspar Porphyry

6 Qtz.-Feldspar Porphyry

550812

518186

518258

558218

DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Soils As/Geology

Date Nov 2009

NTS 92O 019

CaseyMap CAD & Graphics

Fig. 5

552000 m

553000 m

5668000 m

5667000 m

5666000 m

5665000 m

5664000 m

Roderick Creek

LEGEND

Claim Boundaries

Creeks

Roads

Historic Soils Sb

Points : Sb(ppm)

<10

10...20

20...40

>40

2011 Soils Sb

Points : Sb(ppm)

<10

10...20

20...40

>40

Geology

Areas : Lithology

1 Sandstone

2 Siltstone/Argillite

3 Conglomerate

4 Granodiorite

5 Feldspar Porphyry

6 Qtz.-Feldspar Porphyry

DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Soils Sb/Geology

Date Nov 2009

NTS 92O 019

CaseyMap CAD & Graphics

Fig. 6

551000 m | 552000 m | 553000 m

5665000 m

550812

518186

518258

558218

N

<5 <5 6 18 <5 8 33 <5 <5 <5

6 <5 5 8 <5 7 <5 <5 <5 7

30 128 24 10 11 8 <5 <5 9 10

25 <5 50 72 18 130 19

23 <5 24 35 7 12 10 14 <5 <5 7 <5 17 5 18 11 20 14 6 10 <5 12 <5 <5 <5 7

9 19 <5 7 6 15 24 8 20 12 <5 <5 10 15 43 10 35 11 5 12 13 <5 6 14 161

LEGEND

Claim Boundaries
Creeks
Roads

2011 Soil Au
Points : Au
<30
30...60
60...140
>140

Geology
Areas : Lithology

1 Sandstone
2 Siltstone/Argillite
3 Conglomerate
4 Granodiorite
5 Feldspar Porphyry
6 Qtz.-Feldspar Porphyry

0 500 m

DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Geology / Gold in Soil 2011

Date Nov 2009 | NTS 92O 019

CaseyMap CAD & Graphics

Fig. 4a

551000 m

552000 m

553000 m

5665000 m

550812

518186

518258

558218

N

48 23 122 60 32 32 26 12 19 6

275 23 51 24 54 19 16 13 14 15

212 144 74 39 28 12 11 7 7 11

66 22 351 96 150 141 114

693 92 60 99 324 35 60 6 49 54 27 20 27 34 9 15 10 18 24 17 19 0 29 4 0 3 42

47 52 0 37 35 68 95 34 35 13 29 16 14 23 10 40 40 6 19 17 13 23 14 17 69

LEGEND

Claim Boundaries
Creeks
Roads

2011 Soils As
Points : As(ppm)
<50
50...130
130...240
>240

Geology
Areas : Lithology

1 Sandstone
2 Siltstone/Argillite
3 Conglomerate
4 Granodiorite
5 Feldspar Porphyry
6 Qtz.-Feldspar Porphyry

0 500 m

DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Geology / Arsenic in Soil 2011

Date Nov 2009 | NTS 92O 019

CaseyMap CAD & Graphics

Fig. 5a

551000 m | 552000 m | 553000 m

5665000 m

550812 | **518186** | **518258** | **558218**

N

0 500 m

LEGEND

- **Claim Boundaries**
- **Creeks**
- **Roads**

2011 Soils Sb

Points : Sb(ppm)

- <10
- 10...20
- 20...40
- >40

Geology

Areas : Lithology

1 Sandstone
2 Siltstone/Argillite
3 Conglomerate
4 Granodiorite
5 Feldspar Porphyry
6 Qtz.-Feldspar Porphyry

DURFELD GEOLOGICAL MANAGEMENT

Rod-Stir Project

Geology / Antimony in Soil 2011

Date Nov 2009 | NTS 92O 019

CaseyMap CAD & Graphics

Fig. 6a

APPENDIX I: 2011 SOIL SAMPLE RESULTS

			UTM (NAD83)																																					
		station	Station	Station																																				
ANALYTE	line	east	North	(east)	WtKg	Au	Ag	Al	As	Be	Ca	Ba	Bi	Cd	Co	Cr	Cu	Fe	Hg	K	La	Li	Mg	Mn	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sn	Sr	Ti	V	W	Y	Zn	Zr
METHOD					WGH79	FAA313	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
DETECTION					0.001	5	2	0.01	3	0.5	0.01	5	5	1	1	1	0.5	0.01	1	0.01	0.5	1	0.01	2	1	0.01	1	0.01	2	0.01	5	0.5	10	0.5	0.01	1	10	0.5	1	0.5
UNITS					kg	ppb	ppm	%	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm	ppm	%	ppm	%	ppm	ppm	%	ppm	ppm	%	ppm	%	ppm	%	ppm	ppm	ppm	ppm	%	ppm	ppm	ppm	ppm	ppm
L4400N-1650E	4600	1650	5664600	551650	0.205	23	<2	3.06	92	<0.5	0.79	168	<5	<1	23	65	38.9	3.99	<1	0.16	10.6	13	0.88	1330	<1	0.03	54	0.04	8	<0.01	<5	7.1	<10	76.1	0.14	86	<10	7.3	92	8.3
L4400N-1700E	4400	1700	5664400	551700	0.195	9	<2	2.21	47	<0.5	0.37	112	<5	<1	14	44	15.3	3	<1	0.08	6.5	11	0.57	382	<1	0.03	38	0.04	5	<0.01	<5	3.4	<10	34.5	0.16	74	<10	2.9	90	4
L4400N-1750E	4400	1750	5664400	551750	0.22	19	<2	2.46	52	<0.5	0.48	139	<5	<1	17	63	29.8	3.88	<1	0.14	9.1	14	0.85	351	1	0.03	48	0.03	6	<0.01	<5	5.4	<10	60.1	0.2	86	<10	4.4	82	10.3
L4400N-1800E	4400	1800	5664400	551800	0.165	<5	<2	0.71	<3	<0.5	0.18	50	<5	<1	4	8	1.8	1.37	<1	0.03	3.4	2	0.13	235	<1	0.05	7	0.11	3	<0.01	<5	0.9	<10	18.2	0.09	38	<10	1.9	35	2.7
L4400N-1850E	4400	1850	5664400	551850	0.23	7	<2	2.03	37	<0.5	0.27	118	<5	<1	13	41	17.4	2.92	<1	0.05	6.3	11	0.56	335	1	0.03	42	0.06	8	<0.01	<5	3.2	<10	24.7	0.14	63	<10	3	120	6.1
L4400N-1900E	4400	1900	5664400	551900	0.26	6	<2	1.59	35	<0.5	0.38	110	<5	<1	10	38	15	2.68	<1	0.06	8.3	11	0.51	269	<1	0.04	32	0.08	6	<0.01	<5	3.4	<10	34	0.15	59	<10	4.4	92	6.1
L4400N-1950E	4400	1950	5664400	551950	0.3	15	<2	1.92	68	<0.5	0.55	150	<5	<1	15	57	31.1	3.86	<1	0.09	10.9	12	0.75	304	1	0.03	50	0.05	6	<0.01	<5	5.7	<10	45.2	0.17	78	<10	6.1	131	13.3
L4400N-2000E	4400	2000	5664400	552000	0.27	24	<2	1.93	95	<0.5	0.31	139	<5	<1	12	45	16.5	2.94	<1	0.07	8.3	14	0.51	271	1	0.02	49	0.05	7	<0.01	6	3.4	<10	28.9	0.1	57	<10	3	102	6.7
L4400N-2050E	4400	2050	5664400	552050	0.21	8	<2	2.24	34	<0.5	0.36	154	<5	<1	14	46	10.8	2.71	<1	0.09	8.4	17	0.57	349	<1	0.03	53	0.08	7	<0.01	5	3.7	<10	31.3	0.12	53	<10	3.4	147	7.7
L4400N-2100E	4400	2100	5664400	552100	0.305	20	<2	1.81	35	<0.5	0.25	128	<5	<1	11	41	11.3	2.2	<1	0.06	7.5	15	0.57	262	1	0.02	47	0.04	6	<0.01	<5	2.7	<10	25.9	0.09	43	<10	2.6	94	4.4
L4400N-2150E	4400	2150	5664400	552150	0.27	12	<2	1.74	13	<0.5	0.25	170	<5	<1	11	36	8.8	2.15	<1	0.07	6.9	14	0.5	619	<1	0.03	42	0.08	7	<0.01	<5	2.6	<10	24.9	0.1	47	<10	2.8	133	3.5
L4400N-2200E	4400	2200	5664400	552200	0.36	<5	<2	2.09	29	<0.5	0.28	167	<5	<1	14	51	18	2.79	<1	0.07	8.6	15	0.65	271	<1	0.03	54	0.06	8	<0.01	<5	3.7	<10	31.8	0.12	57	<10	3.4	80	7.7
L4400N-2250E	4400	2250	5664400	552250	0.28	<5	<2	2.12	16	<0.5	0.3	155	<5	<1	15	46	11.6	2.62	<1	0.09	7.3	16	0.58	436	<1	0.03	53	0.08	8	<0.01	<5	3.5	<10	29	0.12	52	<10	3.3	115	4.5
L4400N-2300E	4400	2300	5664400	552300	0.255	10	<2	1.9	14	<0.5	0.24	139	<5	<1	10	37	13.1	2.44	<1	0.06	8.3	13	0.53	233	<1	0.03	38	0.09	10	<0.01	<5	2.6	<10	24.6	0.1	48	<10	3.4	127	7.2
L4400N-2350E	4400	2350	5664400	552350	0.25	15	<2	1.68	23	<0.5	0.31	76	<5	<1	10	41	11.1	2.69	<1	0.05	6	17	0.53	196	1	0.03	36	0.05	8	<0.01	<5	2.8	<10	29.9	0.09	59	<10	2.5	58	3.3
L4400N-2400E	4400	2400	5664400	552400	0.28	43	<2	3.01	10	<0.5	0.3	79	<5	<1	15	104	18.4	3.55	<1	0.04	6.4	23	1.42	287	<1	0.02	92	0.09	5	<0.01	<5	5.1	<10	44	0.18	79	<10	4.1	65	9.8
L4400N-2450E	4400	2450	5664400	552450	0.255	10	<2	2.42	40	<0.5	0.27	100	<5	<1	14	78	26.5	3.59	<1	0.05	6	15	0.94	248	1	0.02	66	0.1	6	<0.01	<5	4.7	<10	37.9	0.14	80	<10	3.9	61	6.9
L4400N-2500E	4400	2500	5664400	552500	0.265	35	<2	3.13	40	<0.5	0.25	99	<5	<1	22	79	39.6	3.88	<1	0.05	7.1	15	0.97	561	4	0.03	73	0.08	5	<0.01	<5	5	<10	80.7	0.13	83	<10	4.8	74	6.8
L4400N-2550E	4400	2550	5664400	552550	0.235	11	<2	2.01	6	<0.5	0.28	66	<5	<1	13	82	9.1	2.84	<1	0.05	6.3	20	0.78	227	<1	0.03	65	0.1	7	<0.01	<5	3.7	<10	25.6	0.17	68	<10	3.5	80	10.9
L4400N-2600E	4400	2600	5664400	552600	0.26	5	<2	3.33	19	<0.5	0.38	118	<5	<1	20	128	25.7	3.88	<1	0.05	6.8	25	1.56	325	1	0.02	134	0.08	6	<0.01	<5	5.6	<10	59.9	0.2	87	<10	4.8	75	10.9
L4400N-2650E	4400	2650	5664400	552650	0.3	12	<2	2.9	17	<0.5	0.32	83	<5	<1	15	82	19.4	3.32	<1	0.05	6.8	23	1.06	315	2	0.03	75	0.07	7	<0.01	<5	4.7	<10	69.9	0.18	75	<10	4.1	76	7
L4400N-2700E	4400	2700	5664400	552700	0.225	13	<2	2.71	13	<0.5	0.32	84	<5	<1	16	72	13.2	3.18	<1	0.07	7.4	23	0.78	502	1	0.03	66	0.11	12	<0.01	<5	4.1	<10	39.7	0.16	68	<10	4.6	108	11.3
L4400N-2750E	4400	2750	5664400	552750	0.205	<5	<2	3.23	23	<0.5	0.29	111	<5	<1	14	52	20.4	3.13	<1	0.06	7.6	19	0.62	382	2	0.04	47	0.13	16	<0.01	<5	3.5	<10	139	0.14	64	<10	4.6	94	11.8
L4400N-2800E	4400	2800	5664400	552800	0.25	6	<2	2.43	14	<0.5	0.27	84	<5	<1	12	45	14.5	3.07	<1	0.05	7.9	17	0.63	276	2	0.03	49	0.09	11	<0.01	<5	3.4	<10	43.1	0.13	71	<10	3.7	89	7.1
L4400N-2850E	4400	2850	5664400	552850	0.275	14	<2	3.01	17	<0.5	0.21	116	<5	<1	16	60	24.6	3.25	<1	0.06	8.3	16	0.75	411	2	0.03	61	0.09	7	<0.01	<5	4.3	<10	43.5	0.13	76	<10	5.1	96	11.5
L4400N-2900E	4400	2900	5664400	552900	0.29	161	<2	2.3	69	<0.5	0.26	68	<5	<1	17	89	12.9	4.61	<1	0.07	7.7	14	0.7	232	1	0.02	83	0.12	5	<0.01	<5	6.7	<10	27.1	0.06	94	<10	4.1	62	3.1
L4600N-1650E	4600	1650	5664600	551650	0.3	33	<2	2.49	693	<0.5	0.37	270	<5	<1	19	47	132	4.37	<1	0.24	12	12	0.85	739	4	0.03	41	0.04	6	<0.01	27	9.1	<10	34	0.12	87	<10	8.9	91	8.7
L4600N-1700E	4600	1700	5664600	551700	0.19	<5	<2	1.82	60	<0.5	0.36	162	<5	<1	11	41	16.4	2.99	<1	0.08	8.6	13	0.55	291	1	0.03	37	0.05	7	<0.01	<5	3.8	<10	30.7	0.14	60	<10	3.7	90	8.6
L4600N-1750E	4600	1750	5664600	551750	0.245	24	<2	2.36	99	<0.5	0.33	165	<5	<1	15	44	13.3	3.11	<1	0.08	6.2	16	0.55	303	1	0.02	46	0.07	7	<0.01	<5	3.6	<10	27	0.11	65	<10	2.7	131	8.4
L4600N-1800E	4600	1800	5664600	551800	0.18	35	<2	2.07	324	<0.5	0.26	265	<5	<1	15	49	27.6	4.29	<1	0.08	8.7	13	0.7	429	1	0.02	49	0.05	8	<0.01	12	5.3	<10	23.3	0.06	71	<10	4.8	144	3.5
L4600N-1850E	4600	1850	5664600	551850	0.225	7	<2	1.3	35	<0.5	0.27	105	<5	<1	9	32	8.4	2.33	<1	0.07	4.6	9	0.43	385	<1	0.03	30	0.05	6	<0.01	<5	2.3	<10	22.9	0.12	57	<10	2.3	78	3.4
L4600N-1900E	4600	1900	5664600	551900	0.265	12	<2	2.39	60	<0.5	0.31	191	<5	<1	14	51	13.3	3.06	<1	0.07	6.9	18	0.67	279	<1	0.02	53	0.05	8	<0.01	<5	3.8	<10	29.2	0.13	63	<10	3.2	127	9
L4600N-1950E	4600	1950	5664600	551950	0.175	10	<2	0.73	6	<0.5	0.18	65	<5	<1	5	10	2.4	1.49	<1	0.03	4.1	3	0.17	166	<1	0.04	10	0.08	4	<0.01	<5	1	<10	16.4	0.1	41	<10	1.8	33	4.3
L4600N-2000E	4600	2000	5664600	552000	0.26	14	<2	2.17	49	<0.5	0.32	194	<5	<1	13	48	13.8	2.84	<1	0.1	8.6	15	0.57	324	<1	0.03	51	0.06	10	<0.01	<5	3.4	<10	26.1	0.14	58	<10	3.3	118	8.9
L4600N-2050E	4600	2050	5664600	552050	0.235	<5	<2	1.57	54	<0.5	0.23	149	<5	<1	9	33	12.2	2.43	<1	0.05	7.5	11	0.41	257	<1	0.03	31	0.04	11	<0.01	<5	2.4	<10	22.9	0.12	50	<10	2.7	63	6.2
L4600N-2100E	4600	2100	5664600	552100	0.295	<5	<2	1.31	27	<0.5	0.28	104	<5	<1	8	37	16.7	2.43	<1	0.07	8.1	9	0.5	244	<1	0.02	30	0.03	11	<0.01	<5	2.9	<10	27.1	0.13	49	<10	3.4	55	7.9
L4600N-2150E	4600	2150	5664600	552150	0.325	7	<2	2.03	20	<0.5	0.39	134	<5	<1	13	55	24.3	2.97	<1	0.07	9.1	14	0.68	354	<1	0.02	47	0.03	7	<0.01	<5	4.4	<10	39.1	0.19	66	<10	4.5	69	12.3
L4600N-2200E	4600	2200	5664600	552200	0.31	<5	<2	1.67	27	<0.5	0.3	165	<5	<1	9	36	12.7	2.48	<1	0.08	7.6	12	0.56	338	<1	0.03	33	0.03	11	<0.01	<5	2.8	<10	26.3	0.1	47	<10	3.3	86	9
L4600N-2250E	4600	2250	5664600	552250	0.275	17	<2	1.43	34	<0.5	0.27	174	<5	<1	10	34	15	2.82	<1	0.12	8.9	9	0.52	572	<1	0.03	31	0.05	12	<0.01	<5	2.6	<10	23.5	0.1	53	<10	4.1	79	5.7
L4600N-2300E	4600	2300	5664600	552300	0.185	5	<2	1.52	9	<0.5	0.22	182	<5	<1	9	31	6.3	2.28	<1	0.07	6	10	0.45	429	<1	0.03	32	0.05	7	<0.01	<5	2	<10	22	0.1	58	<10	2.4	97	7
L4600N2350E	4600	2350	5664600	552350	0.245	18	<2	1.71	15	<0.5	0.24	196	<5	<1	8	33	8.8	2.3	<1	0.08	7.1	13	0.6	414	<1	0.03	33	0.04	9	<0.01	<5	2.3	<10	23.7	0.08	45	<10	2.7	96	5.7
L4600N-2400E	4600	2400	5664600	552400	0.235	11	<2	1.47	10	<0.5	0.28	177	<5	<1	7	32	9.3	1.89	<1	0.08	9.1	15	0.49	205	<1	0.02	29	0.03	10	<0.01	<5	2.7	<10	28.8	0.1	38	<10	3.2	78	6.4
L4600N-2450E	4600	2450	5664600	552450	0.24	20	<2	1.94	18	<0.5	0.28	156	<5	<1	11	41	10.2	2.29	<1	0.07	6.8	16	0.55	280	<1	0.02	46	0.05	7	<0.01	<5	3.2	<10	25.9	0.12	51	<10	3	70	5.6
L4600N-2500E	4600	2500	5664600	552500	0.3	14	<2	1.92	24	<0.5	0.28	132	<5	<1	12	45	12.3	2.44	<1	0.07	7.5	16	0.61	254	<1	0.02	50	0.04	11	<0.01	<5	3.2	<10	25.9	0.1	49	<10	2.9	69	6.3
L4600N-2550E	4600	2550	5664600	552550	0.275	6	<2	1.76	17	<0.5	0.29	121	<5	<1	11	42	11.9	2.53	<1	0.06	6.4	14	0.59	267	<1	0.03	42	0.06	7	<0.01	<5	3.4	<10	26.5	0.11	54	<10	3	64	4.3
L4600N-2600E	4600	2600	5664600	552600	0.275	10	<2	2.04	19	<0.5	0.28	149	<5	<1	11	38	8.1	2.61	<1	0.08	5.2	16	0.6	255	<1	0.02	39	0.07	7	<0.01	<5	2.9	<10	25.5	0.07	51	<10	2.1	72	6.5
L4600N-2650E	4600	2650	5664600	552650	0.165	<5	<2	1.04	<3	<0.5	0.13	34	<5	<1	4	7	2.1	1.36	<1	0.03	5.5	2	0.1	102	<1	0.05	5	0.13	4	<0.01	<5	0.9	<10	12	0.09	36	<10	2.7	18	7.4
L4600N-2700E	4600	2700	5664600	552700	0.29	12	<2	1.92	29	<0.5	0.31	111	<5	<1	12	47	14.5	3.02	<1	0.07	6.9	17	0.67	283	<1	0.02	43	0.09	9	<0.01	<5	3.8	<10	25	0.11	61	<10	3.2	75	5.5
L4600N-2750E	4600	2750	5664600	552750	0.175	<5	<2	1.21	4	<0.5	0.15	50	<5	<1	6	14	3.3	1.79	<1	0.03	3.9	4	0.16	172	<1	0.03	9	0.12	7	<0.01	<5	1.1	<10	15.7	0.11	46	<10	2	35	4.5
L4600N-2800E	4600	2800	5664600	552800	0.205	<5	<2	0.87	<3	<0.5	0.1	26	<5	<1	5	14	2.8	1.57	<1	0.03	2.9	3	0.19	123	<1	0.03	10	0.07	4	<0.01	<5	1.1	<10	11	0.1	43	<10	1.4	28	5.8
L4600N-2850E	4600	2850	5664600	552850	0.18	<5	<2	0.77	3	<0.5	0.13	31	<5	<1	4	11	3.1	1.52	<1	0.03	3	2	0.14	110	<1	0.04	7	0.08	3	<0.01	<5	0.9	<10	14.5	0.1	44	<10	1.4	23	3.2
L4600N-2900E	4600	2900	5664600	552900	0.2	7	<2	3.16	42	<0.5	0.24	117	<5	<1	17	74	34	3.88	<1	0.06	8.6	16	0.97	268	2	0.02	68	0.11	6	<0.01	<5	4.9	<10	36.1	0.13	80	<10	4.5	67	11.1
L4900N-1650E	4900	1650	5664900	551650	0.21	25	<2	2	66	<0.5	0.27	139	<5	<1	13	39	32.6	2.91	<1	0.08	5.4	10	0.56	424	2	0.03	38	0.06	6	<0.01	<5	3.5	<10	30.8	0.15	66	<10	3.1	90	4.6
L4900N-1700E	4900	1700	5664900	551700	0.21	<5	<2	1.13	22	<0.5	0.26	91	<5	<1	8	20	7.7	1.95	<1	0.08	4.4	6	0.28	599	<1	0.04	21	0.07	5	<0.01	<5	1.7	<10	21.6	0.12	52	<10	2.3	60	2.9
L4900N-1750E	4900	1750	5664900	551750	0.305	50	<2	2.24	351	<0.5	0.36	125	<5	<1	16	55	74.2	4.35	<1	0.32	10.5	10	0.84	346	3	0.03	46	0.04	16	<0.01	10	7.6	<10	34.8	0.17	89	<10	6.5	74	5.3
L4900N-1800E	4900	1800	5664900	551800	0.25	72	<2	2.44	96	<0.5	0.33	164	<5	<1	16	54	36.2	3.12	<1	0.13	6.6	11	0.79	471	2	0.03	62	0.08	9	<0.01	5	4.5	<10	33.1	0.14	64	<10	3.9	106	4.5
L4900N-1850E	4900	1850	5664900	551850	0.295	18	<2	2.16	150	<0.5	0.35	175	<5	<1	13	54	28.2	3.13	<1	0.15	6.9	12	0.78	507	1	0.03	51	0.06	14	<0.01	10	4.6	<10	32.6	0.14	66	<10	3.8	114	4.6
L4900N-1900E	4900	1900	5664900	551900	0.31	130	<2	2.39	141	<0.5	0.31	151	<5	<1	15	50	18.2	3.18	<1	0.11	8	17	0.6	358	<1	0.03	47	0.11	15	<0.01	14	4.4	<10	26.8	0.11	61	<10	3.4	142	9.8
L4900N-1950E	4900	1950	5664900	551950	0.37	19	<2	1.9	114	<0.5	0.31	141	<5	<1	13	54	25.1	3.22	<1	0.09	8.3	13	0.75	348	<1	0.02	50	0.05	18	<0.01	29	4.5	<10	30.3	0.12	65	<10	4.1	101	3.5
L5400N-1950E	5400	1950	5665400	551950	0.28	30	<2	2.05	212	<0.5	0.55	223	<5	<1	16	49	31.2	3.8	<1	0.36	11.4	13	0.78	802	<1	0.03	49	0.05	7	<0.01	22	6.9	<10	42.2	0.1	73	<10	10.1	67	8.8
L5400N-2000E	5400	2000	5665400	552000	0.3	128	<2	2.22	144	<0.5	0.43	205	<5	<1	16	52	32.7	3.95	<1	0.18	12.5	14	0.75	738	1	0.03	55	0.05	8	<0.01	26	7.4	<10	36.4	0.1	74	<10	10.9	79	9.5
L5400N-2050E	5400	2050	5665400	552050	0.33	24	<2	1.96	74	<0.5	0.83	478	<5	<1	18	43	19.2	3.39	<1	0.25	9.5	15	0.75	1600	<1	0.02	49	0.1	11	<0.01	7	4.9	<10	56.2	0.1	62	<10	7.3	120	5.8
L5400N-2100E	5400	2100	5665400	552100	0.225	10	<2	2.14	39	<0.5	0.46	272	<5	<1	16	48	16.1	3.27	<1	0.13	8.8	15	0.65	1100	<1	0.03	54	0.05	15	<0.01	<5	4.3	<10	37.6	0.12	66	<10	5.8	94	8.9
L5400N-2150E	5400	2150	5665400	552150	0.25	11	<2	2.04	28	<0.5	0.49	173	<5	<1	13	46	16.8	3.17	<1	0.14	7.8	14	0.76	842	<1	0.03	46	0.05	13	<0.01	8	4.2	<10	36.3	0.15	61	<10	4.3	87	7.9
L5400N-2200E	5400	2200	5665400	552200	0.355	8	<2	2.1	12	<0.5	0.47	244	<5	<1	12	37	14	3.44	<1	0.13	8.4	14	1.03	1180	<1	0.02	38	0.06	14	<0.01	<5	4.3	<10	42.7	0.15	59	<10	6	115	7.2
L5400N-2250E	5400	2250	5665400	552250	0.285	<5	<2	2.06	11	<0.5	0.4	220	<5	<1	13	46	15.1	3.13	<1	0.13	9.8	15	0.78	962	<1	0.03	44	0.05	17	<0.01	<5	4.2	<10	42.1	0.13	59	<10	4.8	102	5.5
L5400N-2300E	5400	2300	5665400	552300	0.315	<5	<2	1.61	7	<0.5	0.32	193	<5	<1	9	29	10.4	2.51	<1	0.14	6.7	12	0.61	772	<1	0.02	30	0.06	12	<0.01	<5	2.6	<10	30.8	0.07	42	<10	2.6	77	2.5
L5400N-2350E	5400	2350	5665400	552350	0.29	9	<2	1.51	7	<0.5	0.59	273	<5	<1	11	28	19.2	2.57	<1	0.2	6.1	11	0.66	1400	<1	0.02	28	0.1	11	0.04	<5	2.7	<10	68.9	0.06	38	<10	2.6	61	2.5
L5400N-2400E	5400	2400	5665400	552400	0.235	10	<2	1.46	11	<0.5	0.23	103	<5	<1	7	30	13.6	2.49	<1	0.07	5.9	10	0.49	257	<1	0.02	29	0.04	4	<0.01	<5	2.5	<10	28.8	0.09	43	<10	2.2	43	3.2
L5500N-1950E	5500	1950	5665500	551950	0.265	6	<2	1.69	275	<0.5	0.28	89	<5	<1	10	49	36.4	3.51	<1	0.1	6.2	11	0.69	299	1	0.02	34	0.03	6	<0.01	69	3.9	<10	33.3	0.1	63	<10	3.5	55	4.1
L5500N-2000E	5500	2000	5665500	552000	0.235	<5	<2	1.91	23	<0.5	0.34	137	<5	<1	9	44	15.1	2.81	<1	0.08	5.1	14	0.77	317	<1	0.02	34	0.03	5	<0.01	13	3.6	<10	35.3	0.12	53	<10	2.7	65	8
L5500N-2050E	5500	2050	5665500	552050	0.235	5	<2	1.65	51	<0.5	0.3	120	<5	<1	10	46	23.8	2.96	<1	0.06	5.2	13	0.67	297	<1	0.02	34	0.04	6	<0.01	19	3.6	<10	34.3	0.12	59	<10	2.7	69	6.7
L5500N-2100E	5500	2100	5665500	552100	0.29	8	<2	1.79	24	<0.5	0.35	176	<5	<1	10	41	14.7	2.81	<1	0.08	5.6	15	0.75	724	<1	0.02	37	0.05	8	<0.01	8	3.6	<10	30.9	0.1	51	<10	3.1	114	7.5
L5500N-2150E	5500	2150	5665500	552150	0.28	<5	<2	2.25	54	<0.5	0.24	96	<5	<1	13	62	31.2	3.78	<1	0.07	6.2	23	1.27	582	<1	0.02	45	0.04	7	<0.01	10	5.5	<10	26.6	0.08	74	<10	4.8	81	4.8
L5500N-2200E	5500	2200	5665500	552200	0.325	7	<2	2.15	19	<0.5	0.81	480	<5	<1	13	36	21.8	3.28	<1	0.15	7.6	15	1	2220	<1	0.02	40	0.08	14	<0.01	<5	4.2	<10	63.3	0.14	58	<10	5.4	107	6.4
L5500N-2250E	5500	2250	5665500	552250	0.255	<5	<2	2.15	16	<0.5	0.58	269	<5	<1	14	45	19.9	3.37	<1	0.15	6.1	16	0.99	1580	<1	0.02	45	0.1	11	<0.01	<5	4.2	<10	54.5	0.17	58	<10	4.4	96	6.9
L5500N-2300E	5500	2300	5665500	552300	0.335	<5	<2	2.16	13	0.5	0.53	198	<5	<1	13	46	15.3	3.26	<1	0.11	6.5	16	0.93	717	1	0.02	48	0.09	12	<0.01	<5	4.1	<10	49.4	0.13	61	<10	4.2	118	4.8
L5500N-2350E	5500	2350	5665500	552350	0.32	<5	<2	2.05	14	<0.5	0.38	135	<5	<1	12	45	19.9	3.43	<1	0.11	8	15	0.95	904	<1	0.02	39	0.08	10	<0.01	<5	4.5	<10	42	0.17	57	<10	5	80	4.1
L5500N-2400E	5500	2400	5665500	552400	0.34	7	<2	2.61	15	<0.5	0.48	111	<5	<1	15	44	27.3	4.14	<1	0.11	9	18	1.33	1190	<1	0.02	35	0.1	13	<0.01	<5	5.1	<10	60.8	0.12	57	<10	7.2	94	3.7
L5600N-1950E	5600	1950	5665600	551950	0.325	<5	<2	2.01	48	<0.5	0.29	94	<5	<1	11	51	22	2.98	<1	0.08	4.9	16	0.89	412	<1	0.02	43	0.04	6	<0.01	26	3.9	<10	28.8	0.1	60	<10	2.8	79	5.9
L5600N-2000E	5600	2000	5665600	552000	0.29	<5	<2	1.52	23	<0.5	0.3	105	<5	<1	9	41	14.8	2.62	<1	0.08	4.9	12	0.68	301	<1	0.02	31	0.03	5	<0.01	11	2.8	<10	28.2	0.12	54	<10	2.2	54	6.8
L5600N-2050E	5600	2050	5665600	552050	0.345	6	<2	2.64	122	<0.5	0.49	142	<5	<1	33	65	63	4.5	<1	0.1	13.5	19	1.3	1540	<1	0.02	55	0.09	13	<0.01	28	8.4	<10	44.4	0.08	87	<10	14.4	97	4.7
L5600N-2100E	5600	2100	5665600	552100	0.28	18	<2	1.87	60	<0.5	0.32	82	<5	<1	9	38	19.8	3.23	<1	0.08	5.7	13	0.87	412	<1	0.02	30	0.03	11	<0.01	76	3.9	<10	28.5	0.1	58	<10	3	72	4.8
L5600N-2150E	5600	2150	5665600	552150	0.255	<5	<2	1.6	32	<0.5	0.29	58	<5	<1	7	35	22.1	3.06	<1	0.08	6.7	10	0.72	344	<1	0.02	26	0.03	7	<0.01	<5	3.6	<10	31.4	0.11	53	<10	3.3	51	5.8
L5600N-2200E	5600	2200	5665600	552200	0.32	8	<2	2.18	32	<0.5	0.39	93	<5	<1	12	45	22.9	3.58	<1	0.11	6	15	0.95	677	1	0.02	38	0.05	11	<0.01	<5	4.3	<10	38.5	0.14	62	<10	4.2	74	5.1
L5600N-2250E	5600	2250	5665600	552250	0.26	33	<2	2.34	26	<0.5	0.47	157	<5	<1	12	40	18.1	3.46	<1	0.12	7.8	16	0.93	874	<1	0.02	38	0.08	13	<0.01	<5	3.8	<10	39.1	0.12	57	<10	4.2	113	3.4
L5600N-2300E	5600	2300	5665600	552300	0.235	<5	<2	2	12	<0.5	0.56	194	<5	<1	12	37	15.4	3.3	<1	0.12	5.8	13	0.92	1130	<1	0.02	35	0.12	11	0.02	<5	2.9	<10	45.1	0.13	55	<10	3.7	91	3.1
L5600N-2350E	5600	2350	5665600	552350	0.26	<5	<2	1.94	19	<0.5	0.36	72	<5	<1	9	39	17.5	3.14	<1	0.16	8.3	12	0.8	449	<1	0.02	34	0.05	8	<0.01	<5	3.9	<10	32.4	0.14	61	<10	4	59	4.3
L5600N-2400E	5600	2400	5665600	552400	0.25	<5	<2	1.92	6	<0.5	0.26	104	<5	<1	10	32	11.6	3	<1	0.08	4.6	16	0.83	693	<1	0.02	27	0.06	8	<0.01	<5	2.7	<10	30.6	0.07	50	<10	2.3	99	1.6

APPENDIX II: 2011 ANALYTICAL CERTIFICATES

NOTE THE FIRST 14 SAMPLES IN THE ASSAY CERTIFICATE ARE NOT FROM THE PROJECT AREA AND ARE NOT COVERED BY THIS REPORT.

Final : VC111564 Order: Soil/Silt

Element	WtKg	Au	Ag	Al	As	Be	Ca	Ba	Bi	Cd
Method	WGH79	FAA313	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	0.001	5	2	0.01	3	0.5	0.01	5	5	1
Units	kg	ppb	ppm	%	ppm	ppm	%	ppm	ppm	ppm
00329603-5000	0.275	<5	<2	2.46	19	<0.5	0.83	87	<5	<1
329601	0.500	<5	<2	1.78	25	<0.5	0.72	80	<5	<1
WB-05-01	0.275	6	<2	2.75	46	<0.5	0.86	260	<5	<1
WB-05-04	0.285	8	<2	3.31	85	<0.5	0.71	366	<5	<1
WB-05-03	0.225	6	<2	3.53	93	<0.5	0.80	316	<5	<1
WB-05-02	0.225	<5	<2	2.88	68	<0.5	0.67	487	<5	<1
WB-05-06	0.305	13	<2	3.39	77	<0.5	0.70	298	<5	<1
WB-05-11	0.190	14	<2	3.21	21	<0.5	0.82	327	<5	<1
WB-05-12	0.130	11	<2	3.00	51	<0.5	0.70	334	<5	<1
WB-05-07	0.230	29	<2	2.21	421	<0.5	0.46	250	<5	<1
WB-05-05	0.240	14	<2	2.45	103	<0.5	0.71	337	<5	<1
WB-05-09	0.230	21	<2	3.31	69	<0.5	0.73	865	<5	<1
WB-05-10	0.270	<5	<2	2.83	197	<0.5	0.73	555	<5	<1
WB-05-08	0.345	74	<2	2.71	405	<0.5	0.57	457	<5	<1
L4600N-1650E	0.300	33	<2	2.49	693	<0.5	0.37	270	<5	<1
L4600N-1900E	0.265	12	<2	2.39	60	<0.5	0.31	191	<5	<1
L4600N-1750E	0.245	24	<2	2.36	99	<0.5	0.33	165	<5	<1
L4600N-1700E	0.190	<5	<2	1.82	60	<0.5	0.36	162	<5	<1
L4600N-1850E	0.225	7	<2	1.30	35	<0.5	0.27	105	<5	<1
L4600N-1800E	0.180	35	<2	2.07	324	<0.5	0.26	265	<5	<1
L4600N-2100E	0.295	<5	<2	1.31	27	<0.5	0.28	104	<5	<1
L4600N-2050E	0.235	<5	<2	1.57	54	<0.5	0.23	149	<5	<1
L4600N-1950E	0.175	10	<2	0.73	6	<0.5	0.18	65	<5	<1
L4600N-2000E	0.260	14	<2	2.17	49	<0.5	0.32	194	<5	<1
L4600N-2250E	0.275	17	<2	1.43	34	<0.5	0.27	174	<5	<1
L4600N-2450E	0.240	20	<2	1.94	18	<0.5	0.28	156	<5	<1
L4600N-2150E	0.325	7	<2	2.03	20	<0.5	0.39	134	<5	<1
L4600N2350E	0.245	18	<2	1.71	15	<0.5	0.24	196	<5	<1
L4600N-2550E	0.275	6	<2	1.76	17	<0.5	0.29	121	<5	<1
L4600N-2200E	0.310	<5	<2	1.67	27	<0.5	0.30	165	<5	<1
L4600N-2600E	0.275	10	<2	2.04	19	<0.5	0.28	149	<5	<1
L4400N-1650E	0.205	23	<2	3.06	92	<0.5	0.79	168	<5	<1
L4600N-2400E	0.235	11	<2	1.47	10	<0.5	0.28	177	<5	<1
L4600N-2500E	0.300	14	<2	1.92	24	<0.5	0.28	132	<5	<1
L4600N-2300E	0.185	5	<2	1.52	9	<0.5	0.22	182	<5	<1
L4400N-1700E	0.195	9	<2	2.21	47	<0.5	0.37	112	<5	<1
L4400N-2050E	0.210	8	<2	2.24	34	<0.5	0.36	154	<5	<1
L4400N-2000E	0.270	24	<2	1.93	95	<0.5	0.31	139	<5	<1
L4400N-1950E	0.300	15	<2	1.92	68	<0.5	0.55	150	<5	<1
L4400N-1750E	0.220	19	<2	2.46	52	<0.5	0.48	139	<5	<1
L4400N-1900E	0.260	6	<2	1.59	35	<0.5	0.38	110	<5	<1
L4400N-1850E	0.230	7	<2	2.03	37	<0.5	0.27	118	<5	<1
L4400N-1800E	0.165	<5	<2	0.71	<3	<0.5	0.18	50	<5	<1

Final : VC111564 Order: Soil/Silt

Element	WtKg	Au	Ag	Al	As	Be	Ca	Ba	Bi	Cd
Method	WGH79	FAA313	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	0.001	5	2	0.01	3	0.5	0.01	5	5	1
Units	kg	ppb	ppm	%	ppm	ppm	%	ppm	ppm	ppm
L4400N-2700E	0.225	13	<2	2.71	13	<0.5	0.32	84	<5	<1
L4400N-2650E	0.300	12	<2	2.90	17	<0.5	0.32	83	<5	<1
L4400N-2550E	0.235	11	<2	2.01	6	<0.5	0.28	66	<5	<1
L4400N-2600E	0.260	5	<2	3.33	19	<0.5	0.38	118	<5	<1
L4400N-2150E	0.270	12	<2	1.74	13	<0.5	0.25	170	<5	<1
L4400N-2100E	0.305	20	<2	1.81	35	<0.5	0.25	128	<5	<1
L4400N-2400E	0.280	43	<2	3.01	10	<0.5	0.30	79	<5	<1
L4400N-2300E	0.255	10	<2	1.90	14	<0.5	0.24	139	<5	<1
L4400N-2800E	0.250	6	<2	2.43	14	<0.5	0.27	84	<5	<1
L4400N-2500E	0.265	35	<2	3.13	40	<0.5	0.25	99	<5	<1
L4400N-2900E	0.290	161	<2	2.30	69	<0.5	0.26	68	<5	<1
L4400N-2850E	0.275	14	<2	3.01	17	<0.5	0.21	116	<5	<1
L4400N-2200E	0.360	<5	<2	2.09	29	<0.5	0.28	167	<5	<1
L4400N-2350E	0.250	15	<2	1.68	23	<0.5	0.31	76	<5	<1
L4400N-2250E	0.280	<5	<2	2.12	16	<0.5	0.30	155	<5	<1
L4400N-2750E	0.205	<5	<2	3.23	23	<0.5	0.29	111	<5	<1
L4400N-2450E	0.255	10	<2	2.42	40	<0.5	0.27	100	<5	<1
L4900N-1950E	0.370	19	<2	1.90	114	<0.5	0.31	141	<5	<1
L4600N-2800E	0.205	<5	<2	0.87	<3	<0.5	0.10	26	<5	<1
L4900N-1800E	0.250	72	<2	2.44	96	<0.5	0.33	164	<5	<1
L5400N-2250E	0.285	<5	<2	2.06	11	<0.5	0.40	220	<5	<1
L4900N-1700E	0.210	<5	<2	1.13	22	<0.5	0.26	91	<5	<1
L4900N-1750E	0.305	50	<2	2.24	351	<0.5	0.36	125	<5	<1
L5400N-2000E	0.300	128	<2	2.22	144	<0.5	0.43	205	<5	<1
L4600N-2700E	0.290	12	<2	1.92	29	<0.5	0.31	111	<5	<1
L4900N-1650E	0.210	25	<2	2.00	66	<0.5	0.27	139	<5	<1
L4900N-1850E	0.295	18	<2	2.16	150	<0.5	0.35	175	<5	<1
L4600N-2750E	0.175	<5	<2	1.21	4	<0.5	0.15	50	<5	<1
L5400N-2200E	0.355	8	<2	2.10	12	<0.5	0.47	244	<5	<1
L5400N-2050E	0.330	24	<2	1.96	74	<0.5	0.83	478	<5	<1
L4600N-2900E	0.200	7	<2	3.16	42	<0.5	0.24	117	<5	<1
L5400N-2100E	0.225	10	<2	2.14	39	<0.5	0.46	272	<5	<1
L4900N-1900E	0.310	130	<2	2.39	141	<0.5	0.31	151	<5	<1
L4600N-2850E	0.180	<5	<2	0.77	3	<0.5	0.13	31	<5	<1
L4600N-2650E	0.165	<5	<2	1.04	<3	<0.5	0.13	34	<5	<1
L5400N-1950E	0.280	30	<2	2.05	212	<0.5	0.55	223	<5	<1
L5400N-2150E	0.250	11	<2	2.04	28	<0.5	0.49	173	<5	<1
L5600N-2350E	0.260	<5	<2	1.94	19	<0.5	0.36	72	<5	<1
L5400N-2300E	0.315	<5	<2	1.61	7	<0.5	0.32	193	<5	<1
L5600N-2250E	0.260	33	<2	2.34	26	<0.5	0.47	157	<5	<1
L5600N-2400E	0.250	<5	<2	1.92	6	<0.5	0.26	104	<5	<1
L5500N-2200E	0.325	7	<2	2.15	19	<0.5	0.81	480	<5	<1
L5500N-2300E	0.335	<5	<2	2.16	13	0.5	0.53	198	<5	<1

Element	WtKg	Au	Ag	Al	As	Be	Ca	Ba	Bi	Cd
Method	WGH79	FAA313	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	0.001	5	2	0.01	3	0.5	0.01	5	5	1
Units	kg	ppb	ppm	%	ppm	ppm	%	ppm	ppm	ppm
L5500N-2100E	0.290	8	<2	1.79	24	<0.5	0.35	176	<5	<1
L5500N-1950E	0.265	6	<2	1.69	275	<0.5	0.28	89	<5	<1
L5600N-2100E	0.280	18	<2	1.87	60	<0.5	0.32	82	<5	<1
L5400N-2400E	0.235	10	<2	1.46	11	<0.5	0.23	103	<5	<1
L5600N-2200E	0.320	8	<2	2.18	32	<0.5	0.39	93	<5	<1
L5500N-2250E	0.255	<5	<2	2.15	16	<0.5	0.58	269	<5	<1
L5400N-2350E	0.290	9	<2	1.51	7	<0.5	0.59	273	<5	<1
L5500N-2400E	0.340	7	<2	2.61	15	<0.5	0.48	111	<5	<1
L5500N-2150E	0.280	<5	<2	2.25	54	<0.5	0.24	96	<5	<1
L5500N-2050E	0.235	5	<2	1.65	51	<0.5	0.30	120	<5	<1
L5500N-2000E	0.235	<5	<2	1.91	23	<0.5	0.34	137	<5	<1
L5600N-1950E	0.325	<5	<2	2.01	48	<0.5	0.29	94	<5	<1
L5500N-2350E	0.320	<5	<2	2.05	14	<0.5	0.38	135	<5	<1
L5600N-2050E	0.345	6	<2	2.64	122	<0.5	0.49	142	<5	<1
L5600N-2300E	0.235	<5	<2	2.00	12	<0.5	0.56	194	<5	<1
L5600N-2150E	0.255	<5	<2	1.60	32	<0.5	0.29	58	<5	<1
L5600N-2000E	0.290	<5	<2	1.52	23	<0.5	0.30	105	<5	<1

Element	Co	Cr	Cu	Fe	Hg	K	La	Li	Mg	Mn
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	1	1	0.5	0.01	1	0.01	0.5	1	0.01	2
Units	ppm	ppm	ppm	%	ppm	%	ppm	ppm	%	ppm
00329603-5000	14	59	33.3	3.65	<1	0.06	16.8	20	0.88	507
329601	14	45	31.8	3.33	6	0.06	8.3	13	0.79	527
WB-05-01	14	44	56.5	4.05	<1	0.19	12.2	15	0.89	329
WB-05-04	23	40	180	4.98	<1	0.14	22.9	18	1.09	421
WB-05-03	19	60	75.4	5.06	1	0.28	17.8	20	1.17	430
WB-05-02	15	40	61.8	4.23	<1	0.19	12.5	15	0.94	355
WB-05-06	14	55	77.5	4.72	<1	0.27	11.6	18	1.13	325
WB-05-11	15	51	57.5	4.27	<1	0.22	13.2	17	0.91	369
WB-05-12	14	44	47.4	4.31	<1	0.24	13.8	16	0.80	373
WB-05-07	17	40	89.7	4.23	<1	0.18	15.3	12	0.82	551
WB-05-05	13	37	38.8	3.91	<1	0.26	15.6	15	0.58	352
WB-05-09	17	41	90.1	4.95	2	0.12	14.4	15	1.24	415
WB-05-10	22	29	91.1	5.28	<1	0.11	24.5	14	0.90	456
WB-05-08	17	52	96.1	5.19	1	0.12	22.3	16	1.04	410
L4600N-1650E	19	47	132	4.37	<1	0.24	12.0	12	0.85	739
L4600N-1900E	14	51	13.3	3.06	<1	0.07	6.9	18	0.67	279
L4600N-1750E	15	44	13.3	3.11	<1	0.08	6.2	16	0.55	303
L4600N-1700E	11	41	16.4	2.99	<1	0.08	8.6	13	0.55	291
L4600N-1850E	9	32	8.4	2.33	<1	0.07	4.6	9	0.43	385
L4600N-1800E	15	49	27.6	4.29	<1	0.08	8.7	13	0.70	429
L4600N-2100E	8	37	16.7	2.43	<1	0.07	8.1	9	0.50	244
L4600N-2050E	9	33	12.2	2.43	<1	0.05	7.5	11	0.41	257
L4600N-1950E	5	10	2.4	1.49	<1	0.03	4.1	3	0.17	166
L4600N-2000E	13	48	13.8	2.84	<1	0.10	8.6	15	0.57	324
L4600N-2250E	10	34	15.0	2.82	<1	0.12	8.9	9	0.52	572
L4600N-2450E	11	41	10.2	2.29	<1	0.07	6.8	16	0.55	280
L4600N-2150E	13	55	24.3	2.97	<1	0.07	9.1	14	0.68	354
L4600N2350E	8	33	8.8	2.30	<1	0.08	7.1	13	0.60	414
L4600N-2550E	11	42	11.9	2.53	<1	0.06	6.4	14	0.59	267
L4600N-2200E	9	36	12.7	2.48	<1	0.08	7.6	12	0.56	338
L4600N-2600E	11	38	8.1	2.61	<1	0.08	5.2	16	0.60	255
L4400N-1650E	23	65	38.9	3.99	<1	0.16	10.6	13	0.88	1330
L4600N-2400E	7	32	9.3	1.89	<1	0.08	9.1	15	0.49	205
L4600N-2500E	12	45	12.3	2.44	<1	0.07	7.5	16	0.61	254
L4600N-2300E	9	31	6.3	2.28	<1	0.07	6.0	10	0.45	429
L4400N-1700E	14	44	15.3	3.00	<1	0.08	6.5	11	0.57	382
L4400N-2050E	14	46	10.8	2.71	<1	0.09	8.4	17	0.57	349
L4400N-2000E	12	45	16.5	2.94	<1	0.07	8.3	14	0.51	271
L4400N-1950E	15	57	31.1	3.86	<1	0.09	10.9	12	0.75	304
L4400N-1750E	17	63	29.8	3.88	<1	0.14	9.1	14	0.85	351
L4400N-1900E	10	38	15.0	2.68	<1	0.06	8.3	11	0.51	269
L4400N-1850E	13	41	17.4	2.92	<1	0.05	6.3	11	0.56	335
L4400N-1800E	4	8	1.8	1.37	<1	0.03	3.4	2	0.13	235

Final : VC111564 Order: Soil/Silt

Element	Co	Cr	Cu	Fe	Hg	K	La	Li	Mg	Mn
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	1	1	0.5	0.01	1	0.01	0.5	1	0.01	2
Units	ppm	ppm	ppm	%	ppm	%	ppm	ppm	%	ppm
L4400N-2700E	16	72	13.2	3.18	<1	0.07	7.4	23	0.78	502
L4400N-2650E	15	82	19.4	3.32	<1	0.05	6.8	23	1.06	315
L4400N-2550E	13	82	9.1	2.84	<1	0.05	6.3	20	0.78	227
L4400N-2600E	20	128	25.7	3.88	<1	0.05	6.8	25	1.56	325
L4400N-2150E	11	36	8.8	2.15	<1	0.07	6.9	14	0.50	619
L4400N-2100E	11	41	11.3	2.20	<1	0.06	7.5	15	0.57	262
L4400N-2400E	15	104	18.4	3.55	<1	0.04	6.4	23	1.42	287
L4400N-2300E	10	37	13.1	2.44	<1	0.06	8.3	13	0.53	233
L4400N-2800E	12	45	14.5	3.07	<1	0.05	7.9	17	0.63	276
L4400N-2500E	22	79	39.6	3.88	<1	0.05	7.1	15	0.97	561
L4400N-2900E	17	89	12.9	4.61	<1	0.07	7.7	14	0.70	232
L4400N-2850E	16	60	24.6	3.25	<1	0.06	8.3	16	0.75	411
L4400N-2200E	14	51	18.0	2.79	<1	0.07	8.6	15	0.65	271
L4400N-2350E	10	41	11.1	2.69	<1	0.05	6.0	17	0.53	196
L4400N-2250E	15	46	11.6	2.62	<1	0.09	7.3	16	0.58	436
L4400N-2750E	14	52	20.4	3.13	<1	0.06	7.6	19	0.62	382
L4400N-2450E	14	78	26.5	3.59	<1	0.05	6.0	15	0.94	248
L4900N-1950E	13	54	25.1	3.22	<1	0.09	8.3	13	0.75	348
L4600N-2800E	5	14	2.8	1.57	<1	0.03	2.9	3	0.19	123
L4900N-1800E	16	54	36.2	3.12	<1	0.13	6.6	11	0.79	471
L5400N-2250E	13	46	15.1	3.13	<1	0.13	9.8	15	0.78	962
L4900N-1700E	8	20	7.7	1.95	<1	0.08	4.4	6	0.28	599
L4900N-1750E	16	55	74.2	4.35	<1	0.32	10.5	10	0.84	346
L5400N-2000E	16	52	32.7	3.95	<1	0.18	12.5	14	0.75	738
L4600N-2700E	12	47	14.5	3.02	<1	0.07	6.9	17	0.67	283
L4900N-1650E	13	39	32.6	2.91	<1	0.08	5.4	10	0.56	424
L4900N-1850E	13	54	28.2	3.13	<1	0.15	6.9	12	0.78	507
L4600N-2750E	6	14	3.3	1.79	<1	0.03	3.9	4	0.16	172
L5400N-2200E	12	37	14.0	3.44	<1	0.13	8.4	14	1.03	1180
L5400N-2050E	18	43	19.2	3.39	<1	0.25	9.5	15	0.75	1600
L4600N-2900E	17	74	34.0	3.88	<1	0.06	8.6	16	0.97	268
L5400N-2100E	16	48	16.1	3.27	<1	0.13	8.8	15	0.65	1100
L4900N-1900E	15	50	18.2	3.18	<1	0.11	8.0	17	0.60	358
L4600N-2850E	4	11	3.1	1.52	<1	0.03	3.0	2	0.14	110
L4600N-2650E	4	7	2.1	1.36	<1	0.03	5.5	2	0.10	102
L5400N-1950E	16	49	31.2	3.80	<1	0.36	11.4	13	0.78	802
L5400N-2150E	13	46	16.8	3.17	<1	0.14	7.8	14	0.76	842
L5600N-2350E	9	39	17.5	3.14	<1	0.16	8.3	12	0.80	449
L5400N-2300E	9	29	10.4	2.51	<1	0.14	6.7	12	0.61	772
L5600N-2250E	12	40	18.1	3.46	<1	0.12	7.8	16	0.93	874
L5600N-2400E	10	32	11.6	3.00	<1	0.08	4.6	16	0.83	693
L5500N-2200E	13	36	21.8	3.28	<1	0.15	7.6	15	1.00	2220
L5500N-2300E	13	46	15.3	3.26	<1	0.11	6.5	16	0.93	717

Element	Co	Cr	Cu	Fe	Hg	K	La	Li	Mg	Mn
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	1	1	0.5	0.01	1	0.01	0.5	1	0.01	2
Units	ppm	ppm	ppm	%	ppm	%	ppm	ppm	%	ppm
L5500N-2100E	10	41	14.7	2.81	<1	0.08	5.6	15	0.75	724
L5500N-1950E	10	49	36.4	3.51	<1	0.10	6.2	11	0.69	299
L5600N-2100E	9	38	19.8	3.23	<1	0.08	5.7	13	0.87	412
L5400N-2400E	7	30	13.6	2.49	<1	0.07	5.9	10	0.49	257
L5600N-2200E	12	45	22.9	3.58	<1	0.11	6.0	15	0.95	677
L5500N-2250E	14	45	19.9	3.37	<1	0.15	6.1	16	0.99	1580
L5400N-2350E	11	28	19.2	2.57	<1	0.20	6.1	11	0.66	1400
L5500N-2400E	15	44	27.3	4.14	<1	0.11	9.0	18	1.33	1190
L5500N-2150E	13	62	31.2	3.78	<1	0.07	6.2	23	1.27	582
L5500N-2050E	10	46	23.8	2.96	<1	0.06	5.2	13	0.67	297
L5500N-2000E	9	44	15.1	2.81	<1	0.08	5.1	14	0.77	317
L5600N-1950E	11	51	22.0	2.98	<1	0.08	4.9	16	0.89	412
L5500N-2350E	12	45	19.9	3.43	<1	0.11	8.0	15	0.95	904
L5600N-2050E	33	65	63.0	4.50	<1	0.10	13.5	19	1.30	1540
L5600N-2300E	12	37	15.4	3.30	<1	0.12	5.8	13	0.92	1130
L5600N-2150E	7	35	22.1	3.06	<1	0.08	6.7	10	0.72	344
L5600N-2000E	9	41	14.8	2.62	<1	0.08	4.9	12	0.68	301

Element	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sn	Sr
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	1	0.01	1	0.01	2	0.01	5	0.5	10	0.5
Units	ppm	%	ppm	%	ppm	%	ppm	ppm	ppm	ppm
00329603-5000	<1	0.03	61	0.05	5	<0.01	<5	7.8	<10	51.1
329601	<1	0.03	49	0.05	4	<0.01	<5	5.6	<10	42.3
WB-05-01	1	0.05	33	0.03	6	<0.01	<5	7.9	<10	55.7
WB-05-04	2	0.03	32	0.03	6	<0.01	<5	12.4	<10	65.4
WB-05-03	<1	0.03	39	0.08	6	<0.01	<5	13.5	<10	72.0
WB-05-02	1	0.03	27	0.05	7	<0.01	<5	8.0	<10	60.3
WB-05-06	<1	0.03	32	0.03	6	<0.01	<5	13.3	<10	66.7
WB-05-11	<1	0.04	30	0.05	5	<0.01	<5	10.2	<10	60.3
WB-05-12	<1	0.04	28	0.04	7	<0.01	<5	9.0	<10	55.7
WB-05-07	2	0.03	32	0.04	19	<0.01	11	9.7	<10	38.8
WB-05-05	<1	0.03	27	0.03	19	<0.01	<5	8.0	<10	56.6
WB-05-09	3	0.03	27	0.04	8	<0.01	<5	7.3	<10	68.5
WB-05-10	3	0.03	29	0.07	9	<0.01	<5	8.5	<10	47.8
WB-05-08	1	0.03	35	0.04	43	<0.01	<5	15.9	<10	53.7
L4600N-1650E	4	0.03	41	0.04	6	<0.01	27	9.1	<10	34.0
L4600N-1900E	<1	0.02	53	0.05	8	<0.01	<5	3.8	<10	29.2
L4600N-1750E	1	0.02	46	0.07	7	<0.01	<5	3.6	<10	27.0
L4600N-1700E	1	0.03	37	0.05	7	<0.01	<5	3.8	<10	30.7
L4600N-1850E	<1	0.03	30	0.05	6	<0.01	<5	2.3	<10	22.9
L4600N-1800E	1	0.02	49	0.05	8	<0.01	12	5.3	<10	23.3
L4600N-2100E	<1	0.02	30	0.03	11	<0.01	<5	2.9	<10	27.1
L4600N-2050E	<1	0.03	31	0.04	11	<0.01	<5	2.4	<10	22.9
L4600N-1950E	<1	0.04	10	0.08	4	<0.01	<5	1.0	<10	16.4
L4600N-2000E	<1	0.03	51	0.06	10	<0.01	<5	3.4	<10	26.1
L4600N-2250E	<1	0.03	31	0.05	12	<0.01	<5	2.6	<10	23.5
L4600N-2450E	<1	0.02	46	0.05	7	<0.01	<5	3.2	<10	25.9
L4600N-2150E	<1	0.02	47	0.03	7	<0.01	<5	4.4	<10	39.1
L4600N2350E	<1	0.03	33	0.04	9	<0.01	<5	2.3	<10	23.7
L4600N-2550E	<1	0.03	42	0.06	7	<0.01	<5	3.4	<10	26.5
L4600N-2200E	<1	0.03	33	0.03	11	<0.01	<5	2.8	<10	26.3
L4600N-2600E	<1	0.02	39	0.07	7	<0.01	<5	2.9	<10	25.5
L4400N-1650E	<1	0.03	54	0.04	8	<0.01	<5	7.1	<10	76.1
L4600N-2400E	<1	0.02	29	0.03	10	<0.01	<5	2.7	<10	28.8
L4600N-2500E	<1	0.02	50	0.04	11	<0.01	<5	3.2	<10	25.9
L4600N-2300E	<1	0.03	32	0.05	7	<0.01	<5	2.0	<10	22.0
L4400N-1700E	<1	0.03	38	0.04	5	<0.01	<5	3.4	<10	34.5
L4400N-2050E	<1	0.03	53	0.08	7	<0.01	5	3.7	<10	31.3
L4400N-2000E	1	0.02	49	0.05	7	<0.01	6	3.4	<10	28.9
L4400N-1950E	1	0.03	50	0.05	6	<0.01	<5	5.7	<10	45.2
L4400N-1750E	1	0.03	48	0.03	6	<0.01	<5	5.4	<10	60.1
L4400N-1900E	<1	0.04	32	0.08	6	<0.01	<5	3.4	<10	34.0
L4400N-1850E	1	0.03	42	0.06	8	<0.01	<5	3.2	<10	24.7
L4400N-1800E	<1	0.05	7	0.11	3	<0.01	<5	0.9	<10	18.2

Element	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sn	Sr
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	1	0.01	1	0.01	2	0.01	5	0.5	10	0.5
Units	ppm	%	ppm	%	ppm	%	ppm	ppm	ppm	ppm
L4400N-2700E	1	0.03	66	0.11	12	<0.01	<5	4.1	<10	39.7
L4400N-2650E	2	0.03	75	0.07	7	<0.01	<5	4.7	<10	69.9
L4400N-2550E	<1	0.03	65	0.10	7	<0.01	<5	3.7	<10	25.6
L4400N-2600E	1	0.02	134	0.08	6	<0.01	<5	5.6	<10	59.9
L4400N-2150E	<1	0.03	42	0.08	7	<0.01	<5	2.6	<10	24.9
L4400N-2100E	1	0.02	47	0.04	6	<0.01	<5	2.7	<10	25.9
L4400N-2400E	<1	0.02	92	0.09	5	<0.01	<5	5.1	<10	44.0
L4400N-2300E	<1	0.03	38	0.09	10	<0.01	<5	2.6	<10	24.6
L4400N-2800E	2	0.03	49	0.09	11	<0.01	<5	3.4	<10	43.1
L4400N-2500E	4	0.03	73	0.08	5	<0.01	<5	5.0	<10	80.7
L4400N-2900E	1	0.02	83	0.12	5	<0.01	<5	6.7	<10	27.1
L4400N-2850E	2	0.03	61	0.09	7	<0.01	<5	4.3	<10	43.5
L4400N-2200E	<1	0.03	54	0.06	8	<0.01	<5	3.7	<10	31.8
L4400N-2350E	1	0.03	36	0.05	8	<0.01	<5	2.8	<10	29.9
L4400N-2250E	<1	0.03	53	0.08	8	<0.01	<5	3.5	<10	29.0
L4400N-2750E	2	0.04	47	0.13	16	<0.01	<5	3.5	<10	139
L4400N-2450E	1	0.02	66	0.10	6	<0.01	<5	4.7	<10	37.9
L4900N-1950E	<1	0.02	50	0.05	18	<0.01	29	4.5	<10	30.3
L4600N-2800E	<1	0.03	10	0.07	4	<0.01	<5	1.1	<10	11.0
L4900N-1800E	2	0.03	62	0.08	9	<0.01	5	4.5	<10	33.1
L5400N-2250E	<1	0.03	44	0.05	17	<0.01	<5	4.2	<10	42.1
L4900N-1700E	<1	0.04	21	0.07	5	<0.01	<5	1.7	<10	21.6
L4900N-1750E	3	0.03	46	0.04	16	<0.01	10	7.6	<10	34.8
L5400N-2000E	1	0.03	55	0.05	8	<0.01	26	7.4	<10	36.4
L4600N-2700E	<1	0.02	43	0.09	9	<0.01	<5	3.8	<10	25.0
L4900N-1650E	2	0.03	38	0.06	6	<0.01	<5	3.5	<10	30.8
L4900N-1850E	1	0.03	51	0.06	14	<0.01	10	4.6	<10	32.6
L4600N-2750E	<1	0.03	9	0.12	7	<0.01	<5	1.1	<10	15.7
L5400N-2200E	<1	0.02	38	0.06	14	<0.01	<5	4.3	<10	42.7
L5400N-2050E	<1	0.02	49	0.10	11	<0.01	7	4.9	<10	56.2
L4600N-2900E	2	0.02	68	0.11	6	<0.01	<5	4.9	<10	36.1
L5400N-2100E	<1	0.03	54	0.05	15	<0.01	<5	4.3	<10	37.6
L4900N-1900E	<1	0.03	47	0.11	15	<0.01	14	4.4	<10	26.8
L4600N-2850E	<1	0.04	7	0.08	3	<0.01	<5	0.9	<10	14.5
L4600N-2650E	<1	0.05	5	0.13	4	<0.01	<5	0.9	<10	12.0
L5400N-1950E	<1	0.03	49	0.05	7	<0.01	22	6.9	<10	42.2
L5400N-2150E	<1	0.03	46	0.05	13	<0.01	8	4.2	<10	36.3
L5600N-2350E	<1	0.02	34	0.05	8	<0.01	<5	3.9	<10	32.4
L5400N-2300E	<1	0.02	30	0.06	12	<0.01	<5	2.6	<10	30.8
L5600N-2250E	<1	0.02	38	0.08	13	<0.01	<5	3.8	<10	39.1
L5600N-2400E	<1	0.02	27	0.06	8	<0.01	<5	2.7	<10	30.6
L5500N-2200E	<1	0.02	40	0.08	14	<0.01	<5	4.2	<10	63.3
L5500N-2300E	1	0.02	48	0.09	12	<0.01	<5	4.1	<10	49.4

Element	Mo	Na	Ni	P	Pb	S	Sb	Sc	Sn	Sr
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	1	0.01	1	0.01	2	0.01	5	0.5	10	0.5
Units	ppm	%	ppm	%	ppm	%	ppm	ppm	ppm	ppm
L5500N-2100E	<1	0.02	37	0.05	8	<0.01	8	3.6	<10	30.9
L5500N-1950E	1	0.02	34	0.03	6	<0.01	69	3.9	<10	33.3
L5600N-2100E	<1	0.02	30	0.03	11	<0.01	76	3.9	<10	28.5
L5400N-2400E	<1	0.02	29	0.04	4	<0.01	<5	2.5	<10	28.8
L5600N-2200E	1	0.02	38	0.05	11	<0.01	<5	4.3	<10	38.5
L5500N-2250E	<1	0.02	45	0.10	11	<0.01	<5	4.2	<10	54.5
L5400N-2350E	<1	0.02	28	0.10	11	0.04	<5	2.7	<10	68.9
L5500N-2400E	<1	0.02	35	0.10	13	<0.01	<5	5.1	<10	60.8
L5500N-2150E	<1	0.02	45	0.04	7	<0.01	10	5.5	<10	26.6
L5500N-2050E	<1	0.02	34	0.04	6	<0.01	19	3.6	<10	34.3
L5500N-2000E	<1	0.02	34	0.03	5	<0.01	13	3.6	<10	35.3
L5600N-1950E	<1	0.02	43	0.04	6	<0.01	26	3.9	<10	28.8
L5500N-2350E	<1	0.02	39	0.08	10	<0.01	<5	4.5	<10	42.0
L5600N-2050E	<1	0.02	55	0.09	13	<0.01	28	8.4	<10	44.4
L5600N-2300E	<1	0.02	35	0.12	11	0.02	<5	2.9	<10	45.1
L5600N-2150E	<1	0.02	26	0.03	7	<0.01	<5	3.6	<10	31.4
L5600N-2000E	<1	0.02	31	0.03	5	<0.01	11	2.8	<10	28.2

Final : VC111564 Order: Soil/Silt

Element	Ti	V	W	Y	Zn	Zr
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	0.01	1	10	0.5	1	0.5
Units	%	ppm	ppm	ppm	ppm	ppm
00329603-5000	0.12	87	<10	28.8	54	4.8
329601	0.11	78	<10	10.4	57	4.0
WB-05-01	0.12	60	<10	10.4	81	20.6
WB-05-04	0.03	106	<10	26.9	79	9.3
WB-05-03	0.07	96	<10	20.1	90	17.9
WB-05-02	0.06	71	<10	12.7	87	13.3
WB-05-06	0.09	81	<10	12.9	98	22.2
WB-05-11	0.09	71	<10	15.9	92	23.9
WB-05-12	0.08	70	<10	13.1	98	19.6
WB-05-07	0.06	86	<10	15.1	96	12.2
WB-05-05	0.09	59	<10	16.1	114	20.9
WB-05-09	0.03	89	<10	16.8	79	9.0
WB-05-10	0.02	72	<10	30.0	96	7.7
WB-05-08	0.04	116	<10	25.7	122	14.4
L4600N-1650E	0.12	87	<10	8.9	91	8.7
L4600N-1900E	0.13	63	<10	3.2	127	9.0
L4600N-1750E	0.11	65	<10	2.7	131	8.4
L4600N-1700E	0.14	60	<10	3.7	90	8.6
L4600N-1850E	0.12	57	<10	2.3	78	3.4
L4600N-1800E	0.06	71	<10	4.8	144	3.5
L4600N-2100E	0.13	49	<10	3.4	55	7.9
L4600N-2050E	0.12	50	<10	2.7	63	6.2
L4600N-1950E	0.10	41	<10	1.8	33	4.3
L4600N-2000E	0.14	58	<10	3.3	118	8.9
L4600N-2250E	0.10	53	<10	4.1	79	5.7
L4600N-2450E	0.12	51	<10	3.0	70	5.6
L4600N-2150E	0.19	66	<10	4.5	69	12.3
L4600N2350E	0.08	45	<10	2.7	96	5.7
L4600N-2550E	0.11	54	<10	3.0	64	4.3
L4600N-2200E	0.10	47	<10	3.3	86	9.0
L4600N-2600E	0.07	51	<10	2.1	72	6.5
L4400N-1650E	0.14	86	<10	7.3	92	8.3
L4600N-2400E	0.10	38	<10	3.2	78	6.4
L4600N-2500E	0.10	49	<10	2.9	69	6.3
L4600N-2300E	0.10	58	<10	2.4	97	7.0
L4400N-1700E	0.16	74	<10	2.9	90	4.0
L4400N-2050E	0.12	53	<10	3.4	147	7.7
L4400N-2000E	0.10	57	<10	3.0	102	6.7
L4400N-1950E	0.17	78	<10	6.1	131	13.3
L4400N-1750E	0.20	86	<10	4.4	82	10.3
L4400N-1900E	0.15	59	<10	4.4	92	6.1
L4400N-1850E	0.14	63	<10	3.0	120	6.1
L4400N-1800E	0.09	38	<10	1.9	35	2.7

Final : VC111564 Order: Soil/Silt

Element	Ti	V	W	Y	Zn	Zr
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	0.01	1	10	0.5	1	0.5
Units	%	ppm	ppm	ppm	ppm	ppm
L4400N-2700E	0.16	68	<10	4.6	108	11.3
L4400N-2650E	0.18	75	<10	4.1	76	7.0
L4400N-2550E	0.17	68	<10	3.5	80	10.9
L4400N-2600E	0.20	87	<10	4.8	75	10.9
L4400N-2150E	0.10	47	<10	2.8	133	3.5
L4400N-2100E	0.09	43	<10	2.6	94	4.4
L4400N-2400E	0.18	79	<10	4.1	65	9.8
L4400N-2300E	0.10	48	<10	3.4	127	7.2
L4400N-2800E	0.13	71	<10	3.7	89	7.1
L4400N-2500E	0.13	83	<10	4.8	74	6.8
L4400N-2900E	0.06	94	<10	4.1	62	3.1
L4400N-2850E	0.13	76	<10	5.1	96	11.5
L4400N-2200E	0.12	57	<10	3.4	80	7.7
L4400N-2350E	0.09	59	<10	2.5	58	3.3
L4400N-2250E	0.12	52	<10	3.3	115	4.5
L4400N-2750E	0.14	64	<10	4.6	94	11.8
L4400N-2450E	0.14	80	<10	3.9	61	6.9
L4900N-1950E	0.12	65	<10	4.1	101	3.5
L4600N-2800E	0.10	43	<10	1.4	28	5.8
L4900N-1800E	0.14	64	<10	3.9	106	4.5
L5400N-2250E	0.13	59	<10	4.8	102	5.5
L4900N-1700E	0.12	52	<10	2.3	60	2.9
L4900N-1750E	0.17	89	<10	6.5	74	5.3
L5400N-2000E	0.10	74	<10	10.9	79	9.5
L4600N-2700E	0.11	61	<10	3.2	75	5.5
L4900N-1650E	0.15	66	<10	3.1	90	4.6
L4900N-1850E	0.14	66	<10	3.8	114	4.6
L4600N-2750E	0.11	46	<10	2.0	35	4.5
L5400N-2200E	0.15	59	<10	6.0	115	7.2
L5400N-2050E	0.10	62	<10	7.3	120	5.8
L4600N-2900E	0.13	80	<10	4.5	67	11.1
L5400N-2100E	0.12	66	<10	5.8	94	8.9
L4900N-1900E	0.11	61	<10	3.4	142	9.8
L4600N-2850E	0.10	44	<10	1.4	23	3.2
L4600N-2650E	0.09	36	<10	2.7	18	7.4
L5400N-1950E	0.10	73	<10	10.1	67	8.8
L5400N-2150E	0.15	61	<10	4.3	87	7.9
L5600N-2350E	0.14	61	<10	4.0	59	4.3
L5400N-2300E	0.07	42	<10	2.6	77	2.5
L5600N-2250E	0.12	57	<10	4.2	113	3.4
L5600N-2400E	0.07	50	<10	2.3	99	1.6
L5500N-2200E	0.14	58	<10	5.4	107	6.4
L5500N-2300E	0.13	61	<10	4.2	118	4.8

Final : VC111564 Order: Soil/Silt

Element	Ti	V	W	Y	Zn	Zr
Method	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B	ICP14B
Det.Lim.	0.01	1	10	0.5	1	0.5
Units	%	ppm	ppm	ppm	ppm	ppm
L5500N-2100E	0.10	51	<10	3.1	114	7.5
L5500N-1950E	0.10	63	<10	3.5	55	4.1
L5600N-2100E	0.10	58	<10	3.0	72	4.8
L5400N-2400E	0.09	43	<10	2.2	43	3.2
L5600N-2200E	0.14	62	<10	4.2	74	5.1
L5500N-2250E	0.17	58	<10	4.4	96	6.9
L5400N-2350E	0.06	38	<10	2.6	61	2.5
L5500N-2400E	0.12	57	<10	7.2	94	3.7
L5500N-2150E	0.08	74	<10	4.8	81	4.8
L5500N-2050E	0.12	59	<10	2.7	69	6.7
L5500N-2000E	0.12	53	<10	2.7	65	8.0
L5600N-1950E	0.10	60	<10	2.8	79	5.9
L5500N-2350E	0.17	57	<10	5.0	80	4.1
L5600N-2050E	0.08	87	<10	14.4	97	4.7
L5600N-2300E	0.13	55	<10	3.7	91	3.1
L5600N-2150E	0.11	53	<10	3.3	51	5.8
L5600N-2000E	0.12	54	<10	2.2	54	6.8

APPENDIX III: ANALYTICAL PROCEDURES

Assayers Canada Services Explained

Sample Preparation

Sample preparation procedures are normally fairly straightforward, and can be summarized as:

- **If a sample is wet, it will normally need to be dried**
- **Large samples must be split, often several times, to provide a portion small enough to be handled by the analytical equipment. The size of the final sample is a function of the element being analysed and the analytical method being employed.**
- **The size of particles within the sample must be reduced so that the elements of interest can be properly liberated from the rest of the rock.**

Sample Drying

At Assayers Canada, samples of rock, stream sediments and soils are all dried in an oven at about 60 degrees Celsius. It is possible to dry the samples more quickly (i.e. at a higher temperature), but certain volatile elements (notably Hg) can be lost at higher temperatures.

Sample Size and Particle Size Reduction

The optimum mix of crushing, pulverising and splitting samples to achieve a sample that is small enough and fine grained enough to be analysed, while still giving a fair representation of the element concentrations in the original sample, is a topic about which textbooks have been written, and is a much discussed problem. While the theory and mathematics of the discussion is too complex to be included in this web site, it is advisable that all geologists at least have a cursory understanding of the issues involved here, particularly if the project in question includes very coarse grained ore minerals.

In general, the coarser and less homogenous the distribution of the ore minerals, the finer a specimen should be crushed (or pulverised) before a portion of it is split off for analysis or further sample preparation. Ideally, the entire sample (say 10kg of drill core) would be pulverised to -150 mesh before splitting off a portion for analysis. The trouble with this is that it takes a long time to pulverise a large sample, and hence this would be a very costly solution to the problem.

At Assayers Canada, soil and stream sediment samples (where elements of interest are found in the fine fraction) are passed through an -80 mesh sieve, and the fine fraction is then split (if necessary) and pulverised.

Rock and drill core samples, on the other hand, are first crushed with a jaw crusher and the put through a secondary crusher so that it is 60% less than 10 mesh in size. The sample is then mixed, and a 250-gram sub sample split is taken. The sub sample is then pulverised in a ring pulverizer until 90% of the sample is less than 150 mesh, at which time it is ready for analysis.

Note that coarse gold does not pulverise well, but rather tends to become smeared along the plates of the pulverizer. If a sample is known to contain coarse gold, therefore, it should be sieved after it is pulverised to remove the coarse gold particles. The entire coarse fraction is then analysed, as is a split of the fine fraction. The two assays are then combined to give the total gold content of the original sample.

Assayers Canada Services Explained

Gold and Precious Metal Analysis by Fire Assay

Fire Assaying, a technique that has been around for centuries, is still the most generally accepted method of analysis for gold, and platinum group elements.

Though a number of variations are available (depending on the size of sample assayed and the method of final reading of the metal concentration), the basic technique in Fire Assaying for gold involves adding flux (which includes lead) and silver to the pulverised sample and fusing (melting) it. The extra silver acts as a collector of the gold, and, in very low-grade samples, ensures that at the end of the fusing there is enough precious metal to be easily handled.

At the end of the fusion process, the resultant molten material is poured into a metal mould and allowed to cool into a lead button (which contains the precious metals) at the bottom, overlain by silica glass slag. The slag is chipped off and discarded, and the lead button is subjected to a second process called cupellation, in which the precious metals are separated from the lead.

In cupellation the lead button (containing the gold) is placed into a small porous crucible called a cupel, and heated. The lead then becomes oxidised and is absorbed into the cupel, leaving a small silver/gold bead remaining in the cupel.

It now remains only to separate the silver from the gold. To do this, the bead is placed in a test tube and nitric acid is added, which, when the test tube is put in a hot water bath, dissolves the silver, leaving a small particle of pure gold.

If the particle of gold is large enough, it is usually weighed to determine the original grade of the sample. This is called a gravimetric finish to the fire assay. For lower grade samples with very small and difficult to handle gold particles the gold is dissolved in hydrochloric acid and the gold concentration is measured using AAS.

While Fire Assaying is normally done on a 1 Assay Tonne (roughly 30 gram) split of the pulverised material, a slight cost saving is to be found in selecting a smaller (15-gram) sample size. On the other hand, high-grade samples, for which there must be a gravimetric finish, are slightly more expensive than those that are read on the AAS.

In the analysis of platinum group elements, roughly the same procedure is followed, but the final element readings are normally done using ICP.

Assayers Canada Services Explained

Other Options for Gold Analysis

1. Cyanide Leaching

This method is often used for very sensitive analysis of bulk stream sediments or soils.

The entire sample is put into a cyanide solution and agitated for up to 24 hours, and the free gold in the sample is thus dissolved. The solution is then read on an AAS to determine the gold concentration of the original sample.

This method has the advantage of being able to detect small amounts of gold in large samples, and no additional sample preparation errors are introduced, since the entire sample is leached.

The disadvantage is mainly that the gold must be leachable by cyanide. Thus, it would not be effective in a situation where the gold is tied up in a pyrite matrix, as is the case in refractory ores. For this reason, it is normally recommended only for alluvial or well-oxidized samples.

2. Aqua Regia MIBK

This method is sometimes favoured over fire assay because there is a slight cost saving.

After normal sample preparation, a 10-gram split of the sample is dissolved in Aqua Regia. The gold is liberated from the other constituents of the solution with the addition of Methyl-isobutylketone (MIBK) and then read on the AAS.

While being a little bit less expensive than Fire Assaying, this method is not really recommended for gold analysis, because it is not effective in detecting refractory gold, and MIBK is a highly toxic chemical which raises difficult and largely unnecessary safety and environmental issues.

Assayers Canada Services Explained

Trace Level Geochemistry

There are three basic options available for analysing exploration samples for geochemical levels of most elements normally of interest to the exploration geologist. Geochemical samples (i.e. those not *normally* expected to have ore grade concentrations of critical elements) can be analysed either individually by a variety of traditional wet chemical techniques, or by multi-element ICP, or by Neutron Activation Analysis.

1. Traditional Wet Geochemistry

A wide variety of techniques are employed in traditional geochemical analysis, depending on the element being analysed.

Traditional geochemical analysis basically involves getting a sample into solution, and then using an appropriate method to read the element concentration in the solution. The sample is put into solution by dissolution with mineral acids. Depending on the element being analysed a fusion process may precede this. The type of acid used in the dissolving process is again dependent on the element being assayed. The solutions are then read by AAS, ICP or occasionally some other method.

2. ICP-AES Multi-Element Analysis

The sample is put into a test tube and treated with either Aqua Regia or a cocktail consisting of nitric-perchloric-hydrofluoric-hydrochloric acids, depending on the elements and the detection limits desired.

The beauty of ICP-AES multi-element analysis is the wide range of elements that can be read simultaneously. It is important, however, to be aware of the limitations of the method, the most serious being the fact that, depending on the sample mineralogy, not all elements that are analysed by ICP will invariably dissolve in the Aqua Regia or multi-acid digests. Thus, there is a chance that ICP will underestimate the concentrations of these elements. Another serious limitation to ICP is the fact that there can be interference between different elements. That is, the wavelength of one element's light emission will be close enough to that of another element to cause problems in reading the elements. This is particularly true if one of the elements has a very high concentration.

For the above reasons, ICP is not recommended for analyses that will be used in ore reserve calculations.

3. Instrumental Neutron Activation Analysis (INAA)

INAA has the very real advantage of not requiring the sample to be in solution (thus removing one step in the process, and eliminating any errors associated with that step), and of being able to measure many different elements, including gold, simultaneously.

One disadvantage of INAA is that many elements of interest (including copper and lead) cannot be analysed by the technique. Another disadvantage is the fact that this method requires a nuclear reactor, and there are few of these readily available in Canada.

The sample is prepared as normal and put into vials, which are then put into the reactor. Detection limits can be improved by using larger samples. This method is particularly good for analysis of panned concentrate samples, as it gives gold plus up to 34 different elements from one sample. Using a traditional fire assay (where, for panned concentrates, the entire sample is usually analysed), you can get only the concentration of gold in the sample.

Since Assayers Canada does not have direct access to a nuclear reactor, requests for INAA analysis are contracted out.

COMPARISON OF DIFFERENT TRACE ELEMENT ANALYSIS METHODS

Element	**Geochem**	**ICP AR**	**ICP MAD**	**INAA**
	(Range)	(Range)	(Range)	(DL)
Antimony	0.2-1000	5-10000	---	0.2
Aluminum	---	0.01-15%*	0.01-15%*	---
Arsenic	1-10000	5-10000	---	2
Barium	5-10000	10-10000*	10-10000*	100
Beryllium	2-1000	5-100*	0.5-100	---
Bismuth	0.1-1000	5-10000	5-10000	---
Boron	1-10000	---	---	---
Bromine	---	---	---	1
Calcium	---	0.01-15%*	0.01-15%	1%
Cadmium	0.1-200	1-100	1-100	---
Cerium	---	---	---	3
Cesium	---	---	---	2
Chlorine	---	---	---	100
Chromium	1-10000	1-10000*	1-10000	10
Cobalt	1-10000	1-10000	1-10000	5
Copper	1-10000	1-10000	1-10000	---
Copper Oxide	1-10000	---	---	---
Europium	---	---	---	0.2
Fluorine	10-10000	---	---	---
Gallium	5-10000 (ICP)	---	---	---
Germanium	5-1000 (ICP)	---	---	---
Gold	---	---	---	5 ppb
Hafnium	---	---	---	1
Iridium	---	---	---	5 ppb
Iron	10-10000	0.01-15%*	0.01-15%	0.02%

Lanthanum	---	---	---	1
Lead	1-10000	2-10000	2-10000	---
Lutetium	---	---	---	0.05
Magnesium	---	0.01-15%*	0.01-15%*	---
Manganese	5-10000	5-10000*	5-10000*	---
Mercury	5-50000 ppb	---	---	1
Molybdenum	1-1000	2-10000	2-10000	5
Neodymium	---	---	---	5
Nickel	1-10000	1-10000	1-10000	50
Niobium	10-10000 (ICP)	---	---	---
Phosphorous	10-10000 (ICP)	10-10000*	10-10000	---
Potassium	---	0.01-10%*	0.01-10%	---
Rubidium	---	---	---	30
Samarium	---	---	---	0.1
Scandium	---	1-10000	---	0.1
Selenium	1-100	---	---	5
Silver	0.1-200	0.2-200	0.2-200	5
Sodium	---	0.01-5%*	0.01-5%	0.05%
Strontium	1-10000 (ICP)	1-10000*	1-10000	0.05%
Tantalum	---	---	---	1
Tellurium	2-100	---	---	---
Terbium	---	---	---	0.5
Thallium	5-10000 ppb	---	---	---
Thorium	2-10000 (ICP)	---	---	0.5
Tin	2-1000	10-1000*	---	0.01%
Titanium	---	0.01-10*	0.01-10%	---
Tungsten	5-1000	10-10000*	10-10000	4
Uranium	---	---	---	0.5
Vanadium	5-10000	1-10000	1-10000	---
Ytterbium	---	---	---	0.2
Yttrium	---	1-10000	---	---
Zinc	1-10000	1-10000	1-10000	50
Zirconium	---	1-10000*	---	---

* Elements thus marked may not dissolve completely, or may experience some losses

Assayers Canada Services Explained

Ore Grade Analysis

The above techniques, subject to the limitations mentioned, give reasonably reliable analytical results in the detection ranges indicated. For higher grade samples, and in situations where additional confidence is required in the results (to be reported to the stock exchange, for example) traditional wet chemical techniques are recommended.

For trace level geochemical analyses, the recipe of getting the samples into solution which can be read by the instruments is standard, and does not make allowances for variations in the rock matrix or for the concentration of the element being analysed. As such, if the minerals present in the sample are not those usually encountered not all of it may dissolve, and the analysis may then be on the low side for certain elements. High grade samples, when put into solution using a standard trace level recipe, may result in solutions which have greater concentrations of the elements of interest than the instrument can reliably read. In this case, they would be reported simply as "greater than the maximum value for the technique".

Depending on which elements are being analysed, the methods for ore grade analysis may not differ greatly from those for trace elements. If an ore grade analysis is requested, however, the sample is dissolved using solvents that more vigorously attack it, (thus ensuring that all of that element is in solution) and the solution is then diluted so that concentration of the element is within the range of the instrument on which it will be read.

This attention to detail results in the higher cost of the ore grade analysis.