

Memo

To:	Karyn Lewis, Elgin Mining Incorporated	Client:	Lupin Mines Incorporated
From:	Andrea Bowie, Arlene Laudrum	Project No:	1CL008.000
Cc:	Eric Ketilson, SRK	Date:	December 31, 2015
Subject:	Results of the 2015 Lupin Mine Windblown Tails Survey at Dam 6		

1 Introduction

Concern that windblown tails were being deposited outside the tailings containment area (TCA) was expressed by Aboriginal Affairs and Northern Development Canada (now referred to as Indigenous and Northern Affairs Canada) (INAC) during the Technical Review of the Lupin Mine water licence renewal application. INAC requested that Lupin Mines Incorporated (LMI) develop a formal plan and schedule to address monitoring, cleanup and control of windblown tails. LMI responded on October 10, 2014 by committing to complete a soil sampling program in 2015 at Dam 6 of the Lupin Mine Tailings Containment Area (TCA).

The presence of arsenic in surficial sediment samples had been documented at the toe of Dam 6. A soil sample collected by INAC on July 6, 2012 from the west side of Dam 6, outside the containment area, returned an arsenic concentration of 162 mg/kg. INAC suggested that the result supported their hypothesis that windblown tails were being actively deposited outside of the TCA.

Dam 6 is a perimeter closure dam for Cell 3, located on the southwest side of the TCA (Figure 1). It was constructed in 1992 (Holubec 2005). Tails were deposited in Cell 3 between 1990 and 2005 (Tansey, 2006). The tails in Cell 3 are covered with 1.0 m or more esker material except for an 86,000 m² area of uncovered saturated tails situated more than 750 m from Dam 6. The cover on Cell 3 was placed between 2003 and 2005.

2 Sample Collection

The 2015 sampling program at Dam 6 included the physical and chemical characterization of soil samples collected in a 25 m grid pattern at the downstream base of the dam. The plan to assess the presence of windblown tailings was provided to INAC and the Nunavut Water Board (NWB) in a memo on October 29, 2014 (SRK 2014).

All samples collected to assess the presence of windblown tails were gathered over a three day period from August 14 to 16, 2015. The sampling area was established 5 m off the toe of the dam and the grid consisted of 13 columns and 3 rows spaced 25 m apart. Samples were collected to

characterize the dust on the surface of the soil by utilizing a brush and dustpan. No samples were collected from the southwest corner of the sample grid, as no surficial material was observed in the elevated area. The southwest corner of the sample grid is a ridge covered by vegetation. Initially, every other sample from the first row was submitted for grain size and metal analysis. The sample results were compared to the proposed arsenic concentration management trigger limit of 179 mg/kg (Morrow 2006). If any sample had an exceedance of the management limit the adjacent samples were then submitted for analysis.

Samples were also collected from the crest of Dam 6 on the road, from the esker material covering the tails in the TCA 5 m to the east side of Dam 6 and from the exposed tailings in Cell 3 for comparative purposes. Due to the nature of wetted tails, the sample from Cell 3 was collected with a clean spade up to 10 cm below surface.

In addition, soil samples were collected from shallow pits on August 22, 2015 to twin samples being collected by INAC. Three pits were excavated to the west of Dam 6 and one pit was excavated in the exposed tails on Cell 3. A surface sample and subsurface sample were collected in each pit. The surface soil sample consisted of material collected between 2.5 and 10 cm below surface while the subsurface sample was collected from material between 15 and 25 cm below surface. The samples were collected with a clean spade.

3 Results

The analytical soil sample results are compared to the generic Canadian Council of Ministers of the Environment (CCME) Residential Land Use (RL) and the Industrial Land Use (IL) criteria as well as the proposed site specific arsenic concentration management trigger limit of 179 mg/kg (Morrow 2006) in Table 1.

Maps highlighting the arsenic concentrations in the surficial and subsoil material are presented as Figure 2 and Figure 3, respectively. Samples LUP15059, LUP15061 and LUP15063 shown on Figure 2 were not collected from the dust on surface, they were instead collected between 2.5 and 10 cm below surface. No surficial soil samples could be collected from the southwest ridge (LUP15036, LUP15038 and LUP15039) as no surficial material was observed.

Three rounds of samples were submitted to ALS Environmental, after which the decision not to submit further samples was made as the results were conclusive of elevated arsenic concentrations. The arsenic concentrations in the dust recovered from the surface of the soil ranged from 84.2 to 2,550 mg/kg, with the highest concentrations of arsenic being found in the third (outside) row farthest from the dam. Arsenic was the only element to exceed the CCME guidelines in the dust. The subsoil samples revealed elevated arsenic concentrations from 176 to 2,410 mg/kg (samples LUP15060, LUP150062, LUP150064) beneath a surface layer of sand that had arsenic concentrations that ranged from 47 to 103 mg/kg (samples LUP15059, LUP15061 and LUP15063).

Samples collected from the crest of Dam 6 on the road returned arsenic concentrations that ranged from 21 to 112 mg/kg. The arsenic concentrations in the capped tails esker material on the TCA ranged from 8 to 13 mg/kg. The exposed tails in Cell 3 exhibited arsenic concentrations that ranged from 6,200 to 8,410 mg/kg.

Sieve analysis of the samples was conducted to assess the likelihood of windblown materials being present outside of the TCA. The results revealed that the tailings has a fine texture with less than 20% of the material being more than 75 µm in grain size. The surficial material collected outside of the TCA has a coarse texture with 75 to 97% greater than 75 µm. The subsoil samples were a finer texture material with 45 to 50% greater than 75 µm.

Quality assurance and control measures associated with the collection and analysis of the solids samples included the analysis of blind duplicate samples. The complete listing of laboratory quality control samples and their relative percent difference (RPD) are shown in Table 2. These monitor a combination of the precision of the laboratory analyses, sample preparation errors and genuine short scale variations in soil geochemistry. Results that are either below the detection limit for one or both sample pairs, or below the practical quantitation limit (PQL) have RPD's identified as not applicable.

Five sample pairs were evaluated. Two of the sample pairs had RPD values greater than 25% for two elements of the elements analysed. These data suggest the material sampled was homogeneous and the results will not affect the conclusions or recommendations.

4 Conclusions

The results do not show that windblown tails are currently being deposited outside of the facility as a result of the exposed saturated tails in Cell 3. The size analysis shows that the material analyzed is coarse to fine grain sands. This grain size of material is not indicative of windblown material. The results indicate that the potential for windblown deposition of tailings outside of the TCA has been controlled by the placement of the esker sand cover. The absence of surficial material on elevated areas at the downstream toe of Dam 6 further supports this conclusion.

The arsenic concentrations and grain size of the subsoil samples suggest the historical deposition of tailings occurred in the vicinity of Dam 6. A sand cover is in place over the tails downgradient of the toe of Dam 6. A review of Lupin Mine spill reports and available operating records did not reveal a spill or overtopping of tailings at Dam 6. Nor was documentation found that discussed capping tails on the downstream toe of Dam 6. It is possible that the deposition of tails in this area predates the construction of Dam 6.

The Ecological Risk Assessment for the Lupin Mine Tailings Containment Area (Golder 2004) showed that the risks from sand-covered tailings are acceptable, both for humans and wildlife. The study did not assess areas outside of the TCA.

5 Recommendations

An extension of the 10 cm thick soil cover at the downstream toe of Dam 6 is recommended, based on available site data. Additional soil sampling from shallow pits is required to determine the lateral extent of the cover required. The soil samples should be collected from topographic lows west of the surficial sample grid.

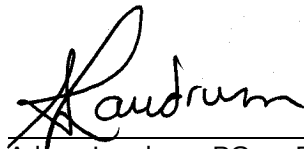
When the final closure plan is being developed for the site, SRK recommends that a human health and ecological risk assessment be conducted for the Lupin Mine site to determine site specific soil quality management trigger limits for contaminants of environmental concern, including arsenic. Minimal sample collection would be involved in order to assess the toxicity of arsenic through speciation identification and to appraise the mobility of arsenic to the surrounding environment through leaching tests. The study would be informed by the results of the environmental effects monitoring programs undertaken at the Lupin Mine. Based on the risk assessment results, the risk remediation strategy for dealing with soil and sediment in excess of the management trigger limits can be developed (i.e. cover [minimum depth of cover required], excavate and relocate, do not disturb).

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Enclosures:
Tables
Figures

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6 References

- Golder 2004. Ecological Risk Assessment for the Lupin Mine Tailings Containment Area. Prepared by Golder Associates Ltd for Kinross Gold Corporation. December 2004.
- Holubec 2005. Lupin Operation Closure Plan For Tailings Containment Area. Prepared by I. Holubec Consulting Inc. for Kinross Gold Corporation. Dated January 2005.
- Lupin 2013. Water Quality Monitoring Plan and Quality Assurance/Quality Control Plan. Prepared by Lupin Mines Incorporated. Dated March 2013.
- Morrow 2006. Phase 1 and 2 Environmental site Assessment, Lupin Mine Site, Nunavut Territory. Prepared by Morrow Environmental Consultants Inc., a member of the SNC-Lavalin Group for Kinross Gold Corp. Dated January 11, 2006.
- SRK 2014. Arsenic concentration in sample of windblown material collected by AANDC in 2012 does not exceed background levels. Prepared by SRK Consulting (Canada) Inc. for Lupin Mines Incorporated. Dated October 29, 2014.
- Tansey 2006. Tails Cells Depositional History.xls. Lupin Mine operational records. File dated March 1, 2006.

Lupin Mine Site

Table 1: 2015 Windblown Tails Data

Client Sample ID	CCME Recreational Land Use (RL) Criteria (mg/kg)	CCME Industrial Land Use (IL) Criteria (mg/kg)	Site Specific Background Concentration (mg/kg)	Units	LUP15001	LUP15004	LUP15007	LUP15010	LUP15013	LUP15016	LUP15056 duplicate of LUP15016	LUP15022	LUP15028	LUP15031	LUP15034	LUP15037
Date Sampled	Exceedance Format	Exceedance Format	Exceedance Format		15-Aug-2015	14-Aug-2015	15-Aug-2015	14-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015
Location					Downstream Toe of Dam 6, Row 1											
ALS Sample ID					L1700420-1	L1661981-1	L1697540-2	L1661981-2	L1697540-5	L1661981-3	L1661981-21	L1661981-4	L1661981-5	L1697540-7	L1661981-6	L1697540-10
Parameter	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	
% Particles > 75um (Coarse/Fine)																
% Sand				%			91.6		95.6					95.6		94.8
% Silt				%			5		3.2					2.6		4.6
% Clay				%			3.4		1.2					1.8		<1.0
General Texture Class				-		Coarse	Sand	Coarse	Sand	Coarse	Coarse	Coarse	Coarse	Sand	Coarse	Sand
% >75um				%		92.4		93.7		96.9	96.5	96	97.2		99	
Metals in Soil by CRC ICPMS																
Aluminum (Al)				mg/kg		5200		4080		4970	4920	4840	4860		4960	
Antimony (Sb)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	12	12	179	mg/kg	310	127	112	142	105	109	114	116	103	86	947	245
Barium (Ba)				mg/kg	34.1	28	29.9	24	27.4	31.7	27.7	31.7	25.4	23.3	26	30.8
Beryllium (Be)	4	8		mg/kg	<0.10	0.14	<0.10	<0.10	<0.10	<0.10	0.1	<0.10	0.11	<0.10	0.1	<0.10
Bismuth (Bi)				mg/kg		<0.20		<0.20		0.32	<0.20	<0.20	<0.20		<0.20	
Boron (B)				mg/kg		<5.0		<5.0		<5.0	<5.0	<5.0	<5.0		<5.0	
Cadmium (Cd)	10	22		mg/kg	<0.020	0.034	<0.020	<0.020	<0.020	<0.020	<0.020	0.03	0.03	0.022	<0.020	0.02
Calcium (Ca)				mg/kg		4990		2410		676	841	1000	2480		917	
Chromium (Cr)	64	87		mg/kg	18.8	20.2	17.7	16.5	16.8	24.6	17.9	17.1	18	17.4	17.2	15.3
Cobalt (Co)	50	300		mg/kg	2.94	5.59	3.31	4.07	3.45	2.88	2.88	3.43	4.01	4.16	3.36	5.24
Copper (Cu)	63	91		mg/kg	11.2	29.4	7.14	7.9	7.54	14.6	10.9	9.25	9.34	7.82	9.25	8.12
Iron (Fe)				mg/kg		9360		8550		9930	9540	10600	10700		10600	
Lead (Pb)	140	600		mg/kg	4.64	2.46	2.94	3.08	2.7	2.42	2.85	2.3	1.87	2.15	3.24	3.29
Lithium (Li)				mg/kg		17.7		11.6		15.3	14.9	15.1	16.2		14.7	
Magnesium (Mg)				mg/kg		3500		2730		3430	3150	3200	3330		3360	
Manganese (Mn)				mg/kg		91.7		78.4		69.6	69.4	82.9	92.6		74.7	
Mercury (Hg)				mg/kg	<0.0050		<0.0050		<0.0050					<0.0050		<0.0050
Molybdenum (Mo)	10	40		mg/kg	0.22	0.24	0.19	0.22	0.29	0.24	0.28	0.23	0.23	0.22	0.36	0.39
Nickel (Ni)	45	89		mg/kg	9.38	15.6	9.24	10.4	9.83	11.5	9.04	8.7	10.4	11.3	9.6	12.6
Phosphorus (P)				mg/kg		218		204		215	225	265	207		259	
Potassium (K)				mg/kg		1440		1430		1610	1460	1700	1660		1300	
Selenium (Se)	1	2.9		mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)				mg/kg		86		110		84	86	79	109		<50	
Strontium (Sr)				mg/kg		14.4		11.7		7.56	7.99	7.24	9.84		4.72	
Thallium (Tl)				mg/kg	0.082	0.087	0.075	0.068	0.08	0.081	0.082	0.077	0.08	0.067	0.069	0.069
Tin (Sn)	50	300		mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)				mg/kg		298		215		253	274	252	260		214	
Uranium (U)				mg/kg	0.441	0.373	0.296	0.266	0.344	0.335	0.404	0.37	0.334	0.347	0.403	0.335
Vanadium (V)	130	130		mg/kg	15.5	15.9	14.3	12.4	14.8	14.2	14.6	14	14.9	13.9	13.9	12.5
Zinc (Zn)	200	360		mg/kg	14.6	18.5	13.5	14.3	14.2	17.5	14.2	16.6	17.3	17	15.9	13.4
Zirconium (Zr)				mg/kg		1.6		1.3		1.4	1.6	1.5	1.3		1.4	

Lupin Mine Site

Table 1: 2015 Windblown Tails Data

Client Sample ID	CCME Recreational Land Use (RL) Criteria (mg/kg)	CCME Industrial Land Use (IL) Criteria (mg/kg)	Site Specific Background Concentration (mg/kg)	Units	LUP15002	LUP15005	LUP15066 duplicate of LUP15005	LUP15008	LUP15011	LUP15014	LUP15017	LUP15029	LUP15032	LUP15067 duplicate of LUP15032	LUP15035
Date Sampled	Exceedance Format	Exceedance Format	Exceedance Format		15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015
Location					Downstream Toe of Dam 6, Row 2										
ALS Sample ID					L1700420-2	L1697540-1	L1697540-11	L1697540-3	L1697540-4	L1697540-6	L1700420-8	L1700420-10	L1697540-8	L1697540-12	L1697540-9
Parameter					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
% Particles > 75um (Coarse/Fine)															
% Sand				%	75.6	93	93.6	90.6	93.6	92.6		94.6	94.6	96.8	99
% Silt				%	17.4	5.6	6	6.4	4	4		1	1.6	2.8	0.43
% Clay				%	7.0	1.4	<1.0	3	2.4	3.4		4.4	3.8	<1.0	0.54
General Texture Class				-	Sandy loam	Sand	Sand	Sand	Sand	Sand		Sand	Sand	Sand	Sand
% >75um				%											
Metals in Soil by CRC ICPMS															
Aluminum (Al)				mg/kg											
Antimony (Sb)	20	40		mg/kg	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Arsenic (As)	12	12	179	mg/kg	1530	191	141	447	370	393	136	682	219	223	402
Barium (Ba)				mg/kg	40.7	32.8	28.7	27.8	31.1	30	30.2	36.1	31	30.3	36
Beryllium (Be)	4	8		mg/kg	<0.10	0.11	0.1	<0.10	<0.10	<0.10	<0.10	<0.10	0.1	0.11	<0.10
Bismuth (Bi)				mg/kg											
Boron (B)				mg/kg											
Cadmium (Cd)	10	22		mg/kg	0.02	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020
Calcium (Ca)				mg/kg											
Chromium (Cr)	64	87		mg/kg	16.6	18.6	16.9	15.8	14.7	15.1	17	16.5	20	20.4	17.4
Cobalt (Co)	50	300		mg/kg	1.99	2.92	2.86	2.83	2.54	2.46	2.56	2.6	3.19	3.24	2.85
Copper (Cu)	63	91		mg/kg	11	10	10.3	7.33	8.43	8.19	7.83	7.78	8.69	9.27	8.67
Iron (Fe)				mg/kg											
Lead (Pb)	140	600		mg/kg	24.9	6.35	4.88	7.79	5.29	5.31	2.92	8.06	4.19	4.77	5.58
Lithium (Li)				mg/kg											
Magnesium (Mg)				mg/kg											
Manganese (Mn)				mg/kg											
Mercury (Hg)				mg/kg	0.03	<0.0050	<0.0050	0.0053	0.0086	0.0076	<0.0050	0.012	0.0053	0.0051	0.0078
Molybdenum (Mo)	10	40		mg/kg	0.38	0.27	0.22	0.23	0.2	0.18	0.19	0.36	0.22	0.28	0.2
Nickel (Ni)	45	89		mg/kg	7.46	9.65	8.82	8.8	8.23	7.76	8.31	8.68	11	11.1	9.77
Phosphorus (P)				mg/kg											
Potassium (K)				mg/kg											
Selenium (Se)	1	2.9		mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20
Silver (Ag)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10
Sodium (Na)				mg/kg											
Strontium (Sr)				mg/kg											
Thallium (Tl)				mg/kg	0.067	0.07	0.066	0.062	0.064	0.058	0.06	0.06	0.073	0.06	0.066
Tin (Sn)	50	300		mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Titanium (Ti)				mg/kg											
Uranium (U)				mg/kg	0.502	0.415	0.364	0.281	0.392	0.415	0.314	0.378	0.437	0.382	0.358
Vanadium (V)	130	130		mg/kg	14.3	14.7	13.1	12.2	12.5	12.6	15.1	14.1	16	15.7	13.6
Zinc (Zn)	200	360		mg/kg	13	14.3	13.7	13.1	12.9	11.9	13	13	15.5	16	13.9
Zirconium (Zr)				mg/kg											

Lupin Mine Site

Table 1: 2015 Windblown Tails Data

Client Sample ID	CCME Recreational Land Use (RL) Criteria (mg/kg)	CCME Industrial Land Use (IL) Criteria (mg/kg)	Site Specific Background Concentration (mg/kg)	Units	LUP15003	LUP15006	LUP15009	LUP15012	LUP15068 duplicate of LUP15012	LUP15015	LUP15018	LUP15030	LUP15033	LUP15059- DAM6 SURFMAT	LUP15061- DAM6 SURFMAT	LUP15063- DAM6 SURFMAT	
Date Sampled	Exceedance Format	Exceedance Format	Exceedance Format		15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	22-Aug-2015	22-Aug-2015	22-Aug-2015	
Location					Downstream Toe of Dam 6, Row 3										Surface soil at downstream toe of Dam 6		
ALS Sample ID					L1700420-3	L1700420-4	L1700420-5	L1700420-6	L1700420-13	L1700420-7	L1700420-9	L1700420-11	L1700420-12	L1662622-3	L1662622-5	L1662622-7	
Parameter	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	
% Particles > 75um (Coarse/Fine)																	
% Sand				%	75.4	82.6	92					83.2					
% Silt				%	19.9	11.8	3.4					8.0					
% Clay				%	4.66	5.6	4.6					8.8					
General Texture Class				-	Loamy sand	Loamy sand	Sand					Loamy sand		Coarse	Coarse	Coarse	
% >75um				%										96	94.1	92.7	
Metals in Soil by CRC ICPSMS																	
Aluminum (Al)				mg/kg										5600	4850	4610	
Antimony (Sb)	20	40		mg/kg	0.23	0.1	<0.10	<0.10	<0.10	<0.10	0.14	0.18	<0.10	<0.10	<0.10	<0.10	
Arsenic (As)	12	12	179	mg/kg	2550	1690	1070	218	266	84.2	2080	2450	350	47.3	103	96.5	
Barium (Ba)				mg/kg	48.5	40.7	40.8	38.5	33.5	30.8	42.3	48.3	39.5	30.2	30.9	28.6	
Beryllium (Be)	4	8		mg/kg	0.21	0.12	<0.10	<0.10	<0.10	<0.10	<0.10	0.11	<0.10	0.11	<0.10	<0.10	
Bismuth (Bi)				mg/kg										<0.20	<0.20	<0.20	
Boron (B)				mg/kg										<5.0	<5.0	<5.0	
Cadmium (Cd)	10	22		mg/kg	0.13	0.041	0.022	<0.020	<0.020	<0.020	<0.020	<0.020	0.023	<0.020	<0.020	<0.020	
Calcium (Ca)				mg/kg										880	1010	885	
Chromium (Cr)	64	87		mg/kg	16.5	13.9	16.5	21.5	18.4	18.2	17.3	18.9	19.6	21.8	19	17.8	
Cobalt (Co)	50	300		mg/kg	31.4	11.4	2.94	3.1	2.95	2.74	2.38	2.57	3.46	3.82	2.82	2.6	
Copper (Cu)	63	91		mg/kg	25.9	13.3	13.7	6.76	8.24	6.72	9.09	12.8	13.5	12.7	8.34	7.6	
Iron (Fe)				mg/kg										11300	11000	9710	
Lead (Pb)	140	600		mg/kg	34.2	24.9	19.4	3.29	3.49	2.38	17	22.3	8.88	3.04	3.49	3.68	
Lithium (Li)				mg/kg										17.6	13.6	12.4	
Magnesium (Mg)				mg/kg										3680	2910	2710	
Manganese (Mn)				mg/kg										88.4	75.7	68	
Mercury (Hg)				mg/kg	0.027	0.022	0.024	<0.0050	0.0058	<0.0050	0.018	0.026	0.025				
Molybdenum (Mo)	10	40		mg/kg	0.49	0.45	0.36	0.44	0.21	0.19	0.35	0.5	0.35	0.31	0.53	0.17	
Nickel (Ni)	45	89		mg/kg	35.5	14.1	10.2	10.5	8.57	8.55	8.34	9.19	11.6	11.9	9.06	8.72	
Phosphorus (P)				mg/kg										241	213	245	
Potassium (K)				mg/kg										1680	1610	1500	
Selenium (Se)	1	2.9		mg/kg	0.27	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	
Silver (Ag)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
Sodium (Na)				mg/kg										92	203	121	
Strontium (Sr)				mg/kg										5.69	9.53	7.34	
Thallium (Tl)				mg/kg	0.09	0.074	0.074	0.069	0.068	0.06	0.08	0.07	0.068	0.102	0.087	0.082	
Tin (Sn)	50	300		mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Titanium (Ti)				mg/kg										324	330	303	
Uranium (U)				mg/kg	0.421	0.37	0.457	0.35	0.343	0.325	0.3	0.454	0.49	0.472	0.392	0.372	
Vanadium (V)	130	130		mg/kg	12.7	11.6	13.4	17.5	15.8	14	14.2	16.4	14.6	18	16.4	14.9	
Zinc (Zn)	200	360		mg/kg	35.1	17	14.5	15.9	14.1	12.6	12.8	13.8	15.2	19.3	15	13.1	
Zirconium (Zr)				mg/kg										2.4	1.8	2.2	

Lupin Mine Site

Table 1: 2015 Windblown Tails Data

Client Sample ID	CCME Recreational Land Use (RL) Criteria (mg/kg)	CCME Industrial Land Use (IL) Criteria (mg/kg)	Site Specific Background Concentration (mg/kg)	Units	LUP15043	LUP15045	LUP15047	LUP15055 duplicate of LUP15047	LUP15049	LUP15051	LUP15053	LUP15044	LUP15046	LUP15048	LUP15050	
Date Sampled	Exceedance Format	Exceedance Format	Exceedance Format		15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015	15-Aug-2015
Location					Crest of Dam 6							Soil cover on Cell 3 upstream of Dam 6				
ALS Sample ID					L1661981-7	L1661981-9	L1661981-11	L1661981-20	L1661981-13	L1661981-15	L1661981-17	L1661981-8	L1661981-10	L1661981-12	L1661981-14	
Parameter					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil
% Particles > 75um (Coarse/Fine)																
% Sand				%												
% Silt				%												
% Clay				%												
General Texture Class				-	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	Coarse	
% >75um				%	87	82.7	85.2	86.9	85.8	92.1	91.1	92	84.8	89.2	88.1	
Metals in Soil by CRC ICPSMS																
Aluminum (Al)				mg/kg	5770	6300	5900	6100	6730	5530	5370	5780	5090	5050	4790	
Antimony (Sb)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
Arsenic (As)	12	12	179	mg/kg	112	77.2	62.4	65.8	98.8	20.5	49.9	12.8	8	12.4	12	
Barium (Ba)				mg/kg	36.9	39.2	34.6	37.6	41.4	36.3	31.8	35.9	29.9	31	28.3	
Beryllium (Be)	4	8		mg/kg	0.12	0.13	0.12	0.13	0.16	0.12	0.13	0.12	0.22	0.18	0.22	
Bismuth (Bi)				mg/kg	0.2	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	
Boron (B)				mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	
Cadmium (Cd)	10	22		mg/kg	0.024	0.027	0.033	0.036	0.033	0.024	0.029	0.028	0.31	0.24	0.34	
Calcium (Ca)				mg/kg	937	1290	1580	1680	1540	989	1280	1250	8380	8860	8190	
Chromium (Cr)	64	87		mg/kg	24.3	28.9	24.6	25.4	27.5	22.4	21	25	20.8	19.8	18.5	
Cobalt (Co)	50	300		mg/kg	3.34	4.22	5.53	6.44	6.13	3.64	3.98	4.25	53.3	47.8	70	
Copper (Cu)	63	91		mg/kg	11.6	12.6	14.4	15.5	17.3	10.8	13.9	13.9	68.5	39.9	66.1	
Iron (Fe)				mg/kg	10500	11500	10900	10800	12200	9380	9480	10300	8500	8270	8030	
Lead (Pb)	140	600		mg/kg	2.67	2.39	2.19	2.13	1.98	1.23	1.53	1.81	1.16	1.04	1.08	
Lithium (Li)				mg/kg	16.3	16.3	17.9	19.4	18.7	18	17	17	25.2	23.3	27.1	
Magnesium (Mg)				mg/kg	3450	3950	3780	3940	4140	3520	3360	3690	5230	5150	5460	
Manganese (Mn)				mg/kg	80.9	87.6	92.5	96.5	103	82.2	83.4	84.8	395	368	438	
Mercury (Hg)				mg/kg												
Molybdenum (Mo)	10	40		mg/kg	0.24	0.38	0.32	0.28	0.29	0.33	0.3	0.2	0.17	0.17	0.21	
Nickel (Ni)	45	89		mg/kg	11.6	15.3	17.5	21	18.6	12.1	13.3	13.8	154	135	184	
Phosphorus (P)				mg/kg	313	337	318	279	286	228	249	311	339	198	244	
Potassium (K)				mg/kg	1790	1950	2020	2180	2520	1820	1670	2160	4120	3120	5000	
Selenium (Se)	1	2.9		mg/kg	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	<0.20	
Silver (Ag)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	<0.10	
Sodium (Na)				mg/kg	66	104	86	99	92	<50	74	56	345	357	436	
Strontium (Sr)				mg/kg	4.48	4.7	5.58	6.32	6.62	3.84	5.76	4.32	23.2	26.2	27.7	
Thallium (Tl)				mg/kg	0.094	0.089	0.099	0.102	0.118	0.099	0.086	0.1	0.16	0.143	0.173	
Tin (Sn)	50	300		mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0	
Titanium (Ti)				mg/kg	334	334	314	362	378	302	292	391	290	260	256	
Uranium (U)				mg/kg	0.719	0.683	0.675	0.615	0.649	0.474	0.552	0.819	1.43	0.931	1.56	
Vanadium (V)	130	130		mg/kg	18.7	20.7	18.9	19.4	23.2	17.6	15.7	20.9	16.3	14.4	14.3	
Zinc (Zn)	200	360		mg/kg	16.6	19	19.7	21.1	22	17.7	18	17.7	56.6	49.1	67.3	
Zirconium (Zr)				mg/kg	2.2	2.4	2	2.2	1.7	1.4	1.9	2.2	1.9	1.6	1.6	

Lupin Mine Site

Table 1: 2015 Windblown Tails Data

Client Sample ID	CCME Recreational Land Use (RL) Criteria (mg/kg)	CCME Industrial Land Use (IL) Criteria (mg/kg)	Site Specific Background Concentration (mg/kg)	Units	LUP15052	LUP15054	LUP15060- DAM6 DEEPMAT	LUP15062- DAM6 DEEPMAT	LUP15064- DAM6 DEEPMAT	LUP15041	LUP15057- CELL3 TAIL	LUP15058- CELL3 DUP	
Date Sampled	Exceedance Format	Exceedance Format	Exceedance Format		15-Aug-2015	15-Aug-2015	22-Aug-2015	22-Aug-2015	22-Aug-2015	16-Aug-2015	22-Aug-2015	22-Aug-2015	
Location					Soil cover on Cell 3 upstream of Dam 6		Subsoil at downstream toe of Dam 6			Cell 3 Tails			
ALS Sample ID					L1661981-16	L1661981-18	L1662622-4	L1662622-6	L1662622-8	L1661981-19	L1662622-1	L1662622-2	
Parameter					Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	
% Particles > 75um (Coarse/Fine)													
% Sand				%									
% Silt				%									
% Clay				%									
General Texture Class				-	Coarse	Coarse	Coarse	Fine	Fine	Fine	Fine	Fine	
% >75um				%	82.5	95.8	50.4	45.7	46.5	14.6	13.2	19.5	
Metals in Soil by CRC ICPMS													
Aluminum (Al)				mg/kg	6270	6350	6480	3930	4130	21300	18300	18100	
Antimony (Sb)	20	40		mg/kg	<0.10	<0.10	0.17	<0.10	<0.10	0.4	0.43	0.41	
Arsenic (As)	12	12	179	mg/kg	10	9	2410	176	830	8410	6200	6750	
Barium (Ba)				mg/kg	34.5	24.5	42.9	19	22.1	115	113	117	
Beryllium (Be)	4	8		mg/kg	0.55	0.11	0.14	<0.10	<0.10	0.45	0.5	0.44	
Bismuth (Bi)				mg/kg	<0.20	<0.20	0.34	<0.20	<0.20	0.82	0.99	1	
Boron (B)				mg/kg	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	<5.0	
Cadmium (Cd)	10	22		mg/kg	0.79	0.036	0.022	<0.020	<0.020	0.16	0.1	0.088	
Calcium (Ca)				mg/kg	13500	1730	1860	1380	1560	9870	9380	9110	
Chromium (Cr)	64	87		mg/kg	22.3	24.2	21.8	14.8	15.3	53.5	45.9	46.4	
Cobalt (Co)	50	300		mg/kg	190	5.02	3.17	2.53	2.34	11.4	6.01	6.35	
Copper (Cu)	63	91		mg/kg	188	16.8	14.6	7.56	8.34	91.8	82.8	66	
Iron (Fe)				mg/kg	9060	10500	23200	8280	12400	91900	84800	86500	
Lead (Pb)	140	600		mg/kg	1.14	1.27	50.7	3.68	12.6	229	217	256	
Lithium (Li)				mg/kg	54.2	17.4	13.6	8.9	9.2	36.3	29.9	29.4	
Magnesium (Mg)				mg/kg	9680	4280	3220	2090	2200	7590	6580	6520	
Manganese (Mn)				mg/kg	1020	95.3	79.8	65.5	62.5	131	137	136	
Mercury (Hg)				mg/kg									
Molybdenum (Mo)	10	40		mg/kg	0.33	0.27	0.61	0.21	0.29	2.1	2.1	2.1	
Nickel (Ni)	45	89		mg/kg	493	16.7	11.4	8.73	8.06	32.7	19.1	22.1	
Phosphorus (P)				mg/kg	263	208	450	415	487	785	794	804	
Potassium (K)				mg/kg	6720	1760	1580	640	760	3140	2980	3030	
Selenium (Se)	1	2.9		mg/kg	<0.20	<0.20	0.21	<0.20	<0.20	1	0.87	0.89	
Silver (Ag)	20	40		mg/kg	<0.10	<0.10	<0.10	<0.10	<0.10	0.14	0.13	0.12	
Sodium (Na)				mg/kg	913	65	206	87	105	315	515	458	
Strontium (Sr)				mg/kg	52.8	7.29	24.3	6.34	10.6	60.4	93.4	79.1	
Thallium (Tl)				mg/kg	0.212	0.106	0.093	<0.050	0.05	0.177	0.185	0.195	
Tin (Sn)	50	300		mg/kg	<2.0	<2.0	<2.0	<2.0	<2.0	2.4	3.1	3	
Titanium (Ti)				mg/kg	345	219	330	315	271	526	466	472	
Uranium (U)				mg/kg	3.05	0.408	0.683	0.756	0.777	1.18	1.01	0.777	
Vanadium (V)	130	130		mg/kg	18.9	16.2	19.2	13.4	15.1	36.9	33.2	33.9	
Zinc (Zn)	200	360		mg/kg	178	20.7	16.4	11.6	11	71.2	76.9	74.9	
Zirconium (Zr)				mg/kg	2.4	1.1	1.1	1.4	1.4	3.7	4.4	4.1	

Lupin Mine Site

Table 2: 2015 Windblown Tails Data Quality Control

Client Sample ID	MRL	PQL	Units	LUP15016 15-Aug-2015 L1661981-3	LUP15056 15-Aug-2015 L1661981-21	LUP15016 & LUP15056 - Duplicate Comparison	LUP15047 15-Aug-2015 L1661981-11	LUP15055 15-Aug-2015 L1661981-20	LUP15047 & LUP15055 - Duplicate Comparison	LUP15005 15-Aug-2015 L1697540-1	LUP15066 15-Aug-2015 L1697540-11	LUP15005 & LUP15066 - Duplicate Comparison	LUP15032 15-Aug-2015 L1697540-8	LUP15067 15-Aug-2015 L1697540-12	LUP15032 & LUP15067 - Duplicate Comparison	LUP15012 15-Aug-2015 L1700420-6	LUP15068 15-Aug-2015 L1700420-13	LUP15012 & LUP15068 - Duplicate Comparison
Parameter				Soil	Soil	RPD	Soil	Soil	RPD	Soil	Soil	RPD	Soil	Soil	RPD	Soil	Soil	RPD
Aluminum (Al)	50	250.0	mg/kg	4970	4920	1%	5900	6100	-3%									na
Antimony (Sb)	0.1	0.5	mg/kg	<0.10	<0.10	na	<0.10	<0.10	na	<0.10	<0.10	na	<0.10	<0.10	na	<0.10	<0.10	na
Arsenic (As)	0.1	0.5	mg/kg	109	114	-4%	62	66	-5%	191	141	30%	219	223	-2%	218	266	-20%
Barium (Ba)	0.5	2.5	mg/kg	31.7	27.7	13%	34.6	37.6	-8%	32.8	28.7	13%	31.0	30.3	2%	38.5	33.5	14%
Beryllium (Be)	0.1	0.5	mg/kg	<0.10	0.10	na	0.12	0.13	na	0.11	0.10	na	0.10	0.11	na	<0.10	<0.10	na
Bismuth (Bi)	0.2	1.0	mg/kg	0.32	<0.20	na	<0.20	<0.20	na									
Boron (B)	5	25.0	mg/kg	<5.0	<5.0	na	<5.0	<5.0	na									
Cadmium (Cd)	0.02	0.1	mg/kg	<0.020	<0.020	na	0.033	0.036	na	<0.020	<0.020	na	<0.020	<0.020	na	<0.020	<0.020	na
Calcium (Ca)	50	250.0	mg/kg	676	841	-22%	1580	1680	-6%									
Chromium (Cr)	0.5	2.5	mg/kg	24.6	17.9	32%	24.6	25.4	-3%	18.6	16.9	10%	20.0	20.4	-2%	21.5	18.4	16%
Cobalt (Co)	0.1	0.5	mg/kg	2.88	2.88	0%	5.53	6.44	-15%	2.92	2.86	2%	3.19	3.24	-2%	3.10	2.95	5%
Copper (Cu)	0.5	2.5	mg/kg	14.6	10.9	29%	14.4	15.5	-7%	10.0	10.3	-3%	8.69	9.27	-6%	6.76	8.24	-20%
Iron (Fe)	50	250.0	mg/kg	9930	9540	4%	10900	10800	1%									
Lead (Pb)	0.5	2.5	mg/kg	2.42	2.85	na	2.19	2	na	6.35	4.88	26%	4.19	4.77	-13%	3.29	3.49	-6%
Lithium (Li)	2	10.0	mg/kg	15.3	14.9	3%	17.9	19.4	-8%									
Magnesium (Mg)	20	100.0	mg/kg	3430	3150	9%	3780	3940	-4%									
Manganese (Mn)	1	5.0	mg/kg	69.6	69.4	0%	92.5	96.5	-4%									
Mercury (Hg)	0.01	0.0	mg/kg							<0.0050	<0.0050	na	0.0053	0.0051	na	<0.0050	0.0058	na
Molybdenum (Mo)	0.1	0.5	mg/kg	0.24	0.28	na	0.32	0.28	na	0.27	0.22	na	0.22	0.28	na	0.44	0.21	na
Nickel (Ni)	0.5	2.5	mg/kg	11.5	9.0	24%	17.5	21.0	-18%	9.65	8.82	9%	11.0	11.1	-1%	10.5	8.57	20%
Phosphorus (P)	50	250.0	mg/kg	215	225	na	318	279	13%									
Potassium (K)	100	500.0	mg/kg	1610	1460	10%	2020	2180	-8%									
Selenium (Se)	0.2	1.0	mg/kg	<0.20	<0.20	na	<0.20	<0.20	na	<0.20	<0.20	na	<0.20	<0.20	na	<0.20	<0.20	na
Silver (Ag)	0.1	0.5	mg/kg	<0.10	<0.10	na	<0.10	<0.10	na	<0.10	<0.10	na	<0.10	<0.10	na	<0.10	<0.10	na
Sodium (Na)	50	250.0	mg/kg	84.0	86.0	na	86.0	99.0	na									
Strontium (Sr)	0.5	2.5	mg/kg	7.56	7.99	-6%	5.58	6.32	-12%									
Thallium (Tl)	0.05	0.3	mg/kg	0.081	0.082	na	0.099	0.102	na	0.070	0.066	na	0.073	0.060	na	0.069	0.068	na
Tin (Sn)	2	10.0	mg/kg	<2.0	<2.0	na	<2.0	<2.0	na	<2.0	<2.0	na	<2.0	<2.0	na	<2.0	<2.0	na
Titanium (Ti)	1	5.0	mg/kg	253	274	-8%	314	362	-14%									
Uranium (U)	0.05	0.3	mg/kg	0.335	0.404	-19%	0.675	0.615	9%	0.415	0.364	13%	0.437	0.382	13%	0.350	0.343	2%
Vanadium (V)	0.2	1.0	mg/kg	14.2	14.6	-3%	18.9	19.4	-3%	14.7	13.1	12%	16.0	15.7	2%	17.5	15.8	10%
Zinc (Zn)	2	10.0	mg/kg	17.5	14.2	21%	19.7	21.1	-7%	14.3	13.7	4%	15.5	16.0	-3%	15.9	14.1	12%
Zirconium (Zr)	1	5.0	mg/kg	1.4	1.6	na	2.0	2.2	na									

Bold RPD value is greater than or equal to +/- 25% and the concentrations of both samples are greater than the PQL.

Notes:

na RPD value is not applicable because one or both results are less than the PQL.

RPD Relative Percent Difference = (Difference/Average)*100.

PQL Practical Quantitation Limit = 5 * Method Reporting Limit (MRL)

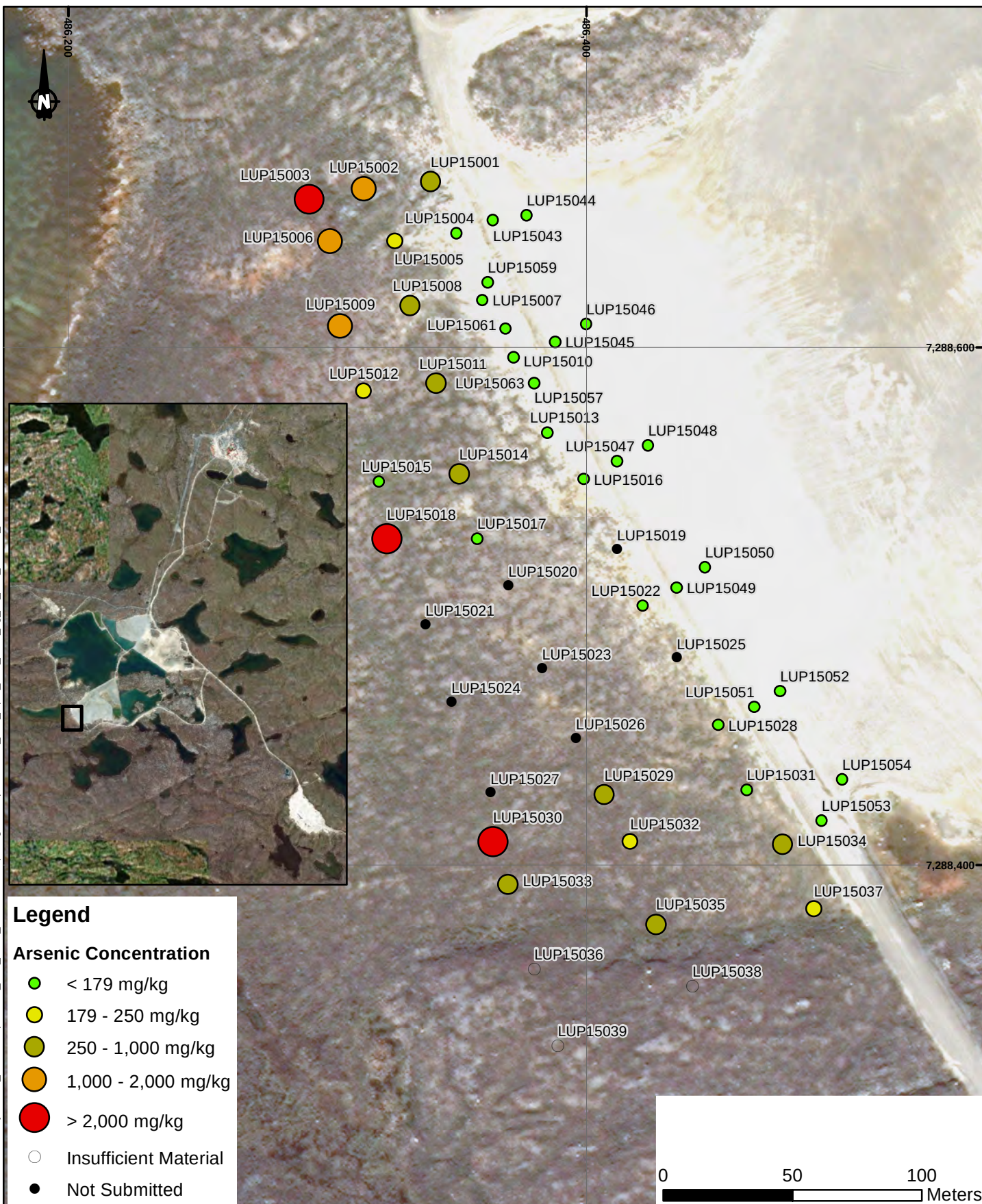
MRL Method Reporting Limit

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NOTES: Image produced by Photosat Information Ltd. 2012 Image data: Aug. 21, 2012 Coordinate System: NAD 1983 UTM Zone 12N 00.51 Kilometers	srk consulting Job No: 1CL008.003 Filename: 1CL008_003_lupin_tails_delin_fig_01_tailings_area	LUPIN MINES INC.	WIND BLOW TAILINGS DELINEATION		
			TAILINGS CONTAINMENT AREA		
			Date: DEC 2015	Approved:	Figure: 1

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Legend

Arsenic Concentration

- < 179 mg/kg
- 179 - 250 mg/kg
- 250 - 1,000 mg/kg
- 1,000 - 2,000 mg/kg
- > 2,000 mg/kg
- Insufficient Material
- Not Submitted



LUPIN MINES INC.

WIND BLOW TAILINGS DELINEATION

**SURFICIAL ARSENIC
CONCENTRATIONS**

Job No: 1CL008.003

Filename: 1CL008_003_lupin_tails_delin_fig_02_surf_arsenic_conc

Date:

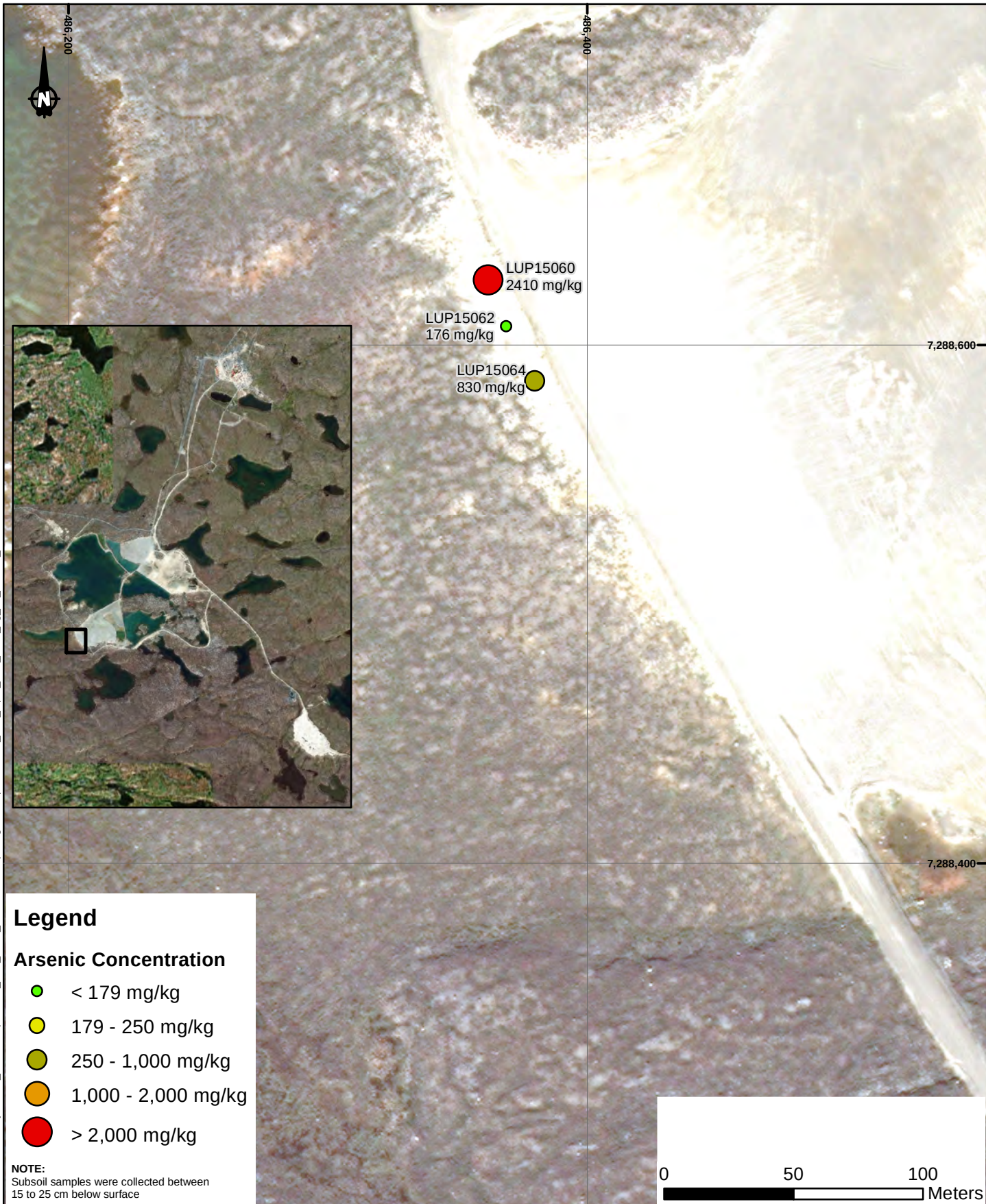
DEC 2015

Approved:

Figure:

2

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 Job No: 1CL008.003 Filename: 1CL008_003_lupin_tails_delin_fig_03_subsoil_arsenic	LUPIN MINES INC.	WIND BLOW TAILINGS DELINEATION		
		SUBSOIL ARSENIC CONCENTRATIONS		
		Date: DEC 2015	Approved:	Figure: 3