



November 1, 2018

Sahtu Land and Board File Numbers: S17L8-003 & S17X-004

Ms. Bonnie Bergsma  
Sahtu Land and Water Board  
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XOE OH0  
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CC:

Michael Brownlee –Public Services and Procurement and Canada  
Melissa Fraser – Transport Canada  
Trevor Bremner – Department of Lands, GNWT;  
Erin Goose – Department of Environment and Natural Resources, GNWT

**Memorandum RE: Sub-Liner Soil Quality Assessment  
Norman Wells Airside Land Treatment Unit  
Norman Wells, Northwest Territories XOE OVO**

Dear Ms. Bergsma:

The following memo documents the soil sampling results of the sub-liner soil quality assessment completed at the Norman Wells Airside Land Treatment Unit (LTU), located on the Norman Wells Airport lands as part of Transport Canada's (TC) Sahtu Land and Water Board Type B Water Licence S17L8-003 and Type A Land Use Permit S17X-004. This memo has been prepared by BluMetric Environmental Inc. (BluMetric) on behalf of TC.

## **LTU SUB-LINER SOIL QUALITY ASSESSMENT**

BluMetric has supported the maintenance, sampling and assessment work that occurred at the Norman Wells LTU facility in 2017/2018 and has provided supervision for local contractor HRN Contracting. Throughout the months of September and October, soil within the bermed area of the LTU has been sampled and characterized based on the Treated Soil Criteria specified within Water Licence S17L8-003. Analytical results have been presented to the Sahtu Land and Water Board (SLWB) as well as the Territorial Land and Water Inspectors to request approval for movement of soil meeting the applicable criteria outside of the LTU bermed area in order to

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facilitate the bagging of impacted cover soil and the assessment of the sub-liner soil quality in preparation for the decommissioning of the facility. The cover soil assessment was completed in October 2018 thereby facilitating the assessment of the sub-liner soil quality.

A final version of the Closure and Reclamation Plan for the Norman Wells LTU was submitted to the SLWB on September 26, 2018. The Closure and Reclamation Plan detailed the Sub-Liner Soil Quality Assessment work plan. The methodology for the assessment is described in the following paragraphs.

Following the assessment of the cover soils, the liner has been removed to allow for the investigation of the underlying soils. The LTU footprint is approximately 100 m x 50 m. Samples were collected from within the overall facility footprint, to a depth of approximately 1.5 m below ground surface, representing an approximate volume of 7,500 m<sup>3</sup> total of sub-liner soils investigated. The LTU footprint was divided into a grid of eight cells, approximately, 25 m x 25 m as shown in Figure 1 (attached). From each cell, samples were collected from three depth profiles; 0 – 0.5 m, 0.5 – 1.0 m, and 1.0 – 1.5 m. Sample locations were selected based on visual observations and were identified as the areas that were most susceptible to having impacts due to their proximity to damaged areas of the liner and/or locations within localized depressions in the liner. Groundwater was encountered within the bottom of most test pits and in some cases prevented soil samples from being collected. An additional test pit was excavated immediately south of the Sump Area to assess any potential impacts to soil immediately downgradient of the sump. A test pit was unable to be installed immediately beneath the liner of the sump due to shallow groundwater infiltration within the sump.

Samples were collected by BluMetric field personnel from test pits that were installed using an excavator. Samples were collected for analysis of BTEX, PHCs F1-F4, metals, and PAHs,. Soil samples were submitted to ALS Laboratories in Edmonton, AB for rush analyses.

BluMetric has conducted soil sampling to meet or exceed the minimum sampling requirements for LTU closure outlined by the SLWB Water Licence (S17L8-003). A summary of soil samples collected and analyzed is presented in Attachment A.

The analytical results for the sub-liner were reviewed and are presented in Tables A-1 through A-3 in Attachment A. No exceedances of the SLWB Water Licence Treated Soil criteria were noted in the sub-liner soils.

## RECOMMENDATIONS

The sub-liner soil quality assessment demonstrates that soil quality beneath the liner has not been impacted by the historical operations of the LTU. The liner has been lifted throughout the LTU and all impacted soil has been bagged and staged for disposal outside of the bermed area.

BluMetric is requesting permission on behalf of TC to move the previously approved treated soils from the LTU back into the bermed area for placement on the sub-liner soils. These soils will remain within the bermed area until the facility enters the final decommissioning that is currently planned for Summer 2019.

Your timely response to this request is appreciated in order to ensure continuity on the work site as we would like to move these soils prior to them freezing.

## CLOSURE

The information presented within this memo has been prepared for the Sahtu Land and Water Board, Public Services and Procurement Canada and Transport Canada. Any use a third party makes of this report, any reliance on the report, or decisions based upon the report, are the responsibility of those third parties unless authorization is received from BluMetric Environmental Inc. in writing. BluMetric Environmental Inc. accepts no responsibility for any loss or damages suffered by any unauthorized third party as a result of decisions made or actions taken based on this report.

If you have any questions please do not hesitate to contact the undersigned.

Respectfully submitted,

**BluMetric Environmental Inc.**



Sabrina Penfold, B.Sc. GIT.  
Environmental Scientist



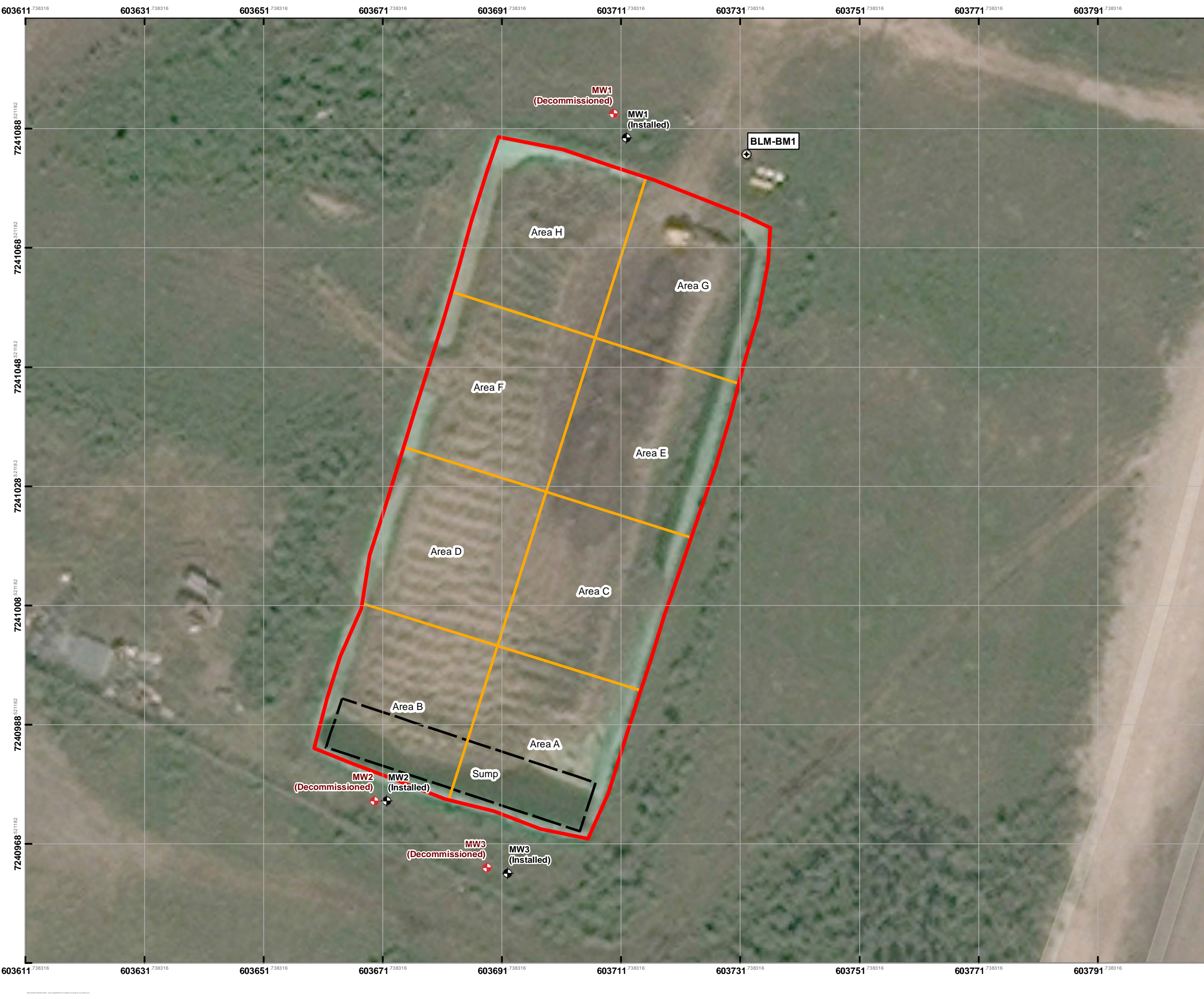
Andrea Jenney, P.Eng.  
Senior Engineer

### List of Attachments

*Attachment A: Figure 1 - Sub-Liner Soil Quality Assessment – Site Plan*

*Attachment B: Sub-Liner Soil Chemistry Tables*

**Attachment A:**  
**Figure 1 - Sub-Liner Soil Quality Assessment – Site Plan**



**LEGEND**

- Benchmarks
- New Monitoring Well Location
- Decommissioned Monitoring Well Location
- Land Treatment Unit Outline
- Areas
- Sump



1				
REV.	DESCRIPTION	YY/MM/DD	BY	CHK

**REFERENCES**  
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**CLIENT**  
 Public Services and Procurement Canada

**PROJECT**  
 Norman Wells Airport  
 Airside Land Treatment Unit  
 Closure & Reclamation Plan

**TITLE**  
**Sub-Liner Soil Quality  
 Assessment - Site Plan**

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<b>PROJECT #</b> 180501		<b>DATE</b> October 30, 2018	
<b>DRAWN</b> KH	<b>CHECKED</b> KM	<b>FIGURE</b> 01	<b>REV</b> 0

**Attachment B:**  
**Norman Wells Airside LTU – Stockpile Soil Chemistry Results**

**Table A-1 - Sub-Liner Soil Sample Analytical Results - Metals**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-A-1	SL-A-2	SL-A-3	SL-B-1	SL-B-2	SL-C-1
Date Sampled				27-Sep-2018	27-Sep-2018	27-Sep-2018	27-Sep-2018	27-Sep-2018	19-Oct-2018
ALS Sample ID				L2172749-25	L2172749-26	L2172749-27	L2172749-28	L2172749-29	L2184553-1
Sample Depth (meters below surface)				0 - 0.5	0.5 - 1.0	1.0 - 1.5	0 - 0.5	0.5 - 1.0	0 - 0.5
<b>Moisture</b>									
Moisture	0.25	%	NV	13.5	15.5	15	14.6	17.9	16.3
<b>Metals</b>									
Antimony (Sb)	0.10	mg/kg	40	0.67	0.58	0.56	0.48	0.56	0.55
Arsenic (As)	0.10	mg/kg	120	8.75	8.75	8.44	8.9	8.26	11.4
Barium (Ba)	0.50	mg/kg	2000	286	392	417	249	379	381
Beryllium (Be)	0.10	mg/kg	8	0.5	0.49	0.47	0.43	0.49	0.58
Cadmium (Cd)	0.020	mg/kg	22	0.314	0.513	0.495	0.31	0.461	0.231
Chromium (Cr)	0.50	mg/kg	87	16.8	17	16.3	15.2	16.3	27.9
Cobalt (Co)	0.10	mg/kg	300	7.77	8	7.8	6.86	7.93	10.9
Copper (Cu)	0.50	mg/kg	91	17.3	19.9	19	15.1	19.3	24.7
Lead (Pb)	0.50	mg/kg	260	8.6	9.01	8.62	7.7	8.72	11.2
Mercury (Hg)	0.0050	mg/kg	24	0.0439	0.0439	0.0405	0.0387	0.0468	0.0486
Molybdenum (Mo)	0.10	mg/kg	40	1.93	1.86	1.87	2.72	1.75	1.45
Nickel (Ni)	0.50	mg/kg	89	24.5	24.9	24.5	22.4	24.6	35.2
Selenium (Se)	0.20	mg/kg	3.9	0.34	0.39	0.41	0.4	0.47	<0.20
Silver (Ag)	0.10	mg/kg	40	0.11	0.13	0.12	<0.10	0.12	0.15
Thallium (Tl)	0.050	mg/kg	1	0.249	0.174	0.172	0.26	0.165	0.166
Tin (Sn)	2.0	mg/kg	100	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	0.05	mg/kg	300	1.13	0.982	1.08	0.967	0.963	1.06
Vanadium (V)	0.20	mg/kg	130	35.7	32.8	32	35	32	47.3
Zinc (Zn)	2.0	mg/kg	360	71.1	85.2	83.3	64.9	82.7	89.9

**14** Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

**Table A-1 - Sub-Liner Soil Sample Analytical Results - Metals**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-C-2	SL-C-3	SL-D-1	SL-D-2	SL-D-3	SL-E-1
Date Sampled				19-Oct-2018	19-Oct-2018	19-Oct-2018	19-Oct-2018	19-Oct-2018	21-Oct-2018
ALS Sample ID				L2184553-2	L2184553-3	L2184553-4	L2184553-5	L2184553-6	L2185520-1
Sample Depth (meters below surface)				0.5 - 1.0	1.0 - 1.5	0 - 0.5	0.5 - 1.0	1.0 - 1.5	0 - 0.5
<b>Moisture</b>									
Moisture	0.25	%	NV	16.6	19	12.1	14.7	21.1	16.6
<b>Metals</b>									
Antimony (Sb)	0.10	mg/kg	40	0.56	0.62	0.62	0.66	0.67	0.58
Arsenic (As)	0.10	mg/kg	120	8.25	10.9	11.1	10.1	8.04	9.83
Barium (Ba)	0.50	mg/kg	2000	376	458	224	436	371	349
Beryllium (Be)	0.10	mg/kg	8	0.36	0.49	0.43	0.52	0.46	0.5
Cadmium (Cd)	0.020	mg/kg	22	0.411	0.555	0.3	0.596	0.503	0.489
Chromium (Cr)	0.50	mg/kg	87	14.9	21	47.4	22.7	13.6	24.5
Cobalt (Co)	0.10	mg/kg	300	8.4	10.3	7	9.8	7.22	8.92
Copper (Cu)	0.50	mg/kg	91	17.8	25	16.5	22.4	17.1	20.1
Lead (Pb)	0.50	mg/kg	260	7.85	11	8.65	11.3	10.6	9.74
Mercury (Hg)	0.0050	mg/kg	24	0.0083	0.0054	<0.0050	<0.0050	0.0372	0.0496
Molybdenum (Mo)	0.10	mg/kg	40	1.82	2.04	3.52	2.25	2.3	2.83
Nickel (Ni)	0.50	mg/kg	89	24	31.1	35.1	30.1	22	30.1
Selenium (Se)	0.20	mg/kg	3.9	0.43	0.58	0.44	0.56	0.46	0.44
Silver (Ag)	0.10	mg/kg	40	0.1	0.16	0.12	0.15	0.12	0.14
Thallium (Tl)	0.050	mg/kg	1	0.141	0.194	0.292	0.217	0.199	0.225
Tin (Sn)	2.0	mg/kg	100	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	0.05	mg/kg	300	0.921	1.09	1.04	1.28	1.37	1.17
Vanadium (V)	0.20	mg/kg	130	27.7	35	33.9	34.4	25.1	33
Zinc (Zn)	2.0	mg/kg	360	75.9	103	60.7	96.8	72.1	88.9

**14** Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit



**Table A-1 - Sub-Liner Soil Sample Analytical Results - Metals**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-E-2	SL-E-3	SL-F-1	SL-F-2	SL-G-1	SL-G-2
Date Sampled				21-Oct-2018	21-Oct-2018	21-Oct-2018	21-Oct-2018	23-Oct-2018	23-Oct-2018
ALS Sample ID				L2185520-2	L2185520-3	L2185520-4	L2185520-5	L2186962-1	L2186962-2
Sample Depth (meters below surface)				0.5 - 1.0	1.0 - 1.5	0 - 0.5	0.5 - 1.0	0 - 0.5	0.5 - 1.0
<b>Moisture</b>									
Moisture	0.25	%	NV	12.2	14.3	16.2	8.07	10.1	10.8
<b>Metals</b>									
Antimony (Sb)	0.10	mg/kg	40	0.38	0.28	0.6	0.41	0.64	0.59
Arsenic (As)	0.10	mg/kg	120	7.13	5.05	9.01	9	11.2	10.8
Barium (Ba)	0.50	mg/kg	2000	101	120	391	224	288	259
Beryllium (Be)	0.10	mg/kg	8	0.28	0.28	0.58	0.35	0.41	0.3
Cadmium (Cd)	0.020	mg/kg	22	0.275	0.184	0.427	0.271	0.286	0.328
Chromium (Cr)	0.50	mg/kg	87	14.5	28	26.8	80.9	22.2	21.1
Cobalt (Co)	0.10	mg/kg	300	3.93	3.92	9.3	5.28	8.59	7.07
Copper (Cu)	0.50	mg/kg	91	11.9	10	22.8	15	20.1	19.9
Lead (Pb)	0.50	mg/kg	260	4.7	4.6	10.4	6.3	8.53	8.99
Mercury (Hg)	0.0050	mg/kg	24	0.0327	0.0252	0.0389	0.0371	0.0726	0.0487
Molybdenum (Mo)	0.10	mg/kg	40	2.6	2.19	2.2	3.95	3.37	3.18
Nickel (Ni)	0.50	mg/kg	89	18.7	18.3	31.3	40.4	30	26.7
Selenium (Se)	0.20	mg/kg	3.9	0.31	0.26	0.43	0.46	0.64	0.86
Silver (Ag)	0.10	mg/kg	40	<0.10	<0.10	0.13	0.11	<0.10	0.1
Thallium (Tl)	0.050	mg/kg	1	0.253	0.122	0.198	0.202	0.356	0.39
Tin (Sn)	2.0	mg/kg	100	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	0.05	mg/kg	300	0.97	0.9	1.09	0.942	1.16	1.16
Vanadium (V)	0.20	mg/kg	130	23.3	25.9	36.1	31.8	29.3	22
Zinc (Zn)	2.0	mg/kg	360	42	31.2	90.2	50.1	87.2	85.3

**14** Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

**Table A-1 - Sub-Liner Soil Sample Analytical Results - Metals**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-G-3	SL-H-1	SL-H-2	SL-H-3	SL-SUMP1-B	SL-SUMP1-C
Date Sampled				23-Oct-2018	23-Oct-2018	23-Oct-2018	23-Oct-2018	12-Oct-2018	12-Oct-2018
ALS Sample ID				L2186962-3	L2186962-4	L2186962-5	L2186962-6	L2180746-1	L2180746-2
Sample Depth (meters below surface)				1.0 - 1.5	0 - 0.5	0.5 - 1.0	1.0 - 1.5	0.6 - 1.0	1.0 - 1.5
<b>Moisture</b>									
Moisture	0.25	%	NV	10.1	8.25	11.4	20.2	17.1	12.1
<b>Metals</b>									
Antimony (Sb)	0.10	mg/kg	40	0.63	0.6	0.42	0.23	0.17	0.43
Arsenic (As)	0.10	mg/kg	120	12.2	11.3	7.6	8.95	6.94	11.8
Barium (Ba)	0.50	mg/kg	2000	265	211	87.8	163	95.9	228
Beryllium (Be)	0.10	mg/kg	8	0.45	0.3	0.26	0.66	0.32	0.36
Cadmium (Cd)	0.020	mg/kg	22	0.341	0.309	0.203	0.041	0.338	0.34
Chromium (Cr)	0.50	mg/kg	87	19.7	22	9.44	35.1	10.3	20.2
Cobalt (Co)	0.10	mg/kg	300	9.49	6.56	3.42	16.8	5.49	8.08
Copper (Cu)	0.50	mg/kg	91	23.6	17.8	12.7	20.8	12.5	19.1
Lead (Pb)	0.50	mg/kg	260	9.59	9.44	4.44	11.3	5.46	9.02
Mercury (Hg)	0.0050	mg/kg	24	0.0482	0.0384	0.0357	0.0591	0.0287	0.0573
Molybdenum (Mo)	0.10	mg/kg	40	4.48	4.68	3.01	0.17	1.73	3.56
Nickel (Ni)	0.50	mg/kg	89	32.5	27.7	15.8	49.4	20.2	29.6
Selenium (Se)	0.20	mg/kg	3.9	1.14	0.49	0.33	<0.20	0.25	0.41
Silver (Ag)	0.10	mg/kg	40	<0.10	0.11	<0.10	<0.10	<0.10	<0.10
Thallium (Tl)	0.050	mg/kg	1	0.484	0.449	0.231	0.079	0.266	0.513
Tin (Sn)	2.0	mg/kg	100	<2.0	<2.0	<2.0	<2.0	<2.0	<2.0
Uranium (U)	0.05	mg/kg	300	1.4	1.06	1.09	0.799	0.943	1.16
Vanadium (V)	0.20	mg/kg	130	30.2	25.4	21.5	45.9	26.4	26.1
Zinc (Zn)	2.0	mg/kg	360	96.9	67.6	40.4	118	46.9	79.2

**14** Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

Table A-2 - Sub-Liner Soil Sample Analytical Results - Volatile Organic Compounds

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-A-1	SL-A-2	SL-A-3	SL-B-1	SL-B-2
Date Sampled				27-Sep-2018	27-Sep-2018	27-Sep-2018	27-Sep-2018	27-Sep-2018
ALS Sample ID				L2172749-25	L2172749-26	L2172749-27	L2172749-28	L2172749-29
<b>Volatile Organic Compounds</b>								
Benzene	0.0050	mg/kg	5	<0.0050	<0.0050	<0.0050	0.0177	<0.0050
Ethylbenzene	0.010	mg/kg	20	<0.010	<0.010	<0.010	<0.010	<0.010
Toluene	0.050	mg/kg	0.8	<0.050	<0.050	<0.050	<0.050	<0.050
ortho-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes (Total)	0.10	mg/kg	20	<0.10	<0.10	<0.10	<0.10	<0.10
F1 (C6-C10)	100	mg/kg	660	<10	<10	<10	<10	<10
F1-BTEX	10	mg/kg	NV	<10	<10	<10	<10	<10
<b>Hydrocarbons</b>								
F2 (C10-C16 Hydrocarbons)	10	mg/kg	1500	<20	<20	<20	<20	<20
F2-Naphth	20	mg/kg	NV	<20	<20	<20	<20	<20
F3 (C16-C34 Hydrocarbons)	50	mg/kg	2500	<20	<20	<20	28	<20
F3-PAH	20	mg/kg	NV	<20	<20	<20	28	<20
F4 (C34-C50 Hydrocarbons)	50	mg/kg	6600	<20	<20	<20	<20	<20
<b>Heavy Hydrocarbons</b>								
F4G-SG (Heavy Hydrocarbons-Grav.)	500	mg/kg	6600	<500	<500	<500	<500	<500

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

**Table A-2 - Sub-Liner Soil Sample Analytical Results - Volatile Organic Compounds**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-C-1	SL-C-2	SL-C-3	SL-D-1	SL-D-2
Date Sampled				19-Oct-2018	19-Oct-2018	19-Oct-2018	19-Oct-2018	19-Oct-2018
ALS Sample ID				L2184553-1	L2184553-2	L2184553-3	L2184553-4	L2184553-5
<b>Volatile Organic Compounds</b>								
Benzene	0.0050	mg/kg	5	<0.0050	<0.0050	<0.0050	0.274	<0.0050
Ethylbenzene	0.010	mg/kg	20	<0.010	<0.010	<0.010	<0.010	<0.010
Toluene	0.050	mg/kg	0.8	<0.050	<0.050	<0.050	<0.050	<0.050
ortho-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes (Total)	0.10	mg/kg	20	<0.10	<0.10	<0.10	<0.10	<0.10
F1 (C6-C10)	100	mg/kg	660	<10	<10	<10	59	<10
F1-BTEX	10	mg/kg	NV	<10	<10	<10	59	<10
<b>Hydrocarbons</b>								
F2 (C10-C16 Hydrocarbons)	10	mg/kg	1500	<20	<20	<20	<20	<20
F2-Naphth	20	mg/kg	NV	<20	<20	<20	<20	<20
F3 (C16-C34 Hydrocarbons)	50	mg/kg	2500	<20	<20	<20	40	<20
F3-PAH	20	mg/kg	NV	<20	<20	<20	40	<20
F4 (C34-C50 Hydrocarbons)	50	mg/kg	6600	<20	<20	<20	<20	<20
<b>Heavy Hydrocarbons</b>								
F4G-SG (Heavy Hydrocarbons-Grav.)	500	mg/kg	6600	<500	<500	<500	<500	<500

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

Table A-2 - Sub-Liner Soil Sample Analytical Results - Volatile Organic Compounds

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-D-3	SL-E-1	SL-E-2	SL-E-3	SL-F-1
Date Sampled				19-Oct-2018	21-Oct-2018	21-Oct-2018	21-Oct-2018	21-Oct-2018
ALS Sample ID				L2184553-6	L2185520-1	L2185520-2	L2185520-3	L2185520-4
<b>Volatile Organic Compounds</b>								
Benzene	0.0050	mg/kg	5	<0.0050	0.084	<0.0050	0.0308	0.0097
Ethylbenzene	0.010	mg/kg	20	<0.010	<0.010	<0.010	0.032	<0.010
Toluene	0.050	mg/kg	0.8	<0.050	<0.050	<0.050	<0.050	<0.050
ortho-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes (Total)	0.10	mg/kg	20	<0.10	<0.10	<0.10	<0.10	<0.10
F1 (C6-C10)	100	mg/kg	660	<10	<10	<10	<10	<10
F1-BTEX	10	mg/kg	NV	<10	<10	<10	<10	<10
<b>Hydrocarbons</b>								
F2 (C10-C16 Hydrocarbons)	10	mg/kg	1500	<20	<20	<20	<20	<20
F2-Naphth	20	mg/kg	NV	<20	<20	<20	<20	<20
F3 (C16-C34 Hydrocarbons)	50	mg/kg	2500	<20	<20	<20	<20	<20
F3-PAH	20	mg/kg	NV	<20	<20	<20	<20	<20
F4 (C34-C50 Hydrocarbons)	50	mg/kg	6600	<20	<20	<20	<20	<20
<b>Heavy Hydrocarbons</b>								
F4G-SG (Heavy Hydrocarbons-Grav.)	500	mg/kg	6600	<500	<500	<500	<500	<500

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

Table A-2 - Sub-Liner Soil Sample Analytical Results - Volatile Organic Compounds

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-F-2	SL-G-1	SL-G-2	SL-G-3	SL-H-1
Date Sampled				21-Oct-2018	23-Oct-2018	23-Oct-2018	23-Oct-2018	23-Oct-2018
ALS Sample ID				L2185520-5	L2186962-1	L2186962-2	L2186962-3	L2186962-4
<b>Volatile Organic Compounds</b>								
Benzene	0.0050	mg/kg	5	<0.0050	0.0074	<0.0050	<0.0050	<0.0050
Ethylbenzene	0.010	mg/kg	20	<0.010	<0.010	<0.010	<0.010	<0.010
Toluene	0.050	mg/kg	0.8	<0.050	<0.050	<0.050	<0.050	<0.050
ortho-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050	<0.050
Xylenes (Total)	0.10	mg/kg	20	<0.10	<0.10	<0.10	<0.10	<0.10
F1 (C6-C10)	100	mg/kg	660	<10	<10	<10	<10	<10
F1-BTEX	10	mg/kg	NV	<10	<10	<10	<10	<10
<b>Hydrocarbons</b>								
F2 (C10-C16 Hydrocarbons)	10	mg/kg	1500	<20	<20	<20	24	<20
F2-Naphth	20	mg/kg	NV	<20	<20	<20	24	<20
F3 (C16-C34 Hydrocarbons)	50	mg/kg	2500	<20	44	41	100	32
F3-PAH	20	mg/kg	NV	<20	44	41	100	32
F4 (C34-C50 Hydrocarbons)	50	mg/kg	6600	<20	<20	<20	38	<20
<b>Heavy Hydrocarbons</b>								
F4G-SG (Heavy Hydrocarbons-Grav.)	500	mg/kg	6600	<500	<500	<500	<500	<500

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

Table A-2 - Sub-Liner Soil Sample Analytical Results - Volatile Organic Compounds

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-H-2	SL-H-3	SL-SUMP1-B	SL-SUMP1-C
Date Sampled				23-Oct-2018	23-Oct-2018	12-Oct-2018	12-Oct-2018
ALS Sample ID				L2186962-5	L2186962-6	L2180746-1	L2180746-2
<b>Volatile Organic Compounds</b>							
Benzene	0.0050	mg/kg	5	<0.0050	<0.0050	<0.0050	<0.0050
Ethylbenzene	0.010	mg/kg	20	<0.010	<0.010	<0.010	<0.010
Toluene	0.050	mg/kg	0.8	<0.050	<0.050	<0.050	<0.050
ortho-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050
meta- & para-Xylene	0.050	mg/kg	NV	<0.050	<0.050	<0.050	<0.050
Xylenes (Total)	0.10	mg/kg	20	<0.10	<0.10	<0.10	<0.10
F1 (C6-C10)	100	mg/kg	660	<10	<10	<10	<10
F1-BTEX	10	mg/kg	NV	<10	<10	<10	<10
<b>Hydrocarbons</b>							
F2 (C10-C16 Hydrocarbons)	10	mg/kg	1500	<20	<20	<20	<20
F2-Naphth	20	mg/kg	NV	<20	<20	<20	<20
F3 (C16-C34 Hydrocarbons)	50	mg/kg	2500	26	29	<20	<20
F3-PAH	20	mg/kg	NV	26	29	<20	<20
F4 (C34-C50 Hydrocarbons)	50	mg/kg	6600	<20	<20	<20	<20
<b>Heavy Hydrocarbons</b>							
F4G-SG (Heavy Hydrocarbons-Grav.)	500	mg/kg	6600	<500	<500	NV	NV

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

**Table A-3 - Sub-Liner Soil Sample Analytical Results - Polycyclic Aromatic Hydrocarbons**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-A-1	SL-A-2	SL-A-3	SL-B-1	SL-B-2	SL-C-1
Date Sampled				27-Sep-2018	27-Sep-2018	27-Sep-2018	27-Sep-2018	27-Sep-2018	19-Oct-2018
ALS Sample ID				L2172749-25	L2172749-26	L2172749-27	L2172749-28	L2172749-29	L2184553-1
Acenaphthene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	0.0040	mg/kg	NV	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.0100	mg/kg	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	0.0050	mg/kg	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.0100	mg/kg	22	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.0400	mg/kg	50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	0.0100	mg/kg	100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
B(a)P Total Potency Equivalent	0.0200	mg/kg	NV	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020

**14** Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit



**Table A-3 - Sub-Liner Soil Sample Analytical Results - Polycyclic Aromatic Hydrocarbons**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-C-2	SL-C-3	SL-D-1	SL-D-2	SL-D-3	SL-E-1
Date Sampled				19-Oct-2018	19-Oct-2018	19-Oct-2018	19-Oct-2018	19-Oct-2018	21-Oct-2018
ALS Sample ID				L2184553-2	L2184553-3	L2184553-4	L2184553-5	L2184553-6	L2185520-1
Acenaphthene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	0.0040	mg/kg	NV	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.0100	mg/kg	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	0.011
Benzo(k)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Dibenz(a,h)anthracene	0.0050	mg/kg	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.0100	mg/kg	22	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.0400	mg/kg	50	<0.010	<0.010	<0.010	<0.010	<0.010	0.012
Pyrene	0.0100	mg/kg	100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
B(a)P Total Potency Equivalent	0.0200	mg/kg	NV	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

**Table A-3 - Sub-Liner Soil Sample Analytical Results - Polycyclic Aromatic Hydrocarbons**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-E-2	SL-E-3	SL-F-1	SL-F-2	SL-G-1	SL-G-2
Date Sampled				21-Oct-2018	21-Oct-2018	21-Oct-2018	21-Oct-2018	23-Oct-2018	23-Oct-2018
ALS Sample ID				L2185520-2	L2185520-3	L2185520-4	L2185520-5	L2186962-1	L2186962-2
Acenaphthene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	0.0040	mg/kg	NV	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.0100	mg/kg	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	0.01	<0.010
Benzo(g,h,i)perylene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	0.013	0.011
Dibenz(a,h)anthracene	0.0050	mg/kg	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.0100	mg/kg	22	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.0400	mg/kg	50	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Pyrene	0.0100	mg/kg	100	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
B(a)P Total Potency Equivalent	0.0200	mg/kg	NV	<0.020	<0.020	<0.020	<0.020	<0.020	<0.020

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit

**Table A-3 - Sub-Liner Soil Sample Analytical Results - Polycyclic Aromatic Hydrocarbons**

Sample ID	ALS MDL	Units	Water Licence Criteria <sup>1</sup>	SL-G-3	SL-H-1	SL-H-2	SL-H-3	SL-SUMP1-B	SL-SUMP1-C
Date Sampled				23-Oct-2018	23-Oct-2018	23-Oct-2018	23-Oct-2018	12-Oct-2018	12-Oct-2018
ALS Sample ID				L2186962-3	L2186962-4	L2186962-5	L2186962-6	L2180746-1	L2180746-2
Acenaphthene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Acenaphthylene	0.0050	mg/kg	NV	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Anthracene	0.0040	mg/kg	NV	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040	<0.0040
Benz(a)anthracene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(a)pyrene	0.0100	mg/kg	0.7	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(b&j)fluoranthene	0.0100	mg/kg	10	0.016	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(g,h,i)perylene	0.0100	mg/kg	NV	0.021	<0.010	<0.010	<0.010	<0.010	<0.010
Benzo(k)fluoranthene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Chrysene	0.0100	mg/kg	NV	0.03	<0.010	<0.010	0.023	<0.010	<0.010
Dibenz(a,h)anthracene	0.0050	mg/kg	10	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050	<0.0050
Fluoranthene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Fluorene	0.0100	mg/kg	NV	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Indeno(1,2,3-c,d)pyrene	0.0100	mg/kg	10	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Naphthalene	0.0100	mg/kg	22	<0.010	<0.010	<0.010	<0.010	<0.010	<0.010
Phenanthrene	0.0400	mg/kg	50	0.031	<0.010	<0.010	0.02	<0.010	<0.010
Pyrene	0.0100	mg/kg	100	0.012	<0.010	<0.010	<0.010	<0.010	<0.010
B(a)P Total Potency Equivalent	0.0200	mg/kg	NV	<0.020	<0.020	<0.020	<0.020	<0.050	<0.050

14 Exceeds water licence criteria

1 - Type B Water Licence S17L8-003

NV - No Value

MDL - Method Detection Limit