

**Table B Soil Exceedances**

AEC Reference Number	AEC Description	Investigation Locations	COCs	Soil Exceedances With Respect to CSR IL Standards VPH (CSR IL) = 200 ug/g
1	Soil and groundwater contamination in vicinity of MW06-2	MW06-2, MW06-3, MW07-6, MW07-7, MW07-8, MW07-9, MW08-10, MW08-11, BH08-12, MW08-13	EPH, BTEX/VPH	<b>MW06-2</b> VPH (960 µg/g) 1.8-2.4 m <b>MW07-6</b> VPH (960 µg/g) 1.7-2.3 m <b>BH08-12</b> VPH (3000 µg/g) 1.35-1.7 m

**Notes:** LEPH concentrations are based on EPH<sub>10-19</sub> analyses.  
 EPH<sub>10-19</sub> concentrations are compared to LEPH standard as a conservative measure.

**4.4 GROUNDWATER ANALYTICAL RESULTS**

The results of the groundwater analytical program are presented in **Table 2** and **Figure 5**. The certified laboratory analytical reports are included in **Appendix B**.

Groundwater samples that exceeded the applicable CSR AW standards for one or more of the parameters analyzed are summarized in **Table C**, below. The federal guidelines were not exceeded.

**Table C Groundwater Exceedances**

AEC Reference Number	AEC Description	Investigation Locations	COCs	Groundwater Exceedances With Respect to CSR AW Standards		
				Monitoring Well	Date	Parameter > CSR AW VPH (CSR) = 1500 ug/L LEPH (CSR) = 500 ug/L
1	Soil and groundwater contamination in vicinity of MW06-2	MW06-2, MW06-3, MW07-6, MW07-7, MW07-8, MW07-9, MW08-10, MW08-11, MW08-13	EPH, BTEX/VPH	MW06-2	7/5/2006	VPH (2400 µg/L) LEPH (2300 µg/L)
					7/6/2007	VPH (2600 µg/L) LEPH (3000 µg/L)
					9/22/2008	LEPH (870 µg/L)
				MW07-6	8/16/2007	VPH (3600 µg/L) LEPH (2300 µg/L)
					9/22/2008	LEPH (700 µg/L)
				MW07-7	8/16/2007	VPH (1700 µg/L) LEPH (1900 µg/L)
					9/22/2008	LEPH (1900 µg/L)
MW07-8	8/16/2007	LEPH (1400 µg/L)				

**Notes:** LEPH concentrations are based on EPH<sub>10-19</sub> analyses.  
 EPH<sub>10-19</sub> concentrations are compared to LEPH standard as a conservative measure.

## 4.5 QUALITY ASSURANCE / QUALITY CONTROL

QA/QC results are provided in **Table 1** and **Table 2** (following the text) and **Appendix B** (certified laboratory analytical reports).

### 4.5.1 Soil

Two duplicate soil samples from the Supplemental Phase 2 ESA were analyzed. The RPD between the duplicate sample and original sample was calculated for parameters where concentrations of the sample and its duplicate were greater than five times the RDL.

The following parameters analyzed in the duplicate soil sample sets exceeded the RPD data quality objective DQO (20%):

- Moisture (23.2%),  $VH_{6-10}$  (85.7%) and VPH (85.7%) analyzed in BH08-12.3 and its duplicate sample (BH08-12.5).

The RPD values that exceeded the DQO may be attributed to the inherent heterogeneity of soil. Overall, the results of the soil samples and their duplicates above the RPD (20%) are not considered to affect the interpretation of the laboratory data and the results should be viewed with the understanding that there is some variability in the dataset. As a conservative measure, if the soil DQO was exceeded, the highest concentration (between the original sample and the field duplicate) was conservatively used.

### 4.5.2 Groundwater

Two duplicate groundwater samples from the Supplemental Phase 2 ESA were analyzed. The RPD between the duplicate sample and original sample was calculated for parameters where concentrations of the sample and its duplicate were greater than five times the RDL.

The following parameters analyzed in the duplicate groundwater sample sets exceeded the RPD data quality objective DQO (20%):

- Xylenes (27%) in MW07-7 and its duplicate sample (MW900/1000) in August 2007; and
- $VH_{6-10}$  (27%) and VPH (28%) in MW07-7 and its duplicate sample (MW08-12) in September 2008.

Overall, the results of the groundwater samples and the corresponding duplicates above the RPD (20%) are not considered to affect the interpretation of the laboratory data and the results should be viewed with the understanding that there is some variability in the dataset. As a conservative measure, if the groundwater DQO was exceeded, the highest concentration (between the original sample and the field duplicate) was conservatively used.

## **5.0 DISCUSSION**

### **5.1 SOIL QUALITY**

VPH concentrations greater than the CSR IL standards were identified in soil collected from MW06-2, MW07-6 and BH08-12. The samples were collected from 1.35 to 2.4 m bgs, which correlates with the depth of the groundwater table in the area. Detectable concentrations of EPH, but less than the applicable standards, were identified at MW06-2 and MW07-7. The EPH impacts have been delineated (laterally and vertically). The soil samples did not contain concentrations of COCs greater than federal guidelines.

AEC-1 is situated immediately down gradient of the CN Rail Line and the former Brownsville Rail Spur (which is currently a dyke), and immediately upgradient of the current Lindal Cedar Homes warehouse and distribution building. Light industrial operations, including wood processing, wood manufacturing and shingle manufacturing are located beyond the former Brownsville Rail Spur, to the southeast of the Site. The specific source of the contamination at AEC-1 has not been identified; however, on-site operations (current or historical) and/or surrounding off-site operations could have contributed to the contamination at AEC-1. The sample collected from BH08-12 from 1.35 to 1.7 m bgs contained the greatest concentration of VPH (3000 ug/g) observed during the Phase 2 ESA delineation, and therefore appears to be near the source.

VPH contaminated soil has essentially been delineated (laterally and vertically) on-site; however, the lateral extent of VPH contamination off-site to southeast of BH08-12 is unknown. It is estimated that approximately 400 m<sup>3</sup> of soil containing VPH at concentrations greater than the provincial IL standards in present within AEC-1. However, we would recommend additional investigation to confirm this number, and to further constrain the contamination extent, if a remediation plan were to be developed.

### **5.2 GROUNDWATER QUALITY**

VPH concentrations greater than CSR AW standards were identified in groundwater collected from MW06-2 (July 2006 and July 2007), MW07-6 (in August 2007), and MW07-7 (in August 2007). Groundwater samples collected in September 2008 did not exceed the CSR AW standards for VPH. Overall, VPH concentrations decreased between August 2007 and September 2008.

LEPH concentrations greater than CSR AW standards were identified in groundwater collected from MW06-2 (in July 2006, July 2007 and September 2008), MW07-6 (in August 2007 and September 2008), MW07-7 (in August 2007 and September 2008) and MW07-8 (in August 2007). Overall, LEPH concentrations decreased between August 2007 and September 2008.

The groundwater samples did not contain concentrations of COCs greater than federal guidelines.

LEPH contaminated groundwater has essentially been delineated on-site; however, the lateral extent of LEPH off-site to the southeast of BH08-12 is unknown.

## 6.0 CONCLUSIONS

The Supplemental Phase 2 ESA was completed to:

- Delineate soil contamination identified in vicinity of AEC-1.
- Delineate groundwater contamination identified in vicinity of AEC-1.
- Evaluate potential remedial/ Site management options for the Site.

Based on available data, the following conclusions are made:

- VPH impacted soil is present within the upper sand unit and the lower silt unit (from approximately 1.4 to 2.4 m bgs) in AEC-1. VPH contaminated soil has essentially been delineated (laterally and vertically) on-site; however, the lateral extent of VPH contamination off-site to southeast of BH08-12 is unknown.
- It is estimated that approximately 400 m<sup>3</sup> of soil impacted with VPH concentrations greater than the applicable provincial industrial land use (IL) standards is present within AEC-1. However, we would recommend additional investigation to confirm this number, and to further constrain the contamination extent, if a remediation plan were to be developed.
- Light extractable petroleum hydrocarbon (LEPH) contaminated groundwater was identified in MW06-2, MW07-6 and MW07-7, and has essentially been delineated on-site. A source for the contamination was not identified in upgradient monitoring well MW07-9. LEPH concentrations in groundwater decreased between July/August 2007 and September 2008.
- The groundwater samples collected in September 2008 did not exceed the applicable provincial standards for VPH.
- Based on a review of the laboratory chromatograms, the elevated VPH in soil and groundwater samples is consistent with an aromatic petroleum hydrocarbon solvent (i.e. Varsol ©).
- Overall, the contamination appears to be localized and the concentrations of VPH and LEPH in groundwater have decreased between July/August 2007 and September 2008.

## 7.0 NEXT STEPS

A remedial options evaluation was completed to address the contamination in support the proposed property transfer of the Site from CN to Transport Canada. The remedial options evaluation for the Site will be provided under a separate cover.

We sincerely appreciate the opportunity to have assisted you with this project and if there are any questions, please do not hesitate to contact the undersigned by phone or email.

Report prepared by:  
**HEMMERA**

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Report peer reviewed by:  
**HEMMERA**

***DRAFT***

John Taylor, P.Eng.  
Senior Environmental Engineer

## 8.0 REFERENCES

British Columbia Ministry of Environment, Technical Guidance on Contaminated Sites, Site Characterization and Confirmation Testing, July 2005.

British Columbia Ministry of Environment, Environmental Management Act, Contaminated Sites Regulation, B.C. Reg. 375/96, July 2004 (as amended up to B.C. Reg. 76/2005).

British Columbia Contaminated Sites Regulation (BC CSR). BC Reg. 375/96 (Effective April 1997 and amended July 1999, November 1999, February 2002, November 2003, and July 2004), including amendments up to B.C. Reg 239/2007, effective July1, 2007.

British Columbia Research (BCR) Corporation, Follow-Up Phenols Testing for Brownsville Site. May 30, 1991.

Fraser River Port Authority, Environmental Audit, On-Site Inspection Report – Generic. July 31, 2000.

Hemmera Envirochem. “Phase 1 Environmental Site Assessment, Fraser River Port Authority, Brownsville Site, Surrey, BC”, September 2006.

Hemmera Envirochem. “Final Report, Phase 2 Environmental Site Assessment, Brownsville Site, Surrey, BC”, May 2008.

Keystone Environmental Ltd., Evaluation of Environmental Investigation Status, Brownsville /Port Mann CN Land Swap, Surrey, BC. September 16, 2002.

Klohn-Crippen Consultants Ltd., Fraser River Harbour Commission, Lindal Cedar Homes Sawmill Expansion, Surrey BC - Preliminary Geotechnical and Environmental Assessments. April 1995.

Public Works and Government Services Environmental Services (PWGSC), Environmental Audit Report Brownsville/Port Mann CN Land Swap, Surrey BC. August 23, 1996.

## **9.0 STATEMENT OF LIMITATIONS**

This report was prepared by Hemmera, based on fieldwork conducted by Hemmera, for the sole benefit and exclusive use of Port Metro Vancouver (PMV). The material in it reflects Hemmera's best judgment in light of the information available to it at the time of preparing this Report. Any use that a third party makes of this Report, or any reliance on or decision made based on it, is the responsibility of such third parties. Hemmera accepts no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions taken based on this Report.

Hemmera has performed the work as described above and made the findings and conclusions set out in this Report in a manner consistent with the level of care and skill normally exercised by members of the environmental science profession practicing under similar conditions at the time the work was performed.

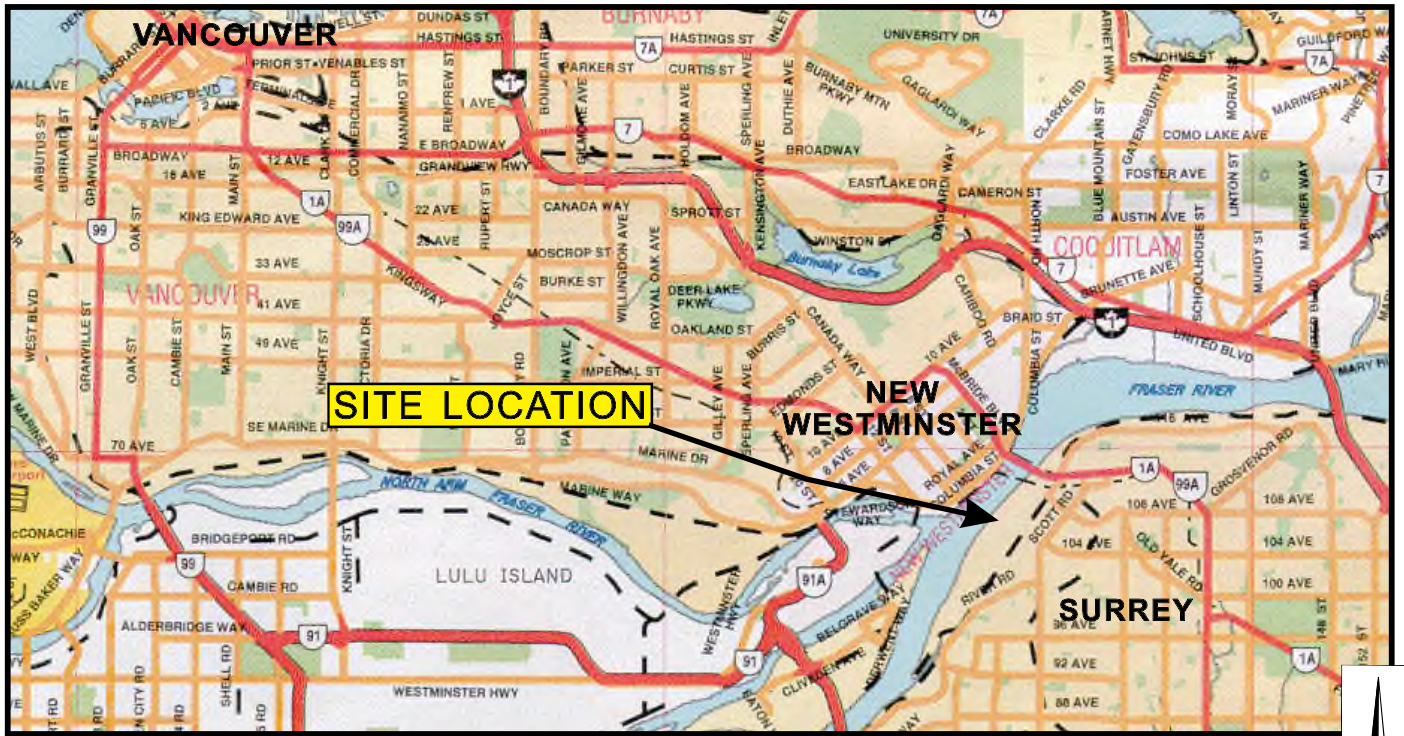
This Report represents a reasonable review of the information available to Hemmera within the established Scope, work schedule and budgetary constraints. It is possible that the levels of contamination or hazardous materials may vary across the Site, and hence currently unrecognised contamination or potentially hazardous materials may exist at the Site. No warranty, expressed or implied, is given concerning the presence or level of contamination on the Site, except as specifically noted in this Report. The conclusions and recommendations contained in this Report are based upon applicable legislation existing at the time the Report was drafted. Any changes in the legislation may alter the conclusions and/or recommendations contained in the Report. Regulatory implications discussed in this Report were based on the applicable legislation existing at the time this Report was written.

In preparing this Report, Hemmera has relied in good faith on information provided by others as noted in this Report, and has assumed that the information provided by those individuals is both factual and accurate. Hemmera accepts no responsibility for any deficiency, mis-statement or inaccuracy in this Report resulting from the information provided by those individuals.

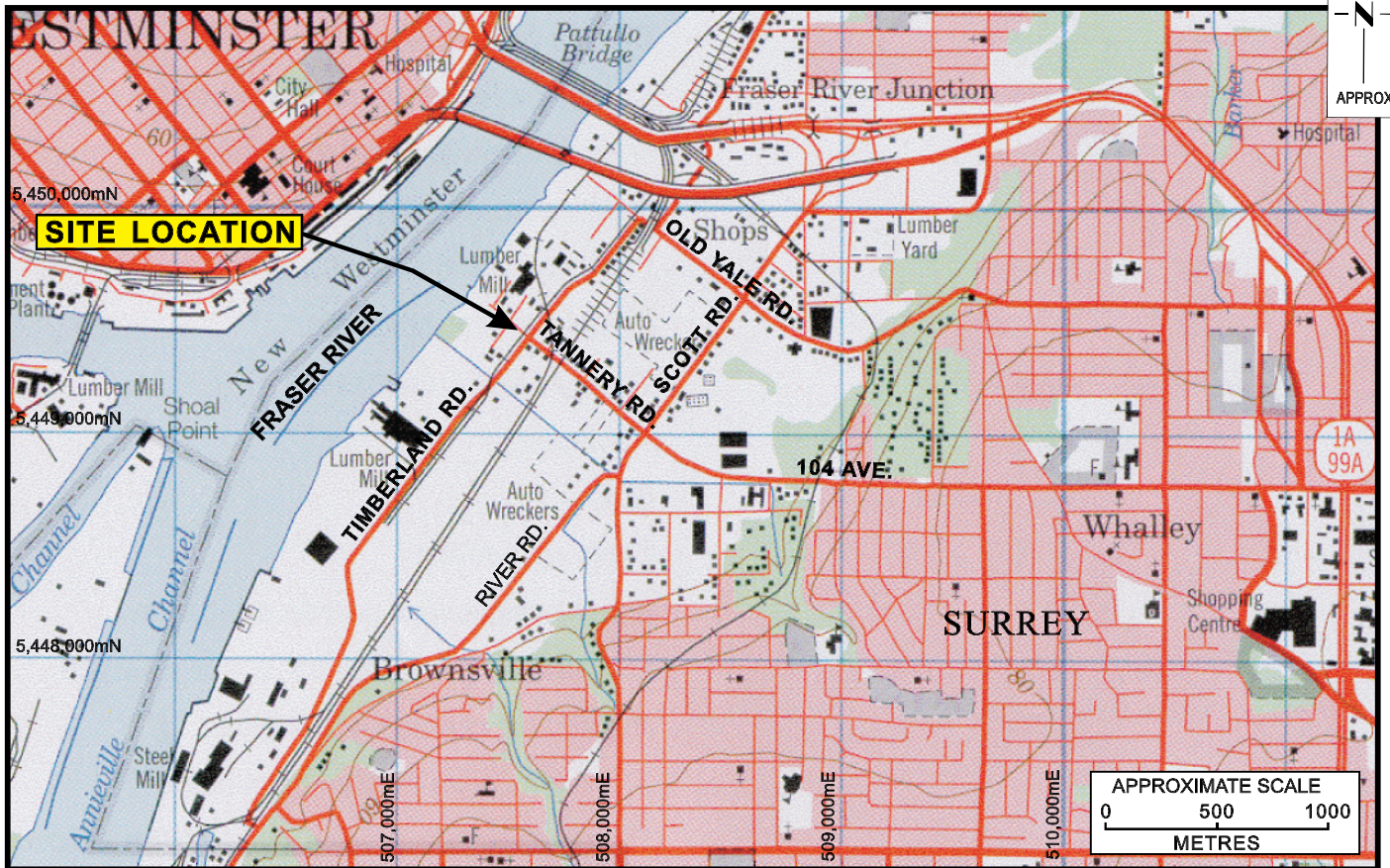
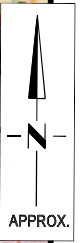
The liability of Hemmera to PMV shall be limited to injury or loss caused by the negligent acts of Hemmera. The total aggregate liability of Hemmera related to this agreement shall not exceed the lesser of the actual damages incurred, or the total fee of Hemmera for services rendered on this project.

# FIGURES





**REGIONAL MAP**



**NTS MAP 92G/2 (New Westminister)**



**HEMMERA**

**DRAFT SUPPLEMENTAL PHASE 2 ESA  
BROWNSVILLE SITE, SURREY, BC**

**SITE LOCATION**

CLIENT:



PROJECT No. 405-003.04

December 2008

FIGURE 1

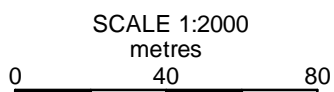
405.003.041



**LEGEND**

- ⊙ Piezometer Location (Klohn-Crippen, 1995)
- ⊕ Auger Test Hole Location (Klohn-Crippen, 1995)
- ⊗ Borehole Location (BC Research, 1991)
- ◆ Borehole/Monitoring Well Location (Hemmera, 2006, 2007 & 2008)
- ⊕ Surface Soil Sample (Hemmera, 2006)

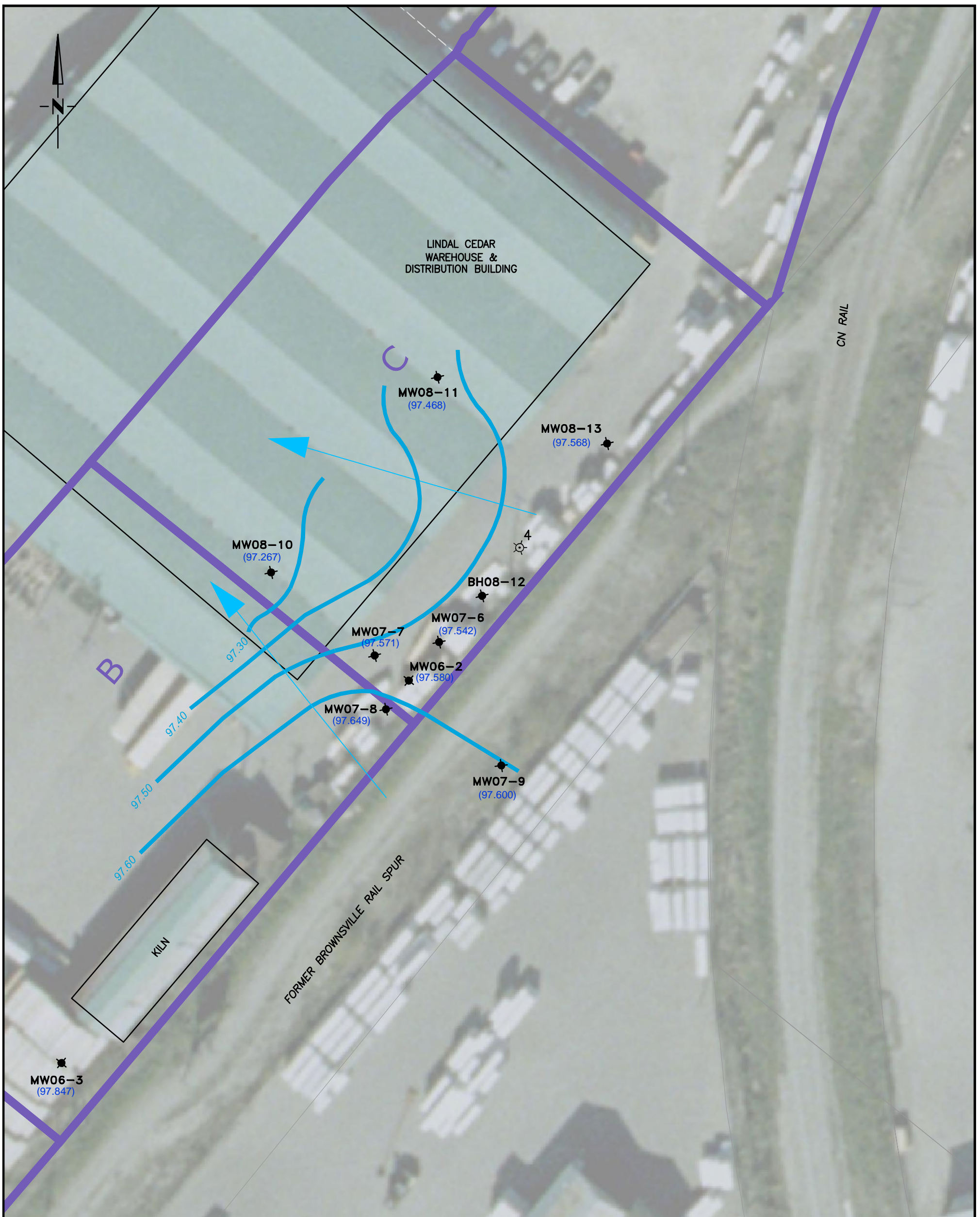
- Parcel & Property Boundaries
- B Parcel Number



**HEMMERA**

CLIENT: PORT METRO VANCOUVER

DRAFT SUPPLEMENTAL PHASE 2 ESA BROWNSVILLE SITE, SURREY, BC		
SITE PLAN - INVESTIGATION LOCATIONS		
PROJECT No. 405-003.04	December 2008	FIGURE 2

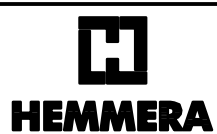
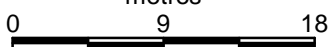


**LEGEND**

- ⊙ Piezometer Location (Klohn-Crippen, 1995)
- ⊕ Auger Test Hole Location (Klohn-Crippen, 1995)
- ⊗ Borehole Location (BC Research, 1991)
- ◆ Borehole/Monitoring Well Location (Hemmera, 2006, 2007 & 2008)
- ⊕ Surface Soil Sample (Hemmera, 2006)
- Parcel & Property Boundaries
- B Parcel Number

- ← Inferred Groundwater Flow Direction
- 97.50 Groundwater Elevation Contour
- (97.649) Groundwater Elevation (m)

SCALE 1:450  
metres



CLIENT:



DRAFT SUPPLEMENTAL PHASE 2 ESA  
BROWNSVILLE SITE, SURREY, BC

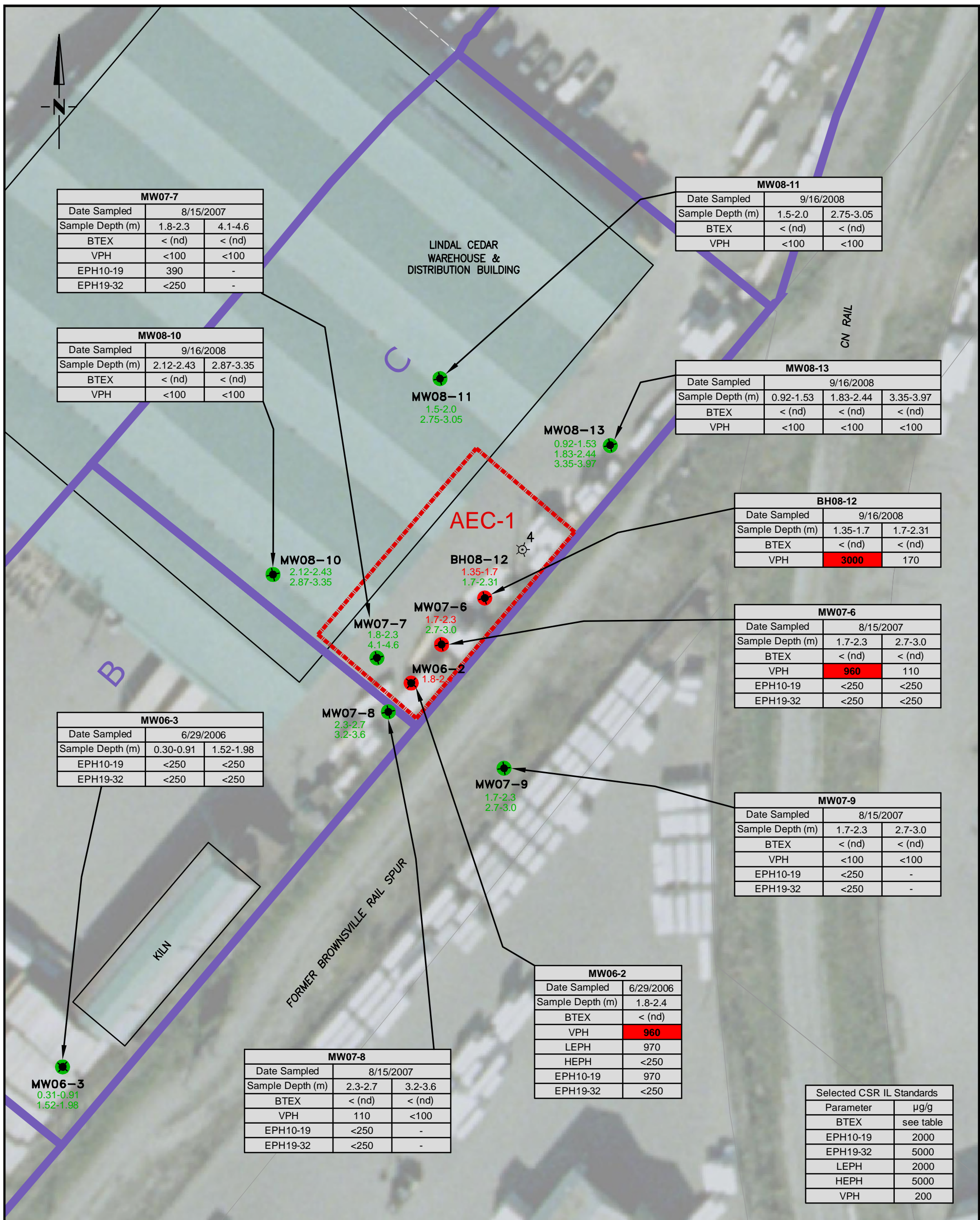
GROUNDWATER ELEVATION CONTOURS  
(SEPTEMBER 2008)

PROJECT No.

405-003.04

December 2008

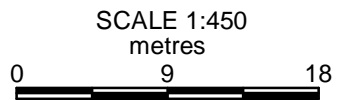
FIGURE 3



**LEGEND**

- ⊙ Piezometer Location (Klohn-Crippen, 1995)
- ⊕ Auger Test Hole Location (Klohn-Crippen, 1995)
- ⊗ Borehole Location (BC Research, 1991)
- ◆ Borehole/Monitoring Well Location (Hemmera, 2006, 2007 & 2008)
- ⊕ Surface Soil Sample (Hemmera, 2006)
- Parcel & Property Boundaries
- B Parcel Number

- ⊙ Sample Location with Concentration(s) Greater Than CSR Standard(s) in Soil
- ⊙ Sample Location with Concentration(s) Less Than CSR Standard(s) in Soil
- Concentration Greater Than CSR Standard(s) in Soil
- 1.7-2.0 Sample Interval (in metres) with Concentration(s) Greater Than CSR Standard(s) in Soil
- 1.7-2.0 Sample Interval (in metres) with Concentration(s) Less Than CSR Standard(s) in Soil



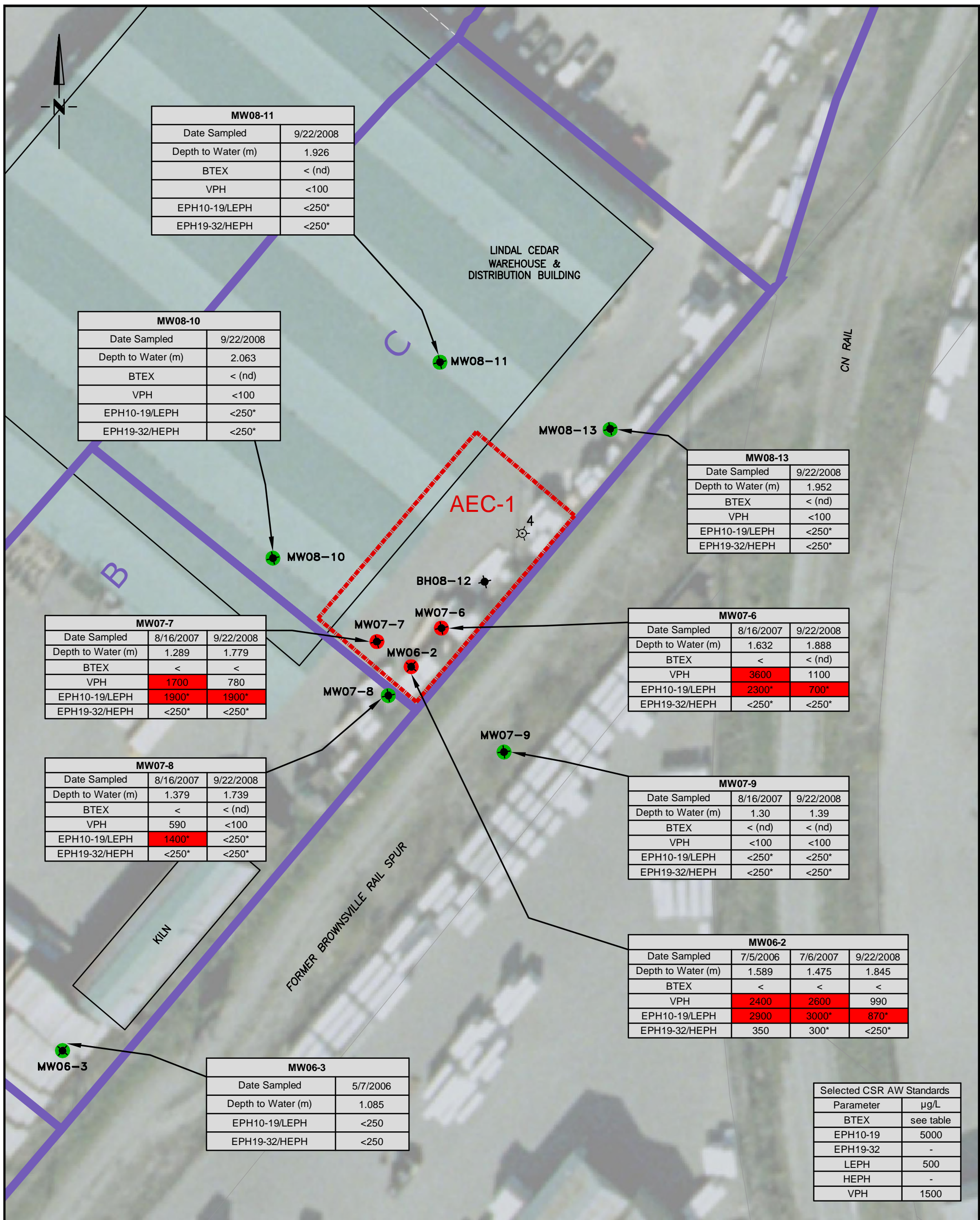
**HEMNERA**

CLIENT: PORT METRO VANCOUVER

**DRAFT SUPPLEMENTAL PHASE 2 ESA  
BROWNSVILLE SITE, SURREY, BC**

**SOIL RESULTS - PETROLEUM HYDROCARBONS**

PROJECT No. 405-003.04	December 2008	FIGURE 4
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MW08-11	
Date Sampled	9/22/2008
Depth to Water (m)	1.926
BTEX	< (nd)
VPH	<100
EPH10-19/LEPH	<250*
EPH19-32/HEPH	<250*

MW08-10	
Date Sampled	9/22/2008
Depth to Water (m)	2.063
BTEX	< (nd)
VPH	<100
EPH10-19/LEPH	<250*
EPH19-32/HEPH	<250*

MW08-13	
Date Sampled	9/22/2008
Depth to Water (m)	1.952
BTEX	< (nd)
VPH	<100
EPH10-19/LEPH	<250*
EPH19-32/HEPH	<250*

MW07-7		
Date Sampled	8/16/2007	9/22/2008
Depth to Water (m)	1.289	1.779
BTEX	<	<
VPH	1700	780
EPH10-19/LEPH	1900*	1900*
EPH19-32/HEPH	<250*	<250*

MW07-6		
Date Sampled	8/16/2007	9/22/2008
Depth to Water (m)	1.632	1.888
BTEX	<	< (nd)
VPH	3600	1100
EPH10-19/LEPH	2300*	700*
EPH19-32/HEPH	<250*	<250*

MW07-8		
Date Sampled	8/16/2007	9/22/2008
Depth to Water (m)	1.379	1.739
BTEX	<	< (nd)
VPH	590	<100
EPH10-19/LEPH	1400*	<250*
EPH19-32/HEPH	<250*	<250*

MW07-9		
Date Sampled	8/16/2007	9/22/2008
Depth to Water (m)	1.30	1.39
BTEX	< (nd)	< (nd)
VPH	<100	<100
EPH10-19/LEPH	<250*	<250*
EPH19-32/HEPH	<250*	<250*

MW06-2			
Date Sampled	7/5/2006	7/6/2007	9/22/2008
Depth to Water (m)	1.589	1.475	1.845
BTEX	<	<	<
VPH	2400	2600	990
EPH10-19/LEPH	2900	3000*	870*
EPH19-32/HEPH	350	300*	<250*

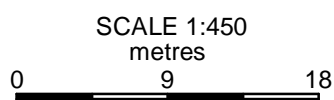
MW06-3	
Date Sampled	5/7/2006
Depth to Water (m)	1.085
EPH10-19/LEPH	<250
EPH19-32/HEPH	<250

Selected CSR AW Standards	
Parameter	µg/L
BTEX	see table
EPH10-19	5000
EPH19-32	-
LEPH	500
HEPH	-
VPH	1500

**LEGEND**

- ⊙ Piezometer Location (Klohn-Crippen, 1995)
- ⊕ Auger Test Hole Location (Klohn-Crippen, 1995)
- ⊗ Borehole Location (BC Research, 1991)
- ◆ Borehole/Monitoring Well Location (Hemmera, 2006, 2007, 2008)
- + Surface Soil Sample (Hemmera, 2006)
- Parcel & Property Boundaries
- B Parcel Number

- Sample Location with Concentration(s) Greater Than CSR Standard(s) in Groundwater
- Sample Location with Concentration(s) Less Than CSR Standard(s) in Groundwater
- Concentration Greater Than CSR Standard(s)
- \* Concentration is based on EPH<sub>10-19</sub> and EPH<sub>19-32</sub> analyses. EPH<sub>10-19</sub> concentration is compared to LEPH standard as conservative measure.



**HEMmera**

CLIENT: PORT METRO VANCOUVER

DRAFT SUPPLEMENTAL PHASE 2 ESA  
BROWNSVILLE SITE, SURREY, BC

GROUNDWATER RESULTS  
PETROLEUM HYDROCARBONS

PROJECT No. 405-003.04	December 2008	FIGURE 5
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# **TABLES**

**Table 1  
Soil Analytical Results**

Parameter	Location ID:		MW06-2	MW06-3		MW07-6		MW07-7			MW07-8		
	Sample ID:		MW06-2-3	MW06-3-1	MW06-3-3	MW07-6-4	MW07-6-7	MW07-7-5	Duplicate (MW600)	RPD	MW07-7-9	MW07-8-5	MW07-8-7
	Date Sampled:		2006-06-29	2006-06-29	2006-06-29	2007-08-15	2007-08-15	2007-08-15	2007-08-15		2007-08-15	2007-08-15	2007-08-15
	CCME IL <sup>3,4</sup>	CSR IL <sup>5,6</sup>											
<b>Sample Info</b>													
Sample Depth, From (m)	-	-	1.83	0.3	1.524	1.828	3.200	1.828	-	-	4.114	2.286	3.200
Sample Depth, To (m)	-	-	2.44	0.91	1.98	2.286	3.657	2.286	-	-	4.57	2.743	3.657
<b>Field Tests</b>													
Field Vapours (% LEL)	-	-	-	-	-	-	-	-	-	-	-	-	-
Field Vapours (ppm)	-	-	520	60	150	405	500	>500	-	-	150	450	100
<b>Physical Tests</b>													
Moisture (%)	-	-	26.9	17.9	35.8	26.8	26.7	25.2	25.1	-	29	25.6	28.1
<b>BTEX</b>													
Benzene	0.0068-0.030 <sup>7</sup>	2.5 <sup>12</sup>	<0.03 <sup>16</sup>	-	-	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	-	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>
Ethylbenzene	0.018-0.082 <sup>8</sup>	20 <sup>13</sup>	<0.03 <sup>16</sup>	-	-	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	-	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>
Styrene	50 <sup>9</sup>	50 <sup>14</sup>	<0.03	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1
Toluene	0.08-0.37 <sup>10</sup>	25 <sup>13</sup>	<0.03	-	-	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	-	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>
Xylenes	2.4-11 <sup>11</sup>	50 <sup>13</sup>	<0.03	-	-	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1
<b>EPHs</b>													
EPH10-19 (Si-gel)	-	2000 <sup>15</sup>	970	<250	<250	770	-	390	-	-	-	<250	-
EPH19-32 (Si-gel)	-	5000 <sup>15</sup>	<250	<250	<250	<250	-	<250	-	-	-	<250	-
LEPH (Si-gel)	-	2000 <sup>14</sup>	970	-	-	-	-	-	-	-	-	-	-
HEPH (Si-gel)	-	5000 <sup>14</sup>	<250	-	-	-	-	-	-	-	-	-	-
<b>VPHs</b>													
VH6-10	-	-	960	-	-	960	110	<100	<100	-	<100	110	<100
VPH	-	200 <sup>14</sup>	960	-	-	960	110	<100	<100	-	<100	110	<100

**Table 1  
Soil Analytical Results**

	Location ID:		MW07-9	MW07-9	MW08-10		MW08-11		BH08-12			MW08-13			
	Sample ID:	MW07-9-3	MW07-9-5	MW08-10.3	MW08-10.4	MW08-11.2	MW08-11.4	BH08-12.3	Duplicate (BH08-12.5)	RPD	BH08-12.4	MW08-13.2	MW08-13.4	MW08-13.5	
	Date Sampled:	2007-08-15	2007-08-15	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	2008-09-16	
Parameter	CCME IL <sup>3,4</sup>	CSR IL <sup>5,6</sup>													
<b>Sample Info</b>															
Sample Depth, From (m)	-	-	1.700	2.667	2.12	2.87	1.5	2.75	1.35	1.35	-	1.7	0.92	1.83	3.35
Sample Depth, To (m)	-	-	2.286	3.048	2.43	3.35	2	3.04	1.7	1.7	-	2.31	1.53	2.44	3.97
<b>Field Tests</b>															
Field Vapours (% LEL)	-	-	-	-	-	-	-	-	10	10	-	5	-	-	-
Field Vapours (ppm)	-	-	150	200	60	50	50	30	-	-	-	-	140	35	30
<b>Physical Tests</b>															
Moisture (%)	-	-	27.6	26.1	25	23.5	21.3	25.1	28.9	22.9	23.2	25.7	15.6	27.8	26.4
<b>BTEX</b>															
Benzene	0.0068-0.030 <sup>7</sup>	2.5 <sup>12</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	-	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>	<0.04 <sup>16</sup>
Ethylbenzene	0.018-0.082 <sup>8</sup>	20 <sup>13</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	-	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>
Styrene	50 <sup>9</sup>	50 <sup>14</sup>	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	-	<0.1	<0.1	<0.1	<0.1
Toluene	0.08-0.37 <sup>10</sup>	25 <sup>13</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	-	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>	<0.5 <sup>16</sup>
Xylenes	2.4-11 <sup>11</sup>	50 <sup>13</sup>	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.3	-	<0.1	<0.1	<0.1	<0.1
<b>EPHs</b>															
EPH10-19 (Si-gel)	-	2000 <sup>15</sup>	<250	-	-	-	-	-	-	-	-	-	-	-	-
EPH19-32 (Si-gel)	-	5000 <sup>15</sup>	<250	-	-	-	-	-	-	-	-	-	-	-	-
LEPH (Si-gel)	-	2000 <sup>14</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-
HEPH (Si-gel)	-	5000 <sup>14</sup>	-	-	-	-	-	-	-	-	-	-	-	-	-
<b>VPHs</b>															
VH6-10	-	-	<100	<100	<100	<100	<100	<100	1200	3000	85.7	170	<100	<100	<100
VPH	-	200 <sup>14</sup>	<100	<100	<100	<100	<100	<100	1200	3000	85.7	170	<100	<100	<100



# Table 1

## Soil Analytical Results

### NOTES

- (1) All values are reported as µg/g unless otherwise noted
- (2) - = No standard or not analyzed
- (3) CCME = Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, 1999, updated to December 2007 (v7.1)
- (4) CCME IL = Chapter 7, Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health, Summary Tables 1 and 2, Industrial land use, Update 7.0 September 2007
- (5) CSR = BC Environmental Management Act, Contaminated Sites Regulation, B.C. Reg. 375/96, including amendments up to B.C. Reg. 239/2007, effective July 1, 2007
- (6) CSR IL = Schedules 4 (Generic) and/or 5 (Matrix), Column VI Industrial, and/or Schedule 10, Column IV, Commercial, Industrial Soil Standard
- (7) Benzene varies with Median grain size in µm as follows for CCME IL, Table 1, Canadian Soil Quality Guidelines:  
0.0068 if Median grain size ≤ 75  
0.030 if Median grain size > 75
- (8) Ethylbenzene varies with Median grain size in µm as follows for CCME IL, Table 1, Canadian Soil Quality Guidelines:  
0.018 if Median grain size ≤ 75  
0.082 if Median grain size > 75
- (9) Table 2, Interim remediation criteria for soil that have not yet been replaced by Canadian Soil Quality Guidelines
- (10) Toluene varies with Median grain size in µm as follows for CCME IL, Table 1, Canadian Soil Quality Guidelines:  
0.08 if Median grain size ≤ 75  
0.37 if Median grain size > 75
- (11) Xylenes varies with Median grain size in µm as follows for CCME IL, Table 1, Canadian Soil Quality Guidelines:  
2.4 if Median grain size ≤ 75  
11 if Median grain size > 75
- (12) Schedule 5, Environmental Protection, Groundwater flow to surface water used by aquatic life, Marine
- (13) Schedule 5, Environmental Protection, Toxicity to soil invertebrates and plants
- (14) Schedule 4, Generic Numerical Soil Standards
- (15) BC Ministry of Water, Land and Air Protection, Director of Waste Management, May 23, 2003, Update on Contaminated Sites, Clarification on Hydrocarbon Analytical Methods and Standards; the Director has extended the EPH/LEPH/HEPH equivalency to July 1, 2010; therefore, EPH concentrations not corrected for PAHs have been conservatively compared to the LEPH/HEPH standards
- (16) The laboratory reported detection limit is greater than the standard/guideline
- (17) Si-gel = silica-gel clean-up

**Table 2  
Groundwater Analytical Results**

Parameter	Location ID:			MW06-2			MW06-3	MW07-6		MW07-7			
	CCME MALx10 <sup>11,12</sup>	CCME FALx10 <sup>11,13</sup>	CSR AW <sup>3,4</sup>	Sample ID:			MW06-3	MW07-6	MW07-6	MW07-7	Duplicate (MW900/1000)	RPD <sup>10</sup>	MW07-7 9/22/2008
				MW06-2	MW06-2	MW06-2							
Date Sampled:	7/5/2006	7/6/2007	9/22/2008	5/7/2006	8/16/2007	9/22/2008	8/16/2007	8/16/2007					
<b>Sample Info</b>													
Well Depth, To Bottom (m)	-	-	-	2.763	2.77	2.745	2.773	2.958	2.958	3.51	-	-	3.5
Well Depth, To Water (m)	-	-	-	1.589	1.475	1.845	1.085	1.632	1.888	1.284	-	-	1.779
<b>Field Tests</b>													
Field Conductivity (uS/cm)	-	-	-	640	20	780	321	-	545.7	-	-	-	752
Field pH	-	-	-	6.31	6.62	6.43	6.54	-	6.16	-	-	-	6.29
Field Temperature (°C)	-	-	-	14.8	15.2	15	17.4	-	15.5	-	-	-	17.6
Field Vapours (% LEL)	-	-	-	-	-	-	-	-	-	-	-	-	25
Field Vapours (ppm)	-	-	-	0	25	50	0	-	50	-	-	-	-
<b>BTEX</b>													
Benzene	1100	3700	1000 <sup>5</sup>	<0.5	3	5.8	-	<0.5	<0.1	<1	1.9	-	1.9
Ethylbenzene	250	900	2000 <sup>6</sup>	0.7	1.1	1.1	-	1.2	<0.1	<1	0.8	-	0.6
Styrene	-	720	720 <sup>7</sup>	<0.5	<0.5	<0.1	-	<0.5	<0.1	<1	<0.1	-	<0.1
Toluene	2150	20	390 <sup>6</sup>	<0.5	3	2.8	-	<0.5	<0.1	1.7	1.8	6	1.7
Xylenes	-	-	-	2.5	2.8	2.9	-	4.4	<0.1	2.9	3.8	27	2.6
<b>EPHs</b>													
EPH10-19	-	-	5000 <sup>7</sup>	2900	3000 <sup>9</sup>	870 <sup>8,9</sup>	<250 <sup>8</sup>	2300 <sup>9</sup>	700 <sup>8,9</sup>	1700 <sup>9</sup>	1900 <sup>9</sup>	11	1700 <sup>8,9</sup>
EPH19-32	-	-	-	350	330	<250 <sup>8</sup>	<250	<250	<250 <sup>8</sup>	300	<250	-	<250 <sup>8</sup>
LEPH	-	-	500 <sup>7</sup>	2900	-	-	<250	-	-	-	-	-	-
HEPH	-	-	-	350	-	-	<250	-	-	-	-	-	-
<b>VPHs</b>													
VH6-10	-	-	15000 <sup>7</sup>	2400	2600	1000	-	3600	1100	1700	1400	19	600
VPH	-	-	1500 <sup>7</sup>	2400	2600	990	-	3600	1100	1700	1400	19	590

**Table 2  
Groundwater Analytical Results**

Parameter	Location ID:			Duplicate (MW08-12)	RPD <sup>10</sup>	MW07-8		MW07-9		MW08-10	MW08-11	MW08-13
	CCME MALx10 <sup>11,12</sup>	CCME FALx10 <sup>11,13</sup>	CSR AW <sup>3,4</sup>			MW07-8	MW07-8	MW07-9	MW07-9	MW08-10	MW08-11	MW08-13
	Date Sampled:					8/16/2007	9/22/2008	8/16/2007	9/22/2008	9/22/2008	9/22/2008	9/22/2008
<b>Sample Info</b>												
Well Depth, To Bottom (m)	-	-	-	3.5	-	3.014	3.006	2.232	2.258	3.799	3.714	3.964
Well Depth, To Water (m)	-	-	-	1.779	-	1.379	1.739	1.3	1.385	2.063	1.926	1.952
<b>Field Tests</b>												
Field Conductivity (uS/cm)	-	-	-	752	-	-	297.4	-	467.1	1101	604	482.5
Field pH	-	-	-	6.29	-	-	5.93	-	6.5	6.37	6.5	6.2
Field Temperature (°C)	-	-	-	17.6	-	-	15.1	-	14.9	14.7	14.7	15.6
Field Vapours (% LEL)	-	-	-	25	-	-	-	-	-	-	-	-
Field Vapours (ppm)	-	-	-	-	-	-	50	-	25	45	40	425
<b>BTEX</b>												
Benzene	1100	3700	1000 <sup>5</sup>	2.1	10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Ethylbenzene	250	900	2000 <sup>6</sup>	0.6	0	0.4	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Styrene	-	720	720 <sup>7</sup>	<0.1	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Toluene	2150	20	390 <sup>6</sup>	2	16	0.3	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
Xylenes	-	-	-	2.7	4	2	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1
<b>EPHs</b>												
EPH10-19	-	-	5000 <sup>7</sup>	1900 <sup>8,9</sup>	-	1400 <sup>9</sup>	<250 <sup>8,9</sup>	<250 <sup>8,9</sup>	<250 <sup>8,9</sup>	<250 <sup>8,9</sup>	<250 <sup>8,9</sup>	<250 <sup>8,9</sup>
EPH19-32	-	-	-	<250 <sup>8</sup>	-	<250	<250 <sup>8</sup>	<250 <sup>8</sup>	<250 <sup>8</sup>	<250 <sup>8</sup>	<250 <sup>8</sup>	<250 <sup>8</sup>
LEPH	-	-	500 <sup>7</sup>	-	-	-	-	-	-	-	-	-
HEPH	-	-	-	-	-	-	-	-	-	-	-	-
<b>VPHs</b>												
VH6-10	-	-	15000 <sup>7</sup>	790	27	590	<100	<100	<100	<100	<100	<100
VPH	-	-	1500 <sup>7</sup>	780	28	590	<100	<100	<100	<100	<100	<100

**Table 2**  
**Groundwater Analytical Results**  
**NOTES**

- (1) All values are reported as µg/L unless otherwise noted
- (2) - = No standard or not analyzed
- (3) CSR = BC Environmental Management Act, Contaminated Sites Regulation, B.C. Reg. 375/96, including amendments up to B.C. Reg. 239/2007, effective July 1, 2007
- (4) CSR AW = Schedule 6, Column II Aquatic Life
- (5) Schedule 6, Generic Numerical Water Standards, Standard to protect marine and/or estuarine aquatic life (Schedule 6, Note 8)
- (6) Schedule 6, Generic Numerical Water Standards, Standard to protect freshwater aquatic life (Schedule 6, Note 6)
- (7) Schedule 6, Generic Numerical Water Standards
- (8) Silica-Gel clean-up conducted
- (9) EPH10-19 value is compared to LEPH standard (500 µg/L) as a conservative measure
- (10) *RPD = Relative Percent Difference (%)*
- (11) CCME = Canadian Council of Ministers of the Environment, Canadian Environmental Quality Guidelines, 1999, updated to January 2006
- (12) CCME MALx10 = Chapter 4, Canadian Water Quality Guidelines for the Protection of Aquatic Life, Summary Table, Marine, Update 7.0, September 2007; all values multiplied by an assumed 10x dilution factor for groundwater entering surface water body
- (13) CCME FALx10 = Chapter 4, Canadian Water Quality Guidelines for the Protection of Aquatic Life, Summary Table, Freshwater Update 7.0, September 2007; all values multiplied by an assumed 10x dilution factor for groundwater entering surface water body

**APPENDIX A**  
**Borehole/Monitoring Well Logs**

## HEMMERA LOGS

**PVC Casing:** all casing is Schedule 40, 50 mm (2") diameter unless otherwise stated.

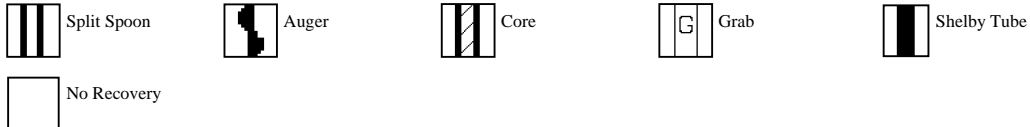
**PVC slot screen:** slot size is 0.25 mm (0.01" / 10 slot) unless otherwise stated.

**TOC:** Top of Casing

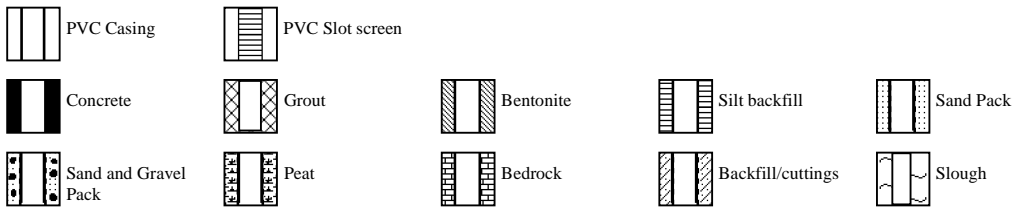
**Density/Consistency:** If no field test has been performed, inverted brackets are placed around the description (e.g. 'medium dense')

**Duplicate samples:** in the 'Samples Analysed' column, if an asterisk appears next to Y (yes) a duplicate of that sample has been analysed (i.e. Y\*)

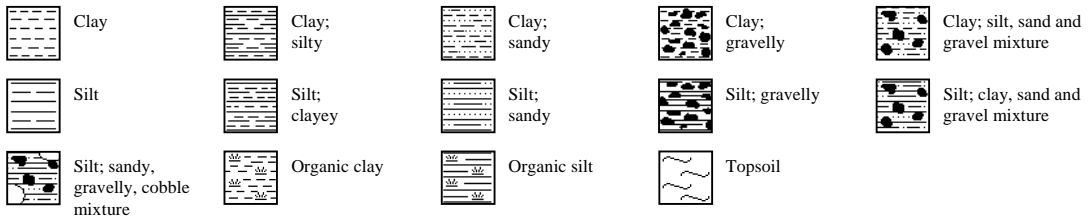
### Sample Type Symbols



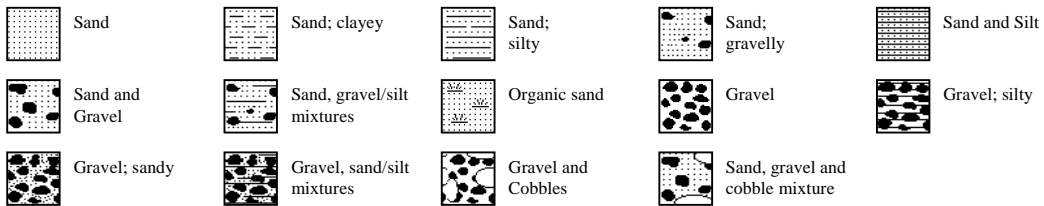
### Well Symbols



### Fine Soil Description Symbols



### Coarse Soil Description Symbols



### Peat Symbols



### Other Symbols



# HEMMERA

**Log of Monitoring Well: MW07-6**

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Rocky Mountain Soil Sampling

Client: PMV

Drilling Method: Solid Stem Augering

Date Drilled: August 15, 2007

Logged by: CMI

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE			SAMPLE					Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour ppm		LEL %
							0 250 500	0 50 100	
ft m									
-2									
-1									
0		Ground Surface	99.50						
		ASPHALT and GRAVEL FILL	0.00						
			99.35						
1		SAND sand (medium to fine grained), trace silt, brown, loose, poorly graded, moist, no odour, no staining	0.15	MW07-6-1	N		55		
2									
3		SILT silt, trace sand (fine grained), trace clay, dark grey, medium stiff, poorly graded, moist to wet, PHC odour, no staining, peat observed at 0.96 m	98.59	MW07-6-2	N		250		
4			0.91						
5				MW07-6-3	N		395		
6									
7				MW07-6-4	Y		405		
8									
9				MW07-6-5	N		325		
10									
11				MW07-6-6	N		460		
12									
		End of Log	95.84	MW07-6-7	Y		500		
			3.66						
13									
14									
15									
16									

Well location: MW07-6	Well casing diameter: 5 cm	Depth of well (TOC): 2.973 m
Depth to water level (TOC): 1.623 m	Well casing material: PVC	Well Elevation (TOC): 99.430 m
Date of water level: August 15, 2007	Well screen slot size: 0.025 cm	Ground Elevation: 99.500 m
Borehole diameter: 15 cm	Well screen interval (bgs): 0.61 to 3.05 m	

**Log of Monitoring Well: MW07-7**

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Rocky Mountain Soil Sampling

Client: PMV

Drilling Method: Solid Stem Augering

Date Drilled: August 15, 2007

Logged by: CMI

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE			SAMPLE					Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour ppm		LEL %
							0 250 500	0 50 100	
ft m									
-2									
-1									
0		Ground Surface	99.41						
		ASPHALT and GRAVEL FILL	0.00 99.26						
		SAND sand (medium to fine grained), trace silt, brown, loose, poorly graded, moist, no odour, no staining	0.15	MW07-7-1	N		250		
1									
2				MW07-7-2	N		250		
3			98.50 0.91						
1		SILT silt, trace sand (fine grained), dark grey, firm, poorly graded, moist to wet, PHC odour, no staining, wood fragments observed from 0.91 and 1.52 m		MW07-7-3	N		400		
4									
5				MW07-7-4	N		475		
6									
2				MW07-7-5	Y		500		
7									
8				MW07-7-6	N		425		
9									
10	3			MW07-7-7	N		295		
11									
12									
13	4			MW07-7-8	N		150		
14									
15			94.84 4.57	MW07-7-9	Y		150		
16		End of Log							

Well location: MW07-7	Well casing diameter: 5 cm	Depth of well (TOC): 3.519 m
Depth to water level (TOC): 1.284 m	Well casing material: PVC	Well Elevation (TOC): 99.350 m
Date of water level: August 15, 2007	Well screen slot size: 0.025 cm	Ground Elevation: 99.410 m
Borehole diameter: 15 cm	Well screen interval (bgs): 0.61 to 3.66 m	



**Log of Monitoring Well: MW07-8**

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Rocky Mountain Soil Sampling

Client: PMV

Drilling Method: Solid Stem Augering

Date Drilled: August 15, 2007

Logged by: CMI

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE			SAMPLE					Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour ppm		LEL %
							0 250 500	0 50 100	
-2		Ground Surface	99.43						
0		ASPHALT and GRAVEL FILL	0.00						
1		SAND sand (medium to fine grained), trace silt, brown, loose, poorly graded, moist, no odour, no staining	99.28 0.15	MW07-8-1	N		25		
3		SILTY SAND sand (medium to coarse grained), silty, brown, loose, poorly graded, no odour, no staining	98.52 0.91	MW07-8-2	N		95		
5		SILT silt, trace sand (medium to fine grained), dark grey, medium stiff, poorly graded, moist to wet, PHC odour, no staining, wood fragments observed, orange mottling from 1.32 to 2.74 m	98.11 1.32	MW07-8-3	N		350		
7				MW07-8-4	N		200		
8				MW07-8-5	Y		450		
10				MW07-8-6	N		130		
11				MW07-8-7	Y		100		
12		End of Log	95.78 3.66						

Well location: MW07-8	Well casing diameter: 5 cm	Depth of well (TOC): 3.014 m
Depth to water level (TOC): 1.379 m	Well casing material: PVC	Well Elevation (TOC): 99.433 m
Date of water level: August 15, 2007	Well screen slot size: 0.025 cm	Ground Elevation: 99.500 m
Borehole diameter: 15 cm	Well screen interval (bgs): 0.61 to 3.05 m	

# Log of Monitoring Well: MW07-9

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Rocky Mountain Soil Sampling

Client: PMV

Drilling Method: Pionjar

Date Drilled: August 15, 2007

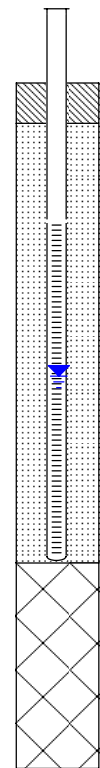
Logged by: CMI

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE			SAMPLE					Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour		LEL
							ppm		%
		Ground Surface	98.52						
0		<b>SAND</b> sand (medium to coarse grained), brown, loose, poorly graded, moist, no odour, no staining, cobbles and roots at surface	0.00	MW07-9-1	N		65		
1									
2									
3									
4				MW07-9-2	N		100		
5									
6		<b>SILT</b> silt, trace sand (medium to fine grained), dark grey, firm, poorly graded, moist to wet, no odour, no staining, wood fragments observed from 1.83 to 2.23 m	96.81						
7			1.70	MW07-9-3	Y		150		
8		<b>SANDY SILT</b> sand (fine to coarse grained), dark grey, firm, wet, no odour, no staining, wood fragments observed from 2.8 to 3.0 m	96.23						
9			2.29	MW07-9-4	N		80		
10				MW07-9-5	Y		200		
11									
12		End of Log	94.86						
13			3.66						
14									
15									
16									



Well location: MW07-9	Well casing diameter: 2.5 cm	Depth of well (TOC): 2.232 m
Depth to water level (TOC): 1.300 m	Well casing material: PVC	Well Elevation (TOC): 98.515
Date of water level: August 15, 2007	Well screen slot size: 0.025 cm	Ground Elevation: 98.515
Borehole diameter: 5 cm	Well screen interval (bgs): 0.61 to 2.13 m	

# Log of Monitoring Well: MW08-10

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Beck Drilling

Client: PMV

Drilling Method: Solid Stem Augering

Date Drilled: September 16, 2008

Logged by: AN

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE				SAMPLE					Backfill details
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour	LEL	
							ppm	%	
		Ground Surface	99.43						
		ASPHALT and GRAVEL FILL	0.00 99.28						
		SAND sand (medium to fine grained), trace silt, yellowish brown, medium dense, homogeneous, dry to moist, no odour, no staining, black mottling at 0.45 m	0.15	MW08-10-1	N		25		
				MW08-10-2	N		30		
		SAND sand (medium to fine grained), trace silt, dark grey, medium dense, homogeneous, moist to wet, no odour, no staining, wood fragments observed at 2.6 m	97.60 1.83				60		
				MW08-10-3	Y		60		
		SILT silt, some sand (medium to fine grained), dark grey, soft, homogeneous, wet, no odour, no staining	96.54 2.90				50		
				MW08-10-4	Y		50		
		End of Log	94.86 4.57						

<b>Well location:</b> MW08-10	<b>Well casing diameter:</b> 5 cm	<b>Depth of well (TOC):</b> 4.57 m
<b>Depth to water level (TOC):</b> 2.063 m	<b>Well casing material:</b> PVC	<b>Well Elevation (TOC):</b> 99.330 m
<b>Date of water level:</b> September 22, 2008	<b>Well screen slot size:</b> 0.025 cm	<b>Ground Elevation:</b> 99.467 m
<b>Borehole diameter:</b> 15 cm	<b>Well screen interval (bgs):</b> 0.91 to 3.96 m	

**Log of Monitoring Well: MW08-11**

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Beck Drilling

Client: PMV

Drilling Method: Hollow/Solid Stem Augering

Date Drilled: September 16, 2008

Logged by: AN

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE			SAMPLE					Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour		LEL
							ppm		%
		Ground Surface	99.45						
		ASPHALT and GRAVEL FILL	0.00 99.30						
		SAND sand (medium to fine grained), trace silt, yellowish brown, medium dense, homogeneous, dry to moist, no odour, no staining	0.15	MW08-11-1	N		10		
		SAND sand (medium to fine grained), trace silt, dark grey, medium dense, homogeneous, moist to wet, no odour, no staining, wood fragments and peat observed from 2.6 to 3.05 m	98.53 0.91						
				MW08-11-2	Y		50		
				MW08-11-3	N		50		
		SILT silt, some sand (medium to fine grained), dark grey, soft, homogeneous, wet, no odour, no staining	96.71 2.74	MW08-11-4	Y		30		
		End of Log	95.49 3.96						

Well location: MW08-11	Well casing diameter: 5 cm	Depth of well (TOC): 3.96 m
Depth to water level (TOC): 1.926 m	Well casing material: PVC	Well Elevation (TOC): 99.394 m
Date of water level: September 22, 2008	Well screen slot size: 0.025 cm	Ground Elevation: 99.449 m
Borehole diameter: 15 cm	Well screen interval (bgs): 0.91 to 3.96 m	

**Log of Borehole: BH08-12**

**Project Name/No:** Brownsville Phase 2 / 405-003.04

**Logged by:** AN

**Client:** PMV

**Drilling Method:** Solid Stem Augering

**Date Drilled:** September 16, 2008

**Drilling Company:** Beck Drilling

**Site Location:** Surrey, BC



**Sheet:** 1 of 1

SUBSURFACE PROFILE				SAMPLE				Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour ppm		LEL %
-2									
-1									
0		Ground Surface	99.51						
0	■	ASPHALT and GRAVEL FILL	0.00 99.36						
1	●	SAND sand (medium to fine grained), trace silt, yellowish brown, medium dense, homogeneous, dry to moist, no odour, no staining	0.15	BH08-12-1	N	●	25		
2									
3	●	SAND sand (medium to fine grained), trace silt, dark grey, medium dense, homogeneous, moist, PHC odour, black staining at 0.9 m	98.60 0.91	BH08-12-2	N	●		5.0	
4									
5	●			BH08-12-3	Y	●		10.0	
6	■	SILT silt, some sand (medium to fine grained), dark grey, soft, homogeneous, moist to wet, PHC odour, no staining, wood fragments at 1.8 to 2.4 m	97.83 1.68	BH08-12-4	Y	●		5.0	
7									
8									
9									
10	■	End of Log	96.46 3.05						
11									
12									
13	●								
14									
15									
16									

**Borehole location:** BH08-12

**Borehole diameter:** 15 cm

**Borehole ground elevation:** 99.510 m

**Borehole depth:** 3.05 m

**Log of Monitoring Well: MW08-13**

Project Name/No: Brownsville Phase 2 / 405-003.04

Drilling Company: Beck Drilling

Client: PMV

Drilling Method: Solid Stem Augering

Date Drilled: September 16, 2008

Logged by: AN

Site Location: Surrey, BC



Sheet: 1 of 1

SUBSURFACE PROFILE			SAMPLE					Backfill details	
Depth	Symbol	Description	Depth/Elev (m)	Sample ID	Analysed Y,N	Sample Type	Vapour ppm		LEL %
							0 250 500	0 50 100	
ft m									
-2									
-1									
0		Ground Surface	99.57						
		ASPHALT and GRAVEL FILL	0.00 99.42						
		SAND sand (medium to fine grained), trace silt, trace gravel, yellowish brown, medium dense, homogeneous, dry to moist, no odour, no staining	0.15				20		
1				MW08-13-1	N				
2									
3		SAND sand (medium to fine grained), trace silt, trace gravel, dark grey, medium dense, poorly graded, moist to wet, no odour, no staining	98.66 0.91				140		
4				MW08-13-2	Y				
5									
6		SILT silt, some sand (medium to fine grained), dark grey, soft, homogeneous, wet, no odour, no staining, peat observed at 1.85 m	97.74 1.83				80		
7				MW08-13-3	N				
8									
9									
10									
11									
12									
13				MW08-13-4	Y		35		
14									
15									
16									
		End of Log	95.61 3.96				30		
				MW08-13-5	Y				

Well location: MW08-13	Well casing diameter: 5 cm	Depth of well (TOC): 3.96 m
Depth to water level (TOC): 1.952 m	Well casing material: PVC	Well Elevation (TOC): 99.520 m
Date of water level: September 22, 2008	Well screen slot size: 0.025 cm	Ground Elevation: 99.572 m
Borehole diameter: 15 cm	Well screen interval (bgs): 0.91 to 3.96 m	

**APPENDIX B**  
**Laboratory Reports**

# Analysis Report



**REPORT ON:** Analysis of Soil Samples

**REPORTED TO:** Hemmera Envirochem Inc.  
250-1380 Burrard St  
Vancouver, BC  
V6Z 2H3

Att'n: Seth Kingsbury

**CHAIN OF CUSTODY:** 2090793, 2036847, 2036824

**PROJECT NAME:** FKPA Brownsville

**PROJECT NUMBER:** 405-003.03

---

**NUMBER OF SAMPLES:** 9 **REPORT DATE:** August 27, 2007

**DATE SUBMITTED:** August 16, 2007 **GROUP NUMBER:** 80817021

**SAMPLE TYPE:** Soil

**NOTE:** Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

## TEST METHODS:

**Volatile Hydrocarbons (VH) in Soil** - analysis was performed using B.C. MOELP CSR-Analytical Method 1 "Volatile Hydrocarbons in Solids by GC/FID" approved August 12, 1999. The method involves methanol extraction and direct injection GC/FID analysis; components ranging from C6 to C10 are quantitated against m-xylene and 1,2,4-trimethylbenzene.

**Volatile Petroleum Hydrocarbons (VPH) in Soil** - results were obtained using B.C. MOELP CSR-Analytical Method Method 5 "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water (VPH)" approved August 12, 1999. VPH is calculated by subtraction of specified MAH compounds from VH concentrations.

**Volatile Organic Compounds in Soil** - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving methanol extraction, and direct injection/GCMS analysis.


**Moisture in Soil** - analysis was performed gravimetrically by heating a separate sample portion at 105 C and measuring the weight loss.

**Extractable Petroleum Hydrocarbons in Water/Soil (LEPH/HEPH-GNS)** - analysis was performed using a draft extraction-GC/FID procedure specified by the B.C. MOELP. Compounds eluting between n-decane (n-C10) and n-nonadecane (n-C19) are defined as Light Extractable Petroleum Hydrocarbons (LEPH). Compounds eluting between n-nonadecane and n-dotriacontane (n-C32) are defined as Heavy Extractable Petroleum Hydrocarbons (HEPH). The results can be compared to Generic Numerical Standard (GNS) criteria. The report states if results were corrected for specified PAH's, & if silica gel cleanup was used.

## TEST RESULTS:

(See following pages)

CANTEST LTD.

  
a/r Zhenyong Gao, M.Sc.  
Coordinator, Trace Organics



REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Conventional Parameters in Soil**

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Moisture
MW07-7-5	Aug 15/07	708170056	25.2
MW07-7-9	Aug 15/07	708170057	29.0
MW-600	Aug 15/07	708170058	25.1
MW07-8-7	Aug 15/07	708170059	28.1
MW07-6-4	Aug 15/07	708170060	26.8
MW07-6-7	Aug 15/07	708170061	26.7
MW07-9-3	Aug 15/07	708170062	27.6
MW07-9-5	Aug 15/07	708170063	26.1
MW07-8-5	Aug 15/07	708170064	25.6
DETECTION LIMIT UNITS			0.1 %

% = percent

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil**

CLIENT SAMPLE IDENTIFICATION:	MW07-7-5	MW07-7-9	MW-600	MW07-8-7	
DATE SAMPLED:	Aug 15/07	Aug 15/07	Aug 15/07	Aug 15/07	
CANTEST ID:	708170056	708170057	708170058	708170059	DETECTION LIMIT
Benzene	<	<	<	<	0.04
Ethylbenzene	<	<	<	<	0.5
Toluene	<	<	<	<	0.5
Xylenes	<	<	<	<	0.1
Styrene	<	<	<	<	0.1

Results expressed as micrograms per gram, on a dry weight basis. ( $\mu\text{g/g}$ )

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil**

CLIENT SAMPLE IDENTIFICATION:	MW07-6-4	MW07-6-7	MW07-9-3	MW07-9-5	
DATE SAMPLED:	Aug 15/07	Aug 15/07	Aug 15/07	Aug 15/07	
CANTEST ID:	708170060	708170061	708170062	708170063	DETECTION LIMIT
Benzene	<	<	<	<	0.04
Ethylbenzene	<	<	<	<	0.5
Toluene	<	<	<	<	0.5
Xylenes	<	<	<	<	0.1
Styrene	<	<	<	<	0.1

Results expressed as micrograms per gram, on a dry weight basis. ( $\mu\text{g/g}$ )

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil**

CLIENT SAMPLE IDENTIFICATION:	MW07-8-5	
DATE SAMPLED:	Aug 15/07	
CANTEST ID:	708170064	DETECTION LIMIT
Benzene	<	0.04
Ethylbenzene	<	0.5
Toluene	<	0.5
Xylenes	<	0.1
Styrene	<	0.1

Results expressed as micrograms per gram, on a dry weight basis. ( $\mu\text{g/g}$ )

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Monocyclic Aromatic Hydrocarbons-Methanol Extraction- in Soil**

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Volatile Hydrocarbons VHS6-10	VPHs
MW07-7-5	Aug 15/07	708170056	<	<
MW07-7-9	Aug 15/07	708170057	<	<
MW-600	Aug 15/07	708170058	<	<
MW07-8-7	Aug 15/07	708170059	<	<
MW07-6-4	Aug 15/07	708170060	960	960
MW07-6-7	Aug 15/07	708170061	110	110
MW07-9-3	Aug 15/07	708170062	<	<
MW07-9-5	Aug 15/07	708170063	<	<
MW07-8-5	Aug 15/07	708170064	110	110
DETECTION LIMIT UNITS			100 $\mu\text{g/g}$	100 $\mu\text{g/g}$

$\mu\text{g/g}$  = micrograms per gram, on a dry weight basis.

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Extractable Petroleum Hydrocarbons - Silica-gel Cleanup in Soil**

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	EPHs10-19 (Silica-gel treated)	EPHs19-32 (Silica-gel treated)
MW07-7-5	Aug 15/07	708170056	390	<
MW07-6-4	Aug 15/07	708170060	770	<
MW07-9-3	Aug 15/07	708170062	<	<
MW07-8-5	Aug 15/07	708170064	<	<
DETECTION LIMIT UNITS			250 $\mu\text{g/g}$	250 $\mu\text{g/g}$

$\mu\text{g/g}$  = micrograms per gram, on a dry weight basis.

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



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**Batch Quality Control for Monocyclic Aromatic Hydrocarbons-Methanol Extraction- in Soil (QC# 97707)**

Parameter	Blank (ug/g)	Blank Limits
Volatile Hydrocarbons VHs6-10	< .100	100

ug/g = micrograms per gram

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



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Instrument Quality Control for the HP Dir Inj GC-FID/MS 1119-1118 (QC# 191036)

QC Type: Detection Limit Check Standard

Parameter	% Recovery	Limits
Volatile Hydrocarbons VHS6-10	101	50 - 150



REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Batch Quality Control for Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil (QC# 97707)**

Parameter	Blank (ug/g)	Blank Limits	Method Performance Check Spike (% Recovery)	Method Performance Check Spike Limits
Benzene	< 0.04	0.04	80	58 - 126
Ethylbenzene	< 0.5	0.5	81	66 - 116
Toluene	< 0.5	0.5	83	76 - 124

ug/g = micrograms per gram

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817021



**Batch Quality Control Frequency Summary**

MeOH Extr'n Prep BTEX/VPH Soil (Batch# 97707)

QC Type	No. Samples
Blank	1
Method Performance Check Spike	1

EPH (LEPH/HEPH)- Soil Prep (Batch# 97769)

QC Type	No. Samples
Blank	1
Cert Ref Material RTC CRM355	1
Duplicate	1
Method Performance Check Spike	1

MeOH Extr'n Prep BTEX/VPH Soil (Batch# 97707)

QC Type	No. Samples
Batch Size	48

EPH (LEPH/HEPH)- Soil Prep (Batch# 97769)

QC Type	No. Samples
Batch Size	18

# AUTO FAX

## COVER SHEET

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CanTest Ltd.

Professional  
Analytical  
Services

4606 Canada Way  
Burnaby, BC  
V5G 1K5

Fax: 604 731 2386

Tel: 604 734 7276

1 800 665 8566

Date: September 22, 2008  
To: Hemmera Envirochem Inc.  
Att'n: Seth Kingsbury  
From: LINKS Automatic Fax  
Subject: Analytical results for Group# 90917051

### MESSAGE:

The analytical results on these pages are being sent to you via the CANTEST Laboratory Information News and Knowledge System (LINKS) "AutoFax" service. This transmission includes data submitted under the following project information:

CANTEST Group# 90917051  
Project Name: Brownsville  
Project Number: 405-003.04  
Submission Date: September 17, 2008  
Matrix: Soil

A signed final report and invoice will be sent within two weeks.

Thank you for considering CANTEST for your analytical needs. Please feel free to contact a Technical Service Representative at (604) 734-7276 (1-800-665-8566) should you have any questions about the LINKS "AutoFax" or any other CANTEST services.



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REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 22, 2008

GROUP NUMBER: 90917051

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**Conventional Parameters in Soil**

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Moisture
BH08-12.3	Sep 16/08	809170309	28.9
BH08-12.4	Sep 16/08	809170320	25.7
BH08-12.5	Sep 16/08	809170321	22.9
MW08-13.2	Sep 16/08	809170323	15.6
MW08-13.4	Sep 16/08	809170324	27.8
MW08-13.5	Sep 16/08	809170325	26.4
MW08-10.3	Sep 16/08	809170328	25.0
MW08-10.4	Sep 16/08	809170329	23.5
MW08-11.2	Sep 16/08	809170330	21.3
MW08-11.4	Sep 16/08	809170331	25.1
DETECTION LIMIT UNITS			0.1 %

% = percent

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 22, 2008

GROUP NUMBER: 90917051

**Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil**

CLIENT SAMPLE IDENTIFICATION:	BH08-12.3	BH08-12.4	BH08-12.5	MW08-13.2	DETECTION LIMIT
DATE SAMPLED:	Sep 16/08	Sep 16/08	Sep 16/08	Sep 16/08	
CANTEST ID:	809170309	809170320	809170321	809170323	
Benzene	<	<	<	<	
Ethylbenzene	<	<	<	<	0.5
Toluene	<	<	<	<	0.5
Xylenes	<	<	<	<	0.1
Styrene	<	<	<	<	0.1

Results expressed as micrograms per gram, on a dry weight basis. (µg/g)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 22, 2008

GROUP NUMBER: 90917051

**Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil**

CLIENT SAMPLE IDENTIFICATION:	MW08-13.4	MW08-13.5	MW08-10.3	MW08-10.4	DETECTION LIMIT
DATE SAMPLED:	Sep 16/08	Sep 16/08	Sep 16/08	Sep 16/08	
CANTEST ID:	809170324	809170325	809170328	809170329	
Benzene	<	<	<	<	0.04
Ethylbenzene	<	<	<	<	0.5
Toluene	<	<	<	<	0.5
Xylenes	<	<	<	<	0.1
Styrene	<	<	<	<	0.1

Results expressed as micrograms per gram, on a dry weight basis. (µg/g)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 22, 2008

GROUP NUMBER: 90917051

Monocyclic Volatile Hydrocarbons-Direct Injection- in Soil

CLIENT SAMPLE IDENTIFICATION:	MW08-11.2	MW08-11.4	
DATE SAMPLED:	Sep 16/08	Sep 16/08	
CANTEST ID:	809170330	809170331	DETECTION LIMIT
Benzene	<	<	0.04
Ethylbenzene	<	<	0.5
Toluene	<	<	0.5
Xylenes	<	<	0.1
Styrene	<	<	0.1

Results expressed as micrograms per gram, on a dry weight basis. (µg/g)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 22, 2008

GROUP NUMBER: 90917051

**Monocyclic Aromatic Hydrocarbons-Methanol Extraction- in Soil**

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	Volatile Hydrocarbons VHS6-10	VPHs
BH08-12.3	Sep 16/08	809170309	1200	1200
BH08-12.4	Sep 16/08	809170320	170	170
BH08-12.5	Sep 16/08	809170321	3000	3000
MW08-13.2	Sep 16/08	809170323	<	<
MW08-13.4	Sep 16/08	809170324	<	<
MW08-13.5	Sep 16/08	809170325	<	<
MW08-10.3	Sep 16/08	809170328	<	<
MW08-10.4	Sep 16/08	809170329	<	<
MW08-11.2	Sep 16/08	809170330	<	<
MW08-11.4	Sep 16/08	809170331	<	<
DETECTION LIMIT UNITS			100 µg/g	100 µg/g

µg/g = micrograms per gram, on a dry weight basis.  
 < = Less than detection limit



**Analysis Report**

CANTEST LTD.

Professional  
Analytical  
Services4606 Canada Way  
Burnaby, B.C.  
V5G 1K5

FAX: 604 731 2386

TEL: 604 734 7276

1 800 665 8566

**REPORT ON:** Analysis of Soil Samples**REPORTED TO:** Hemmera Envirochem Inc.  
250-1380 Burrard St  
Vancouver, BC  
V6Z 2H3**Att'n: Seth Kingsbury****CHAIN OF CUSTODY:** 2042054, 2042053  
**PROJECT NAME:** Brownsville  
**PROJECT NUMBER:** 405-003.04  
**P.O. NUMBER:** 4629**NUMBER OF SAMPLES:** 10**REPORT DATE:** September 22, 2008**DATE SUBMITTED:** September 17, 2008**GROUP NUMBER:** 90917051**SAMPLE TYPE:** Soil**NOTE:** Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.**TEST METHODS:**

**Volatile Hydrocarbons (VH) in Soil** - analysis was performed using B.C. MOELP CSR-Analytical Method 1 "Volatile Hydrocarbons in Solids by GC/FID" approved August 12, 1999. The method involves methanol extraction and direct injection GC/FID analysis; components ranging from C6 to C10 are quantitated against m-xylene and 1,2,4-trimethylbenzene.

**Volatile Petroleum Hydrocarbons (VPH) in Soil** - results were obtained using B.C. MOELP CSR-Analytical Method Method 5 "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water (VPH)" approved August 12, 1999. VPH is calculated by subtraction of specified MAH compounds from VH concentrations.

**Volatile Organic Compounds in Soil** - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving methanol extraction, and direct injection/GCMS analysis.

**Moisture in Soil** - analysis was performed gravimetrically by heating a separate sample portion at 105 C and measuring the weight loss.

**TEST RESULTS:**

(See following pages)

CANTEST LTD.

# Analysis Report



**REPORT ON:** Analysis of Water Samples

**REPORTED TO:** Hemmera Envirochem Inc.  
250-1380 Burrard St  
Vancouver, BC  
V6Z 2H3

Att'n: Seth Kingsbury

**CHAIN OF CUSTODY:** 2036823  
**PROJECT NAME:** FRPA Brownsville  
**PROJECT NUMBER:** 405-003.03

---

**NUMBER OF SAMPLES:** 6

**REPORT DATE:** August 27, 2007

**DATE SUBMITTED:** August 16, 2007

**GROUP NUMBER:** 80817037

**SAMPLE TYPE:** Water

**NOTE:** Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.

**TEST METHODS:**

**Volatile Organic Compounds in Water and Soil** - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving sparging with a Purge and Trap apparatus and analysis using GC/MS.


**Volatile Hydrocarbons (VH) and Volatile Petroleum Hydrocarbons (VPH) in Water** - analysis was performed using B.C. MOELP CSR-Analytical Method 2 "Volatile Hydrocarbons in Water by GC/FID" and CSR-Analytical Method 5 "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water (VPH)" approved August 12, 1999. The method involves sparging/collection using a Purge & Trap apparatus with GC/MS analysis; VH components ranging from C6 to C10 are quantified against m-xylene and 1,2,4-trimethylbenzene. VPH is calculated by subtraction of specified MAH compounds from VH concentrations.

**Extractable Petroleum Hydrocarbons and Light and Heavy Extractable Petroleum Hydrocarbons in Water** - analysis was performed using B.C. MOELP CSR-Analytical Method 4 "Extractable Petroleum Hydrocarbons in Water by GC/FID" and CSR-Analytical Method 6 "Calculation of Light and Heavy Extractable Petroleum Hydrocarbons in Solids or Water (LEPH & HEPH)". The method involves DCM extraction and GC/FID analysis. EPH components ranging from C10 to C19 and C19 to C32 are quantified against eicosane (n-C20). LEPH & HEPH are calculated by subtraction of specified PAH's.

**TEST RESULTS:**

(See following pages)

CANTEST LTD.

  
Zhenyong Gao, M.Sc.  
Coordinator, Trace Organics

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817037



**Monocyclic Aromatic Hydrocarbons in Water**

CLIENT SAMPLE IDENTIFICATION:	MW07-6	MW07-7	MW07-8	MW07-9	
DATE SAMPLED:	Aug 16/07	Aug 16/07	Aug 16/07	Aug 16/07	
CANTEST ID:	708170107	708170111	708170115	708170118	
ANALYSIS DATE:	Aug 17/07	Aug 17/07	Aug 17/07	Aug 17/07	DETECTION LIMIT
Benzene	< 0.5	< 1	<	<	0.1
Ethylbenzene	1.2	< 1	0.4	<	0.1
Toluene	< 0.5	1.7	0.3	<	0.1
Xylenes	4.4	2.9	2.0	<	0.1
Volatile Hydrocarbons VHW6-10	3600	1700	590	<	100
VPHw	3600	1700	590	<	100
Styrene	< 0.5	< 1	<	<	0.1
<b>Surrogate Recovery</b>					
Toluene-d8	115	108	95	95	-
Bromofluorobenzene	90	87	93	82	-

Results expressed as micrograms per liter ( $\mu\text{g/L}$ )

Surrogate recoveries expressed as percent (%)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817037



**Monocyclic Aromatic Hydrocarbons in Water**

<b>CLIENT SAMPLE IDENTIFICATION:</b>	<b>MW1000</b>	
<b>DATE SAMPLED:</b>	Aug 16/07	
<b>CANTEST ID:</b>	708170139	
<b>ANALYSIS DATE:</b>	Aug 17/07	<b>DETECTION LIMIT</b>
Benzene	1.9	0.1
Ethylbenzene	0.8	0.1
Toluene	1.8	0.1
Xylenes	3.8	0.1
Volatile Hydrocarbons VHW6-10	1400	100
VPHw	1400	100
Styrene	<	0.1
<b>Surrogate Recovery</b>		
Toluene-d8	103	-
Bromofluorobenzene	84	-

Results expressed as micrograms per liter ( $\mu\text{g/L}$ )

Surrogate recoveries expressed as percent (%)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817037



**Extractable Petroleum Hydrocarbons (EPH) in Water**

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	EPHw10-19	EPHw19-32
MW07-6	Aug 16/07	708170107	2300	<
MW07-7	Aug 16/07	708170111	1700	300
MW07-8	Aug 16/07	708170115	1400	<
MW07-9	Aug 16/07	708170118	<	<
MW900	Aug 16/07	708170120	1900	<
DETECTION LIMIT UNITS			250 $\mu\text{g/L}$	250 $\mu\text{g/L}$

$\mu\text{g/L}$  = micrograms per liter  
< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817037



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**Batch Quality Control for Extractable Petroleum Hydrocarbons (EPH) in Water (QC# 97840)**

Parameter	Blank (ug/L)	Blank Limits
EPHw10-19	< 250	250
EPHw19-32	< 250	250

ug/L = micrograms per liter

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817037



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**Instrument Quality Control for the HP5890GC + ECD(PCB) or FID(EPH) (QC# 191322)**

QC Type: Detection Limit Check Standard

Parameter	% Recovery	Limits
EPHw10-19	64	50 - 150
EPHw19-32	80	50 - 150

REPORTED TO: Hemmera Envirochem Inc.

REPORT DATE: August 27, 2007

GROUP NUMBER: 80817037



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**Batch Quality Control Frequency Summary**

TEH/EPH Water Preparation (Batch# 97840)

QC Type	No. Samples
Blank	1
Method Performance Check Spike	1

Volatiles Analysis (Batch# 97760)

QC Type	No. Samples
Batch Size	21

TEH/EPH Water Preparation (Batch# 97840)

QC Type	No. Samples
Batch Size	17



# AUTO FAX

## COVER SHEET



CanTest Ltd.

Professional  
Analytical  
Services

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Burnaby, BC  
V5G 1K5

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1 800 665 8566

Date: September 30, 2008  
To: Hemmera Envirochem Inc.  
Att'n: Seth Kingsbury  
From: LINKS Automatic Fax  
Subject: Analytical results for Group# 90923148

### MESSAGE:

The analytical results on these pages are being sent to you via the CANTEST Laboratory Information News and Knowledge System (LINKS) "AutoFax" service. This transmission includes data submitted under the following project information:

CANTEST Group# 90923148  
Project Name: Brownsville  
Project Number: 405-003.04  
Submission Date: September 23, 2008  
Matrix: Water

A signed final report and invoice will be sent within two weeks.

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REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 30, 2008

GROUP NUMBER: 90923148

**Monocyclic Aromatic Hydrocarbons in Water**

CLIENT SAMPLE IDENTIFICATION:	MW08-2	MW08-6	MW08-7	MW08-8	DETECTION LIMIT
DATE SAMPLED:	Sep 22/08	Sep 22/08	Sep 22/08	Sep 22/08	
CANTEST ID:	809230761	809230762	809230763	809230764	
ANALYSIS DATE:	Sep 25/08	Sep 25/08	Sep 25/08	Sep 25/08	
Benzene	5.8	<	1.9	<	
Ethylbenzene	1.1	<	0.6	<	0.1
Toluene	2.8	<	1.7	<	0.1
Xylenes	2.9	<	2.6	<	0.1
Volatile Hydrocarbons VHw6-10	1000	1100	600	<	100
VPHw	990	1100	590	<	100
Styrene	<	<	<	<	0.1
<b>Surrogate Recovery</b>					
Toluene-d8	103	102	102	97	-
Bromofluorobenzene	92	95	95	92	-

Results expressed as micrograms per liter ( $\mu\text{g/L}$ )

Surrogate recoveries expressed as percent (%)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 30, 2008

GROUP NUMBER: 90923148

**Monocyclic Aromatic Hydrocarbons in Water**

CLIENT SAMPLE IDENTIFICATION:	MW08-9	MW08-10	MW08-11	MW08-12	DETECTION LIMIT
DATE SAMPLED:	Sep 22/08	Sep 22/08	Sep 22/08	Sep 22/08	
CANTEST ID:	809230765	809230766	809230767	809230768	
ANALYSIS DATE:	Sep 25/08	Sep 25/08	Sep 25/08	Sep 25/08	
Benzene	<	<	<	2.1	0.1
Ethylbenzene	<	<	<	0.6	0.1
Toluene	<	<	<	2.0	0.1
Xylenes	<	<	<	2.7	0.1
Volatile Hydrocarbons VHW6-10	<	<	<	790	100
VPHw	<	<	<	780	100
Styrene	<	<	<	<	0.1
<b>Surrogate Recovery</b>					
Toluene-d8	95	94	94	102	-
Bromofluorobenzene	96	97	95	95	-

Results expressed as micrograms per liter ( $\mu\text{g/L}$ )

Surrogate recoveries expressed as percent (%)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 30, 2008

GROUP NUMBER: 90923148

**Monocyclic Aromatic Hydrocarbons in Water**

CLIENT SAMPLE IDENTIFICATION:	MW08-13	
DATE SAMPLED:	Sep 22/08	
CANTEST ID:	809230769	
ANALYSIS DATE:	Sep 25/08	DETECTION LIMIT
Benzene	<	0.1
Ethylbenzene	<	0.1
Toluene	<	0.1
Xylenes	<	0.1
Volatile Hydrocarbons VHw6-10	<	100
VPHw	<	100
Styrene	<	0.1
<b>Surrogate Recovery</b>		
Toluene-d8	94	-
Bromofluorobenzene	92	-

Results expressed as micrograms per liter ( $\mu\text{g/L}$ )

Surrogate recoveries expressed as percent (%)

< = Less than detection limit

REPORTED TO: Hemmera Envirochem Inc.



REPORT DATE: September 30, 2008

GROUP NUMBER: 90923148

## Extractable Petroleum Hydrocarbons - Silica-gel Cleanup in Water

CLIENT SAMPLE IDENTIFICATION:	SAMPLE DATE	CANTEST ID	EPHw10-19 (Silica-gel treated)	EPHw19-32 (Silica-gel treated)
MW08-2	Sep 22/08	809230761	870	<
MW08-6	Sep 22/08	809230762	700	<
MW08-7	Sep 22/08	809230763	1700	<
MW08-8	Sep 22/08	809230764	<	<
MW08-9	Sep 22/08	809230765	<	<
MW08-10	Sep 22/08	809230766	<	<
MW08-11	Sep 22/08	809230767	<	<
MW08-12	Sep 22/08	809230768	1900	<
MW08-13	Sep 22/08	809230769	<	<
DETECTION LIMIT UNITS			250 µg/L	250 µg/L

µg/L = micrograms per liter

&lt; = Less than detection limit

**Analysis Report**

CANTEST LTD.

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1 800 665 8566

**REPORT ON:** Analysis of Water Samples**REPORTED TO:** Hemmera Envirochem Inc.  
250-1380 Burrard St  
Vancouver, BC  
V6Z 2H3**Att'n: Seth Kingsbury****CHAIN OF CUSTODY:** 2124930  
**PROJECT NAME:** Brownsville  
**PROJECT NUMBER:** 405-003.04  
**P.O. NUMBER:** 4629**NUMBER OF SAMPLES:** 9**REPORT DATE:** September 30, 2008**DATE SUBMITTED:** September 23, 2008**GROUP NUMBER:** 90923148**SAMPLE TYPE:** Water**NOTE:** Results contained in this report refer only to the testing of samples as submitted. Other information is available on request.**TEST METHODS:****Volatile Organic Compounds in Water and Soil - analysis was performed using procedures based on U.S. EPA Methods 624/8240/8260, involving sparging with a Purge and Trap apparatus and analysis using GC/MS.****Volatile Hydrocarbons (VH) and Volatile Petroleum Hydrocarbons (VPH) in Water - analysis was performed using B.C. MOELP CSR-Analytical Method 2 "Volatile Hydrocarbons in Water by GC/FID" and CSR-Analytical Method 5 "Calculation of Volatile Petroleum Hydrocarbons in Solids or Water (VPH)" approved August 12, 1999. The method involves sparging/collection using a Purge & Trap apparatus with GC/MS analysis; VH components ranging from C6 to C10 are quantified against m-xylene and 1,2,4-trimethylbenzene. VPH is calculated by subtraction of specified MAH compounds from VH concentrations.****Extractable Petroleum Hydrocarbons in Water/Soil (LEPH/HEPH-GNS) - analysis was performed using a draft extraction-GC/FID procedure specified by the B.C. MOELP. Compounds eluting between n-decane (n-C10) and n-nonadecane (n-C19) are defined as Light Extractable Petroleum Hydrocarbons (LEPH). Compounds eluting between n-nonadecane and n-dotriacontane (n-C32) are defined as Heavy Extractable Petroleum Hydrocarbons (HEPH). The results can be compared to Generic Numerical Standard (GNS) criteria. The report states if results were corrected for specified PAH's, & if silica gel cleanup was used.****COMMENTS:****Samples received at 14.4 degrees Celsius.****TEST RESULTS:****(See following pages)**

CANTEST LTD.



# Supplemental Site Investigation Surrey Brownsville Site (Lots 2, 3, 4, 5, 6) Surrey, BC

June 2013

Project #: 2090-1103

**Prepared for:**

Vancouver Fraser Port Authority  
100 The Pointe, 999 Canada Place  
Vancouver, BC V6C 3T4



Franz Environmental Inc.  
308 – 1080 Mainland Street  
Vancouver, BC V6B 2T4  
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**SUPPLEMENTAL SITE INVESTIGATION**

**SURREY BROWNSVILLE SITE (LOTS 2, 3, 4, 5, 6)  
SURREY, BC**

Prepared for:  
Vancouver Fraser Port Authority  
100 The Pointe, 999 Canada Place  
Vancouver, BC V6C 3T4

Prepared by:  
Franz Environmental Inc.  
308 -1080 Mainland Street  
Vancouver, BC V6B 2T4

Project No. 2090-1103  
June 2013



## EXECUTIVE SUMMARY

The following represent key localized or site wide areas of environmental concern (AECs) identified at the Surrey Brownsville Site (Lots 2,3,4,5 and 6) through FRANZ's 2011 Supplemental Site Investigation (SSI). These issues will be carried forward and evaluated with respect to risks to receptors in a subsequent human health and ecological risk assessment. Long term management or remedial options will be prepared for the Site based on the outcomes of the risk assessment.

### **Site or Area Wide Issues**

- **Groundwater Metals** - Concentrations of multiple metals (aluminum, arsenic, antimony, barium, cadmium, chromium, copper, iron, lead, manganese, mercury, nickel, selenium, titanium, zinc) in groundwater exceed federal Guidelines in monitoring wells across the Site. Groundwater also exceeds provincial Standards/ Guidelines for various metals (aluminum, arsenic, antimony, barium, cadmium, chromium, iron, lead, manganese, nickel, zinc) including at upgradient Site boundaries. Metals exceedances have been identified offsite and the impact area remains undelineated and is expected area wide including on neighboring properties. With metal impacts identified in near shore wells, further characterization of groundwater and surface water interaction at the Fraser River is recommended.
- **Soil PAHs** – PAH parameters (index of additive cancer risk (IACR), naphthalene and phenanthrene) exceed federal soil Guidelines in numerous localized areas across the Site. These low level PAH impacts are expected to be present site-wide and are generally limited to the sandy fill/upper silt intervals (0-4m bgs). Soil from one tested offsite location north of B-Mill (Lot 5) also exceeds federal guidelines for PAHs (naphthalene, phenanthrene, acenaphthene, fluorene and IACR) however this offsite PAH impact may not be originating from onsite sources. Tested onsite and offsite soil does not exceed provincial soil Standards for PAHs.

### **Localized Issues by Lot**

#### ***Lots 2 and 4***

- **Soil Metals** - Soil exceeding federal Guidelines for various metals (chromium, copper, cadmium, nickel, zinc, antimony, arsenic) is present in the area north and west of the tannery on Lot 4 (impact area of 1.6 ha) and at depths of 0.6-4.6 m bgs, for a potential volume estimate of 64,000 m<sup>3</sup>. Onsite soil also exceeds provincial metal Standards (antimony, arsenic, cadmium, chromium, copper, lead, zinc). Soil metals (chromium) exceeding federal and provincial Guidelines/Standards were confirmed southwest of Lots 2 and 4 (offsite) and remain to be horizontally or vertically delineated. Chromium concentrations in soil southwest of Lots 2/4 are expected to be reflective of the previous industrial use of the southwest properties, and not necessarily indicative of offsite migration.

- **Groundwater MAHs and VOCs** - Groundwater exceeds current federal Guidelines for toluene and benzene in one near shore well (100m<sup>2</sup>) in Lot 2. Chlorobenzene and toluene concentrations in this well also exceed provincial water quality guidelines. Based on current groundwater data in the area, it is likely that these exceedances are from historical point sources and are no longer present onsite.
- **Groundwater PAHs** - Pyrene concentrations in one nearshore well in Lot 2 exceeds federal and provincial Guidelines. Low level PAH concentrations in soil are anticipated to be widespread across the Site and there remains a potential for low level PAH concentrations to be present in groundwater site-wide. Given that this well is within 10m of the surface water environment, there remains a potential for migration to the Fraser River. Re-sampling MW2-30 is recommended to verify this result in near shore groundwater.
- **Groundwater Chlorophenols** – Groundwater pentachlorophenol and 2,3,4,6-tetrachlorophenol concentrations exceed federal guidelines in one well at Lot 4, for an 1000m<sup>2</sup> impact area. Groundwater at this location also exceeds provincial Standards for Pentachlorophenol and 2,4,5-trichlorophenol. Chlorophenol impacts are not expected to be migrating off the Lot 2/4 area.

### **Lot 3**

- **Soil Metals** – Soil exceeds federal Guidelines for metals (arsenic, copper, zinc) in one location in the Lot 3 road ditch adjacent to Dyke Road (estimated 10m<sup>2</sup> impact area). Road ditch soil also exceeds provincial Standards for metals (arsenic, copper, and/or zinc) for estimated impact areas of approximately 10m<sup>2</sup> around two road ditch hotspots. Localized hotspots (estimated 10m<sup>2</sup> for each) for metals (chromium, lead and/or zinc) exceeding provincial Standards were identified around the septic AST (APEC 8), former lumber storage area (APEC 9) and former kiln (APEC 19) in Lot 3. Soil southwest of Lot 3 exceeds provincial Standards for lead (Pb). This lead impact has not been fully delineated, and may be reflective of the previous industrial use of the southwestern properties.
- **Soil EPH (C19-32) and HEPH in Soil** – Soil exceeds provincial Standards for EPH(C19-32) and HEPH to depths of 1.5 m bgs in one 100m<sup>2</sup> road ditch area downgradient of the mineral oil and grease spill (APEC 16), and one 500m<sup>2</sup> area onsite and upgradient of APEC 16. These areas potentially represent a volume of 900 m<sup>3</sup> of EPH (C19-32) /HEPH impacted soil in Lot 3. Given the proximity of the impacts to the Site boundary, further investigation is recommended in the area of MV-11BH-07M to delineate HEPH impacts around the Site boundary.
- **Soil Chlorophenols** – Soil exceeds provincial Standards for pentachlorophenol in one location in the A-Mill (APEC 7) footprint of Lot 3. For estimation purposes this impact is assumed to have a 10m<sup>2</sup> area.

- **Groundwater Phenols/Chlorophenols** – Groundwater concentrations of phenols and chlorophenols (Pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4-dichlorophenol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, and phenol) exceed federal guidelines in wells at and south of the A-Mill footprint (APECs 7 and 9) for a plume of approximate 3000-5000 m<sup>2</sup> area. Groundwater in this impact area also exceeds provincial phenol and chlorophenol Standards (pentachlorophenol, 2,3,4,6-tetrachlorophenol, and total tetrachlorophenols, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, phenol, 2-methyl 4,6-dinitrophenol, 2,3,4,5-tetrachlorophenol, 3,4,5-trichlorophenol, and total trichlorophenols).

### **Lot 5**

- **Soil Xylenes/ EPH (C10-19)/ VPH/ Toluene** - Soil on the north side of the B-Mill footprint (APEC 14) and downgradient of the waste oil AST and gasoline UST (APECs 10 and 11) exceeds federal Guidelines for xylenes, and provincial Standards for xylenes, EPH(C10-19) and VPH. The onsite impact area is estimated to be 400m<sup>2</sup>, for an approximate impacted soil volume of 600 m<sup>3</sup>. Soil from two offsite locations adjacent to Lot 5, exceed federal Guidelines for toluene but are compliant with applicable provincial Standards. Offsite toluene concentrations are not expected to be originating from Site operations.
- **Soil Chlorophenols** – Soil on the north side of the B-Mill footprint (APEC 14) exceeds federal guidelines for pentachlorophenol and 2, 3, 4, 6-tetrachlorophenol. Concentrations of 2, 3, 4, 6-tetrachlorophenol also exceed provincial soil Standards. The identified impact area is approximately 400 m<sup>2</sup> and likely does not extend off Site.
- **Soil Metals** – Zinc concentrations exceeding federal and provincial Guidelines/Standards were identified in offsite soil (0.5-1 m bgs) adjacent to the Lot 5 boundary. The zinc impact has not been fully delineated on the offsite property and is unlikely to be originating from onsite operations.
- **Groundwater MAHs** – Groundwater concentrations of ethylbenzene exceeds federal and provincial Guidelines in a 250 m<sup>2</sup> impact area adjacent to the AST and UST (APECs 10 and 11) in Lot 5. Impacted groundwater is not anticipated to extend offsite.
- **Groundwater LEPH** - LEPH concentrations in groundwater exceed provincial groundwater Standards in the area at and downgradient of the AST and UST (APECs 10 and 11) in Lot 5. The plume remains to be delineated offsite, but extends across the Site boundary and is expected to cover an area of approximately 900m<sup>2</sup>. Further work is recommended to delineate the LEPH plume offsite.
- **Groundwater PAHs** - Groundwater in Lot 5 exceeds federal and provincial Guidelines/Standards for naphthalene at and downgradient of the Lot 5 AST/UST (APECs 10 and 11) for an onsite impact area of approximately 1,000 m<sup>2</sup>. Benzo(a)pyrene, fluoranthene and pyrene concentrations in groundwater from one offsite well adjacent to the Lot 5 boundary exceeded

federal Guidelines, with concentrations of benzo[a]pyrene also exceeding provincial Standards. Offsite impacts are not fully delineated but are unlikely to be originating from Site operations.

- **Groundwater Chlorophenols** - Chlorophenol concentrations in groundwater exceed federal Guidelines at three areas in Lot 5: **(1)** the B-Mill footprint (for pentachlorophenol, 2,3,4,6-tetrachlorophenol, and 2,4,6-trichlorophenol) for an approximate 1500m<sup>2</sup> impact area that does not appear to extend offsite. Concentrations of chlorophenols (pentachlorophenol, tetrachlorophenols (2,3,4,5; 2,3,4,6; and 2,3,5,6, isomers) and trichlorophenols (2,3,4-; 2,3,5-; 2,4,5-; 2,4,6-; 3,4,5- isomers)) in this area also exceed provincial Standards. **(2)** at one location in the west of Lot 5 (for pentachlorophenol) for an estimated impact area of 700m<sup>2</sup>. **(3)** at the southeastern Lot 5 boundary (for pentachlorophenol, 2,3,4,6-tetrachlorophenol) for an estimated impact area of 1250 m<sup>2</sup>. Chlorophenol concentrations at the southeast boundary (Pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4-trichlorophenol, and 2,3,6-trichlorophenol) exceed provincial Standards and may extend offsite in this area. Further investigation is recommended in the 5-BH29 area to delineate chlorophenol impacts around the southeastern Site boundary.

#### **Lot 6**

- **Soil Metals** - Soil exceeds federal arsenic Guidelines at depths of 3-4 m bgs in two Lot 6 foreshore locations. Arsenic impacts are expected to be localized (assumed for estimation purposes to be 10 m<sup>2</sup> around each identified hotspot). Arsenic concentrations at one of the foreshore locations also exceed provincial Soil Standards.
- **Soil VPH** - Soil concentrations of VPH at the east side of the Lindal Warehouse Building (APEC 34) in Lot 6 exceed provincial Standards and represent a localized impact area of approximately 400m<sup>2</sup>, with a vertical thickness of about 1.5 meters. The estimated volume of impacted material is approximately 600 m<sup>3</sup>.
- **Groundwater VPH** - VPH concentrations in groundwater at one well southwest of the former kiln (APEC 22) exceed provincial Standards and represents a localized VPH plume (estimated 100 m<sup>2</sup>) at this location.
- **Groundwater LEPH** – LEPH groundwater concentrations exceed provincial Standards in two areas of Lot 6: **(1)** at the location of the Lot 6 oil shed (APEC 21) for an estimated 100m<sup>2</sup> plume. **(2)** at the east side of the Lindal Warehouse building (APEC 34, source not identified) for an impact area of approximately 200m<sup>2</sup>.
- **Groundwater PAHs** - PAHs (acridine, anthracene, benzo[a]anthracene, benzo[a]pyrene, fluoranthene, fluorene, phenanthrene and pyrene) exceed federal groundwater guidelines at the east side of the Lindal Warehouse Building (APEC 34, source not identified) for an approximate 200m<sup>2</sup> impact area. Benzo[a]pyrene, phenanthrene and pyrene concentrations in groundwater at these wells also exceed provincial groundwater Standards.

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## **1.0 INTRODUCTION**

Franz Environmental Inc. (FRANZ) was retained by Vancouver Fraser Port Authority (VFPA) to conduct a Supplemental Site Investigation (SSI) at the Surrey Brownsville Site (Lots 2,3,4,5, and 6) in Surrey, BC (the Site). The work was commissioned under contract 80415 as per our work plan submitted on September 28, 2011, and the onsite work was conducted between December 2011 and February 2012.

### **Report Background**

Subsequent to the VFPA taking ownership of the Site, it underwent environmental monitoring triggered by the VFPA's own due diligence process. Between the years of 1990-2010, environmental site investigations were conducted in the various Site Lots to identify and characterize the contaminated site liabilities. During these investigations soil and groundwater contamination was identified, potentially related to the following sources:

- historical operations of sawmills and a tannery onsite;
- historical or current equipment fuelling and maintenance activities;
- historical uncontrolled releases from lumber treatment (chromium and chlorophenols);
- unknown fill quality;
- poor housekeeping at current or former operations;
- and other adjacent offsite activities (i.e. autowrecking yards, former lumber and tannery operations, rail line right of way).

The aim of the current SSI work conducted by FRANZ is to comprehensively summarize historical and current site information to support the development of remedial options and/or long-term risk management strategies for ongoing use of the Site.

### **Scope of Work**

The objective of this report is to document the findings of all investigations to provide a comprehensive assessment of the soil and groundwater quality on the Site.

A work plan was provided to VFPA by FRANZ, dated September 28, 2011 which identified current data gaps and provided a plan to further investigate soil and groundwater at the Site. The scope of work for the SSI included the following tasks:

- Conduct a review of historical environmental investigation reports and compile all historical data available for the Site;
- Georeference historical station locations and input this information into FRANZ'S Geographic Information System (GIS);
- Digitize analytical results for historical soil and groundwater sampling locations, and include this information in our database and GIS and compare results to current regulatory guidelines;

- Produce a complete list of APECs and PCOCs for the Site;
- Identify site investigation data gaps and prepare detailed sampling and analysis plans to address these gaps at the Site;
- Drill boreholes for soil sample collection, and install monitoring wells at APEC locations as per our proposed work plan dated September 28, 2011;
- Monitor groundwater and collect samples at all newly installed monitoring wells and at selected existing monitoring wells;
- Prepare a SSI report that summarizes the analytical results of the 2011 field investigation in conjunction with analytical results from previous investigations, and provides recommendations for risk management of contaminated soil and/or groundwater at the Site.

## 2.0 SITE DESCRIPTION

The Site is located in Surrey, BC, approximately 0.5km southwest of the Pattullo Bridge. The Site is situated on the east banks of the Fraser River and covers an area of approximately 16.2 ha (Figure 1).

The Site is divided into five lots (Lots 2,3,4,5,6) with Lot 6 comprised of Parcels A,B,C, Rem-C,7, and 8) as described in the Phase 2 ESA Report for the area (Hemmera, 2008). APECs identified across the Site are further discussed in Section 2.7.

### Surrounding Site Description

Land use surrounding the Site is as follows:

- **North:** The Fraser River is north and northwest of the Site (adjacent to the Lot 6 boundary). Historical sawmilling activities took place on the adjacent northeast property, as historically B-Mill (on Lot 5) extended over the northeast Site boundary, and the offsite portion was not included in the 1999 land purchase.
- **East:** Commercial autobody and autowrecking operations, and a metals depot border the Site (Lots 3 and 5) in this direction.
- **South:** A City of Surrey Park (Tannery Park) is currently located southwest of the Site, (adjacent to Lot 2 and 4 boundaries). Tannery and wood processing operations historically occurred adjacent to the Site in the south/southwest directions.
- **West:** The Fraser River is directly adjacent to the Site (Lots 2 and 6) boundary in this direction.

### Site History

The VFPA (formerly the Fraser River Port Authority) has owned Lots 2, 3, 4, and 5 of the Site since 1999 when the land was purchased in a foreclosure sale of Imperial Lumber Ltd. The two sawmills onsite (in Lots 3 and 5) were operated by Imperial Lumber Ltd from the 1950s until the 1980s. At both sawmills, complete processing of raw logs to finished lumber occurred, including sorting, milling, planning, stamping, and treating with antisapstains. A tannery operated by Leckie JW Co., was also historically present in the Lot 4 area until approximately 1970 (Next Environmental Inc, 1998e-h).

In 2008, the VFPA acquired the former CN Rail right-of-way, in the north western portion (Lot 6) of the Site, and adjacent to the current rail corridor. Historical activities at Lot 6 include the following (per Hemmera, Phase 1 ESA report, 2006):

- Wood chipping activities carried out by two sawmilling operations in the southwest portion of the Lot. Brown Lee Mills operated in the southwest of Lot 6 from 1962 to the 1970s, and Smallwood Sawmills has operated in the southwest of Lot 6 from the 1980's to present.

- Wood storage and distribution activities in the central portion of Lot 6. Lindal Cedar homes has operated in the centre of Lot 6 from the 1980's to present.
- Manufacture, storage and log salvaging operations have occurred in the northeastern portion of Lot 6 from the 1930s to the 1960s. Brownsville Mills has operated in the northeast of the Lot from 1963 to the 1980s, Lyndowana Lumber Ltd has operated in the northeast of the Lot from 2003-2006.

### **Current Site Use**

The Surrey Brownsville Site is currently zoned and used for various industrial activities, including those listed in the below Lots (and identified in Figure 2a):

- **Lots 2/4:** Apex Terminals Inc. currently operates a lumber storage and distribution centre in Lots 2 and 4.
- **Lot 3:** Apex Terminals Inc, and Kwest Lumber currently operate in Lot 3, where lumber storage, and distribution by truck and rail, vehicle maintenance, lumber cutting and packaging activities occur onsite.
- **Lot 5:** Apex Terminals Inc. and RDM Enterprises operate in Lot 5, where lumber storage and distribution by truck and rail, large vehicle and equipment storage, and equipment maintenance activities occur.
- **Lot 6:** Smallwood Sawmill and the Lindal Cedar Homes Warehouse and Distribution Centre currently operate in Lot 6, where lumber storage and distribution, and wood chipping activities occur.

## **Topography and Geology**

Topographic information for the Site was obtained from COSMOS. The Site is relatively flat, ranging in elevation between 2 and 4m above sea level (asl), with the highest elevation areas in the southwest corner (Lot 2) and along a raised pedestrian path running between Lot 6 and Lots 3 and 5. From the southwest corner of the Site, there is a slight slope down to the east/northeast, and west, towards the Fraser River.

Regional surficial geologic information was obtained from Armstrong and Hicock (map 1484A). Surficial geology in the vicinity of the Site is comprised of bog, swamp and shallow lake deposits; specifically, lowland peat up to 14m thick, in part overlying either overbank sandy to silt loam or overbank silty to silt clay loam.

Local surficial geology was observed during previous environmental investigations and by FRANZ during the 2011 SSI.

Generally soil stratigraphy can be divided along Dyke Road, into eastern and western Site portions. In the western portion of the Site (Lots 2 and 4, and 6), a surficial sand layer was observed to depths ranging between 0.5 and 3.8m below ground surface (bgs). In the vicinity of the former tannery, a layer of dark sandy fill (inclusive of wood debris and animal waste (hair) between 0.6 and 1.3m thick was observed.

In the eastern portion of the Site (Lots 3 and 5) a surficial sand to sandy silt layer was observed to depths ranging between 0.5 and 2.25m bgs.

In all areas of the Site, the surficial layer is underlain by sandy silt to silt, containing discontinuous peat lenses and occasional woody debris, to the final borehole depth of 6 m bgs. This stratigraphy is consistent with the bog, swamp and shallow lake deposits described in map 1484A above.

In select boreholes across the Site, discontinuous wood waste fill (approximately 0.5m thick) was encountered between the sand and silt intervals.

## **Hydrogeology**

According to the BC Water Resources Atlas (BC WRA), the 9 km<sup>2</sup> Fraser River Junction Aquifer underlies the Site. This is a Type IIIB Aquifer, with low demand, and moderate productivity and vulnerability. The water use of the aquifer is classified as non-drinking water. Potable drinking water is currently supplied to the Site via the Greater Vancouver Water District (GVWD) municipal piped distribution system, which primarily draws from reservoirs in North Vancouver. Details regarding the underlying aquifer are presented in Appendix G.

Depth to groundwater was measured in onsite wells during the 2011 SSI and ranged between 0.31m and 3.655m below top of casing (TOC). Groundwater flow direction onsite is inferred to be

to the west/northwest (towards the Fraser River) as identified during previous site investigations (NEXT Environmental 1998, Hemmera 2006, 2008).

### **Previous Investigations**

The Site has undergone environmental monitoring as a component of risk management. Historical investigation and monitoring program reports for the Site were reviewed by FRANZ prior to completing the current SSI. As part of the current work, sampling locations and analytical results were extracted from the historical reports, digitized, input into our database and GIS mapping systems, and re-assessed against current Federal and Provincial Standards and Guidelines (see Section 3.0). The reviewed reports are as follows:

- Phase 3 Environmental Property Investigation, Imperial Lumber Property Surrey, BC. SRK-Robinson Inc., April 1994.
- Pre-Cleanup Environmental Investigation, Imperial Lumber Ltd. Site, Surrey, BC. SRK-Robinson Inc., October 1994.
- Environmental Stage 1 Preliminary Site Investigation at 11715 Tannery Road, Lot 17, District Lots 7 and 8 (Imperial Lumber Lot 2), Surrey, BC. Next Environmental Inc., June 1998.
- Environmental Stage 1 Preliminary Site Investigation at 11715 Tannery Road, Parcel 1, Reference Plan 6432, Block A, District Lot 7 (Imperial Lumber Lot 4) Surrey, BC. Next Environmental Inc., June 1998.
- Environmental Stage 1 Preliminary Site Investigation at 11715 Tannery Road, Lot 52, District Lots 6 and 7 (Imperial Lumber Lot 3) Surrey, BC. Next Environmental Inc., July 1998.
- Environmental Stage 1 Preliminary Site Investigation at 10897 Timberland Road, Parcel D, Reference Plan 15209 of Parcel B, District Lots 5 and 6 (Imperial Lumber Lot 5), Surrey, BC. Next Environmental Inc., July 1998.
- Environmental Stage 2 Preliminary Site Investigation at 11715 Tannery Road, Lot 52, District Lots 6 & 7 (Imperial Lumber Lot 3), Surrey, BC. Next Environmental Inc., September 1998.
- Environmental Stage 2 Preliminary Site Investigation at 10897 Timberland Road, Parcel D, Reference Plan 15209 of Parcel B, District Lots 5 & 6 (Imperial Lumber - Lot 5), Surrey, BC. Next Environmental Inc., September 1998.
- Environmental Stage 2 Preliminary Site investigation at 11715 Tannery Road, Parcel 1, Reference Plan 6432, Block A, District Lot 7 (Imperial Lumber - Lot 4), Surrey, BC. Next Environmental Inc., September 1998.
- Environmental Stage 2 Preliminary Site Investigation at 11715 Tannery Road, Lot 17, District Lots 7 and 8 (Imperial Lumber Lot 2) Surrey, BC. Next Environmental Inc., September 1998.
- Review and Assessment of Contaminated Sites and Buildings Issues at Imperial Lumber Lots 2, 3, 4 and 5. BC Research Inc., final April 1999.



- GW Monitoring Wells, Lots 3 & 5, Imperial Lumber Site 3. BC Research Inc., September 1999.
- Site Monitoring, March 30, 2000, Lots 3 & 5, Imperial Lumber Site. BC Research Inc., May 2000.
- Chromium Level Monitoring, June 15, 2000, Lots 2 and 4, Imperial Lumber Site. BC Research Inc., July 2000.
- Site Monitoring, March 26, 2001, Lots 3 & 5, Imperial Lumber Site. BC Research Inc., April 2000.
- Risk Management Plan for Imperial Lumber Lots 2, 3, 4, and 5. BC Research Inc., October 2001.
- Site Monitoring, Oct 15, 2001, Lots 3 & 5, Imperial Lumber. BC Research Inc., November 2001.
- Site Monitoring, December 17, 2003, Lots 3 & 5, Imperial Lumber. Vizon SciTec Inc., May 2004.
- Site Monitoring, November 3, 2004, Lots 3 and 5, Imperial Lumber. Vizon SciTec Inc., December 2004.
- Phase I Environmental Site Assessment, Fraser River Port Authority, Brownsville Site, Surrey, BC. Hemmera, September 2006.
- Remedial Options Evaluation, Brownsville Site, Surrey, BC. Hemmera, December 2008.
- Supplemental Phase 2 Environmental Site Assessment, Brownsville Site, Surrey, BC. Hemmera, December 2008.
- Results of April 2009 (Q4) GW Monitoring/Sampling at Port Metro Vancouver Surrey Lots 2 & 4, Surrey Lots 3 & 5, 11715 Tannery Road, Surrey, BC. Hemmera, July 2009.
- Results of November 2009 GW Sampling Program at the Vancouver Fraser Port Authority's Surrey Lots 2&4, Surrey Lots 3&5, 11715 Tannery Road, Surrey, BC. Hemmera, September 2010.
- Mountainview Reload: Project Review and Data Gap Identification – Final Report. Hemmera, March 2011.

### **APECs and PCOCs**

Following the review of historical reports and data, FRANZ prepared a complete list of APECs and PCOCs for the Site.

The APECs identified are presented in Table 1. and Figure 2b. In some cases, the APECs were determined based on activities occurring in discrete locations (i.e.: APEC 3, Paint AST located in the east portion of A Mill ((Lot 3)). In other cases, the APECs were determined based on larger operations where targeting a specific, discrete location as a potential source of contamination was not possible due to the nature of the activities (i.e.: APEC 9, Former Lumber Storage Area (Lot 3)).

Associated potentially contaminating substances were identified according to the activities conducted at each APEC. PCOCs were then identified according to the applicable regulations at the Site and offsite.

**Table 1 APECS and PCOCs**

APEC	On/ Off Site	APEC Description	Potentially Contaminating Substance	Media	PCOCs										
					Metals	PAH	Sulfides	VOC s	F2/F3 (L/HEPH)	F4	BTEX	F1 (VPH)	Glycols	Salts	Phenols/ Chlorophenols
1	ON	Former Leckie JW Co. Tannery	Tannery process chemicals: Cr, Sulfides, Salts and solvents	SOIL	x		x	x						x	
				GW	x		x	x						x	
2	ON	Lumber Storage Area	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x			x						x
				GW	x	x			x						x
3	ON	Paint AST in the east central portion of the main building	Paint, solvents	SOIL	x			x							
				GW	x			x							
4	ON	Former Mill Service Shop	Oils, waste oil, hydraulic fluids, solvents, hydraulic hoists, metal machining (metals)	SOIL	x	x		x	x	x	x	x	x		
				GW	x	x		x	x		x	x	x		
5	ON	Waste Oil AST outside the Mill Service Shop	Waste oil, solvents	SOIL	x	x		x	x		x	x	x		
				GW	x	x		x	x		x	x	x		
6	ON	Former fueling facility	Diesel, gasoline	SOIL		x			x		x	x			
				GW		x			x		x	x			
7	ON	Main Building (Lumber Storage, Packaging, Application of PCP)	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x			x						x
				GW	x	x			x						
8	ON	Septic UST	Waste disposal (paints, chemicals etc.)	SOIL		x		x	x		x	x	x		X
				GW		x		x	x		x	x	x		X
9	ON	Former Lumber Storage Area	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x			x						X
				GW	x	x			x						x
10	ON	Gasoline UST	Gasoline	SOIL					x		x	x			
				GW					x		x	x			
11	ON	Waste Oil AST	Waste oil,	SOIL	x	x			x	x	x	x	x		

APEC	On/ Off Site	APEC Description	Potentially Contaminating Substance	Media	PCOCs										
					Metals	PAH	Sulfides	VOC s	F2/F3 (L/HEPH)	F4	BTEX	F1 (VPH)	Glycols	Salts	Phenols/ Chlorophenols
			solvents	GW	x	x			x		x	x	x		
12	ON	Disposal area for hydraulic in-ground hoists	Hydraulic fluid, PCBs	SOIL				x	x	x					
				GW				x	x						
13	ON	Former Green Chain and Planer Mill	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x			x						x
				GW	x	x			x						
14	ON	Former Chlorophenol Dip Tank (location of former hydraulic hoists)	Wood treatment chemicals (CCA, chlorophenols), PCBs, hydraulic fluid	SOIL	x	x			x	x					x
				GW	x	x			x						
15	ON	Wood Chip and Wood Debris Area	Organic leachate: Phenolics, metals, wood treatment chemicals (CCA, chlorophenols)	SOIL	x										x
				GW	x										
16	ON	Area of Mineral Oil and Grease above Level C in soil identified by SRKR	Petroleum hydrocarbons (mineral oil and grease)	SOIL		x			x	x	x	x			
				GW		x			x		x	x			
17	OFF	Auto Wrecking Yard along Timberland Road (Air Photos)	Automotive fuels and fluids, antifreeze, solvents, metals,	SOIL	x	x		x	x		x	x	x		
				GW	x	x		x	x		x	x	x		
18	OFF	Rypac Aluminum Recycling Ltd. At 10746 Parton Road (BC Online)	Metals, petroleum hydrocarbons	SOIL	x	x			x						
				GW	x	x			x						
19	ON	Former Kiln A- Lot 3 (South)	Konus Oil	SOIL		x			x						
				GW		x			x						
20	ON	Former Kiln - Lot 5	Konus Oil	SOIL		x			x						
				GW		x			x						
21	ON	Oil Storage Shed - Brownsville	Konus Oil/Heating Oil	SOIL		x			x		x	x			
				GW		x			x		x	x			
22	ON	Former Kiln -	Konus Oil	SOIL		x			x		x	x			

APEC	On/ Off Site	APEC Description	Potentially Contaminating Substance	Media	PCOCs										
					Metals	PAH	Sulfides	VOC s	F2/F3 (L/HEPH)	F4	BTEX	F1 (VPH)	Glycols	Salts	Phenols/ Chlorophenols
		Brownsville		GW		x				x		x			
23	ON	Former Green Chain - Brownsville	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x				x					x
				GW	x	x				x					x
24	OFF	Former PCP Spray Tank, Spray Area and Lumber Storage - Brownsville	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x				x					x
				GW	x	x				x					x
25	ON	Lumber Storage Area - Brownsville	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x				x					x
				GW	x	x				x					x
26	ON	Fill Lot 2/4	Metals, PAHs, petroleum hydrocarbons	SOIL	x	x				x		x	x		
				GW	x	x				x		x	x		
27	ON	Historical Chromium-impacted soil stockpile on Lot 2/4	Metals, (potentially from treated lumber or tannery wastes)	SOIL	x										
				GW	x										
28	ON	Fill Lot 3	Metals, PAHs, petroleum hydrocarbons	SOIL	x	x				x		x	x		
				GW	x	x				x		x	x		
29	ON	Fill Lot 5	Metals, PAHs, petroleum hydrocarbons	SOIL	x	x				x		x	x		
				GW	x	x				x		x	x		
30	ON	Fill Lot 6	metals, PAHs, petroleum hydrocarbons	SOIL	x	x				x		x	x		
				GW	x	x				x		x	x		
31	ON	Lumber Storage Area - Lot 5	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x				x					x
				GW	x	x				x					x
32	ON	Former Kiln B - Lot 3 (North)	Konus Oil	SOIL		x				x					
				GW		x				x					
33	OFF	Diesel Spill – railway	Diesel	SOIL		x				x					
				GW		x				x					
34	ON	VPH and LEPH Plume by Warehouse- Lot 6	Petroleum hydrocarbons	Soil		x				x		x	x		
				GW		x				x		x	x		

### 3.0 REGULATORY FRAMEWORK

The Site is under the jurisdiction of the Port. The applicable guidelines governing concentrations of various parameters in soil, groundwater and surface water at the Site are therefore Federal.

In general, onsite soil analytical results were compared against Canadian Council of Minister's of the Environment (CCME) Soil Quality Guidelines. Groundwater analytical results were compared against Environment Canada's Federal Interim Groundwater Quality Guidelines (FIGQG) that were developed for sites with funding from the Federal Contaminated Sites Action Plan (FCSAP) (applicable to groundwater >10m from a surface water body) and against Health Canada's Guidelines for Canadian Drinking Water Quality (applicable to groundwater with the potential to be used as a potable water resource, discussed in Section 3.1.1). Soil and groundwater collected from offsite locations near Site boundaries were also compared to federal Guidelines, this was done to consider situations where impacted offsite media may have the potential to move onsite.

Per Environment Canada guidance (FIGQG, May 2010), groundwater within 10m of a surface water body was assessed against surface water guidelines; therefore, onsite groundwater analytical results located within 10 m of the banks of the Fraser River were compared against CCME Water Quality Guidelines.

The land surrounding the Site is under provincial jurisdiction. As a result, soil and groundwater analytical results from tested locations onsite and offsite were also compared against BC Contaminated Sites Regulations (CSR) Standards. This was done to consider stations located outside the Site boundary and drilled for delineation purposes, or for selected stations located at or near the Site boundary, where impacted onsite media may have the potential to move offsite. According to the CSR Technical Guidance 15 (Draft), concentration limits are not specified for groundwater within 10m of a surface water body high water mark. As a measure of conservatism, groundwater concentrations from wells within this dilution zone were compared against BC Working or Approved Water Quality Guidelines. Onsite and offsite soil results were also compared and characterized against provincial soil Relocation Standards (Schedule 7) in case impacted material onsite or at/near the Site boundaries has the potential to be excavated and transported offsite during future remediation efforts.

Details regarding the site specific standards applicable to soil and groundwater are discussed in Appendix H.

#### **4.0 SUPPLEMENTAL SITE INVESTIGATION METHODOLOGY**

The field portion of the SSI was conducted by FRANZ personnel between December 9 and 17, 2011 and between February 1 and 14, 2012.

Detailed descriptions of the methodologies used during field activities are described in the following sections. Photographs taken during field activities are presented in Appendix A.

##### **Utility Locates**

Western Utility Locate Services was contracted to locate any potential underground utilities at the Site on December 9, 2011. A ground-penetrating radar (GPR) and electromagnetic (EM) induction device were used to locate conductive (i.e. metal) utilities in the vicinity of all proposed borehole locations.

##### **Borehole Drilling and Soil Sampling**

Rocky Mountain Soil Sampling Inc. (RMSS) was contracted to provide drilling services between December 12 and 17, 2011. A total of 25 boreholes were drilled. Twenty-one of these boreholes were completed as monitoring wells. All boreholes were drilled using solid stem augers. Borehole logs are presented in Appendix B.

Soil samples were collected as grab samples during auger drilling. To prevent cross contamination, a new pair of nitrile gloves was used to collect each sample. Samples were collected from each stratigraphic unit and placed into laboratory supplied, sterile jars. A portion of each sample was placed in a Ziplog bag and screened for vapours using a portable gas monitor (RKI Eagle).

All samples, upon collection, were placed in a cooler with ice in order to keep the samples cold during the remainder of sampling and transportation to the project laboratory for analysis. The project laboratory for this project was Agat Laboratories (AGAT) in Burnaby, BC. Soil samples were selected for analysis based on soil headspace vapour screening results, the presence of soil staining or odours, and stratigraphic location. Analytical parameters tested varied according to PCOCs identified for each APEC.

##### **Monitoring Well Construction**

Monitoring wells were installed in 21 of the boreholes. Each of the wells are 50 mm in diameter, constructed of Schedule 40 polyvinyl chloride (PVC) pipe. One well (MV-11BH-04M) consists of a 10 foot screened section and a riser pipe; all other wells consist of a 5 foot screened section and a riser pipe. Silica sand was used to backfill the boreholes to one foot above the screen; bentonite chips were then used to backfill the hole to one foot below ground surface. More silica sand was used as backfill above the bentonite. Each of the wells was finished with a flush-mounted protective casing set in concrete.

Well completion details are presented in Appendix B (borehole logs).

## **Groundwater Sampling**

Between February 1 and 15, 2012, groundwater sampling was completed for 20 of the 21 newly installed monitoring wells and select existing wells. One well installed by FRANZ in 2011 MV-11BH-04M, was destroyed by truck traffic and could not be sampled. Some of the existing wells were not sampled, for one of the following reasons:

- The well could not be located;
- The well had been destroyed or compromised; or
- The well was located beneath stacks of lumber or equipment which could not be moved

The locations of the new and previously installed wells are presented in Figures 3-2 through 11-5.

For all wells, FRANZ developed the wells using dedicated inertial sample pumps (low density polyethylene tubing with inertial foot valve) to remove any sediment that had accumulated and to ensure formation water was present for sampling. The wells were developed until either a minimum of three well volumes (including sand pack) was removed or the well was pumped dry. To minimize the potential for cross-contamination, all purging was completed with dedicated inertial pumps.

Prior to groundwater sampling, each monitoring well was purged using a peristaltic pump and dedicated tubing. The wells were purged until a minimum of three well volumes of groundwater was removed and stable groundwater chemistry was reached. Following purging samples were collected, also using a peristaltic pump, into laboratory supplied, sterile bottles. To prevent cross contamination, a new pair of nitrile gloves was used to collect each sample. Water samples collected for dissolved metals analysis were field filtered using Waterra High Density In-Line filters designed to remove sediment greater than 45 microns. The filtered water was acidified in the field with laboratory-supplied preservative (nitric acid). Water samples collected for sulfide were preserved in the field with laboratory-supplied sodium hydroxide and zinc acetate.

The collected samples were stored in insulated coolers and chilled with ice during the remainder of sampling and transportation to AGAT. Analytical parameters tested varied with PCOCs identified at each APEC.

## **5.0 QUALITY ASSURANCE/QUALITY CONTROL**

FRANZ has a Quality Assurance/Quality Control (QA/QC) protocol that includes appropriate techniques for soil sampling, sample storage, shipping and handling as well as the collection of duplicates. This section pertains to the sampling conducted by FRANZ in December 2011 and February 2012.

To minimize possible cross contamination, disposable nitrile rubber gloves, were worn while collecting samples and were replaced after handling each sample. The soil and groundwater samples were placed into laboratory supplied, appropriately labeled, jars and bottles. The samples were placed into insulated coolers and kept cool with frozen ice packs during transport to the laboratory. FRANZ personnel maintained chain of custody control for the samples submitted to AGAT through the use of chain of custody documentation.

### **Laboratory Quality Assurance and Quality Control Procedures**

AGAT is a Canadian Association for Laboratory Accreditation (CALA) certified laboratory with stringent internal QA/QC protocols. Analytical precision was evaluated by the laboratory using internal duplicate analyses. AGAT's QA/QC documentation is provided with the analytical report and it was reviewed by FRANZ as part of the QA/QC protocol.

### **Field QA/QC Samples**

Field sample QA/QC consisted of collecting duplicate samples to monitor both sampling and laboratory analytical precision and accuracy, with respect to soil and groundwater samples collected at the Site. Duplicate samples were also collected and analyzed to identify sample variability. One duplicate sample was collected for every ten samples collected during the sampling program.

### **Precision/Accuracy**

Analytical precision was evaluated by performing duplicate analyses on a single sample, whereby, the sampling precision is evaluated by collecting and analyzing field duplicate samples. Precision is evaluated by calculating the relative percent difference (RPD) for a sample and duplicate pair according to the following equation:

$$\text{RPD} = \{2(X_1 - X_2)/(X_1 + X_2)\} * 100$$

where:  $X_1$  = concentration for sample 1 of duplicate pair, and  
 $X_2$  = concentration for sample 2 of duplicate pair.

Blind duplicates were submitted at a nominal rate of approximately 10%, rounded up for both water and soil.

The following bulleted list presents the data quality objectives (DQOs) for this project.

- PAH: 75% in soil, 45% in water



- VOC (including BTEX/VPH): 60% in soil, 45% in water
- EPH: 60% in soil, 45% in water
- Metals (Ag, Al, Ba, Hg, K, Mo, Na, Pb, Sn, Sr, Ti): 60% in soil, 30% in water
- Other Metals: 45% in soil, 30% in water
- General Inorganics in Soil: 45%
- General Inorganics in Water: 30%

These levels are specified on the BC MOE's (Q&A) website (i.e., Standards - Question/Answer # 36) which indicates the recommended relative percent difference (RPD) for duplicate field samples not exceed 1.5 times the acceptable lab RPD for the same compound. Acceptable DQOs for laboratory duplicates which are derived from the BC Environmental Laboratory Manual (Section A) for the prescribed elements and compounds.

RPD was not calculated if either the sample or its duplicate were less than reported detection limit (RDL), or if either the sample or its duplicate were less than five times the RDL. Soil RPD, because true soil duplicates are essentially impractical, usually measures more than analytical variability and so must be interpreted less rigidly than water RPD results.

### **Soil RPDs**

Ten sample/duplicate pairs were collected in soil. They are listed below:

- MV-11BH-08-2 / MV-DUP1
- MV-11BH-16M-1 / MV-DUP2
- MV-11BH-15M-3 / MV-DUP3
- MV-11BH-11M-1 / MV-DUP4
- BV-11BH-01M-5 / BV-DUP5
- MV-11BH-01M-4 / MV-DUP6
- MV-11BH-17M-3 / MV-DUP7
- BV-11BH-07M-2 / BV-DUP8
- BV-11BH-04M-3 / BV-DUP9
- BV-11BH-05M-5 / BV-DUP10

Duplicate analysis results for soil are presented in Appendix C. Duplicates were collected for VPH/BTEX, PHC fractions 1-4, LEPH/HEPH, PAH, metals, VOCs and chlorinated and non-chlorinated phenols.

RPDs were not calculated for BTEX, styrene, LEPH, PHC fractions F1 and F2, and select PAH, VOCs, metals and phenols samples. For these parameters, sample and/or duplicate concentrations were less than 5x reportable detection limits (RDL).

All calculated RPDs for VPH, PHC fractions F3 and F4 and PAH are less than the target levels of precision.

The calculated RPD for HEPH in sample/duplicate pair MV-11BH-11M-1 / MV-DUP4 is 81%, which exceeds the target level of precision. Both the sample and duplicate concentration are significantly below the CSR IL Standard for HEPH; and there are no CCME Guidelines for HEPH. Therefore, the variability in the RPD is not materially significant with respect to classification of the sample or duplicate against federal or provincial Guidance.

The calculated RPD for antimony in sample/duplicate pair BV-11BH-04M-3 / BV-DUP9 is 78%, which exceeds the target level of precision. Both the sample and duplicate concentration for antimony are well below the Federal Guideline and the BC CSR Standard for this parameter; therefore, the variability in the RPD is not materially significant with respect to classification of the sample or duplicate against federal or provincial Guidance..

Only 2 of the 10 duplicate samples analyzed in soil exceeded the targeted level of precision. Exceedances of the targeted level of precision do not indicate a systematic bias in the SSI soil sampling program on the following rationale:

- All other RPDs in soil samples collected on the same days (December 15 and 17, 2011) as the exceeding sample/duplicate pairs were well within the target levels of precision. Tabulated RPD data for the noted days are included in Appendix C.
- Lab reports for soil samples collected December 15 and 17, 2012 did not identify QA/QC comments related to sample quality or integrity.
- The noted RPD exceedances in soil metals and petroleum hydrocarbons is indicative of some variability in the dataset likely attributable to the following:

(1) natural heterogeneity of metals in soil, both sample and duplicate concentrations of antimony fall within the range seen in soil from adjacent locations in the Lot 6 area; and

(2) the fact that soil samples and duplicates were collected as co-located replicates under comparable conditions adjacent in time and space, as opposed to true duplicates from a homogenized sample. Soil replicates were collected during the program due to concerns with contaminant volatilization during homogenization for true duplicates. Therefore we expect replicate RPDs to be higher than typical duplicate RPDs.

### **Groundwater RPDs**

Five sample/duplicate pairs were collected in groundwater. They are listed below:

- BV-11BH-02M / BV-GWDUP1
- MV-11BH-03M / MV-GWDUP2
- MV-11BH-14M / MV-GWDUP3
- MV-11BH-15M / MV-GWDUP4
- 3-BH10 / MV-GWDUP5

Duplicate analysis results for groundwater are presented in Appendix D. Duplicates were collected for VH, VPH/BTEX, PHC fractions 1-4, LEPH, EPH, dissolved metals, chloride, VOCs and chlorinated and non-chlorinated phenols.

RPDs were not calculated for VPH/BTEX, LEPH/HEPH, PHC fractions F1-F4, PAH, some dissolved metals, VOCs and phenols. For these parameters, sample and/or duplicate concentrations are less than 5x the RDL.

The calculated RPDs for dissolved molybdenum in sample/duplicate pair BV-11BH-02M / BV-GWDUP1 is 56%, which exceeds the target level of precision. Both the sample and duplicate concentration of molybdenum are well below the Federal Interim Guideline and the BC CSR Standard; therefore, the variability in the RPD is not materially significant with respect to classification of the sample or duplicate with respect to federal or provincial Guidance..

Only 1 of 5 duplicate samples analyzed in groundwater exceeded the targeted level of precision. Exceedances of the targeted level of precision do not indicate a systematic bias in the SSI groundwater sampling program on the following rationale:

- All other groundwater samples collected on the same day (February 2, 2012) as the exceeding sample/duplicate pair (BV-11BBH-02M/BV-GWDUP1) were well within the target levels of precision for this pair. Tabulated RPD data for February 2, 2012 is included in Appendix D.
- A review of the field notes and lab reports for samples collected February 2, 2012 did not identify any QA/QC comments related to sample quality or integrity with the potential to affect precision in the data set.

### **Representativeness**

Representativeness is a measurement of how well the data collected represents the conditions at the Site. Representativeness was achieved through use of the standard FRANZ field, sampling, and analytical procedures and by an appropriate program design and implementation. All project data (analytical data, figures, tables, text, etc.) was reviewed by a qualified technical individual who was not part of the core project staff.

### **Sample Holding Times**

Recommended sample holding times are set so that samples are analyzed before significant degradation of the sample and specific analyte of interest in the sample. None of the samples exceeded their respective holding times

### **QA/QC Summary**

Based on a review of the QA/QC program and the data quality indicators discussed above, we conclude that the data quality objectives have been substantially achieved. Our validated dataset allows us to make valid inferences and conclusions regarding classification of the site soil and groundwater, in relation to the provincial Standards or federal Guidelines.

## 6.0 SUPPLEMENTAL SITE INVESTIGATION RESULTS

FRANZ's review of the historical reports and analytical data identified 34 APECs (30 onsite and 4 offsite). All APECs are presented on Figure 2b. Offsite investigation locations were discussed as they related to delineating onsite APECs. Offsite APECs were not investigated or discussed in the SSI as they are outside of the scope of work for this project. Soil and groundwater results are presented on Figures 3 through 14, and in full tabular form in Tables 2 through 78. Laboratory reports/analytical certificates are included in Appendix E (soil) and Appendix F (groundwater).

Soil and groundwater analytical results for each APEC are discussed separately in the following section. In some cases, when physical proximity and similar PCOCs allow it, APECs are discussed together. All of the investigation data is presented for soil and groundwater, including historical data from previous investigation/monitoring reports. Soil and groundwater investigation data collected in 2011 is considered to be the most representative of the Site conditions.

In some cases, actual reported concentrations for some parameters could not be retrieved from historical reports, because of the poor quality of the copies available. In select cases, results were identified greater than the BC CSR IL Standards in a highlighted cell, but because report is a black and white photocopy, the results are shown as a black cell in a table, and it is therefore impossible to retrieve a numerical value for them. Whenever this is the case, FRANZ has identified the investigation station as being greater than the applicable Standard or Guideline, by highlighting it in red on tables and figures. A star symbol (\*) was used instead of a numerical value in the analytical tables.

Guidelines for petroleum hydrocarbon fractions F1-F4 and BTEX were developed according to the toxicological and physico-chemical properties of the different fractions. For fractions F1-F4, benzene, ethylbenzene, toluene, and xylenes the applicable guideline is dependent on soil texture. For the purposes of this report, sand and gravels were identified as coarse-textured soils and silt and clay as fine-textured soil, as per "The Summary of A Protocol for the Derivation of Environmental and Human Health Soil Quality Guidelines" (CCME 2006).

For fractions F1-F4, the applicable guidelines are also dependent on sample depth. Samples collected between 0-3 m below ground surface (bgs) were considered surface samples, and samples collected deeper than 3 m bgs were considered to be subsoil samples.

PCOCs detected at concentrations greater than the applicable Guidelines and/or Standards are referred to as contaminants of concern (COCs). APECs where one or more COCs have been identified in any of the tested media are referred to as areas of environmental concern (AECs).

### **Lots 2/4 (APECs 1, 2, 26, 27)**

Due to their physical proximity and similar PCOCs, investigation results for APECs in Lots 2/4 are presented in the same section.

APEC	APEC Description	Substance	Media	PCOCs										
				Metals	Sulfides	VOC s	F2/F3 (L/HEPH)	PAH	BTEX	F1 (VPH)	Glycols	Salts	Phenols/ Chlorophenols	
1	Former Leckie JW Co. Tannery	Tannery process chemicals: Chromium, Sulfides, Salts and solvents	SOIL	x	x	x							x	
			GW	x	x	x							x	
2	Lumber Storage Area	Wood treatment chemicals (CCA*, chlorophenols)	SOIL	x			x	x						x
			GW	x			x	x						x
26	Fill Lot 2/4	Metals, PAHs, petroleum hydrocarbons	SOIL	x			x	x	x	x				
			GW	x			x	x	x	x				
27	Historical Chromium soil stockpile Lot 2/4	Chromium	SOIL	x										
			GW	x										

Lots 2 and 4 (and their associated APECs) are located in the southwest section of the Site (see Figure 2). The two Lot areas are adjoining and currently paved; two office buildings (Apex Terminals) remain in the southeast corner of Lot 4. The remainder of the Lot 2/4 area is currently used for storage.

The footprint of the former tannery (APEC 1) is located in the southeast corner of Lot 4, adjacent to Tannery Road. According to previous investigation reports, a stockpile of chromium-impacted soil (approximately 150m<sup>3</sup>), that was historically located on the Lot 2/4 area (APEC 27), originated from a former excavation on the west adjacent property. Soil excavated from this offsite location was subsequently stockpiled on the southwest side of the Lots 2/4 area (NEXT Environmental Inc,1998a,h). Given that these APECs and adjacent properties to the south and west are anticipated to have had similar land use history, chromium impacts were investigated across the Lots 2/4 area (NEXT Environmental Inc,1998a,h). Fill soil of unknown quality (APEC 26), and impacts from storage of treated lumber (APEC 2) have the potential to be present in various locations, thus PCOCs related to these APECs were also investigated across the Lots 2/4 area.

Prior to the 2011 SSI, 47 boreholes were drilled across Lots 2/4, 26 of which were finished as monitoring wells. One borehole, completed as a monitoring well, was drilled south of Lots 2/4. During the 2011 SSI, FRANZ drilled 1 borehole (MV-11BH-01M (onsite)) in the northwest corner

of the Lot 2/4 area, and 2 boreholes (MV-11BH-02M and MV-11BH-03M (offsite)) south-west of the Lots 2/4 area and adjacent to Tannery Road. All three boreholes were finished as monitoring wells. Soil and groundwater results for onsite and offsite investigation locations related to the Lots 2/4 area are presented in Figures 3 through 14 and Tables 2 through 22.

### **Soil Analytical Results**

In some locations across Lots 2 and 4 soil pH was slightly acidic or slightly basic, but overall the mean soil pH of approximately 6.7, was within the normal range (pH 6-8) defined by CCME.

Soil samples were collected from across Lots 2 and 4 and analyzed for BTEX, VPH, styrene, metals, chlorophenols, PAHs, and VOCs. Soil from the two boreholes adjacent to (southwest of) Lots 2 and 4 were tested for metals, PAHs, VPH, BTEX, styrene, PHCs F1-F4, LEPH, HEPH, phenols and chlorophenols, chloride anion, sulphide, and VOCs.

Of the parameters analyzed soil anions, metals, and PAHs in onsite and offsite locations exceeded CCME guidelines and/or BC CSR Standards and require further discussion.

### **Anions (salts)**

Chloride (Cl<sup>-</sup>) concentrations in offsite soil (MV-11BH-02M, south of Lots 2/4) exceeds BC CSR Schedule 7 Standards for relocation of soil to non-agricultural land. Based on this, if soil were to be excavated from the MV11-BH-02M area it would require a soil relocation agreement to be moved off the property. Although concentrations of chloride in offsite soil require a soil relocation agreement for removal from the area; as offsite chloride concentrations do not exceed applicable BC CSR IL Soil Standards, chloride contamination has not been identified for the area.

### **Metals**

Soil in both Lots 2 and 4 exceed CCME IL (IL+) Guidelines for multiple metals (chromium (Cr), copper (Cu), cadmium (Cd), nickel (Ni), zinc (Zn), antimony (Sb) and arsenic (As)). Of these metals exceedances, chromium exhibits the highest concentrations in soil and the greatest area of impact. The vertical extent of the metals impact includes the sandy fill layer underlying the asphalt, down to the underlying silt layer; for an impacted layer about 4 m thick. The horizontal extent is localized to the area north-northwest of the tannery footprint (APEC1) extending further west to the banks of the Fraser River (an identified area of approximately 1.6 ha). The impact area is generally delineated by compliant soil results at the north and northeast boundaries of Lots 2 and 4.

Metal concentrations in the onsite impact area also exceed BC CSR IL Standards and Schedule 7 Relocation Standards for antimony, arsenic, cadmium, chromium, copper lead, and zinc. Tin concentrations in the impact area exceed BC CSR Schedule 7 Relocation Standards

only. Based on the Schedule 7 exceedances, removal of metals- impacted soil from Lots 2 and 4 area and transfer to offsite non agricultural land would require a soil relocation agreement.

Previous investigations on the southwest adjacent property have identified “metals impacted soil” in this offsite area (NEXT Environmental Inc,1998h). Offsite metals impacts (chromium) were confirmed on the southwest adjacent property during the 2011 SSI, where chromium concentrations exceeding CCME IL Guidelines, and BC CSR IL and BC CSR Schedule 7 Standards were identified in subsurface soil from the new MV-11BH-02M borehole (4.5-5 mbgs). Similar industrial activities have occurred at both the Site and the west adjacent property; as such metals impacts identified to the southwest are expected to be reflective of the previous industrial use of the west and southwest properties; and are not necessarily indicative of offsite migration.

### **PAHs**

Concentrations of PAHs in soil (naphthalene and/or phenanthrene) exceed CCME IL Soil Guidelines for protection of aquatic life, in all 4 locations tested on Lots 2 and 4. Total PAHs in onsite soil also exceed the calculated health based index of additive cancer risk (IACR) for protection of drinking water. The PAH impacted soil (0.6-2.4 m bgs) in this section is co-located to the metals impacted sandy fill and silt intervals discussed previously. Onsite soil PAH concentrations do not exceed BC CSR IL or Schedule 7 Relocation Standards. The low level PAH exceedances around the Lots 2/4 area have not been fully delineated; localized areas of low level PAH exceedances have been identified site wide.

PAH concentrations in soil from the area southwest of Lots 2/4 exceed BC CSR Schedule 7 Relocation Standards for benzo[a]anthracene, benzo[a]pyrene, benzo[b]fluoranthene, benzo[k]fluoranthene, and indeno [1,2,3,-c,d]pyrene in 1 of the 2 offsite locations tested (MV-11BH-02M, 5-6 m bgs), but are compliant with applicable BC CSR IL Soil Standards. Given the Schedule 7 exceedances, if soil from the PAH impact area southwest of Lots 2/4 were to be excavated it would require a soil relocation agreement to be transported to offsite non-agricultural land. Soil in the area southwest of Lots 2/4 also exceeds CCME IL Guidelines for Naphthalene, Phenanthrene, and/or PAH IACR in the silty sand unit (MV-11BH-02M, 4.5-6 m bgs, and MV11-BH-03M, 2-3 mbgs). Offsite PAH impacts are not fully delineated. Similar industrial activities have occurred at both the Site and the adjacent property; such that PAH impacts may not be indicative of offsite migration but rather reflective of the previous industrial use of the southwest properties.

### ***Groundwater Analytical Results***

Groundwater samples were collected from monitoring wells (8 within 10m of the high water mark, and 22 greater than 10m from the high water mark) across Lots 2 and 4 and were analyzed for VPH, BTEX, styrene, dissolved metals, chlorophenols and VOCs. Samples from select monitoring



wells on Lot 2 were also tested for chloride ion, sulphide, PAHs, phenols, L/HEPH, EPH, VH (C6-C10) and petroleum hydrocarbon fractions F1-F4.

Groundwater samples collected from new monitoring wells installed on the southwest adjacent property (one <10m from the high water mark, and one >10m from the high water mark) were analyzed for chloride ion, sulphide, BTEX, VPH, VH (C6-C10), styrene, dissolved metals, PAHs, phenols and chlorophenols, VOCs, L/HEPH, EPH, and petroleum hydrocarbon fractions F1-F4.

Concentrations of MAHs (toluene), VOCs (chlorobenzene), PAHs (pyrene), chlorophenols, and dissolved metals exceed applicable federal (CCME, FCSAP, or Health Canada DW quality) Guidelines and/or provincial (BC MOE Water Quality Guidelines (BC WQGs) or BC CSR Standards) Standards/Guidelines in various locations across Lots 2 and 4. Groundwater exceedances for the specified parameters are discussed below.

### **VOCs/MAHs**

Groundwater exceeded CCME Guidelines for the protection of aquatic life for toluene and chlorobenzene in monitoring well 2-BH28 (last sampled July 1998) adjacent to the Fraser River. Chlorobenzene and toluene concentrations in this well also exceed BC WQGs. As toluene and chlorobenzene concentrations were less than CCME and BC WQG Guideline in adjacent wells groundwater exceedances for VOCs/MAHs are expected to be localized to an area of approximately 100m<sup>2</sup>. The 2-BH28 well could not be accessed to be sampled during the current SSI program. Sampling of the nearby well MW2-30 during the SSI program indicated non-detect toluene and chlorobenzene concentration in groundwater. It is likely that these exceedances are from historical point sources and are no longer present onsite. Re-sampling or re-drilling a well in the 2-BH28 location is required to verify that VOC impacts do not remain in groundwater at this location.

### **PAHs**

Groundwater exceeded CCME Guidelines for the protection of aquatic life for pyrene (MW2-30) in one of two wells tested on Lot 2. While only two wells were tested on the Lot, there remains a potential for low level PAH exceedances to be present in groundwater across the Lot 2/4 area based on the identified PAHs exceedances in soil across the Site. Pyrene concentrations in groundwater from this location also exceed BC Water Quality Guidelines. Pyrene impacts identified at Lot 2 are bounded to the Site by compliant groundwater from wells southwest and west of the Lot. Given that this well is within 10m of the surface water environment, a potential for offsite migration to the Fraser River remains. Re-sampling MW2-30 is required to verify this result in near shore groundwater.

### **Chlorophenols**

Nine wells were tested and one groundwater sample (4-BH5, collected in July 1998) exceeds guidelines for pentachlorophenol (FCSAP AW Interim Groundwater Guidelines) and 2,3,4,6-tetrachlorophenol (FCSAP AW and Health Canada DW Guidelines). SSI sampling efforts in the

area were focused on delineating around the known exceedance rather than re-sampling within the historical impact area.

Pentachlorophenol and 2,4,5-trichlorophenol concentrations at 4-BH5 exceed BC CSR AW/DW Standards, however groundwater from offsite wells southwest of 4-BH5 are compliant with provincial Standards for chlorophenols. The chlorophenol impact area is bounded to the north, northeast and southwest, and expected to be localized to an approximate 1000m<sup>2</sup> area around Lot 4 (APEC 1).

### Dissolved Metals

Dissolved metals were tested in 27 locations. Dissolved metal concentrations (aluminum, antimony, arsenic, barium, cadmium, chromium, copper, iron, lead, mercury, nickel, selenium, titanium, zinc) in groundwater exceed applicable federal Guidelines in 17 of the 27 wells. Onsite groundwater also exceeds provincial Guidelines/Standards for aluminum, antimony, arsenic, barium, cadmium, chromium, iron, lead, manganese, nickel, and zinc.

Groundwater from the two offsite wells southwest of Lots 2 and 4 also exceed provincial guidelines/Standards (chromium, iron, manganese) and federal guidelines (arsenic, cadmium, chromium, iron, manganese, titanium, zinc) for metals.

The area of metals impacted groundwater is not delineated onsite, and is expected to be area-wide including on neighbouring properties.

A summary of environmental issues at Lots 2 and 4 to be carried forward into the subsequent risk assessment is presented in the table below.

Media	Contaminant (s) of Concern	Area (m <sup>2</sup> )	Identified Depth (m bgs)	Volume (m <sup>3</sup> )	Comments
Soil	Metals (Cr*, Cu*, Cd*, Ni*, Zn*, Sn*, Sb*, As*)	Estimated 1.6 ha	0.6-4.6	undefined	Metals above CCME and BC CSR IL Soil Standards (related to APECs 1,2 26 and 27) is generally bounded at the north and northeast of Lots 2/4.
	Naphthalene and Phenanthrene	site wide	0.6 – 2.4	undefined	PAHs above CCME IL Soil Standards was identified on Lots 2 and 4 (APECs 1, 2, 26, 27). Low level PAH impacts appear to be present across the Site

Groundwater	Metals (Al*, As*, Sb*, Ba*, Cd*, Cr*, Cu, Fe*, Pb*, Hg, Mn*, Ni*, Se, Ti, Zn*)	area wide	n/a	undefined	Dissolved metal impacts have not been delineated onsite and are expected to be area wide including on neighbouring properties.
Groundwater	Pentachlorophenol* 2,3,4,6 Tetrachlorophenol and 2,4,5 Trichlorophenol*	Estimated 1000m <sup>2</sup>	n/a	undefined	The chlorophenol impact area is expected to be localized to the Lot 4 (APEC 1) area.
Groundwater	Toluene* and Chlorobenzene*	Estimated 100m <sup>2</sup>	n/a	undefined	Localized to one near shore location in Lot 2 (APECs 2/26/27).
Groundwater	Pyrene*	Potential to be Site wide	n/a	undefined	Expected site-wide, given the potential for low level PAHs to be present in soil. A potential for offsite migration to the Fraser River remains for the impact in the nearshore Lot 2 area (APEC 2/26/27). Re-sampling MW2-30 is required to verify this result in near shore groundwater.
Offsite soil	Chloride* concentrations in soil from the southwest adjacent property (MV-11BH-02M, 4.5-5 m bgs) exceeded BC CSR Schedule 7 Standards. Chromium* concentrations at this location also exceed BC CSR IL and Schedule 7 Soil Standards. Chromium and chloride impacts have not been fully delineated. Impacts identified to the southwest may be reflective of the previous industrial use of the southwestern properties, and not necessarily indicative of offsite migration.				
Offsite groundwater	Metals (As, Cd, Cr*, Fe,* Mn*, Ti, Zn) impacted groundwater has not been delineated around offsite locations, and is expected to be area-wide including on neighbouring properties.				

\*Exceeds BC CSR IL Standards and/or BC CSR Schedule 7 Standards for soil, or BC CSR AW/DW Standards or BC WQGs for groundwater.

### **Lot 3 (APECs 3, 4, 5, 6, 8, 7, 32, 9, 16, 19, 28)**

Due to their physical proximity and similar PCOCs, investigation results for APECs in Lot 3 are presented in the same section.

APEC	APEC Description	Substance	Media	PCOCs										
				Metals	Sulfides	VOC s	F2/F3 (L/HEPH)	PAH	BTEX	F1 (VPH)	Glycols	F4	Phenols/ Chlorophenols	
3	Paint AST in the east central portion of the main building	Paint, solvents	SOIL	x		x								
			GW	x		x								
4	Former Mill Service Shop	Oils, waste oil, hydraulic fluids, solvents, hydraulic hoists, metal machining (metals)	SOIL	x		x	x	x	x	x	x	x		
			GW	x		x	x	x	x	x	x			
5	Waste oil AST outside the Mill Service Shop	Waste oil, solvents	SOIL	x		x	x	x	x	x	x			
			GW	x		x	x	x	x	x	x			
6	Former fueling facility	Diesel, gasoline	SOIL				x	x	x	x				
			GW				x	x	x	x				
8	Septic UST	Waste disposal (paints, chemicals etc.)	SOIL			x	x	x	x	x	x		X	
			GW			x	x	x	x	x	x		X	
7	Main Building (Lumber Storage, Packaging, Application of PCP to lumber)	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x			x	x					X	
			GW	x			x	x					X	
32	Former Kiln B - Lot 3 (North)	Konus Oil	SOIL				x	x						
			GW				x	x						
9	Former Lumber Storage Area	Wood treatment chemicals (CCA, chlorophenols,)	SOIL	x			x	x					X	
			GW	x			x	x					X	
16	Area of Mineral Oil and Grease above Level C in soil identified by SRKR	Petroleum hydrocarbons (mineral oil and grease)	SOIL				x	x	x	x		x		
			GW				x	x	x	x				
19	Former Kiln A- Lot 3 (South)	Konus Oil	SOIL				x	x						
			GW				x	x						
28	Fill Lot 3	Metals, PAHs, petroleum hydrocarbons	SOIL	x			x	x	x	x				
			GW	x			x	x	x	x				

Lot 3 (and its associated APECs) is located in the south portion of the Site (see Figure 2b). Activities at Lot 3 have historically consisted of lumber manufacturing, staining, and storage. Lot areas not covered by building footprints are currently paved. The Canadian National Railway

(CNR) right of way borders Lot 3 to the east, and Timberland Road, Tannery Road, and Dyke Road border Lot 3 to the South and West. Lot 6 of the Site is directly north of Lot 3.

The Main Lumber Storage and Packaging Building, also referred to as the Imperial Lumber “A Mill”, and Kiln Storage Buildings remain onsite. The rest of the Lot area is currently used as a lumber product storage area.

The potential for soil and groundwater impacts from chemical leaks and spills led to APEC identification in the following areas:

- A-Mill (APEC 7) was the storage area for processed lumber, and reportedly the location of “antisapstain (pentachlorophenol) application to lumber products” (SRK Robinson, 1994b; Next Environmental Inc., 1998e).
- Franz identified the footprints of the former Dry Kiln (APEC 19) and former Wet Kiln (APEC 32) for investigation based on the potential use of kerosene oil as a heating fuel for the kilns.
- a 2,250 L paint AST (APEC 3) “formerly used to contain paint for painting labels on lumber and lumber packaging” in the east –central portion of the A Mill building (NEXT Environmental Inc., 1998c).
- “Waste oil storage (APEC 5) and heavy oil staining” identified at the A Mill shop footprint (APEC 4) (NEXT Environmental Inc., 1998c).
- “Surface staining, a pump island barrel storage, and the presence of a diesel UST “in the vicinity of the former fueling facility (APEC 6) (NEXT Environmental Inc., 1998c).
- “A septic UST (APEC 8) identified on the east Side of the Lot”, with the potential to release regulated substances to the subsurface (NEXT Environmental Inc., 1998c).
- Historical storage of lumber products (APEC 9) is localized to the southwest of this section (adjacent to Tannery Road).
- Historical mineral oil and grease impacts in surface soil (APEC 16) identified during subsurface investigations in the southwest of this section, as well as on the west adjacent property (SRK Robinson Inc, 1994a).
- Fill material of unknown quality (APEC 28) has the potential to be present in various locations across the Lot, thus PCOCs related to this APEC were investigated at stations across the Lot 3 area.

Prior to the 2011 SSI thirty-four boreholes were drilled in APEC areas across Lot 3, twenty- one of which were installed as monitoring wells. In 1998, one surface soil sample (3-S1) was collected from exposed soil in the vicinity of the former paint AST. Four surficial soil samples were also collected from drainage ditches northwest (samples S2 and S3, adjacent to Dyke Road), and west of the lot (S4 and S5, adjacent to Tannery Road) (NEXT Environmental, 1998e). One surface soil sample (SS-2) was also historically collected from the offsite west adjacent property.

During the 2011 SSI, FRANZ conducted the following:

- drilled one borehole finished as a monitoring well for soil and groundwater characterization at newly identified APEC 34 (MV-11BH-17M).
- drilled one borehole completed as a monitoring well on the west adjacent (offsite) property (MV-11BH-04M) for horizontal delineation of identified site impacts. Offsite MV-11BH-04M was destroyed before groundwater could be collected from the well.
- drilled seven boreholes (MV-11BH-05, MV-11BH-06, MV-11BH-07M, MV-11BH-08, MV-11BH-09 and MV-11BH-10M, MV-11BH-14M) at and around APECs 9, 16, 19 and 28. Three of these boreholes (07M, 10M, and 14M) were installed as monitoring wells.

In 2012, FRANZ re-sampled six of the existing monitoring wells remaining around Lot 3 APECs 4,5,6,7,8 and 28 (3-BH10, 3-BH11, 3BH-31, MW07-9, OW5, and 3BH-29) and completed groundwater sampling at each of the newly installed monitoring wells (07M, 10M, 14M and 17M) around APECs 9, 16, 19, 28 and 34.

Soil and groundwater results for Lot 3 investigation locations are presented in Figures 2 through 13 and Tables 23 through 40.

### ***Soil Analytical Results***

Soil pH of fill and underlying silts in some locations across the lot was slightly acidic, but overall the mean pH of approximately 6.3, was within the normal range (pH 6-8) defined by CCME.

Soil samples were collected in surficial fill and underlying silt at locations on the east side of the A-Mill Building; around the former mill service shop (APEC 4), waste oil AST (APEC 5) former fueling facility (APEC 6) and septic UST (APEC 8). Representative samples were analyzed for EPH and L/HEPH (regulated under the BC CSR and applicable at offsite surrounding properties), metals, and PAHs. PAHs in soil around APEC 5 (waste oil AST) and metals in soil around APEC 8 (septic UST) exceeded CCME guidelines and/or BC CSR IL Soil Standards and require further discussion.

Soil samples were collected from the Dyke Road ditch, and in surficial fill and underlying silt at and around the paint AST footprint (APEC 3), the A-Mill Building footprint (APEC 7), and in the former kiln footprint north of A-Mill (APEC 32). Road ditch soils were analyzed for metals. Soil from the paint AST area was analyzed for VOCs, BTEX, styrene and VPH. Representative samples from around the A-Mill and former kiln footprints were analyzed for PHC fractions F2-F4, metals, PAHs, EPH, L/HEPH, and phenols/chlorophenols. Soil metals, chlorophenols, and PAHs exceeded CCME soil guidelines and/or BC CSR IL Soil Standards in various samples and require further discussion.

Soil samples were collected from the Tannery Rd. ditch, and surficial fill and underlying silt at and around the former kiln (APEC 19), former lumber storage area (APEC 9), and the identified oil and

grease impact area (APEC 16). Ditch soils were analyzed for EPH (C10-19) and (C19-32). Soil from the former kiln area was analyzed for metals, PAHs, and petroleum hydrocarbon fractions (PHCs) F2-F4. Samples from the former lumber storage area were analyzed for VPH, LEPH/HEPH, EPH (C10-19) and (C19-32), phenols/ chlorophenols and metals. Soil samples from the former oil and grease impact area were analyzed for VPH, LEPH/HEPH, PHCs F1-F4, BTEX, styrene, MTBE, and PAHs. Of the parameters analyzed soil petroleum hydrocarbon compounds (HEPH, EPH C19-32), metals, and PAHs exceeded CCME guidelines and/or BC CSR IL Standards in various samples from these APEC areas and require further discussion.

Surficial soil locations across the Lot 3 area were tested for unknown fill quality (APEC 28) PCOCs of metals, EPH, VPH, PHCs F1-F4, BTEX, PAHs as well as chlorophenols.

### **Metals**

One of two surficial soil samples collected from the Lot 3 road ditch and analyzed for metals exceeded applicable CCME soil guidelines for arsenic, copper and zinc (S2, adjacent to Dyke Road). Soil samples also exceeded BC CSR IL Standards (applicable offsite) and BC CSR Schedule 7 Standards for arsenic (S2), copper (S2), and zinc (S2 and S3). These soil exceedances are currently not delineated, but are expected to be surficial and localized, as soil collected from nearby onsite boreholes and one offsite (MV-11BH-04M) borehole were IL- for metals. If arsenic/copper/zinc impacted soil is removed from the Lot 3 road ditch, a soil relocation agreement will be required to move material to an offsite location.

Chromium and lead concentrations around the septic AST (APEC 8) do not exceed applicable CCME IL soil guidelines, but do exceed BC CSR IL soil Standards for these parameters in one of three locations tested in the area east of A-Mill (3-BH-7, 1.5 m bgs). Metal impacts remain to be delineated to the north/northeast, but are expected to be localized. Metals concentrations (chromium, lead, zinc) in surficial soil exceeding BC CSR IL Soil Standards were also identified around the former lumber storage area (APEC 9, 3-BH-2, 0.76 m bgs) and former kiln (APEC 19, 3-BH6, 0.6 m bgs) Again, metal concentrations in these locations do not exceed applicable CCME soil quality guidelines for the Site, and the BC CSR soil exceedances are delineated and expected to be localized.

High concentrations of chromium, lead and zinc in onsite Lot 3 soils appear to be surficial, limited to the upper 1 m of fill soil and sporadic (limited to localized hotspots) across the Lot 3 area. Concentrations of chromium, lead, and zinc in onsite soils not only exceed BC CSR IL Standards but also the BC CSR Schedule 7 Relocation Standard, such that removal of chromium/lead/zinc impacted soil from the Lot 3 area would require a soil relocation agreement for removal of material to an offsite location.

Lead concentrations in surficial soil sampled from the west adjacent property (SS-2) also exceeded BC CSR IL and Schedule 7 Standards, and within the same range of concentrations identified in soil onsite. Metals impacts identified offsite to the west are not necessarily

considered to be indicative of offsite migration but rather reflective of the previous industrial use of the western properties.

### **Pentachlorophenol**

Pentachlorophenol soil concentrations in Lot 3 do not exceed applicable CCME IL soil guidelines, but do exceed BC CSR IL soil Standards and BC CSR Schedule 7 soil Standards in one location historically tested in the A-Mill footprint (APEC 7, 3-BH-4-SRK, 0.3 m bgs). The pentachlorophenol impact is horizontally delineated, and expected to be a localized hotspot. If pentachlorophenol impacted soil were to be removed from this location, the material would require a relocation permit prior to being moved offsite.

### **Petroleum Hydrocarbons (EPH (C19-32), HEPH)**

Soil exceeded BC CSR IL Standards for HEPH or EPH (C19-32) (as a measure of HEPH) in two of thirteen locations tested in this Lot (MV-11BH-07M, upgradient of APEC 16; and S4, ditch soil down-gradient of APEC 16). EPH and HEPH are not federally regulated, instead analytical results from these locations were compared to BC CSR IL Standards based on their proximity to the Site boundary, and the potential for impacts on adjacent properties. The vertical extent of hydrocarbon impacts in the borehole is limited to approximately 1.5 m bgs. Ditch soil impacts are also expected to be surficial. Impacted soil appears to be localized to approximately 500m<sup>2</sup> around MV-11BH-07M, and approximately 100m<sup>2</sup> around ditch sample S4.

Previous investigations identified concentrations of mineral oil and grease exceeding former BC Criteria Level C on the property adjacent to MV11BH-07M (SRK Robinson Inc, 1994a). Similar industrial activities have occurred at both the Site and the west adjacent property; as such, petroleum hydrocarbon impacts identified offsite to the west are not necessarily considered to be indicative of offsite migration but rather reflective of the previous industrial use of the western properties.

Soil around APEC 16 exceeds BC CSR Schedule 7 Standards for HEPH, EPH (C10-19), and EPH (C19-32) such that if petroleum hydrocarbon impacted soil around APEC 16 were to be excavated it would require a relocation permit to be moved offsite.

### **PAHs**

Concentrations of naphthalene and phenanthrene in soil exceeded CCME IL Soil Guidelines for protection of freshwater aquatic life in one of two locations tested around APECs 4,5,6, and 8. The identified onsite PAH exceedance (3-BH8, 0.6 m bgs) is located adjacent to the waste oil AST. However, the soil PHCs (EPH, L/HEPH) at this location were non detect suggesting that the PAHs are not sourced from the AST.



Soil concentrations of PAHs (naphthalene) slightly exceed CCME IL Soil Guidelines for protection of aquatic life, in the one borehole at the former kiln (APEC 32). The onsite PAH exceedances (0.5-1 m bgs) is located in the footprint of the former kiln however, the soil PHCs (F2-F4, L/HEPH) at this location were very low or non-detect, suggesting that the PAHs are not sourced from kiln activities.

Concentrations of naphthalene and phenanthrene in soil exceed CCME IL Soil Guidelines for protection of aquatic life in two of three locations tested in the APECs 9,16,19, 28 area. Identified onsite PAH exceedances (0.75-3 m bgs) at the former kiln (APEC 19, MV-11BH-10M) and former lumber storage area (APEC 9, MV11-BH07M) are located in the sandy fill and underlying silt and wood debris.

Identified Lot 3 PAH concentrations do not exceed BC CSR IL Standards, or Schedule 7 Standards for soil relocation permitting. The low level PAH exceedances around the Lot 3 waste oil AST, former kilns, and former lumber storage area have not been fully delineated; localized areas of low level PAH exceedances have been identified site wide.

### ***Groundwater Analytical Results***

Groundwater collected from wells around A Mill was analyzed for benzene, ethylbenzene, toluene, and styrene, metals, PAHs, EPH, L/HEPH, PHCs F2-F4 VH, VPH chlorophenols, phenols and methyl-tert-butyl ether (MTBE).

Groundwater from wells from around the former kiln footprints (APECs 19 and 32) were tested for BTEX, dissolved metals, PAHs, EPH, VH, VPH, L/HEPH, PHCs F2-F4 and MTBE.

Groundwater from wells around the the former mill service shop (APEC 4)/waste oil AST (APEC 5)/former fueling facility (APEC 6)/septic UST (APEC 8) area was analyzed for BTEX, styrene, dissolved metals, PAHs, EPH, L/HEPH, VPH, VH, VOCs and PHCs F1-F4.

Groundwater from wells around the oil and grease impact area (APEC 16) was analyzed for BTEX, styrene, PAHs, EPH, L/HEPH, VH.VPH, PHCs F1-F4 and MTBE.

Groundwater collected from wells around the former lumber storage area (APEC 9) was analyzed for BTEX, dissolved metals, PAHs, EPH, L/HEPH, PHCs F2-F4, phenols and chlorophenols.

Groundwater from wells across the Lot 3 area were tested for unknown fill quality (APEC 28) PCOCs of metals, PHCs F1-F4, BTEX, and PAHs.

Dissolved metals phenols, and chlorophenols, in onsite groundwater exceed federal guidelines and/or provincial Standards in various locations and require further discussion.

### **Dissolved Metals**

Groundwater exceeded applicable federal guidelines as well as provincial Standards for dissolved iron and manganese in all wells tested across Lot 3.

In addition to the Lot wide iron and manganese impacts, groundwater in the north of Lot 3 exceeded applicable federal guidelines for the following parameters and areas:

- dissolved arsenic, aluminum, zinc, barium, copper, and lead in two of two wells tested around the A Mill footprint (APEC 7). Soil metals are compliant with federal guidelines and provincial Standards in the A Mill footprint, however road ditch soils in this area exceed federal guidelines and provincial standards for arsenic, copper and zinc.
- dissolved arsenic, aluminum, zinc, chromium and cadmium in two of two wells tested around the former mill service shop (APEC 4) /waste oil AST (APEC 5) /former fueling facility (APEC 6) /septic UST (APEC 8) area. Localized chromium and lead impacts (above BC CSR soil Standards only) were identified in surficial soil around the APEC 8 area.
- In addition to the Lot wide iron and manganese impacts, groundwater in the south of Lot 3 exceeded applicable federal guidelines for the following parameters and areas:
  - dissolved arsenic, aluminum, zinc, copper cadmium, chromium in both wells tested around the former lumber storage area (APEC 9). A localized chromium, lead, and zinc hotspot (above BC CSR Soil Standards) was identified in surficial soil in the former lumber storage area.
  - dissolved aluminum, zinc, titanium copper, cadmium in one well tested at the former kiln footprint (APEC 19).
- In addition to the Lot wide iron and manganese impacts, groundwater in the north of Lot 3 exceeded BC CSR AW/DW Standards for the following parameters and areas:
  - dissolved barium and zinc in the A Mill footprint,
  - dissolved arsenic in the former mill service shop/waste oil AST/former fueling facility/septic UST area.

Metals impacted groundwater at Lot 3 is not delineated onsite and is expected to be area-wide, including on neighboring properties.

### **Phenol and Chlorophenols**

Groundwater samples exceeded applicable federal guidelines for pentachlorophenol and 2,3,4,6-tetrachlorophenol in one of (3-BH27, sampled 1998-2004) of the nine wells tested in the A Mill footprint (APEC 7). Concentrations of pentachlorophenol, 2,3,4,6-tetrachlorophenol, and total tetrachlorophenols in monitoring well 3-BH27 also exceed BC CSR DW/AW Standards. The area around 3-BH27 is also where localized pentachlorophenol impacts (concentrations exceeding BC CSR Standards) were identified in soil. The horizontal extent of chlorophenols impacted groundwater in this section has been delineated by wells screened within approximately the same interval (0.6-3.6 m bgs) as 3-BH27, to the south, north, and west of this location.

Groundwater also exceeded applicable federal guidelines for chlorophenols and phenols in two wells (of four wells tested) in the former lumber storage area (APEC 9) immediately south of the A-Mill. Monitoring wells MW3-29 (last sampled November 2009) and 3BH-29 (last sampled February 2012) exceed FCSAP AW Interim Groundwater Guidelines and/or Health Canada Drinking Water Quality Guidelines for 2,4-Dichlorophenol, 2,4,5-Trichlorophenol, 2,4,6- Trichlorophenol, 2,3,4,6-

Tetrachlorophenol, Pentachlorophenol and Phenol. Concentrations of 2,4,6- trichlorophenol, 2,3,4,6-tetrachlorophenol, pentachlorophenol, phenol, 2-methyl 4,6-dinitrophenol, 2,3,4,5-tetrachlorophenol, 3,4,5-trichlorophenol, total tetrachlorophenols, and total trichlorophenols in these wells also exceed BC CSR AW and DW Standards. Impacted groundwater has been generally delineated to the east, west, and northwest (generally cross gradient and down-gradient) of the MW3-29/3-BH29 area.

Chlorophenols impacts in the A Mill footprint (3-BH27) and wells immediately south of A Mill (3-BH29 and MW3-29) are expected to be related based on proximity to source, and similar identified groundwater COCs. Chlorophenol impacts in groundwater have not been fully delineated cross gradient or up-gradient of 3-BH29/MW3-29. Previous investigations in the area have identified the building area around this impact as the location where “PCP (antisapstain) spray was reportedly applied to lumber” (Next Environmental Inc.,1998e). The chlorophenols impact area is expected to be localized to the south-central portion of the Main Lumber Storage and Packaging Building/A-Mill (approximately 3,000-5000 m<sup>2</sup>).

**Summary**

A summary of environmental issues at Lot 3 which will be carried forward into the subsequent risk assessment is presented in the table below.

Media	Contaminant (s) of Concern	Area (m <sup>2</sup> )	Depth (m bgs)	Volume (m <sup>3</sup> )	Comments
Soil	Naphthalene and Phenanthrene	site wide	0-3	undefined	Localized areas of low-level PAH exceedances in soil at the waste oil AST (APEC 5), former kilns (APECs 19 and 32) and former lumber storage area (APEC 9); low level PAH impacts appear to be present across the Site
	Metals (As*, Cu*, Zn*) (road ditch)  (Cr*, Pb*, Zn exceed BC CSR IL/ Schedule 7 Standards only)	Assumed 10 at each location  Assumed 10 at each location	undefined  Up to 1	undefined  Up to 30	Impact area in the road ditch currently not delineated.  Localized areas of metals above BC CSR IL Standards in fill soil around the Lot 3 septic AST (APEC 8), former kiln (APEC 19) and former

					lumber storage area (APEC 9).
	HEPH* and EPH (C19-32)*  (EPH (C10-19)* exceeds BC CSR Schedule 7 Standards only)	Estimated 500 (07M) and estimated 100 (S4)	Up to 1.5	undefined	Expected to be localized hydrocarbon impacts around the oil and grease impact area (APEC 16).  Impacts have not been delineated towards the west adjacent property (offsite).
	(Pentachlorophenol* exceed BC CSR IL/ Schedule 7 Standards only)	Assumed 10	undefined	undefined	Localized hotspot of pentachlorophenol above BC CSR IL Standards in the A Mill footprint (APEC 7).
Groundwater	Dissolved Metals (Al, As*, Ba*, Cu, Cd, Cr, Fe* , Pb, Mn*, Ti, Zn*)	area wide	n/a	undefined	Impacts have been identified across Lot 3; and have not been delineated onsite.
	Pentachlorophenol*, 2,3,4,6-Tetrachlorophenol* (total Tetrachlorophenols* also exceed BC CSR Standards only) (3-BH27)  2,4-Dichlorophenol, 2,4,5-Trichlorophenol*, 2,4,6-Trichlorophenol*, 2,3,4,6-Tetrachlorophenol*, Pentachlorophenol* and Phenol* (2-methyl 4,6-dinitrophenol, 2,3,4,5-tetrachlorophenol, 3,4,5-trichlorophenol*,	Estimated 3,000-5000	n/a	undefined	Impact area is expected to be localized to the south-central portion of the Main Lumber Storage and Packaging Building/A-Mill (APECs 7 and 9).

	total tetrachlorophenols, total trichlorophenols also exceed BC CSR Standards only) (3-BH29 and MW3-29)				
Offsite Soil	Metals (Pb*)	Lead concentrations in soil from the west adjacent property (SS-2, 0.2 m bgs) exceeded BC CSR IL and Schedule 7 Standards. Offsite impacts have not been fully delineated. Impacts identified offsite to the west are not necessarily indicative of offsite migration but may be reflective of the previous industrial use of the western properties.			

\*Exceeds BC CSR IL Standards and/or BC CSR Schedule 7 Standards for soil, or BC CSR AW/DW Standards for groundwater.

**Lot 5 (APECs 10, 11, 12, 13, 14, 15, 20, 29, 31)**

Due to their physical proximity and similar PCOCs, investigation results for APECs in Lot 5 are presented in the same section.

APEC	APEC Description	Substance	Media	PCOCs										
				Metals	F4	Sulfides	VOC s	F2/F3 (L/HEPH)	PAH	BTEX	F1 (VPH)	Glycols	Salts	Phenols/ Chlorophenols
10	Gasoline UST	Gasoline	SOIL					x		x	x			
			GW					x		x	x			
11	Waste oil AST	Waste oil, solvents	SOIL	x	x			x	x	x	x	x		
			GW	x				x	x	x	x	x		
12	Area of disposal for former in-ground hydraulic hoists	Hydraulic fluid	SOIL		x		x	x						
			GW				x	x						
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)	Wood treatment chemicals (CCA, chlorophenols)	SOIL	x	x			x	x					x
			GW	x				x	x					
13	Former Green Chain and Planer	Wood treatment chemicals	SOIL	x				x	x					x

	Mill	(CCA, chlorophenols)	<b>GW</b>	x					x	x									x	
15	Wood Chip and Wood Debris Area	Organic leachate: Phenolics, metals, wood treatment chemicals (CCA, chlorophenols)	<b>SOIL</b>	x															x	
			<b>GW</b>	x																x
20	Former Kiln - Lot 5	Konus Oil	<b>SOIL</b>						x	X										
			<b>GW</b>						x	X										
29	Fill Lot 5	Metals, PAHs, petroleum hydrocarbons	<b>SOIL</b>	x					x	x	x	x								
			<b>GW</b>	x					x	x	x	x								
31	Lumber Storage Area - Lot 5	Wood treatment chemicals (CCA, chlorophenols)	<b>SOIL</b>	x					x	x										x
			<b>GW</b>	x						x	x									

Most of the above APECs are localized near the northeastern and eastern boundaries of Lot 5 (see Figure 2b). APECs 29 and 31 are lot-wide APECs investigating soil quality across Lot 5.

Activities in Lot 5 have historically consisted of lumber manufacturing, staining/treatment, and storage, as well as truck and transport operations. APEC footprints are mainly located around the Imperial Lumber “B Mill” building (also referred to as the B Mill Waste Storage Shed) and the former Green Chain and Planer building.

The Lot is currently used for lumber storage, and remaining buildings include two storage sheds southwest of B-Mill, a work shed south of the B-Mill, and an office building southeast of B-Mill. Most of the Lot is paved with the exception of the B-Mill footprint which reportedly has a graveled floor (Next Environmental Inc.,1998d) and exposed surficial soil in the area around the two southern storage buildings. Lot 5 is bordered to the west by the CNR right of way, to the north by an offsite construction and storage company (RDM Enterprises- Imperial Yard (Next Environmental Inc, 1998d)), and to the east by up gradient and offsite APEC 17 (Auto Wrecking Yard).

The potential for soil and groundwater impacts from chemical leaks and spills led to APEC identification in the following areas:

- A Gasoline UST (APEC 10) with associated pump island located south of the B-Mill Building. The gasoline UST is understood to be no longer in use, but remains onsite. The size of the UST remains unknown (Next Environmental Inc.,1998d).
- A 1350 litre Waste Oil AST (APEC 11) with surficial soil staining, and used oil filters identified around the AST location, south of the B-Mill Building (Next Environmental Inc.,1998d).

- “Surface staining and corroded asphalt in the vicinity of the hydraulic hoist disposal area, on the southwest side of the B Mill Building” (APEC 12) (Next Environmental Inc.,1998d).
- “The former location of an aboveground chlorophenol dipping tank (operated by hydraulic hoists) in the B-Mill Building” (APEC 14) (Next Environmental Inc.,1998d).
- The potential for leaks and spills from “historical application of PCP to lumber in the former Green Chain and Planer building” (APEC 13) (Next Environmental Inc, 1998d).
- The potential for wood treatment chemicals (e.g. PCP) to be present on “wood chips and wood debris (APEC 15) identified in the northeast of the Lot” and adjacent to the Green Chain and Planer Mill Building (Next Environmental Inc, 1998d).
- A former Kiln footprint (APEC 20) where lumber was dried in a controlled environment, is located in the northeast corner of this Site section. This area was identified as an APEC based on the potential use of konus oil as a heating fuel for the kiln.

Lot-wide APECs (APEC 29 and APEC 31) were identified on the following basis:

- Imported fill of unknown origin and quality (APEC 29), was identified during drilling investigations encountering sandy fill extending 2-3 m below ground surface on Lot 5 (NEXT Environmental 1998).
- Historical storage of treated lumber (APEC 31) has the potential to impact underlying soil and groundwater in uncovered portions of the Site.

**B-Mill Area (APECs 10,11,12,14):** Historical soil and groundwater data from 23 boreholes (18 completed as monitoring wells) drilled in the B-Mill Area were used to support the investigation of APECs 10,11,12,and 14. During the 2011 SSI, FRANZ drilled 4 boreholes around these APECs (one onsite (MV-11BH-15M), and three offsite (MV-11BH-11M to 13M) to aid in horizontal delineation of impacts. All four boreholes were finished as monitoring wells. In February 2012, FRANZ sampled groundwater from all newly installed monitoring wells and one existing monitoring well (5-BH-23) onsite.

**Former Green Chain and Planer Mill and Kiln Area (APECs 13,15,20):** Historical soil and groundwater data from 11 boreholes (six completed as monitoring wells) drilled in the northeastern portion of the Lot support the investigation of APECs 13,15 and 20. As part of the 2011 SSI, FRANZ planned to drill and to install a monitoring well in the APEC 20 footprint. Due to ongoing Site operation, APEC 20 was not accessible and drilling at the proposed location was not possible.

**Lot Wide Area (APECs 29,31):** Historical soil and groundwater data from four test pits and 24 boreholes (10 completed as monitoring wells) located across Lot 5 support the investigation of APECs 29 and 31. During the 2011 SSI, FRANZ drilled one borehole in the centre of the Lot (away from building APECs), finished as a monitoring well (MV11-BH-16M) to further characterize soil fill/ and groundwater quality at Lot 5. In February 2012, FRANZ conducted groundwater sampling at this newly installed well.

Soil and groundwater results for Lot 5 investigation locations are presented in Figures 2 through 14 and Tables 41 through 60.

### **Soil Analytical Results**

Soil samples collected from sand fill and underlying silt and organics layers around the Former Green Chain and Planer Mill and Kiln area (APECs 13,15, and 20) were compliant with applicable guidelines for BTEX, metals and chlorophenols/phenols; as well as VPH and EPH (C10-19) and (C19-32) which are regulated under the BC.CSR. PAHs were identified as a secondary PCOC for this area but were not historically tested in soil. This is not considered a significant data gap on the basis that EPH (a primary PCOC) concentrations were non-detect in soil collected from the Former Green Chain and Planer Mill and Kiln area.

Soil samples collected from fill and the underlying silt layer at locations across Lot 5 (APECS 29, and 31) were compliant with applicable guidelines and Standards for BTEX, PAHs, PHC F1-F4, chlorinated and non-chlorinated phenols, and metals, L/HEPH and EPH. Soil pH of sandy fill and underlying silts from locations across the lot was slightly acidic, with a mean pH of approximately 5.8, slightly below the normal range (pH 6-8) defined by CCME.

Onsite soil around the B Mill Building (APECs 10,11,12,14) was analyzed for PAHs, BTEX, PCBs VOCs, metals, EPH, L/HEPH, VPH and chlorinated and non-chlorinated phenolics. Soil sampled from offsite locations (north and adjacent to APECs 10,11,12, and 14) was analyzed for VOCs (MTBE), BTEX, Styrene, L/HEPH, VPH, petroleum hydrocarbon fractions F1-F4, PAHs, metals, and chlorinated and non-chlorinated phenolics.

Soil concentrations exceeded applicable CCME guidelines and/or CSR Standards (IL and Schedule 7) for the below listed parameters around the B-Mill Building, and are further discussed in the following sections.

- Xylenes, EPH(C10-19), VPH (onsite)
- Chlorophenols (onsite),
- PAHs (onsite and offsite),
- Toluene and zinc (offsite),

### **Xylenes / EPH (C10-19) / VPH**

Soil in one (5-BH27, 0.6 m bgs) of 11 locations tested around B-Mill exceeds CCME IL (IL+) Guidelines, as well as BC CSR IL Standards for xylenes. Xylene impacted soil does not appear to extend offsite, and is bounded onsite to an estimated area of 400 m<sup>2</sup>. The vertical impact extent has not been delineated but is expected to be limited to the sandy fill layer in this section (approximately 0-1.5. m bgs). VPH and EPH (C10-19) concentrations greater than BC CSR IL



Standards are co-located to the xylene impacted sandy fill layer at 5-BH27. VPH and EPH (C10-19) concentrations in cross gradient and downgradient locations are non-detect, and bound onsite PHC impacts in this area.

Soil at the 5-BH27 location also exceeds BC CSR Schedule 7 Standards, and based on the measured soil concentrations a soil relocation agreement would be required to move the xylene, VPH, and EPH (C10-19)-impacted soil from this area to offsite non-agricultural land.

### **Chlorophenols**

Of the nine locations tested onsite and offsite around B-Mill, soil exceeded CCME IL (IL+) Guidelines for pentachlorophenol and 2,3,4,6-tetrachlorophenol in the sandy fill layer at one location (5-BH27, 0.6 m bgs) where xylene, VPH, and EPH(C10-19) impacts were also identified.

Soil in the sandy fill layer also exceeds BC CSR IL and Schedule 7 Standards at 5-BH22 (pentachlorophenol, 0.46 m bgs) and 5-BH27 (pentachlorophenol and 2,3,4,6-tetrachlorophenol, 0.6 m bgs).

Chlorophenol impacts do not extend offsite, and are bounded cross gradient and downgradient of B-Mill for an estimated impact area of approximately 400 m<sup>2</sup>. The vertical extent of impacts has not been delineated onsite. Due to exceedances of BC CSR Schedule 7 Standards, chlorophenol impacted soil around the B-Mill footprint would require a soil relocation agreement for removal to offsite non-agricultural land.

### **PAHs**

Soil concentrations of naphthalene and phenanthrene exceed CCME IL Soil Guidelines for protection of freshwater aquatic life, and the CCME calculated health based index of additive cancer risk (IACR) for protection of potable groundwater in two of four onsite locations tested around B-Mill (5-BH23 and 5-BH27). Onsite PAH concentrations (with impacts in the upper 1.5 m of soil) do not exceed BC CSR IL Standards or Schedule 7 Standards for soil relocation permitting. The low level PAH exceedances around the B-Mill footprint have not been fully delineated; localized areas of low level PAH exceedances have been identified site wide.

PAH concentrations in soil from offsite locations immediately north and adjacent to B-Mill (11M, 12M, and 13M, 0.5-2 m bgs) are above CCME Guidelines for acenaphthene, fluorene, naphthalene, phenanthrene, and PAH IACR; but are compliant with BC CSR IL and Schedule 7 Standards. PAH concentrations in soil from these offsite locations are generally 3-10x the concentrations identified in onsite soil; offsite impacts may not be originating from onsite source activities.

### **Zinc/ Toluene**

Total zinc concentrations exceed CCME IL Guidelines, as well as BC CSR IL Standards for the protection of Aquatic Life in one offsite location (MV-11BH-12M, 0.5-1 m bgs) adjacent to B-Mill.

This offsite impact has been delineated down gradient (onsite), but not fully delineated crossgradient on the offsite property. Zinc concentrations in soil samples from the same interval onsite were one order of magnitude lower than concentrations observed at MV-11BH-12M, therefore it is unlikely that IL+ soil at MV-11BH-12M is originating from operations at the Site. Concentrations of zinc in surficial soil at this offsite location not only exceed BC CSR IL Standards but also the BC CSR Schedule 7 Relocation Standard, such that zinc impacted soil from this area would require a soil relocation agreement for removal of material offsite.

Toluene concentrations in surficial soil from two offsite locations (MV-11BH-11M and MV11-BH-12M, 0.5-1 m bgs) are greater than federal soil guidelines, but compliant with the applicable CSR IL and Schedule 7 Standards. Toluene concentrations at all tested locations on Lot 5 are compliant with CCME and BC CSR Standards/Guideline; offsite concentrations of toluene are not expected to be originating from operations at the Site.

### ***Groundwater Analytical Results***

Groundwater from Lot 5 was analyzed for PHCs F1–F4, BTEX, styrene, PAHs, metals, chlorophenols, PHCs F2-F4, VPH, EPH, LEPH, HEPH, and VOCs. Concentrations of Ethylbenzene, LEPH, PAHs, chlorophenols and dissolved metals in onsite groundwater exceed federal guidelines and/or provincial Standards in various locations and require further discussion.

Groundwater collected from wells offsite and adjacent to Lot 5 was analyzed for BTEX, styrene, dissolved metals, MTBE, phenols and chlorophenols, PHCs F1-F4, EPH, VPH, VH (C6-C10), LEPH, and PAHs. Concentrations of LEPH, dissolved metals, and PAHs in offsite groundwater exceed BC CSR Standards and are also discussed in the following sections.

### **Ethylbenzene**

BTEX concentrations in groundwater from the Lot wide area (APEC 29, 31) and Green chain, planer mill and kiln area (APEC 13,15,20) were compliant with applicable guidelines and Standards.

In the B-Mill area (APEC 10,11,12,14), ethylbenzene concentrations exceeded Canadian Drinking Water Guidelines as well as BC CSR DW Standards at one of seven locations tested (5-BH25, last sampled in 1998). Ethylbenzene concentrations do not exceed FCSAP Guidelines for the protection of freshwater/marine aquatic life.

The ethylbenzene impact area is located adjacent to the AST and UST in the B-Mill Area (APECs 10 and 11) and likely attributable to leaks from these sources. Ethylbenzene impacts do not appear to extend offsite. Impacted groundwater is generally delineated to the north south, and west of this location and represents a historical impact area of approximately 250 m<sup>2</sup>.

## LEPH

VPH, EPH, LEPH, and F2 concentrations in groundwater from the Lot wide area (APEC 29, 31) and Green chain, planer mill and kiln area (APEC 13, 15, 20) were compliant with applicable Guidelines and Standards.

VPH, EPH, F1 and F2 concentrations in groundwater around the B-Mill are compliant with current federal Guidelines and provincial Standards. However, historically a LEPH plume has been identified by SRK Robinson Inc. (1994), and Next Environmental Inc. (1998) at and down-gradient of the AST and UST in the B-Mill Area (APECs 10/11).

LEPH concentrations in groundwater from 5-BH25 (sampled 2001), and 5-BH27 (sampled 2001) exceed BC CSR AW/DW Standards. Groundwater concentrations of LEPH in 5-BH23 (down gradient of the AST/UST and IL+ in 2001) are currently less than BC CSR Standards. Offsite groundwater tested from a well adjacent to the AST and UST area (MV-11BH-11M, sampled 2012) also exceeds BC CSR Standards for LEPH. The LEPH plume has not been delineated offsite, although it has been delineated east (onsite MW5-20, up-gradient) and southwest (onsite 5-BH23, downgradient) of the APECs 10 and 11 location. The LEPH plume around MV-11BH-11M /5-BH25/5-BH-27 is expected to represent a localized impact area of approximately 900m<sup>2</sup>. Further work is recommended to delineate the LEPH plume offsite.

## PAHs

PAH concentrations in groundwater from the Green Chain, Planer Mill and Kiln area (APECs 13,15,20) and in groundwater in the south and central areas of Lot 5 (APEC 29,31) were compliant with applicable federal guidelines, as well as being below BC CSR DW/AW Standards.

Groundwater tested from wells in the B-Mill Area (APECs 10,11,12,14) exceeded FCSAP Interim Groundwater Guidelines for Naphthalene (IL+) in three locations (5-BH25, 5-BH27 and MW5-20, collected in 1998 and 2009) adjacent to and west of the AST/UST onsite. Groundwater in this area also exceeds BC CSR AW/DW Standards for naphthalene (5-BH27 only). Monitoring well 5-BH23 (previously IL+ for naphthalene in 1998) was re-sampled by FRANZ in 2012 and all PAHs were less than the laboratory detection limit at this location. The reduction in concentrations could (in part) be attributed to a change in sampling methodology from sampling with watterra tubing or bailers by previous consultants to low flow sampling conducted by FRANZ. As a result, it is likely that the historical analytical results were influenced by a sampling artefact (high turbidity), which may have resulted in elevated reported concentrations.

Naphthalene impacted groundwater at the B-Mill area is co-located with localized ethylbenzene and LEPH impacted groundwater, suggesting that PAH impacts are potentially related to a historical fuel leak or spill from the AST or UST onsite (APEC 10 or 11). Naphthalene impacts in groundwater have been delineated west (downgradient) and southwest (cross-gradient) of these wells for a historical impact area of approximately 1,000 m<sup>2</sup>.

Offsite groundwater, tested from a well adjacent to the AST and UST (MV-11BH-11M) had concentrations of benzo(a)pyrene, fluoranthene and pyrene greater than FCSAP guidelines for the protection of aquatic life, with concentrations of benzo[a]pyrene also exceeding applicable BC CSR AW/DW Standards. PAH exceedances are not delineated offsite.

Benzo(a)pyrene, fluoranthene and pyrene concentrations in groundwater from onsite wells were all below laboratory detection limits, suggesting that PAH contamination at MV-11BH-11M is unlikely to be originating from operations at the Site. Re-sampling of onsite and offsite wells downgradient of APECs 10 and 11 (MV-11BH-11M, MW5-20, MV-11BH-12M, 5BH-27) should be conducted to confirm current groundwater PAH concentrations.

### Metals

Groundwater tested in the following Lot 5 areas exceeded applicable federal guidelines for numerous metals:

- **Green Chain and Planer Mill and Kiln area:** Groundwater tested from MW5-12 (last sampled November 2009) exceeded FCSAP Aquatic Life Guidelines for dissolved chromium. The chromium concentration identified at MW5-12 does not exceed BC CSR DW and AW Standards. Chromium concentrations in wells downgradient of this location (BV11BH-03M, 04M, 09M), are compliant with the FCSAP AW Guideline however metals impacted groundwater has not been fully delineated onsite. This well has not been historically tested for any other metals than chromium, and there remains the potential for other exceeding metals concentrations in groundwater in this area.
- **Lot wide area:** Groundwater tested from 5-BH29, (last sampled in 1998) exceeded applicable FCSAP Aquatic Life Guidelines and/or Canadian Drinking Water Quality Guidelines for dissolved aluminum, arsenic, copper, iron, manganese, and zinc. Dissolved arsenic, iron, and manganese at this well also exceed BC CSR DW and AW Standards. During the 2011 SSI, monitoring well 5-BH29 was proposed to be re-sampled to confirm metals impacts, but the well could not be located amid debris and machinery in this portion of the Site.
- **B-Mill area:** Onsite groundwater tested from 5-BH27, (last sampled in 1999) exceeded applicable FCSAP Aquatic Life Guidelines and/or Canadian Drinking Water Quality Guidelines for dissolved aluminum, arsenic, cadmium, copper, iron, manganese, and zinc. Groundwater also exceeded BC CSR Aquatic Life and/ or Drinking Water Quality Standards for arsenic, cadmium, iron and manganese. Soil metals are compliant with federal and provincial standards in Lot 5.

Groundwater sampled from offsite wells adjacent to the B-Mill Area (MV-11BH-12M and MV11-BH13M, sampled in 2012) also have concentrations of aluminum, arsenic, cadmium, copper, iron, manganese, titanium, and zinc above federal groundwater guidelines. Offsite wells exceed applicable BC CSR AW and DW Standards for dissolved arsenic, iron, and manganese. Groundwater concentrations of metals in offsite wells are also generally greater than concentrations identified in onsite Lot 5 wells.

The area of metals impacted groundwater at Lot 5 is not delineated onsite, and is expected to be area wide including on neighboring properties.

## Chlorophenols

Groundwater from six wells tested between 1994 and 2009 in the Green chain, planer mill, and kiln area (APEC 13/15/20) was compliant with federal Guidelines and provincial Standards for phenols and chlorinated phenols.

Lot 5 groundwater exceeded applicable federal guidelines for pentachlorophenol and 2,3,4,6-tetrachlorophenol in multiple locations across the Lot wide area and around B-Mill.

- **Lot Wide Area:** Seven wells were tested and groundwater samples from two locations (5-BH29 (collected in 2003) and 5-BH31 (collected in 1998)) exceeded applicable federal Guidelines for pentachlorophenol, and 2,3,4,6,-tetrachlorophenol. Pentachlorophenol concentrations exceed BC CSR Standards at 5-BH31. Concentrations of pentachlorophenol 2,3,4,6-tetrachlorophenol 2,3,4,5-tetrachlorophenol, 2,3,4-trichlorophenol, and 2,3,6,-trichlorophenol also exceed BC CSR Standards at the Site boundary (5-BH29).

Pentachlorophenol impacted groundwater at well 5-BH31 is expected to be localized to an area of approximately 700m<sup>2</sup>; and has been generally bounded by compliant results further up gradient and down gradient of this location. Full delineation remains to be conducted in this area.

Under the BC CSR, AW Standards for chlorophenols vary with pH and temperature. As pH and temperature readings were not available for the December 2003 sampling event at 5-BH29, historical pH records from the July 1998 sampling event (pH 6.13), and mean Site wide groundwater temperature from a December 2007 sampling event (9.3°C) were used to determine appropriate CSR Standards with which to evaluate 2003 analytical results at the Site boundary well (5-BH29).

Chlorophenol impacted groundwater at the Site boundary (5-BH29) is generally bounded by compliant results in wells northwest and northeast of this well for an estimated impact area of approximately 1250 m<sup>2</sup>. The groundwater impact area at the boundary is not fully delineated and chlorophenol impacts may extend offsite and warrants additional investigation in this area.

- **B Mill Area:** Groundwater from 10 wells in this Site section were tested and six exceeded applicable federal guidelines for pentachlorophenol, 2,3,4,6-tetrachlorophenol, and 2,4,6-trichlorophenol around the northwestern portion of the B-Mill footprint, where a PCP dip tank was formerly located (5-BH27, BH32, BH33, BH34, MW5-13, MW5-32, last sampled 2003-2009). Groundwater concentrations of pentachlorophenol, tetrachlorophenols (2,3,4,5; 2,3,4,6; and 2,3,5,6, isomers) and trichlorophenols (2,3,4-; 2,3,5-; 2,4,5-; 2,4,6-; 3,4,5- isomers) in the B-Mill area also exceed BC CSR AW/DW Standards. Chlorophenol impacted groundwater has been localized to the western portion of the B-Mill Building (approximately 1500 m<sup>2</sup>). Based on 2011 SSI investigation results chlorophenol impacts do not extend offsite in this area.

## Summary

A summary of environmental issues at Lot 5 which will be carried forward into the subsequent risk assessment is presented in the table below.

Media	Contaminant (s) of Concern	Area (m <sup>2</sup> )	Depth (m bgs)	Volume (m <sup>3</sup> )	Comments
Soil	Xylenes*, EPH(C10-19)*, VPH*	Estimated 400	undefined	undefined	Localized to the north side of the B-Mill footprint (APEC 14), and down gradient of the waste oil AST and gasoline UST (APECs 10 and 11). Does not extend off Site.
	Pentachlorophenol * and 2,3,4,6- Tetrachlorophenol*	Estimated 400	undefined	undefined	Localized to the north side of the B-Mill footprint where the dip tank was formerly located (APEC 14), Does not extend off Site.
	Naphthalene and Phenanthrene	site wide	0-1.5	undefined	Localized area of low-level PAH exceedances in soil at B-Mill; low level PAH impacts appear to be present across the Site.  PAH concentrations in soil from offsite locations adjacent to B-Mill are generally 3-10x the concentrations identified in onsite soil, offsite PAH impacts may not be originating from onsite source activities.
Groundwater	Ethylbenzene*	250	n/a	undefined	Ethylbenzene impacts in groundwater are located adjacent to the AST and UST in the B-Mill Area (APECs 10 and 11) and likely attributable to leaks from these sources. Impact area does not extend off Site
	LEPH*	900	n/a	undefined	A LEPH plume (approximately 900 m <sup>2</sup> ), has been identified onsite and offsite at and down-gradient of the AST and UST in the B-Mill

					Area (APECs 10/11).
	Naphthalene*	Estimated 1,000	n/a	undefined	<p>Some elevated historical concentrations might be the result of a sampling artefact.</p> <p>Naphthalene exceedances are co-located with ethylbenzene and LEPH impacted groundwater, suggesting that PAH impacts may be related to a historical fuel leak/spill from the AST or UST onsite (APEC 10 or 11).</p>
	Dissolved Al, As*, Cr, Cd*, Cu, Fe*, Mn* Ti, and Zn	area wide	n/a	undefined	<p>Impacts have been identified across Lot 5 and not been delineated onsite.</p> <p>Concentrations of metals in offsite wells are generally greater than concentrations identified in onsite Lot 5 wells</p>
	<p>Pentachlorophenol*, and 2,3,4,6-Tetrachlorophenol* (Tetrachlorophenols (2,3,4,5; 2,3,5,6, isomers) and trichlorophenols (2,3,4-; 2,3,5-; 2,4,5-; 2,4,6-; 3,4,5- isomers) exceed BC CSR AW/DW Standards here.)</p> <p>Pentachlorophenol*</p> <p>Pentachlorophenol*, 2,3,4,6-tetrachlorophenol*, (2,3,4,5-tetrachlorophenol*,</p>	<p>1500</p> <p>Estimated 700 (5-BH31)</p> <p>Estimated 1250 (5-BH29)</p>	n/a	n/a	<p>Localized to the northwestern portion of the B-Mill footprint. Impacts in this area do not extend offsite.</p> <p>Identified in the west portion of the Lot. Impact area remains un-delineated but is expected to be localized</p> <p>Identified in the southeast portion of the Lot (adjacent to</p>

	<p>2,3,4-trichlorophenol*, and 2,3,6-trichlorophenol* exceed BC CSR AW/DW Standards here)</p>				<p>Timberland Road). Impact area remains undelineated There is a potential for off Site impacts.</p>
<p>Off Site soil</p>	<p>IL+ soil (Zinc*) is present off Site ( 0.5-1 mbgs), at the Site boundary, This offsite impact has not been fully delineated, however it does not seem to be originating from operations occurring on Site.</p> <p>Toluene soil concentrations off Site ( 0.5-1 mbgs), at the Site boundary, are greater than CCME soil guidelines but compliant with CSR IL Standards. Toluene concentrations offsite do not seem to be originating from operations occurring on Site.</p> <p>PAH soil concentrations (naphthalene, phenanthrene, fluorene and acenaphthene) in offsite locations adjacent to B-Mill are greater than CCME guidelines, but compliant with applicable CSR IL Standards.</p>				
<p>Off Site groundwater</p>	<p>Groundwater with LEPH (approximately 900 m<sup>2</sup>), has been identified onsite and offsite at the B-Mill area.</p> <p>Benzo(a)pyrene*, Fluoranthene and Pyrene concentrations greater than the applicable BC CSR Standards have been identified in an offsite well adjacent to the B-Mill area, PAH impacts in this well do not seem to be related to PAH contamination on Site.</p> <p>Groundwater from offsite wells adjacent to B-Mill also exceed federal and provincial Standards/Guidelines for dissolved aluminum, arsenic*, chromium, copper, iron*, manganese*, titanium, and zinc.</p> <p>Pentachlorophenol, 2,3,4,5-Tetrachlorophenol, 2,3,5,6-Tetrachlorophenol, 2,3,4-Trichlorophenol and 2,3,5-Trichlorophenol concentrations exceed BC CSR AW/DW Standards at the southeast Site boundary (5-BH-29).</p> <p>The impact area potentially extends offsite, thus warranting further investigation in the area.</p>				

\*Exceeds BC CSR IL Standards and/or BC CSR Schedule 7 Standards for soil, or BC CSR AW/DW Standards for groundwater.

**Lot 6 (APECs 21, 22, 23, 25, 30, 34)**

Due to their physical proximity, investigation results for APECs in Lot 6 are presented in the same section.



APEC	APEC Description	Substance	Media	PCOCs									
				Metals	Sulfides	VOC s	F2/F3 (L/HEPH)	PAH	BTEX	F1 (VPH)	Glycols	Salts	Phenols/ Chlorophenols
21	Oil Storage Shed - Brownsville	Konus Oil/Heating Oil	SOIL				X	X	X	X			
			GW				X	X	X	X			
22	Former Kiln - Brownsville	Konus Oil	SOIL				X	X	X	X			
			GW				X	X	X	X			
23	Former Green Chain - Brownsville	Wood treatment chemicals (CCA, chlorophenols)	SOIL	X			X	X					X
			GW	X			X	X					
25	Lumber Storage Area - Brownsville	Wood treatment chemicals (CCA, chlorophenols)	SOIL	X			X	X					X
			GW	X			X	X					
30	Fill Lot 6	Metals, PAHs, petroleum hydrocarbons	SOIL	X			X	X	X	X			
			GW	X			X	X	X	X			
34	VPH and LEPH Plume by Warehouse-Lot 6	Petroleum hydrocarbon source	SOIL				X	X	X	X			
			GW				X	X	X	X			

Lot 6 (and its associated APECs) is located in the northwestern portion of the Site (Figure 2b). Historical and current land use in this area consists mainly of wood manufacturing/ processing, and lumber storage. Lot 6 is currently covered (paved) only in the southwest portion of the lot. The area is bordered to the east/southeast by the former Brownsville Rails Spur and CNR right of way, where a historical diesel spill from a train collision (offsite APEC 33) has been indicated to have occurred, and by the reported location of the former dip tank where PCP was applied to lumber (offsite APEC 24). The Fraser River foreshore borders the lot directly to the west.

At present the Lindal Cedar Homes Warehouse and Distribution Building (adjacent to APEC 34), the Oil Storage Shed where oil staining was identified during the 2006 Hemmera Site visit (APEC 21), the Former Kiln (APEC 22), the Sawmill Building, and office trailers remain onsite. The Green Chain where hydrocarbon staining was observed during the 2006 Hemmera Phase 1 ESA site visit (APEC 23) is no longer in use or present at the Site.

The historical Phase 1 ESA conducted at this lot identified “approximately 1m of wood waste (including hog fuel) in onsite fill” (Hemmera, 2006), as such fill of unknown origin and quality, was identified as a lot-wide APEC (APEC 30) to be investigated across Lot 6.

Historical storage of chlorophenol-treated lumber has the potential to impact soil and groundwater in uncovered portions of Lot 6, a lot wide APEC (APEC 25) has been identified to investigate this potential issue at Lot 6.

Prior to the 2011 SSI, nine boreholes were drilled in Lot 6, all of which were completed as monitoring wells. During the 2011 SSI, FRANZ drilled eight boreholes, each installed as monitoring wells (BV11-BH-01M to 05M along the western boundary of the Site, and BV-11BH-07M to 09M at or adjacent to APECs 21, 22, and 23). In February 2012, FRANZ completed groundwater sampling at all existing and newly installed monitoring wells at Lot 6. Soil and groundwater results for investigation locations related to the Lot are presented in Figures 2 through 14 and Tables 61 through 78.

### ***Soil Analytical Results***

Soil samples were collected in sandy fill mixed with wood debris, and underlying silt layers at the identified APECs. Representative soil samples were analyzed for BTEX, styrene, MTBE, metals, PHCs F1-F4, chlorinated and non-chlorinated phenols. Select soil samples were also analyzed for VPH, EPH, LEPH in this section, as LEPH and VPH soil and groundwater exceedances identified adjacent to the Warehouse building onsite (APEC 34) (Hemmera, 2006, 2008b).

Soil PAHs, and metals concentrations exceed CCME guidelines. VPH and metals concentrations in soil exceed BC CSR IL Standards and Schedule 7 Standards for relocation to non-agricultural land. Exceedances of various parameters are further discussed below.

### **PAHs**

Concentrations of PAHs in soil (naphthalene and phenanthrene) exceed CCME IL Soil Guidelines for protection of aquatic life at two building locations (the oils storage shed (APEC 21) and former green chain (APEC 23)) and at four (01M, 02, 04 and 05M) of five locations tested along the lot foreshore. In two of the foreshore locations (02M and 05M) PAH concentrations also exceed the calculated Index of Additive Cancer Risk (IACR) for protection of potable drinking water. Identified PAH exceedances (0-4 m bgs) are located in the sandy fill and underlying silt and wood debris layer.

Onsite PAH concentrations do not exceed BC CSR Standards and based on the current soil concentrations a soil relocation agreement would not required to move PAH -impacted soil from Lot 6 offsite to non-agricultural land.

The low level PAH exceedances in this lot have not been delineated, and are generally anticipated to be site wide. Soil PAH exceedances at the building location (oil storage shed and former green chain) may be contributed to by surface spills from historical fuel storage and handling activities

in these areas, as evidenced by PHC like odours and staining noted on the ground during previous investigations onsite (Hemmera, 2006), and identification of a small LEPH plume in groundwater at the oil shed location.

## **VPH**

VPH, EPH, and LEPH are regulated under the BC CSR, which is not directly applicable at the Site under its current ownership. However it is of note that soil concentrations of VPH at three locations on the east side of the Lindal Warehouse Building (APEC 34, source not determined) (MW06-2, MW07-6, and BH08-12) exceed the CSR IL Standard for VPH and represent a localized impact area (approximately 400m<sup>2</sup>) with a vertical thickness of about 1.5 m (approximately 1.0-2.5 m bgs). Soil in the VPH impact area also exceeds CSR Schedule 7 Standards, and would require a soil relocation agreement to move impacted material to offsite non-agricultural land. Concentrations of VPH, EPH, and L/HEPH in soil samples collected from fill and silt layers at down-gradient foreshore locations are all less than BC CSR Standards.

## **Metals**

Subsurface soil concentrations of arsenic exceed CCME IL (IL+) Guidelines in two of five tested foreshore locations onsite (01M and 05M, 3-4 m bgs). Generally arsenic concentrations at Lot 6 appear to increase with increasing depth, with the highest concentrations identified in the underlying silt unit. The horizontal extents of IL+ soil for arsenic have not been fully delineated, but given that exceeding concentrations in sampled silts are less than 2x CCME Guidelines, they are expected to be localized around each of borehole BV-11BH-01M and BV011BH-05M.

Arsenic concentrations in the subsurface soil also exceeds BC CSR IL Standards and Schedule 7 Standards at BV-11BH-01M, such that arsenic impacted soil at this location would require a relocation permit if removed from the Site.

## ***Groundwater Analytical Results***

2012 groundwater samples were collected from Lot 6 monitoring wells along the foreshore and downgradient of the oil shed and green chain building APECs. Samples were analyzed for BTEX, styrene, MTBE, PHC fractions F1-F4, PAH and chlorinated/non-chlorinated phenols. Select groundwater samples from this Lot were also analyzed for VPH, EPH, LEPH, as LEPH and VPH soil and groundwater exceedances (APEC 34) have been identified east and adjacent to the Warehouse building onsite (Hemmera, 2006, 2008b).

Dissolved metals and PAHs in groundwater exceed applicable CCME guidelines. Localized LEPH and VPH concentrations in groundwater exceed BC CSR Standards. Exceedances are further discussed below.

## **Dissolved Metals**

Dissolved metals concentrations in groundwater exceeded FCSAP guidelines for the protection of freshwater/marine aquatic life (aluminum, arsenic, iron, manganese, titanium and zinc) and Drinking Water Quality Guidelines (arsenic, iron, manganese) at all five wells tested in this Lot.

Metals concentrations in groundwater (arsenic, iron, manganese) also exceed BC CSR DW and/or AW Standards in tested wells. The area of metals impacted groundwater is not delineated onsite, and is expected to be area-wide including on neighboring properties.

### **VPH, EPH, LEPH**

VPH, EPH, and LEPH which are regulated under the BC CSR Standards are not directly applicable at the Site under its current ownership, but are of interest due to their applicability to groundwater at surrounding offsite properties.

2012 groundwater concentrations of LEPH exceeded the CSR AW Standard at BV-11BH-07M, and potentially represent a localized LEPH plume (estimate 100m<sup>2</sup>) at the location of the oil shed onsite (APEC 21). LEPH in groundwater has been delineated downgradient of this location.

Groundwater concentrations of LEPH are currently 2-3x the CSR AW Standard at two well locations (MW06-2 and MW07-7) at the east side of the Lindal Warehouse building (APEC 34). The LEPH plume is currently delineated and expected to represent a localized impact area of approximately 200m<sup>2</sup>. VPH (previously IL+) groundwater concentrations in this area have decreased over time and are currently compliant with BC CSR AW Standards.

Groundwater concentrations of VPH at monitoring well MW06-3, located southwest of the former kiln (APEC 22) historically exceeded CSR AW Standards (last sampled in 2006) despite soil being compliant at the location. This well was scheduled to be re-sampled during the 2011 SSI to confirm groundwater quality, but the well had been destroyed and paved over. The historical exceedance potentially represents a localized VPH plume (estimate 100 m<sup>2</sup>) at this location. VPH in groundwater has been delineated downgradient of and crossgradient of this location.

### **PAHs**

Groundwater exceeded FCSAP Interim Groundwater Guidelines for acridine, anthracene, benzo[a]anthracene, benzo[a]pyrene, fluoranthene, fluorene, phenanthrene and pyrene in two of ten locations tested in this Site section (at MW06-2 and MW07-7, last sampled in 2012). PAH impacted groundwater is co-located (and co-related) to wells where historical VPH impacts in soil (approximately 400 m<sup>2</sup>) and LEPH impacts in groundwater approximately 200 m<sup>2</sup>) have been identified. Benzo[a]pyrene, phenanthrene and pyrene concentrations in groundwater at these wells also exceeds BC CSR Standards.

PAH impacted groundwater has been delineated down-gradient and cross gradient of this location.

### Summary

A summary of environmental issues at Lot 6 which will be carried forward into the subsequent risk assessment is presented in the table below.

Media	Contaminant (s) of Concern	Area (m <sup>2</sup> )	Depth (m bgs)	Volume (m <sup>3</sup> )	Comments
Soil	PAH (Naphthalene and Phenanthrene, calculated IACR)	site wide	0 - 4	undefined	Low-level PAHs in soil appear to be present across the Site.
	Arsenic*	Assumed 10 around each hotspot	3 - 4	2X10	Impact area is not delineated but expected to be localized at Lot 6.
	VPH*	400	1-2.5	600	Impact area appears to be localized to the east side of the Warehouse building (APEC 34) at Lot 6.
Groundwater	Metals (As*, Fe*, Mn*, Ti, Zn)	area wide	n/a	undefined	Impacts have not been delineated onsite.
	LEPH*	1x 200 1x 100	n/a	undefined	Impact areas appear to be localized to the east side of the Warehouse building (APEC 34), and at the oil storage shed (APEC 21) at Lot 6.
	VPH*	100	n/a	undefined	Impact area appears to be localized to an area southwest of the former kiln (APEC 22) at Lot 6.
	PAH (Acridine, Anthracene, Benzo(a)anthracene, Benzo(a)pyrene*, Fluoranthene, Fluorene, Phenanthrene* and Pyrene*)	200	n/a	undefined	PAH impacts are localized to the east side of the Warehouse building (APEC 34) at Lot 6.

\*Exceeds BC CSR IL Standards and/or BC CSR Schedule 7 Standards for soil, or BC CSR AW/DW Standards for groundwater.

## 7.0 SUMMARY OF AREAS OF ENVIRONMENTAL CONCERN

The results of the 2011 SSI and previous investigations at the Site have identified key localized and site-wide areas of environmental concern (AECs) which are summarized in the below sections and have been presented in Figures 15 to 18. These summary figures are organized by parameter group and illustrate soil and groundwater exceedances of federal Guidelines or provincial Guidelines/ Standards separately.

### Site or Area Wide Issues

**Metals in Groundwater** - Concentrations of various metals (Al, As, Sb, Ba, Cd, Cr, Cu, Fe, Pb, Mn, Hg, Ni, Se, Ti, Zn) in groundwater exceed Health Canada, FCSAP, or CCME Guidelines in monitoring wells across the Site. Tested offsite groundwater wells north and southwest of the Site also exceed federal guidelines for metals (Al, As, Cd, Cu, Cr, Fe, Mn, Ti, Zn). The metals impacted area remains undelineated and is expected area wide including on neighbouring properties. With exceeding metals concentrations identified in wells located near the western Site boundary (Lots 2 and 6); impacted groundwater may be reaching the Fraser River. Bearing this in mind, we recommend further investigation and characterization of groundwater and surface water interactions at the River.

Onsite groundwater also exceeds provincial Standards/ Guidelines for various metals (Al, As, Sb, Ba, Cd, Cr, Fe, Pb, Mn, Ni, Zn) including at upgradient northeast and southeast Site boundaries. Tested offsite groundwater wells north, southwest of the Site also exceed provincial Guidelines/Standards for various metals (As, Cr, Fe, Mn). Exceeding metals concentrations in groundwater are expected to be contributed to by numerous sources including naturally occurring background concentrations in area soils and groundwater, as well as potential impacts from surrounding up-gradient property activities. Figures 16a and 16b show the location and extent of metals contamination identified during this SSI.

**PAHs in Soil** - Concentrations of PAHs (naphthalene and phenanthrene) exceed CCME IL Soil Guidelines for the protection of aquatic life in numerous localized areas across the Site. These low level PAH impacts in soil are expected to be present site-wide. In select locations total PAHs in onsite soil also exceed the calculated health based index of additive cancer risk (IACR) for protection of potable groundwater. The vertical extent of PAH exceedances is generally limited to the sandy fill and upper silt intervals where wood debris is present (0-4m bgs). PAH concentrations in soil from offsite locations north of B-Mill (Lot 5) also exceed CCME IL Soil Guidelines for PAHs (naphthalene, phenanthrene, acenaphthene, fluorene and IACR) however concentrations are generally 3-10x those identified in onsite Lot 5 soil. Offsite PAH impacts may not be originating from onsite source activities.

Tested onsite and offsite soil does not exceed provincial soil Standards for PAHs. As the BC CSR IL Standards are not as stringent as the CCME Guidelines for naphthalene and phenanthrene, IL+ soil for PAHs identified onsite is not anticipated to extend off Site, where the land is under

provincial jurisdiction. Figures 17a and 17b show the location and extent of PAH contamination identified during this SSI.

### **Localized Issues by Lot**

#### ***Lots 2 and 4***

**Metals in Soil** - Soil exceeding federal Guidelines for various metals (Cr, Cu, Cd, Ni, Zn, Sb, As) is present in the area north and west of the tannery (APEC 1) on Lot 4. The metals impacted area (1.6 ha) is generally limited by compliant soil at the north and northeast boundaries of Lots 2 and 4. Impacts were identified in fill and native silts at depths of 0.6-4.6 m bgs, for a potential volume estimate of approximately 64,000 m<sup>3</sup>. In the impacted area, chromium exhibits the highest concentrations in soil and the greatest area of impact. Metals (chromium) exceeding federal Guidelines were also confirmed in the area southwest of Lots 2/4 (offsite) during the 2011 SSI and remain to be horizontally or vertically delineated.

Onsite soil also exceeds provincial Standards for metals (Sb, As, Cd, Cr, Cu, Pb, Zn), as does soil tested from a location southwest of Lots 2 and 4. Exceeding chromium concentrations identified southwest of Lots 2 and 4 are expected to be reflective of the previous industrial use of the southwest properties, and not necessarily indicative of offsite migration. Figures 16a and 16b shows the location and extent of metals contamination identified during this SSI.

**MAHs and VOCs in Groundwater** - Groundwater exceeds CCME AW Guidelines for Toluene and Benzene in one near shore well in Lot 2, last, sampled July 1998. Chlorobenzene and toluene concentrations in this well also exceed provincial water quality guidelines. Impacted groundwater is delineated onsite and expected to represent a localized impact area of approximately 100 m<sup>2</sup>. Based on current groundwater data in the area, it is likely that these exceedances are from historical point sources and are no longer present onsite. Figures 15a and 15b show the location and extent of MAH and VOC contamination identified during this SSI.

**PAHs in Groundwater** - Pyrene concentrations in one near shore well in Lot 2 slightly exceeds CCME AW Guidelines as well as BC Water Quality Guidelines. Low level PAH concentrations in soil are anticipated to be widespread across the Site and there remains a potential for low level PAH concentrations to be present in groundwater site-wide. Pyrene impacts identified at Lot 2 are bounded to the Site by compliant groundwater from wells southwest and west of the Lot. Given that this well is within 10m of the surface water environment, there remains a potential for offsite migration to the Fraser River. Re-sampling MW2-30 is required to verify this result in near shore groundwater. Figures 17a and 17b show the location and extent of PAH contamination identified during this SSI.

**Chlorophenols in Groundwater** - Groundwater concentrations of pentachlorophenol and 2,3,4,6-tetrachlorophenol exceed federal guidelines in one well (last sampled in 1998) at Lot 4. The

exceedance is generally delineated to an impact area of approximately 1000m<sup>2</sup>. Groundwater at this location also exceeds provincial Standards for Pentachlorophenol and 2,4,5-trichlorophenol, but is compliant in offsite nearby wells. Chlorophenol impacts are not expected to be migrating off the Lot 2/4 area. Figures 18a and 18b show the location and extent of chlorophenol contamination identified during this SSI.

### **Lot 3**

**Metals in Soil** – Soil exceeds CCME soil Guidelines for metals (As, Cu, Zn) in one of two locations tested from the Lot 3 road ditch adjacent to Dyke Road. The impact area is currently not delineated, but likely to be surficial and localized (for estimation purposes, we assume 10m<sup>2</sup>) around the hotspot.

Soil from both tested road ditch locations exceeds BC CSR Standards for metals (As, Cu, and/or Zn) for an assumed impact area of approximately 10m<sup>2</sup> around each road ditch hotspot. Concentrations of metals (Cr, Pb and/ or Zn) in soil also exceed BC CSR Standards around the septic AST (APEC 8), former lumber storage area (APEC 9) and former kiln (APEC 19). The BC CSR soil exceedances are limited to the upper 1 m of fill soil and sporadic (for estimation purposes, assumed to be limited to 10m<sup>2</sup> around each hotspot) across the Lot 3 area.

Surficial soil from the property southwest of Lot 3 exceed BC CSR Standards for lead (Pb). Offsite impacts have not been fully delineated, and are not necessarily indicative of offsite migration, but may be reflective of the previous industrial use of the southwest properties.

Figures 16a and 16b shows the location and extent of metals contamination identified during this SSI.

**EPH (C19-32) and HEPH in Soil** – Soil exceeding BC CSR Standards for EPH(C19-32) and HEPH is present in one road ditch location (estimated 100m<sup>2</sup>) downgradient of the mineral oil and grease spill (APEC 16) and one onsite location upgradient (estimated 500m<sup>2</sup>) of APEC 16. The EPH/ HEPH impact area around each location has not been fully delineated towards the west adjacent property (offsite) but is expected to be localized and surficial (limited to < 1.5 m bgs). These areas together potentially represent a volume of 900 m<sup>3</sup> of EPH (C19-32) /HEPH impacted soil in Lot 3. Given the proximity of the impacts to the southern Site boundary, it is possible that soil exceeding BC CSR Standards for HEPH is present offsite in this area. Further investigation is recommended in the area of MV-11BH-07M to delineate HEPH impacts around the Site boundary.

Petroleum hydrocarbon impacts identified offsite of Lot 3 are not necessarily considered to be indicative of offsite migration; but rather reflective of the previous industrial use of the southwest properties.

Figure 15b shows the location and extent of EPH and HEPH contamination identified during this SSI.



**Chlorophenols in Soil** – Pentachlorophenol concentrations in surficial soil (0.3m bgs) exceed BC CSR Standards (but not federal guidelines) in one location in the A-Mill (APEC 7) footprint of Lot 3. The soil impact is horizontally delineated to an approximate 10m<sup>2</sup> area around this location. Impacts are not expected to be migrating offsite. Figures 18a and 18b show the location and extent of chlorophenol contamination identified during this SSI.

**Chlorophenols in Groundwater** – Groundwater concentrations of phenols and chlorophenols (Pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,4-dichlorophenol, 2,4,5-trichlorophenol, 2,4,6-trichlorophenol, and phenol) exceed federal guidelines in wells at and immediately south of the A-Mill footprint (APECs 7 and 9). The groundwater plume remains to be fully delineated cross gradient and upgradient of this area, but is expected to be localized to an approximate 3000-5000 m<sup>2</sup> area.

Groundwater in this 3000-5000m<sup>2</sup> impact area also exceeds provincial Standards for phenols and chlorophenols (pentachlorophenol, 2,3,4,6-tetrachlorophenol, and total tetrachlorophenols, 2,4,6-trichlorophenol, 2,4,5-trichlorophenol, phenol, 2-methyl 4,6-dinitrophenol, 2,3,4,5-tetrachlorophenol, 3,4,5-trichlorophenol, and total trichlorophenols). Figures 18a and 18b show the location and extent of chlorophenol contamination identified during this SSI.

### **Lot 5**

**Xylenes/ EPH (C10-19)/ VPH/ Toluene in Soil** - Xylene concentrations in soil at one location on the north side of the B-Mill footprint (APEC 14) and downgradient of the waste oil AST and gasoline UST (APECs 10 and 11) exceed federal soil Guidelines. Soil at this location also exceeds provincial soil Standards for Xylenes, EPH(C10-19) and VPH. The Xylenes/ EPH (C10-19)/ VPH soil impact is localized to an area of approximately 400m<sup>2</sup>. Soil sampled from outside the Site boundaries is compliant with federal and provincial soil Standards/Guidelines, so impacts likely do not extend offsite. The vertical extent of impacts at this location has not been fully delineated but is expected to be limited to the sandy fill (approximately 1.5 m bgs) for a potential impacted soil volume of 600 m<sup>3</sup>.

Toluene concentrations at two offsite locations adjacent to Lot 5 are greater than federal soil Guidelines, but compliant with provincial Standards applicable to the offsite area. Offsite concentrations of toluene are not expected to be originating from operations at the Site. Figure 15b shows the location and extent of MAH, EPH and VPH contamination identified during this SSI.

**Chlorophenols in soil** - Pentachlorophenol and 2, 3, 4, 6-tetrachlorophenol concentrations in soil at one location in the north side of the B-Mill footprint (APEC 14) exceed federal soil Guidelines. Concentrations of 2, 3, 4, 6-tetrachlorophenol also exceed provincial soil Standards. Chlorophenol impacts are bounded cross gradient and downgradient of this location, for an identified impact area of approximately 400 m<sup>2</sup>. Soil tested from the adjacent offsite area was compliant with federal and provincial Standards/Guidelines, so impacts are not likely to extend off Site. Figures 18a and 18b show the location and extent of chlorophenol contamination identified during this SSI.

**Metals in Soil** –Zinc concentrations exceeding federal and provincial Guidelines/Standards were identified in offsite soil (0.5-1 m bgs) adjacent to the Lot 5 boundary. The zinc impact has been delineated down gradient (onsite) but not fully delineated on the offsite property. As onsite concentrations of zinc are approximately one magnitude lower than identified offsite concentrations, it is unlikely that zinc impacts are originating from operations at the Site. Figures 16a and 16b shows the location and extent of metals contamination identified during this SSI.

**MAHs in Groundwater** – Groundwater concentrations of ethylbenzene exceeds federal and provincial Guidelines in a 250 m<sup>2</sup> impact area adjacent to the AST and UST (APECs 10 and 11) in Lot 5. Impacts are generally delineated to the north, south, and west of this area. Tested offsite groundwater was compliant with federal and provincial Guidelines/ Standards, and ethylbenzene impacted groundwater is not anticipated to extend offsite. Figures 15a and 15b show the location and extent of MAH contamination identified during this SSI.

**LEPH in Groundwater** - LEPH concentrations in groundwater exceed provincial groundwater Standards at three locations (1 offsite and 2 onsite) in the area at and downgradient of the AST and UST (APECs 10 and 11) in Lot 5. The LEPH plume has not been delineated offsite, but has been bounded to the east and south west onsite. The onsite AST/UST is a suspect historical source for the plume. The LEPH plume extends across the Site boundary and is expected to cover an impact area of approximately 900m<sup>2</sup>. Further work is recommended to delineate the LEPH plume offsite. Figure 15b shows the location and extent of LEPH contamination identified during this SSI.

**PAHs in Groundwater** - Groundwater in Lot 5 exceeded federal groundwater Guidelines for Naphthalene in three locations at and downgradient (west) of the AST/UST (APECs 10 and 11) onsite. Naphthalene concentrations in this area also exceeds BC CSR AW/DW Standards. Naphthalene impacts are co-located with historical ethylbenzene and LEPH impacted groundwater, and potentially related to a historical leak or spill from the AST or UST onsite. The naphthalene plume is delineated downgradient and cross-gradient (southwest) for an onsite impact area of approximately 1,000 m<sup>2</sup>.

Benzo(a)pyrene, fluoranthene and pyrene concentrations in groundwater from one offsite well adjacent to the Lot 5 boundary exceeded federal Guidelines, with concentrations of benzo[a]pyrene also exceeding BC CSR Standards applicable offsite. Offsite PAH impacts are not delineated. As concentrations of these COCs onsite near the Lot 5 boundary are non-detect, the identified offsite contamination is unlikely to be originating from operations at the Site. Figures 17a and 17b show the location and extent of PAH contamination identified during this SSI.

**Chlorophenols in Groundwater** - Chlorophenol concentrations in groundwater exceed federal Guidelines at three areas in Lot 5: (1) the B-Mill footprint, (APEC 14) (2) the west portion of Lot 5 , (3) the southeast portion of Lot 5.

Chlorophenol (pentachlorophenol, 2,3,4,6-tetrachlorophenol, and 2,4,6-trichlorophenol) concentrations exceed federal guidelines in the northwestern portion of the B-Mill footprint

(APEC14) for an impact area of approximately 1500m<sup>2</sup>. Concentrations of chlorophenols (pentachlorophenol, tetrachlorophenols (2,3,4,5; 2,3,4,6; and 2,3,5,6, isomers) and trichlorophenols (2,3,4-; 2,3,5-; 2,4,5-; 2,4,6-; 3,4,5- isomers)) in this impact area also exceed provincial Standards applicable offsite. Based on 2011 investigation results, the chlorophenol plume does not appear to extend offsite in this area.

Pentachlorophenol concentrations exceed federal and provincial groundwater Guidelines/Standards at one location in the west of Lot 5 (5-BH31). Impacts are expected to be localized to an area of approximately 700m<sup>2</sup>; with compliant results up gradient and down gradient of this location,

- Chlorophenol (Pentachlorophenol, 2,3,4,6-tetrachlorophenol) concentrations exceed federal Guidelines at the southeastern Lot 5 boundary (5-BH29). With compliant results in wells northwest and northeast of this well the impact area is expected to be approximately 1250 m<sup>2</sup>. Chlorophenol concentrations (Pentachlorophenol, 2,3,4,6-tetrachlorophenol, 2,3,4,5-tetrachlorophenol, 2,3,4-trichlorophenol, and 2,3,6-trichlorophenol) in this well also exceed provincial Standards applicable offsite. The chlorophenol plume at the southeastern Lot 5 boundary is not fully delineated; there is a potential for offsite groundwater impacts in this area. Further investigation is recommended in the area of 5-BH29 to delineate chlorophenol impacts around the Site boundary.

Figures 18a and 18b show the location and extent of chlorophenol contamination identified during this SSI.

## **Lot 6**

**Metals in Soil** - Soil exceeding federal Guidelines is present at depths of 3-4 m bgs in two foreshore locations (BV-11BH-01M and BV-11BH-05M) at Lot 6. Arsenic soil impacts are expected to be localized at these two onsite locations, and assumed to be representative of an impact area of 10 m<sup>2</sup> around each identified hotspot, and total impact soil volume of 20m<sup>3</sup>.

Arsenic soil concentrations at one of the foreshore locations (BV-11BH-01M) also exceeds provincial Soil Standards applicable offsite. Figures 16a and 16b shows the location and extent of metals contamination identified during this SSI.

**VPH in Soil** - Soil concentrations of VPH at three locations on the east side of the Lindal Warehouse Building (APEC 34) in Lot 6 (MW06-2, MW07-6, and BH08-12) exceed the CSR IL Standard for VPH and represent a localized impact area of approximately 400m<sup>2</sup>, with a vertical thickness of about 1.5 m (approximately 1.0-2.5 m bgs). Figures 15a and 15b show the location and extent of VPH contamination identified during this SSI.

**VPH in Groundwater** - Groundwater concentrations of VPH at one well southwest of the former kiln (APEC 22, MW06-3) exceeded provincial Standards (last sampled in 2006). The historical exceedance potentially represents a localized VPH plume (estimate 100 m<sup>2</sup>) at this location. VPH in

groundwater has been delineated downgradient of and crossgradient of this location. Figures 15a and 15b show the location and extent of VPH contamination identified during this SSI.

**LEPH in Groundwater** – LEPH groundwater concentrations exceed provincial Standards in two areas of Lot 6. A localized LEPH plume (estimate 100m<sup>2</sup>) is identified at the location of the oil shed onsite (APEC 21, BV-11BH-07M). LEPH in groundwater has been delineated downgradient of this location. A LEPH plume is also identified at the east side of the Lindal Warehouse building (APEC 34, MW06-2 and MW07-7). The Warehouse LEPH plume is delineated and expected to represent a localized impact area of approximately 200m<sup>2</sup>. Figures 15a and 15b show the location and extent of LEPH contamination identified during this SSI.

**PAHs in Groundwater** - Groundwater concentrations of PAHs (acridine, anthracene, benzo[a]anthracene, benzo[a]pyrene, fluoranthene, fluorene, phenanthrene and pyrene) exceed federal guidelines in two wells at the east side of the Warehouse Building (APEC 34, MW06-2 and MW07-7). Benzo[a]pyrene, phenanthrene and pyrene concentrations in groundwater at these wells also exceeds BC CSR Standards. The PAH plume is bounded to an approximate 200m<sup>2</sup> area. Figures 17a and 17b show the location and extent of PAH contamination identified during this SSI.

## **8.0 PROPOSED REMEDIAL/ RISK MANAGEMENT OPTION**

From a site-wide perspective, FRANZ's proposed remedial/risk management option is to complete a Human Health and Ecological Risk Assessment (HH-ERA) for the identified AECs onsite. This preference is due to logistical difficulties in conducting an *ex-situ* remediation within an active area such as the Surrey Brownsville Site.

Unacceptable risks identified from the subsequent risk assessment can then be addressed through localized remediation or long term risk management options.

## 9.0 PROFESSIONAL STATEMENT

Pursuant to the requirements of Part 16 of the CSR, FRANZ affirms that:

- This documentation has been prepared in accordance with all requirements of the Waste Management Act and Regulations.
- The persons signing this report have demonstrable experience with this type of investigation and the site conditions.

The FRANZ personnel conducting this investigation were:

### **Viviane Dubois Cote, M.Sc, P.Geo.**

Ms Viviane Dubois-Côté, formerly of Franz Environmental Inc. coordinated the 2011 field investigation and assisted with the preparation of this supplemental site investigation (SSI) report. Ms. Dubois Cote is an Intermediate Environmental Geoscientist with Franz Environmental Inc. with 6 years of experience in the assessment and remediation of contaminated Sites. Ms. Dubois-Côté has worked on numerous Stage I, II and DSI Environmental Site Assessments and remedial activities on a variety of residential, industrial and commercial sites in Quebec, New-Brunswick, the Yukon, Nunavut and British Columbia.

### **Amanda Salway, B.Sc, G.I.T.**

Ms. Salway co-authored this SSI report and conducted the 2011 field investigation. Ms. Salway is a junior environmental scientist with five years of experience. She has worked on a variety of projects involving the different aspects of contaminated site management including: phased environmental site assessment (ESA), remediation, risk assessment, data management, communications and project management. She is experienced in environmental field activities, follow-up reporting, project budgeting, scheduling, and delivery.

### **Meagan Gourley, M.E.T, EPt.**

Ms. Gourley co-authored this SSI report. Ms. Gourley is an environmental scientist with four years of experience conducting ecological and human health risk assessment and environmental site assessment (Phase I and Phase II). Ms. Gourley has also contributed to the development of media sampling protocols and procedures, conducted multiple data gap analyses, and designed and executed field programs(soil, groundwater, sediment and soil vapor) in remote or challenging locations on a variety of wildlands, commercial and industrial sites. Investigations have been in support of risk assessment, ex-situ remediation, and phased environmental site assessments for federal government and private clients in Alberta, British Columbia, Yukon Territory, Nunavut, and the Northwest Territories. Ms. Gourley has a background in pharmacology, human health and eco-toxicology where she has designed and conducted research experiments investigating xenobiotic cellular defense and detoxification mechanisms, and contaminant mechanisms of action in invertebrate, mammalian, and piscine organisms

### **Nick Dayal, Eng.L.**

Mr. Dayal provided senior review for the SSI report. Mr. Dayal has more than 20 years of experience in the areas of contaminated sites management, environmental site assessments, contaminant hydrogeology, remedial options assessment, and remediation. He has managed numerous Phase I, II and III Environmental Site Assessments on a variety of industrial and commercial properties, and reviewed hundreds of reports including Phase I, II and III ESAs, risk assessments, remedial actions plans, and confirmation of remediation. Nick has conducted detailed quantitative human health/ecological risk assessments for petroleum hydrocarbon and metals impacted sites. He has conducted hazard assessments by reviewing chemical properties and identifying suitable toxicity estimates, calculated exposure and risk for humans using Johnson/Ettinger soil vapour intrusion model.

## **10.0 STANDARD LIMITATIONS**

This report has been prepared exclusively for the Vancouver Fraser Port Authority (VFPA). Any other person or entity may not rely upon the report without the express written consent from Franz Environmental Inc. and VFPA.

The conclusions presented represent the best judgment of the assessors based on current environmental standards and on the site conditions observed in 2011. Due to the nature of the investigation and the limited data available, the assessors cannot warrant against undiscovered environmental liabilities.

The material in this report reflects Franz Environmental Inc.'s judgment in light of the information available to us at the time of preparation. Should additional information become available, FRANZ requests that this information be brought to our attention so that we may re-assess the conclusions presented herein.

There is no warranty, expressed or implied that the work reported herein has uncovered and resolved all potential environmental liabilities associated with the subject site, nor does the report preclude the possibility of contamination outside of the areas of investigation. The findings of this report were developed in a manner consistent with a level of care and skill normally exercised by members of the environmental science and engineering profession currently practicing under similar conditions in the area. The undersigned believe this report to be accurate, however they cannot guarantee the completeness or accuracy of information supplied to them.

Any use of which a third party makes of this report, or any reliance on, or decisions to be made based on it, are the responsibility of such third parties. The authors accept no responsibility for damages, if any, suffered by any third party as a result of decisions made or actions based on this report.

A potential remains for the presence of unknown, unidentified, or unforeseen surface and sub-surface contamination. Any evidence of such potential site contamination would require appropriate surface and sub-surface exploration and testing. If new information is developed in future work (which may include excavations, borings, or other studies), FRANZ should be requested to re-evaluate the conclusions of this report, and to provide amendments as required.

We trust that this information is satisfactory for your present requirements. Should you have any questions or require additional information, please do not hesitate to contact the undersigned.

Yours truly,

**Franz Environmental Inc.**

*Prepared by:*



Amanda Salway, B.Sc, G.I.T  
Environmental Scientist



Meagan Gourley, M.E.T., EPt.  
Environmental Scientist

*Reviewed By:*



Nick Dayal, Eng.L  
Senior Environmental Scientist



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Next Environmental Inc., September 1998g. Environmental Stage 2 Preliminary Site investigation at 11715 Tannery Road, Parcel 1, Reference Plan 6432, Block A, District Lot 7 (Imperial Lumber - Lot 4), Surrey, BC

Next Environmental Inc., September 1998h. Environmental Stage 2 Preliminary Site Investigation at 11715 Tannery Road, Lot 17, District Lots 7 and 8 (Imperial Lumber Lot 2) Surrey, BC.

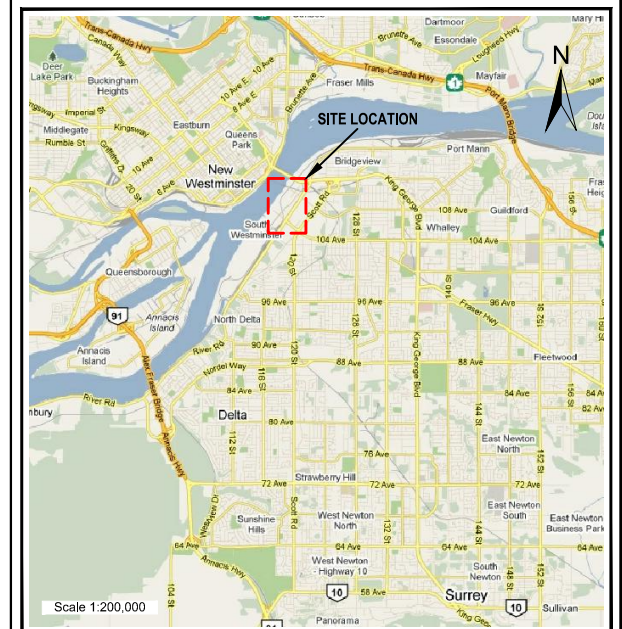
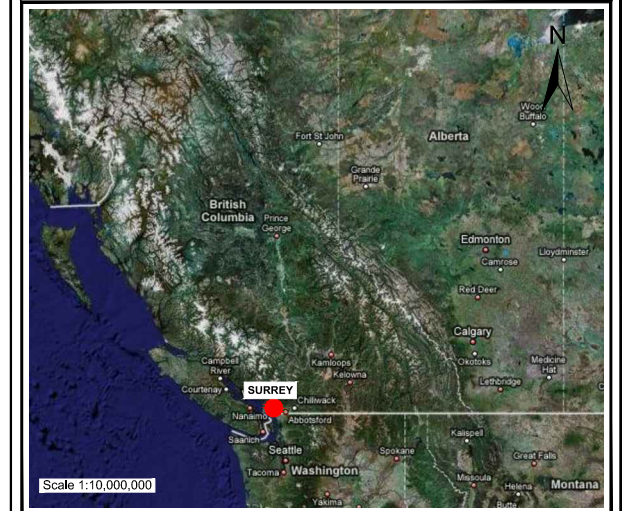
SRK-Robinson Inc., April 1994a. Phase 3 Environmental Property Investigation, Imperial Lumber Property Surrey, BC.

SRK-Robinson Inc., October 1994b. Pre-Cleanup Environmental Investigation, Imperial Lumber Ltd. Site, Surrey, BC.

Vizon SciTec Inc., May 2004a. Site Monitoring, December 17, 2003, Lots 3 & 5, Imperial Lumber.

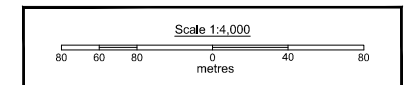
Vizon SciTec Inc., December 2004b. Site Monitoring, November 3, 2004, Lots 3 and 5, Imperial Lumber.

## FIGURES



**LEGEND**

Site Boundary



Title: **SITE LOCATION**

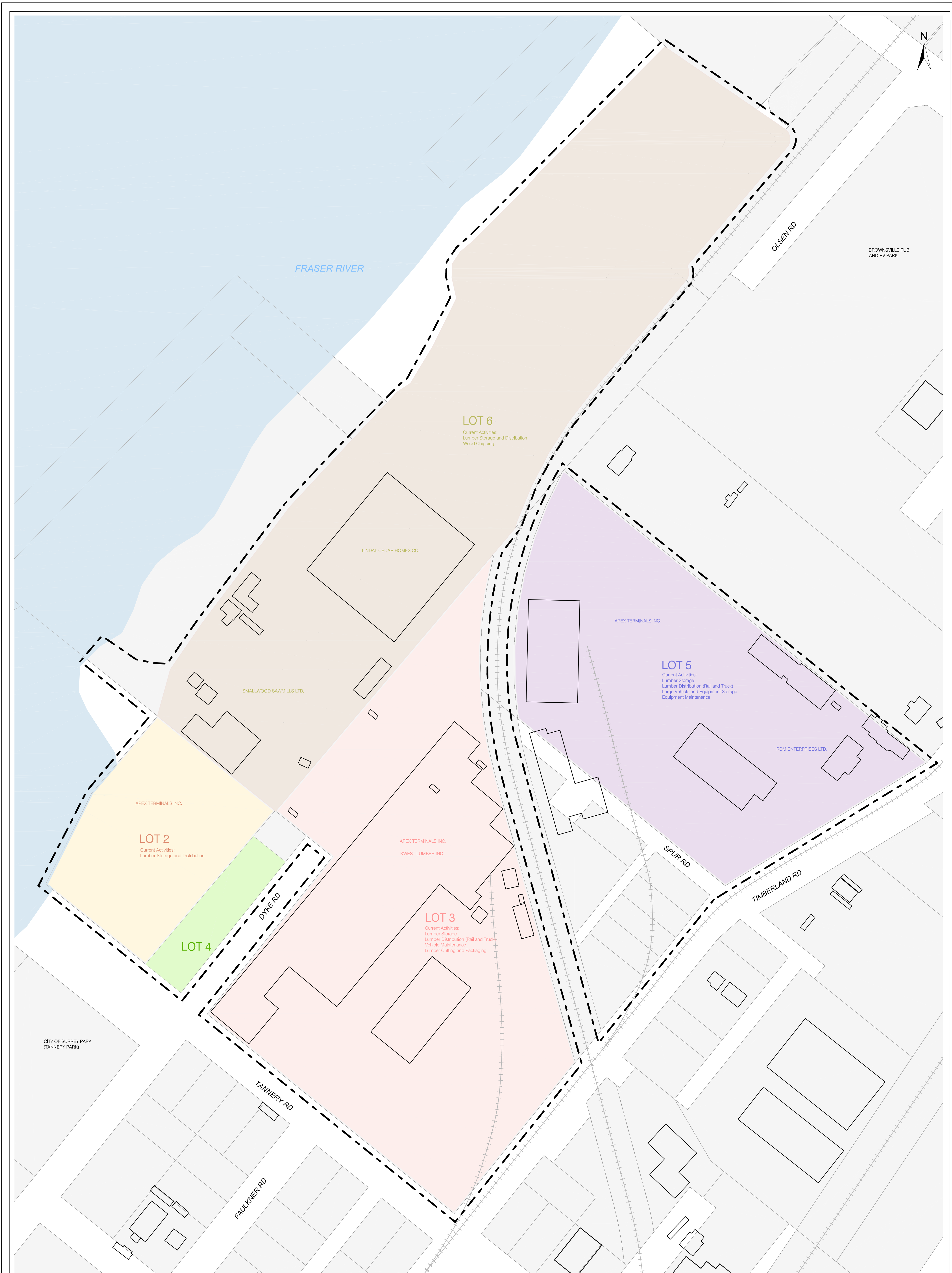
Project: **DATA GAP ANALYSIS  
MOUNTAINVIEW RELOAD/BROWNSVILLE AREA  
SURREY, BC**

Owner: **VANCOUVER FRASER PORT AUTHORITY**



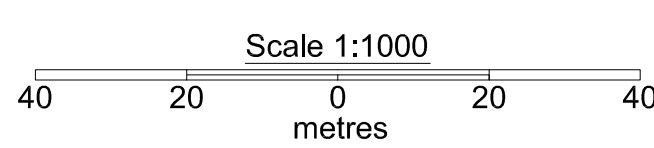
Date: **APRIL 2012**


**FIGURE 1**



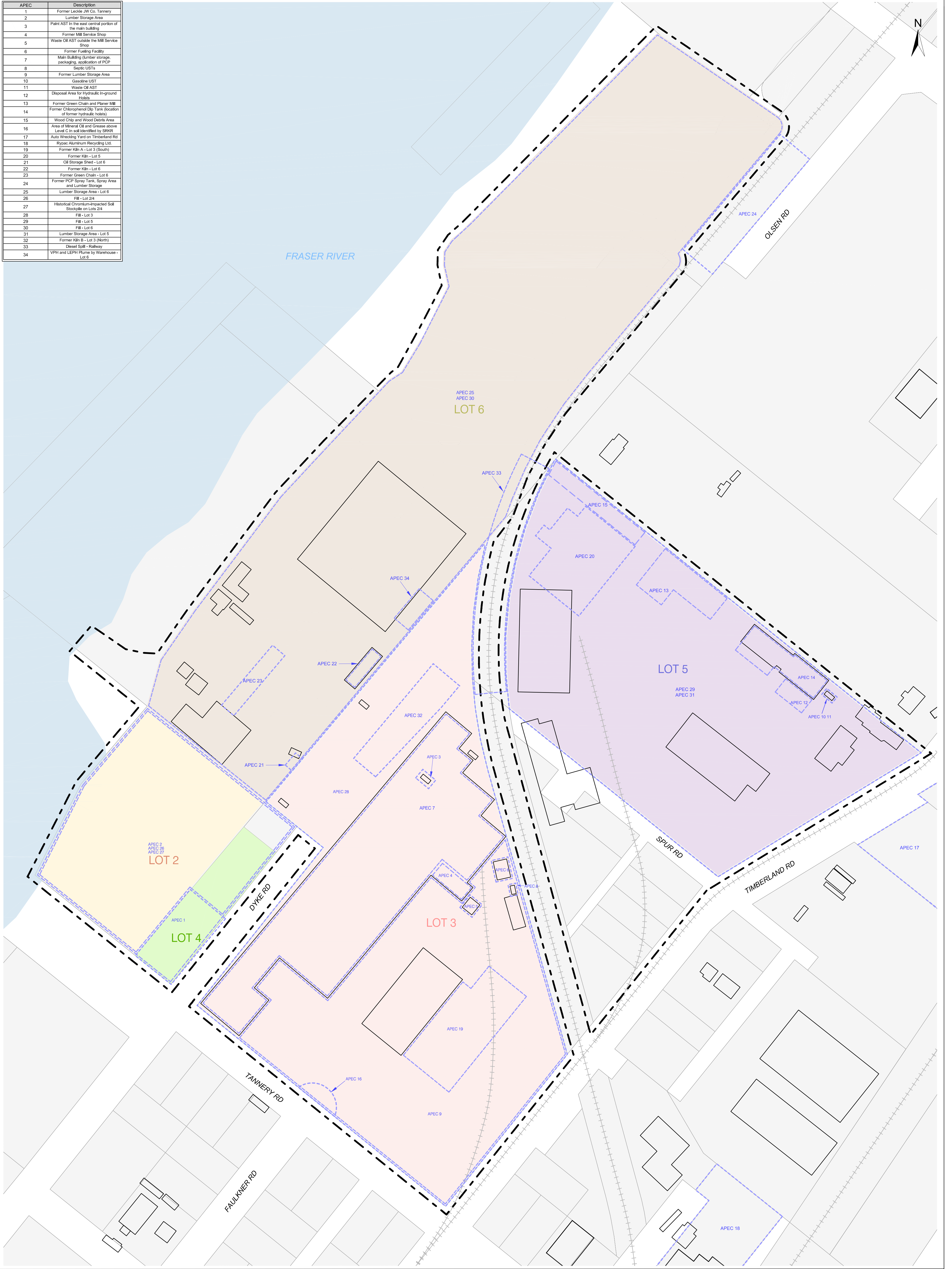
**LEGEND**

- +++++ Railway
- - - - Site Boundary
- ▭ Existing Structure
- ▭ Property Boundary
- Lot 2
- Lot 3
- Lot 4
- Lot 5
- Lot 6



Title:	<b>LOTS AND CURRENT SITE USE</b>	
Project:	DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC	
Client:	VANCOUVER FRASER PORT AUTHORITY	
Date:	MAY 2013	
	FIGURE 2A	

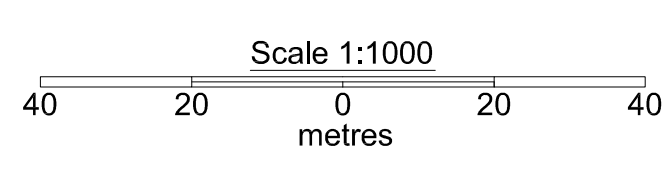
APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Plant AST in the east central portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building lumber storage, packaging application of PCP
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Disposed Area for Hydraulic In-ground Hoists
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chip and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROB
17	Auto Wrecking Yard on Timberland Rd
18	Rybac Aluminum Recycling Ltd.
19	Former Kiln A - Lot 3 (South)
20	Former Kiln - Lot 5
21	Oil Storage Shed - Lot 6
22	Former Kiln - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	Fill - Lot 2/4
27	Historical Chromium-impacted Soil Stockpile on Lots 2/4
28	Fill - Lot 3
29	Fill - Lot 5
30	Fill - Lot 6
31	Lumber Storage Area - Lot 5
32	Former Kiln B - Lot 3 (North)
33	Diesel Spill - Railway
34	VRH and LEPH Plume by Warehouse - Lot 6



**LEGEND**

	Area of Potential Environmental Concern (APEC)		Lot 2
	Railway		Lot 3
	Site Boundary		Lot 4
	Existing Structure		Lot 5
	Property Boundary		Lot 6

<b>Title:</b> LOTS AND AREAS OF POTENTIAL ENVIRONMENTAL CONCERN	
<b>Project:</b> DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC	
<b>Client:</b> VANCOUVER FRASER PORT AUTHORITY	
	<b>Date:</b> MAY 2013
<b>FIGURE 2B</b>	



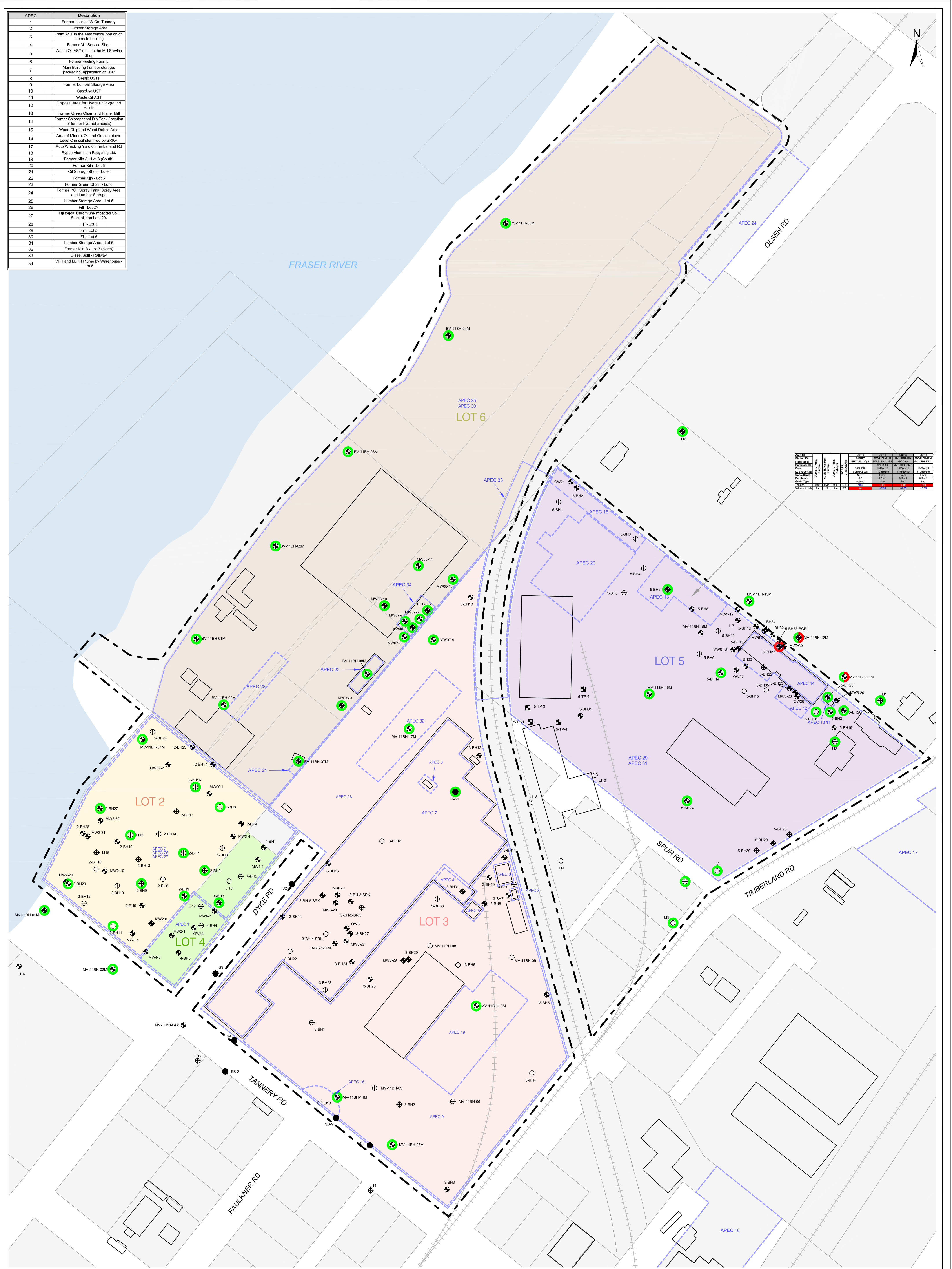


APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Paint AST in the east central portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building (lumber storage, packaging, application of PCP)
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Disposal Area for Hydraulic In-ground Hoists
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chips and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROR
17	Auto Wrecking Yard on Timberland Rd
18	Rypac Aluminum Recycling Ltd
19	Former K&H A - Lot 3 (South)
20	Former K&H - Lot 5
21	Oil Storage Shed - Lot 6
22	Former K&H - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	FB - Lot 2/4
27	Historical Chromium-impacted Soil Spoils on Lots 2/4
28	FB - Lot 3
29	FB - Lot 5
30	FB - Lot 6
31	Lumber Storage Area - Lot 5
32	Former K&H B - Lot 3 (North)
33	Diesel Spill - Railway
34	VPH and LEPH Plume by Warehouse - Lot 6

FRASER RIVER



Area ID	Area Name	Area Type	Area Status	Area Date	Area Size (m <sup>2</sup> )	Area Volume (m <sup>3</sup> )	Area Weight (kg)
LOT 2	LOT 2	Area of Potential Environmental Concern	Active	2012-11-09	10,000	10,000	10,000
LOT 3	LOT 3	Area of Potential Environmental Concern	Active	2012-11-09	10,000	10,000	10,000
LOT 4	LOT 4	Area of Potential Environmental Concern	Active	2012-11-09	10,000	10,000	10,000
LOT 5	LOT 5	Area of Potential Environmental Concern	Active	2012-11-09	10,000	10,000	10,000
LOT 6	LOT 6	Area of Potential Environmental Concern	Active	2012-11-09	10,000	10,000	10,000



**LEGEND**

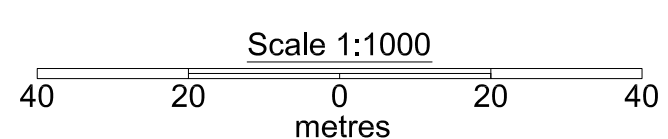
- Area of Potential Environmental Concern (APEC)
- Railway
- Site Boundary
- Existing Structure
- Property Boundary
- Test Pit
- Borehole
- Monitoring Well
- Surface Soil Sample

● One or more analytical parameters are greater than the applicable BC CSR Soil Standards  
● All analytical parameters are less than the applicable BC CSR Soil Standards  
● One or more analytical parameters are greater than the applicable CCME Soil Standards  
● All analytical parameters are less than the applicable CCME Soil Standards

■ Lot 2  
■ Lot 3  
■ Lot 4  
■ Lot 5  
■ Lot 6

**NOTES**

- All units in ug/g.
- "-" indicates that there is no applicable standard or analyses were not performed.
- Red cells indicates parameter exceeds CCME IL (Fine, Surface). (Current as of 9-November-2012)
- Bold indicates parameter exceeds CCME IL (Coarse, Surface). (Current as of 9-November-2012) - Coloured rings represent most recent sampling date.
- Underline indicates parameter exceeds CCME IL (Fine, Subsoil). (Current as of 9-November-2012)
- Refer to Tables for Full Soil Results.



**Title:** ANALYTICAL RESULTS - MAHs IN SOIL

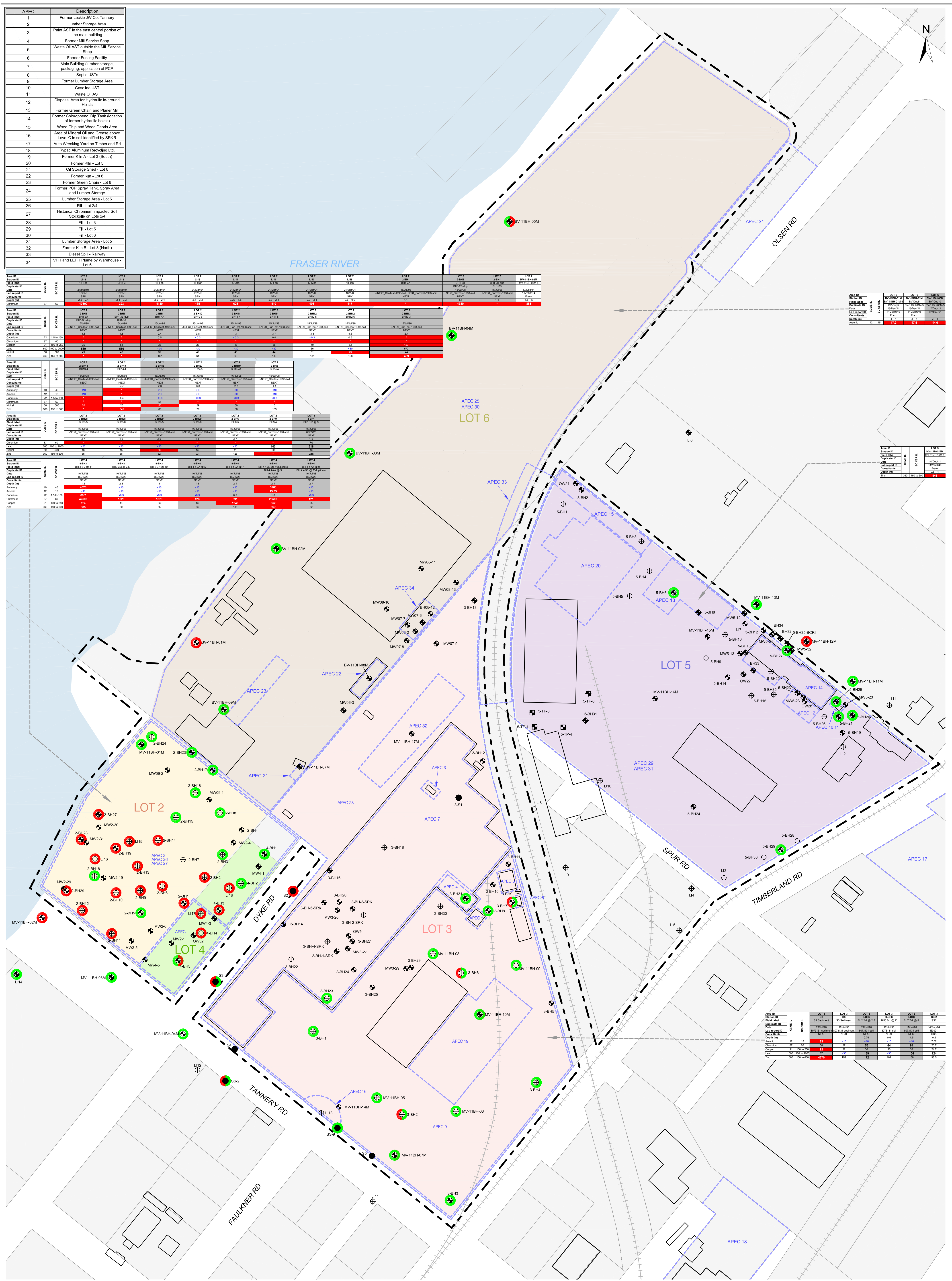
**Project:** DATA GAP ANALYSIS  
SURREY-BROWNSVILLE, SURREY, BC

**Client:** VANCOUVER FRASER PORT AUTHORITY

**Date:** MAY 2013

**FIGURE 3**

**FRANZ ENVIRONMENTAL INC.**  
CONSULTING • ENGINEERING • TECHNOLOGIES



APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Paint AST in the east corner portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building (lumber storage, packaging, application of PCP)
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Deposited Area for Hydraulic H-ground Holes
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chips and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROR
17	Auto Wrecking Yard on Timberland Rd
18	Rypac Aluminum Recycling Ltd
19	Former K&N A - Lot 3 (South)
20	Former K&N - Lot 5
21	Oil Storage Shed - Lot 6
22	Former K&N - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	FB - Lot 2/4
27	Historical Chromium-impacted Soil (topology on Lots 2/4)
28	FB - Lot 3
29	FB - Lot 5
30	FB - Lot 6
31	Lumber Storage Area - Lot 5
32	Former K&N B - Lot 3 (North)
33	Diesel Spill - Railway
34	VPH and LEPH Plume by Warehouse - Lot 6

Area ID	Station ID	Depth (m)	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Area 26	26-1	0.0-0.3	100	100	100	100	100
	26-2	0.3-0.6	100	100	100	100	100
Area 27	27-1	0.0-0.3	100	100	100	100	100
	27-2	0.3-0.6	100	100	100	100	100

Area ID	Station ID	Depth (m)	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Area 28	28-1	0.0-0.3	100	100	100	100	100
	28-2	0.3-0.6	100	100	100	100	100

Area ID	Station ID	Depth (m)	Lot 2	Lot 3	Lot 4	Lot 5	Lot 6
Area 29	29-1	0.0-0.3	100	100	100	100	100
	29-2	0.3-0.6	100	100	100	100	100

**LEGEND**

- Area of Potential Environmental Concern (APEC)
- Railway
- Site Boundary
- Existing Structure
- Property Boundary
- Test Pit
- Borehole
- Monitoring Well
- Surface Soil Sample

**NOTES**

- All units in ug/g.
- "-" indicates that there is no applicable standard or analyses were not performed.
- Red cells indicates parameter exceeds CCME IL. (Current as of 13-November-2012).
- Bold indicates parameter exceeds BC CSR IL. (Current as of 13-November-2012)
- Coloured rings represent most recent sampling date.
- Black stations were not tested for parameters presented in current drawing.
- Refer to Tables for Full Soil Results.

**Lot Color Key:**

- Lot 2 (Yellow)
- Lot 3 (Orange)
- Lot 4 (Green)
- Lot 5 (Purple)
- Lot 6 (Brown)

**Soil Standard Key:**

- One or more analytical parameters are greater than the applicable BC CSR Soil Standards
- All analytical parameters are less than the applicable BC CSR Soil Standards
- One or more analytical parameters are greater than the applicable CCME Soil Standards
- All analytical parameters are less than the applicable CCME Soil Standards

Scale 1:1000  
40 20 0 20 40 metres

**Title:** ANALYTICAL RESULTS - METALS IN SOIL

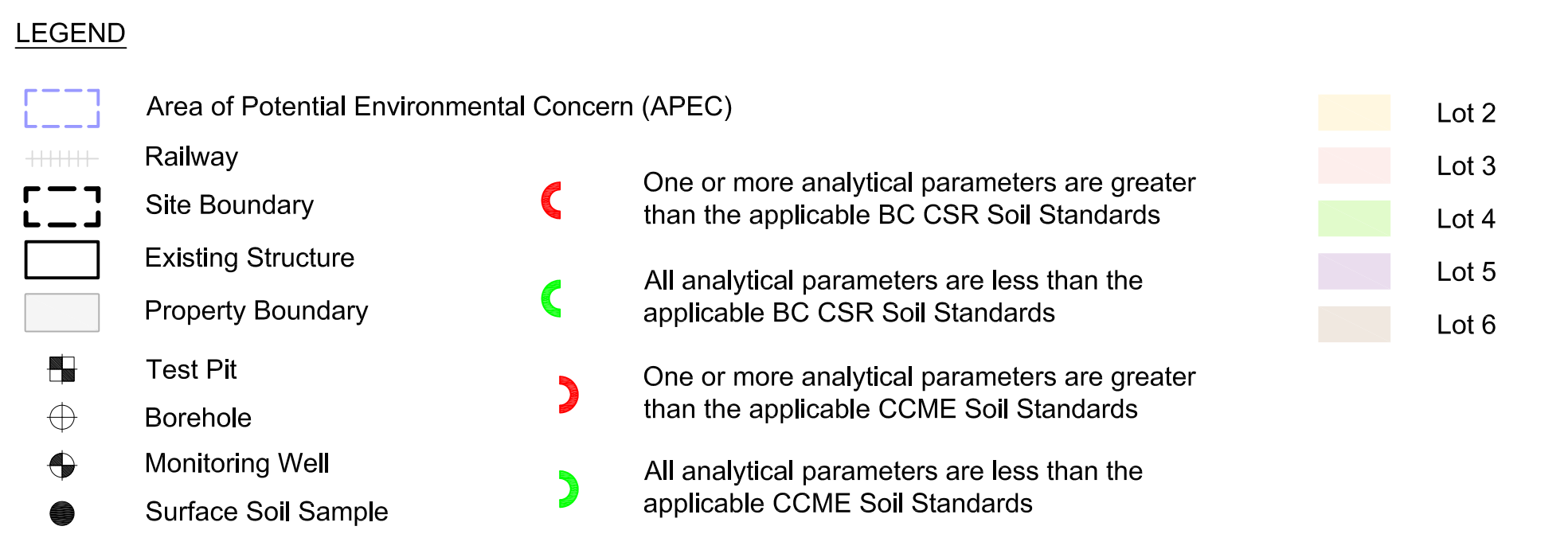
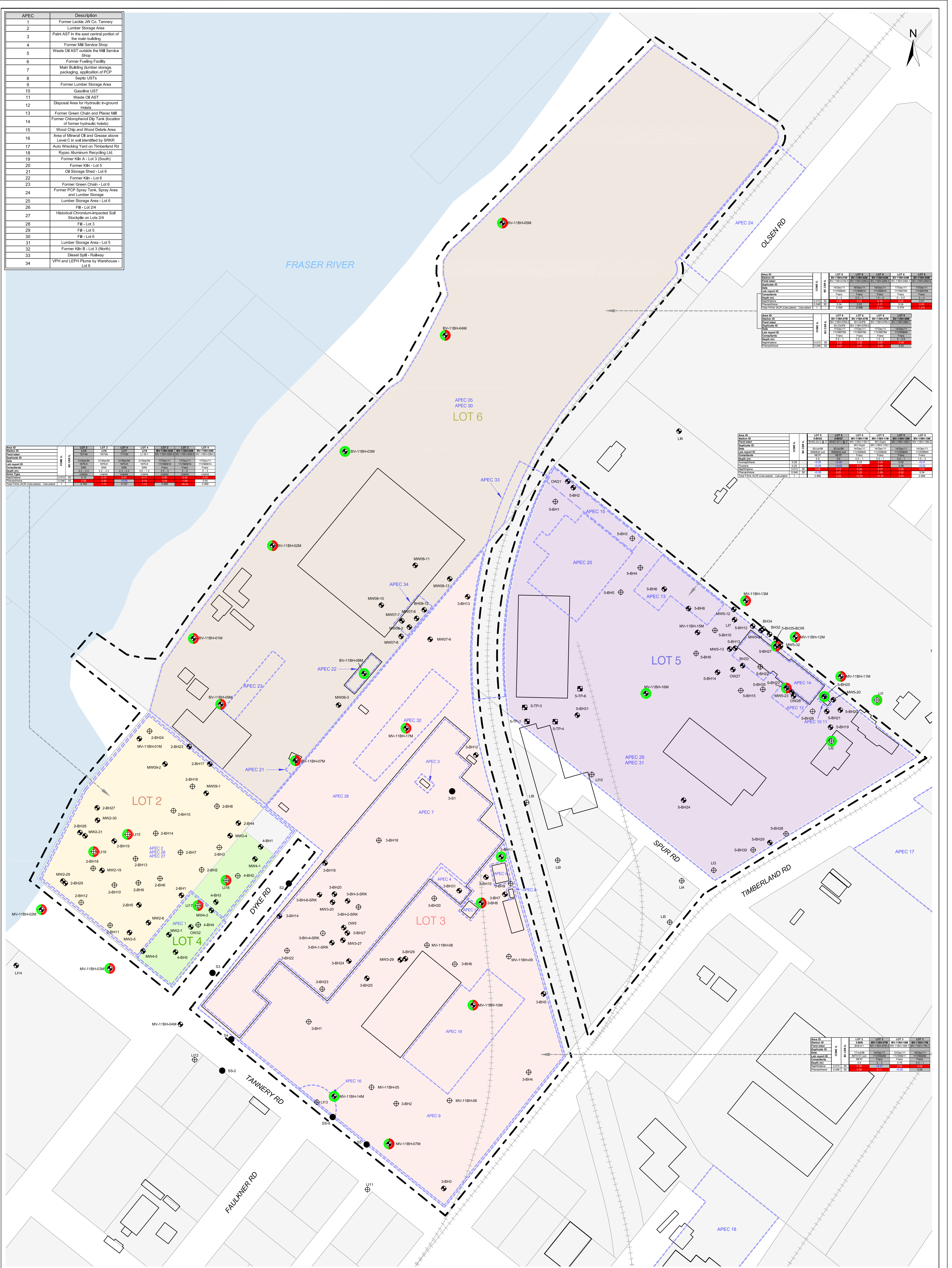
**Project:** DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC

**Client:** VANCOUVER FRASER PORT AUTHORITY

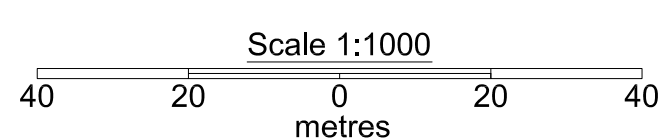
**Date:** MAY 2013

**FIGURE 4**

FRANZ ENVIRONMENTAL INC.  
CONSULTING • ENGINEERING • TECHNOLOGIES



**NOTES**  
- All units in ug/g.  
- "-" indicates that there is no applicable standard or analyses were not performed.  
- Red cells indicates parameter exceeds CCME IL. (Current as of 9-November-2012)  
- Bold indicates parameter exceeds CSR IL. (Current as of 9-November-2012)  
- Coloured rings represent most recent sampling date.  
- Refer to Tables for Full Soil Results.



Title: **ANALYTICAL RESULTS - PAHs IN SOIL**

Project: **DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC**

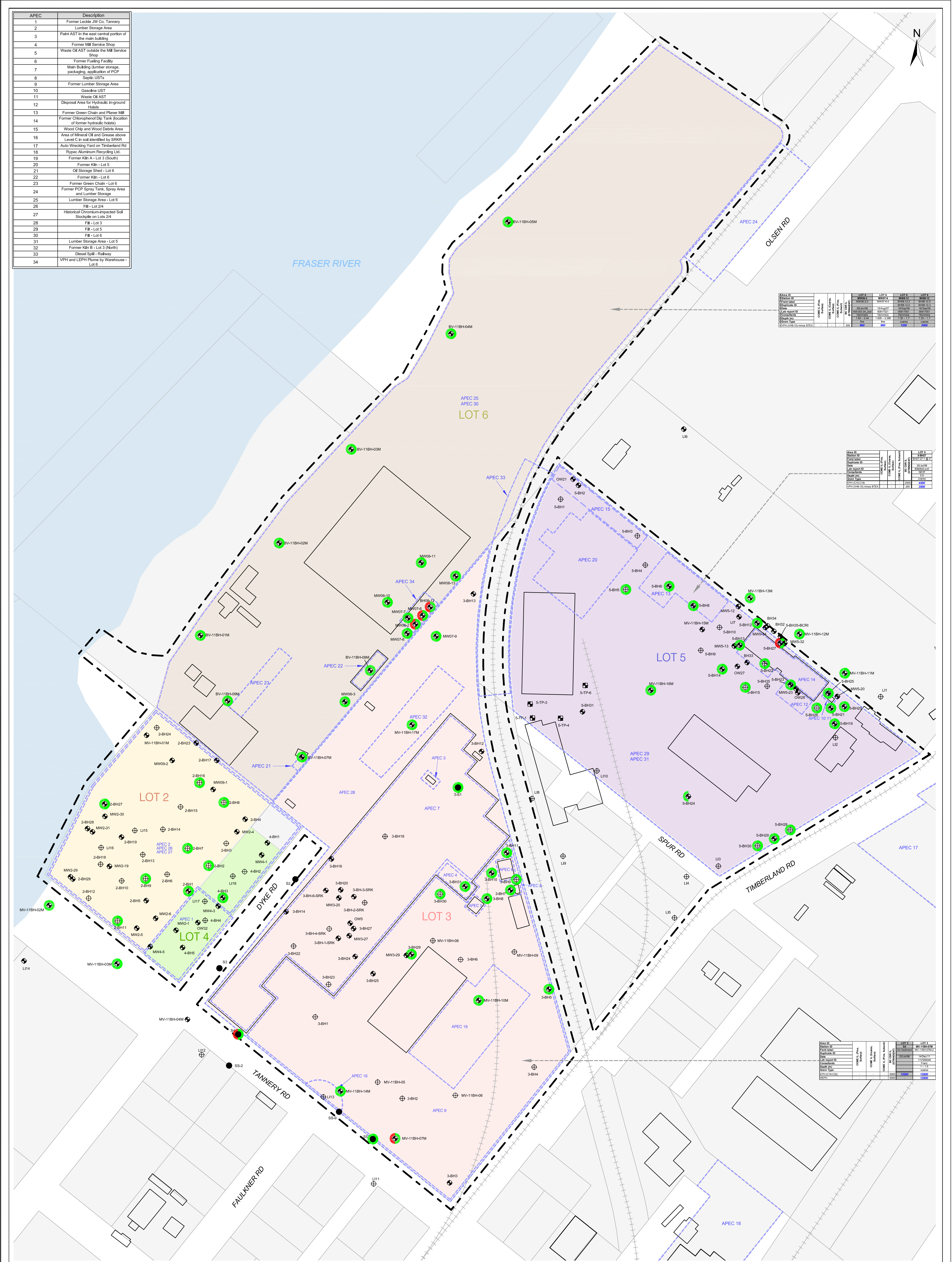
Client: **VANCOUVER FRASER PORT AUTHORITY**

Date: **MAY 2013**

**FIGURE 5**

**FRANZ ENVIRONMENTAL INC.**  
CONSULTING • ENGINEERING • TECHNOLOGIES

APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Paint AST in the east corner portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building (lumber storage, packaging, application of PCP)
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Disposal Area for Hydraulic In-ground Hoists
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chips and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROR
17	Auto Wrecking Yard on Timberland Rd
18	Rypac Aluminum Recycling Ltd
19	Former Kib A - Lot 3 (South)
20	Former Kib - Lot 5
21	Oil Storage Shed - Lot 6
22	Former Kib - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	FB - Lot 2/4
27	Historical Chromium-impacted Soil Spoils on Lots 2/4
28	FB - Lot 3
29	FB - Lot 5
30	FB - Lot 6
31	Lumber Storage Area - Lot 5
32	Former Kib B - Lot 3 (North)
33	Diesel Spill - Railway
34	VPH and LEPH Plume by Warehouse - Lot 6



Area ID	Station ID	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)
LOT 2	MW2-30	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 3	MW3-20	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 4	MW4-5	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 5	MW5-12	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 6	MW6-10	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0

Area ID	Station ID	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)
LOT 5	MW5-13	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 5	MW5-14	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 5	MW5-15	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 5	MW5-16	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 5	MW5-17	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0

Area ID	Station ID	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)	Depth (m)	Depth (ft)
LOT 3	MW3-21	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 3	MW3-22	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 3	MW3-23	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 3	MW3-24	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0
LOT 3	MW3-25	0.30	1.0	0.30	1.0	0.30	1.0	0.30	1.0

**LEGEND**

- Area of Potential Environmental Concern (APEC)
- Railway
- Site Boundary
- Existing Structure
- Property Boundary
- Test Pit
- Borehole
- Monitoring Well
- Surface Soil Sample

<span style="background-color: yellow; width: 20px; height: 10px; display: inline-block;"></span> Lot 2	<span style="color: red; font-weight: bold;">●</span> One or more analytical parameters are greater than the applicable BC CSR Soil Standards
<span style="background-color: lightcoral; width: 20px; height: 10px; display: inline-block;"></span> Lot 3	<span style="color: green; font-weight: bold;">●</span> All analytical parameters are less than the applicable BC CSR Soil Standards
<span style="background-color: lightgreen; width: 20px; height: 10px; display: inline-block;"></span> Lot 4	<span style="color: red; font-weight: bold;">●</span> One or more analytical parameters are greater than the applicable CCME Soil Standards
<span style="background-color: lightblue; width: 20px; height: 10px; display: inline-block;"></span> Lot 5	<span style="color: green; font-weight: bold;">●</span> All analytical parameters are less than the applicable CCME Soil Standards
<span style="background-color: lightpurple; width: 20px; height: 10px; display: inline-block;"></span> Lot 6	

**NOTES**

- All units in ug/g.
- "-" indicates that there is no applicable standard or analyses were not performed.
- Red cells indicates parameter exceeds CCME IL (Fine, Surface) (Current as of 9-November-2012)
- Bold indicates parameter exceeds CCME IL (Coarse, Surface) (Current as of 9-November-2012)
- Underline indicates parameter exceeds CCME IL (Fine, Subsoil) (Current as of 9-November-2012)
- Coloured rings represent most recent sampling date.
- Refer to Tables for Full Soil Results.

Scale 1:1000

40    20    0    20    40  
metres

Title: **ANALYTICAL RESULTS - PHCs IN SOIL**

Project: **DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC**

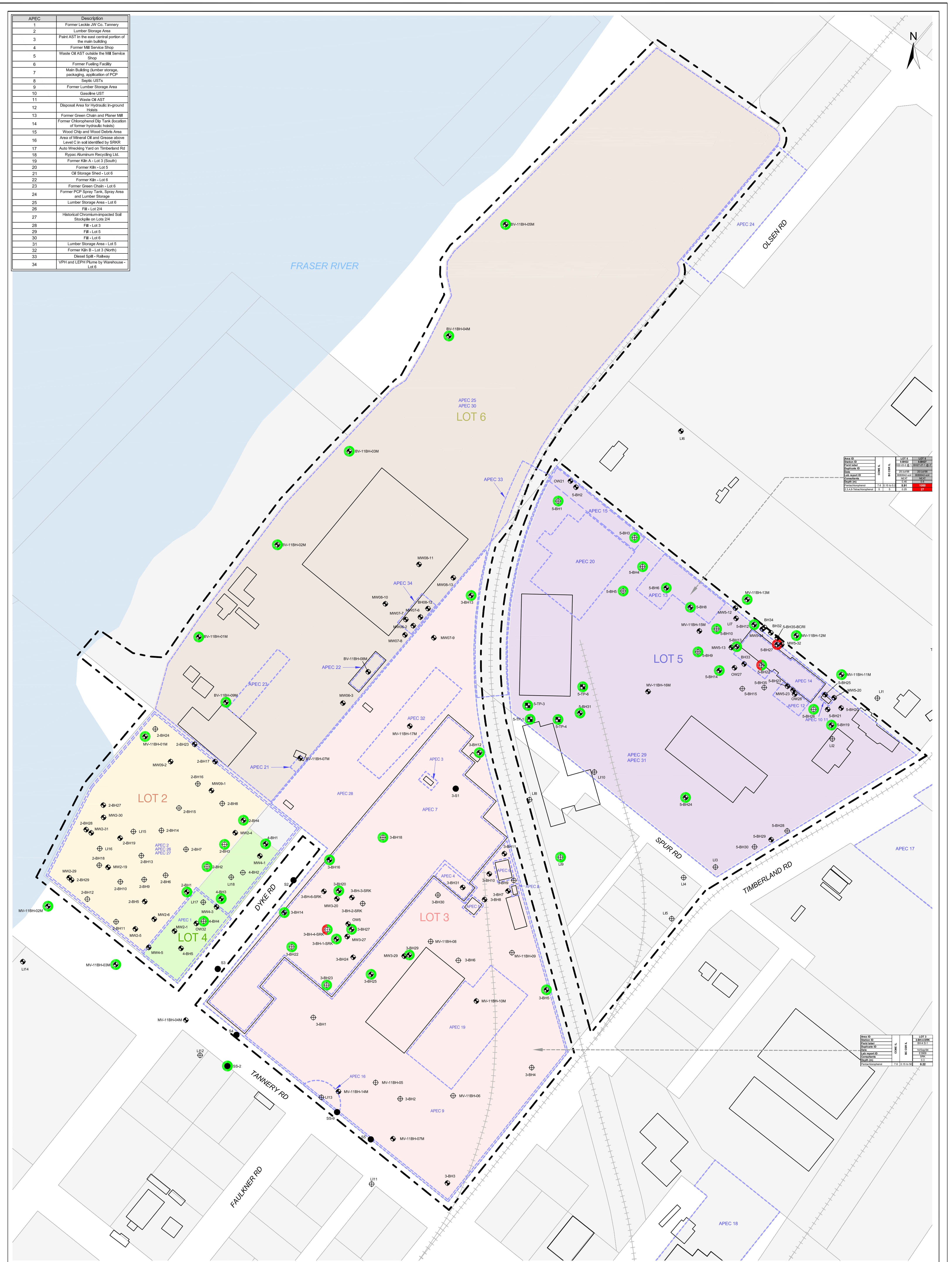
Client: **VANCOUVER FRASER PORT AUTHORITY**

Date: **MAY 2013**

**FIGURE 6**

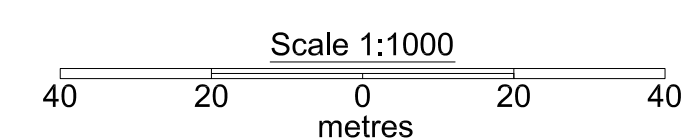
2090-1103/CAD/CBI/Analytical Posters.dwg

APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Paint AST in the east central portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building (lumber storage, packaging, application of PCP)
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Disposal Area for Hydraulic In-ground Hoists
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chips and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROR
17	Auto Wrecking Yard on Timberland Rd
18	Rypac Aluminum Recycling Ltd
19	Former K&H A - Lot 3 (South)
20	Former K&H - Lot 5
21	Oil Storage Shed - Lot 6
22	Former K&H - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	FB - Lot 2/4
27	Historical Chromium-impacted Soil Spoils on Lots 2/4
28	FB - Lot 3
29	FB - Lot 5
30	FB - Lot 6
31	Lumber Storage Area - Lot 5
32	Former K&H B - Lot 3 (North)
33	Diesel Spill - Railway
34	VPH and LEPH Plume by Warehouse - Lot 6



LEGEND	
	Area of Potential Environmental Concern (APEC)
	Railway
	Site Boundary
	Existing Structure
	Property Boundary
	Test Pit
	Borehole
	Monitoring Well
	Surface Soil Sample
	One or more analytical parameters are greater than the applicable BC CSR Soil Standards
	All analytical parameters are less than the applicable BC CSR Soil Standards
	One or more analytical parameters are greater than the applicable CCME Soil Standards
	All analytical parameters are less than the applicable CCME Soil Standards
	Lot 2
	Lot 3
	Lot 4
	Lot 5
	Lot 6

**NOTES**  
 - All units in ug/g.  
 - "-" indicates that there is no applicable standard or analyses were not performed.  
 - Red cells indicates parameter exceeds CCME IL. (Current as of 9-November-2012)  
 - Bold indicates parameter exceeds BC CSR IL. (Current as of 9-November-2012)  
 - Coloured rings represent most recent sampling date.  
 - Refer to Tables for Full Soil Results.



**Title:** ANALYTICAL RESULTS - PHENOLS/CHLOROPHENOLS IN SOIL

**Project:** DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC

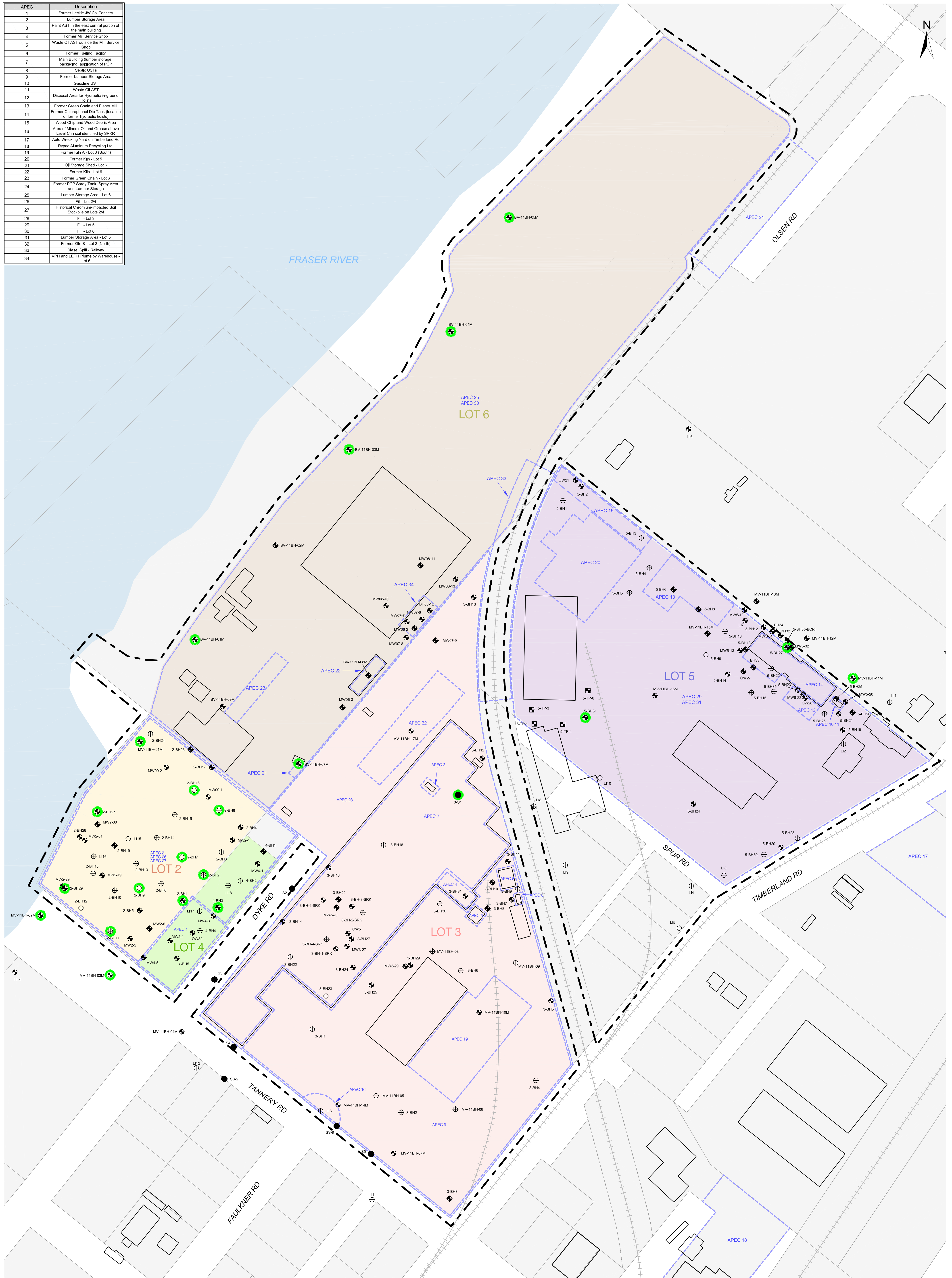
**Client:** VANCOUVER FRASER PORT AUTHORITY

**Date:** MAY 2013

**FIGURE 7**

**FRANZ ENVIRONMENTAL INC.**  
 CONSULTING • ENGINEERING • TECHNOLOGIES

APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Plant AST in the east central portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building Lumber storage, packaging application of PCP
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Disposed Area for Hydraulic In-ground Hoists
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chip and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROB
17	Auto Wrecking Yard on Timberland Rd
18	Ryback Aluminum Recycling Lot
19	Former Kih A - Lot 3 (South)
20	Former Kih - Lot 5
21	Oil Storage Shed - Lot 6
22	Former Kih - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	Fill - Lot 2/4
27	Historical Chromium-impacted Soil Stockpile on Lots 2/4
28	Fill - Lot 3
29	Fill - Lot 5
30	Fill - Lot 6
31	Lumber Storage Area - Lot 5
32	Former Kih B - Lot 3 (North)
33	Diesel Spill - Railway
34	VRH and LEPH Plume by Warehouse - Lot 6



**LEGEND**

	Area of Potential Environmental Concern (APEC)		Lot 2
	Railway		Lot 3
	Site Boundary		Lot 4
	Existing Structure		Lot 5
	Property Boundary		Lot 6
	Test Pit		
	Borehole		
	Monitoring Well		
	Surface Soil Sample		

**NOTES**

- Coloured rings represent most recent sampling date.
- Refer to Tables for Full Soil Results.

	One or more analytical parameters are greater than the applicable BC CSR Soil Standards
	All analytical parameters are less than the applicable BC CSR Soil Standards
	One or more analytical parameters are greater than the applicable CCME Soil Standards
	All analytical parameters are less than the applicable CCME Soil Standards

**Scale 1:1000**

**Title: ANALYTICAL RESULTS - VOCs IN SOIL**

**Project: DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC**

**Client: VANCOUVER FRASER PORT AUTHORITY**

**Date: MAY 2013**

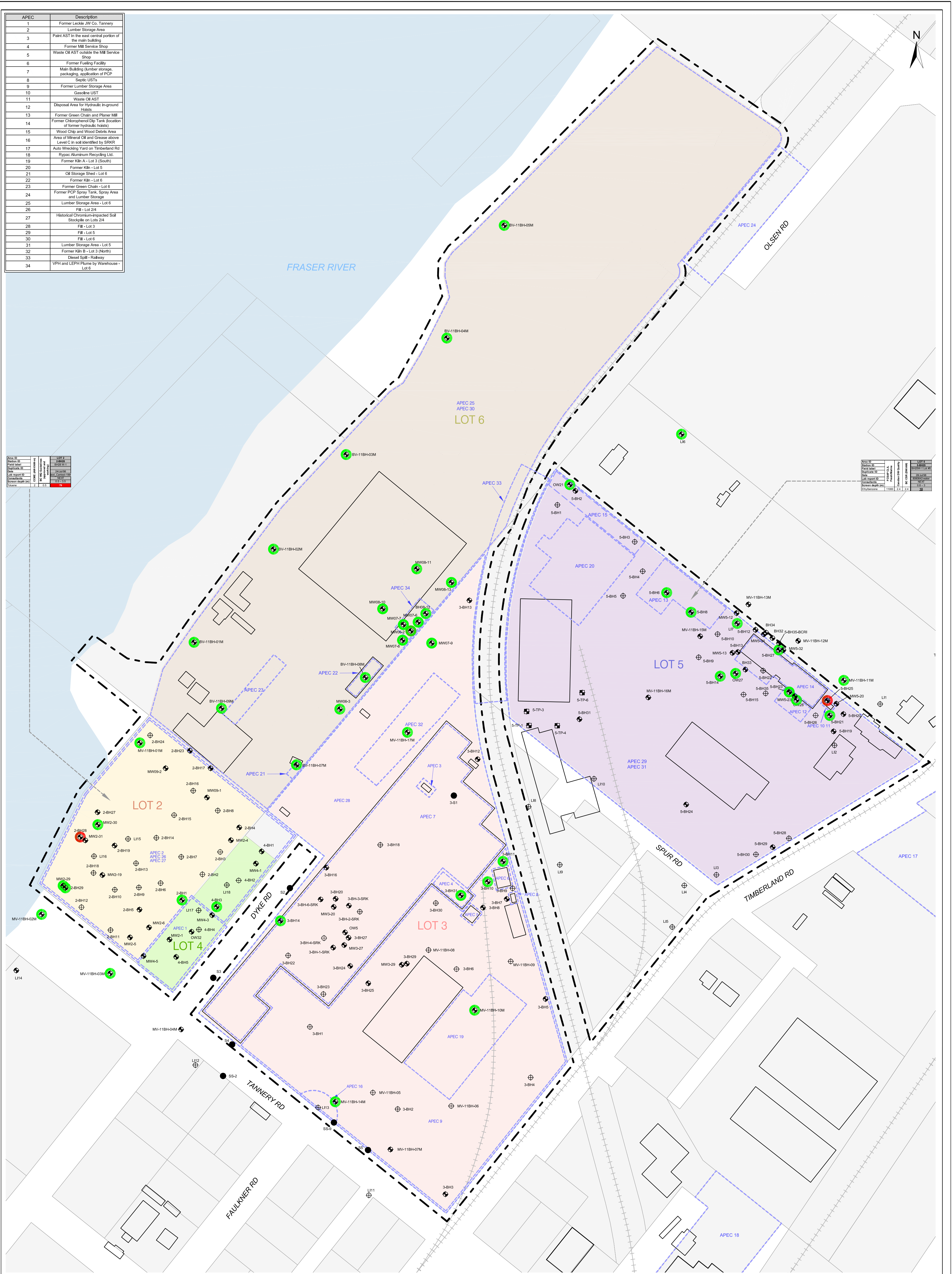
**FIGURE 8**

**FRANZ ENVIRONMENTAL INC.**  
CONSULTING • ENGINEERING • TECHNOLOGIES

APEC	Description
1	Former Leckie JW Co. Tannery
2	Lumber Storage Area
3	Paint AST in the east central portion of the main building
4	Former Mill Service Shop
5	Waste Oil AST outside the Mill Service Shop
6	Former Fueling Facility
7	Main Building (lumber storage, packaging, application of PCP)
8	Septic USTs
9	Former Lumber Storage Area
10	Gasoline UST
11	Waste Oil AST
12	Disposal Area for Hydraulic In-ground Hoists
13	Former Green Chain and Planer Mill
14	Former Chlorophenol Dip Tank (location of former hydraulic hoists)
15	Wood Chips and Wood Debris Area
16	Area of Mineral Oil and Grease above Level C in soil identified by SROR
17	Auto Wrecking Yard on Timberland Rd
18	Rypac Aluminum Recycling Ltd
19	Former K&H A - Lot 3 (South)
20	Former K&H - Lot 5
21	Oil Storage Shed - Lot 6
22	Former K&H - Lot 6
23	Former Green Chain - Lot 6
24	Former PCP Spray Tank, Spray Area and Lumber Storage
25	Lumber Storage Area - Lot 6
26	FB - Lot 2/4
27	Historical Chromium-impacted Soil Spoils on Lots 2/4
28	FB - Lot 3
29	FB - Lot 5
30	FB - Lot 6
31	Lumber Storage Area - Lot 5
32	Former K&H B - Lot 3 (North)
33	Diesel Spill - Railway
34	VPH and LEPH Plume by Warehouse - Lot 6

Area ID	Lot	Color
1	1	Light Blue
2	2	Light Green
3	3	Light Orange
4	4	Light Yellow
5	5	Light Purple
6	6	Light Brown

Area ID	Lot	Color
1	1	Light Blue
2	2	Light Green
3	3	Light Orange
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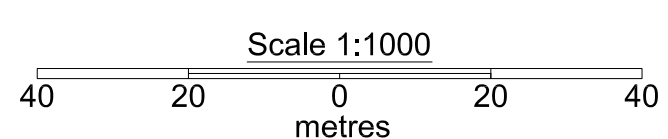
**LEGEND**

- Area of Potential Environmental Concern (APEC)
- Railway
- Site Boundary
- Existing Structure
- Property Boundary
- Test Pit
- Borehole
- Monitoring Well
- Surface Soil Sample

<ul style="list-style-type: none"> <li><span style="color: red; font-size: 20px;">C</span> One or more analytical parameters are greater than the applicable FCSAP and Canadian DW Groundwater Standards</li> <li><span style="color: green; font-size: 20px;">C</span> All analytical parameters are less than the applicable FCSAP and Canadian DW Groundwater Standards</li> <li><span style="color: red; font-size: 20px;">C</span> One or more analytical parameters are greater than the applicable BC CSR Groundwater Standards</li> <li><span style="color: green; font-size: 20px;">C</span> All analytical parameters are less than the applicable BC CSR Groundwater Standards</li> </ul>	<table style="width: 100%; border-collapse: collapse;"> <tr><td style="width: 50%;"><span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 2</td><td style="width: 50%;"><span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 2</td></tr> <tr><td><span style="background-color: #ffe0b2; border: 1px solid black; padding: 2px;"> </span> Lot 3</td><td><span style="background-color: #ffe0b2; border: 1px solid black; padding: 2px;"> </span> Lot 3</td></tr> <tr><td><span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 4</td><td><span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 4</td></tr> <tr><td><span style="background-color: #e1bee7; border: 1px solid black; padding: 2px;"> </span> Lot 5</td><td><span style="background-color: #e1bee7; border: 1px solid black; padding: 2px;"> </span> Lot 5</td></tr> <tr><td><span style="background-color: #d7ccc8; border: 1px solid black; padding: 2px;"> </span> Lot 6</td><td><span style="background-color: #d7ccc8; border: 1px solid black; padding: 2px;"> </span> Lot 6</td></tr> </table>	<span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 2	<span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 2	<span style="background-color: #ffe0b2; border: 1px solid black; padding: 2px;"> </span> Lot 3	<span style="background-color: #ffe0b2; border: 1px solid black; padding: 2px;"> </span> Lot 3	<span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 4	<span style="background-color: #fff9c4; border: 1px solid black; padding: 2px;"> </span> Lot 4	<span style="background-color: #e1bee7; border: 1px solid black; padding: 2px;"> </span> Lot 5	<span style="background-color: #e1bee7; border: 1px solid black; padding: 2px;"> </span> Lot 5	<span style="background-color: #d7ccc8; border: 1px solid black; padding: 2px;"> </span> Lot 6	<span style="background-color: #d7ccc8; border: 1px solid black; padding: 2px;"> </span> Lot 6
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**NOTES**

- All units in ug/L
- "-" indicates that there is no applicable standard or analyses were not performed.
- Red cells indicates parameter exceeds CCME (AW-fIAW-m). (Current as of 15-November-2012)
- Bold cells indicates parameter exceeds BC WQ Guidelines
- Coloured rings represent most recent sampling date.
- Refer to Tables for Full Groundwater Results.



<b>Title:</b>	<b>ANALYTICAL RESULTS - MAHs IN GROUNDWATER</b>
<b>Project:</b>	DATA GAP ANALYSIS SURREY-BROWNSVILLE, SURREY, BC
<b>Client:</b>	VANCOUVER FRASER PORT AUTHORITY
<b>Date:</b>	MAY 2013
	<b>FIGURE 9</b>