Review of Findings
Phase Two ESA
Former Thornbury Landfill Site

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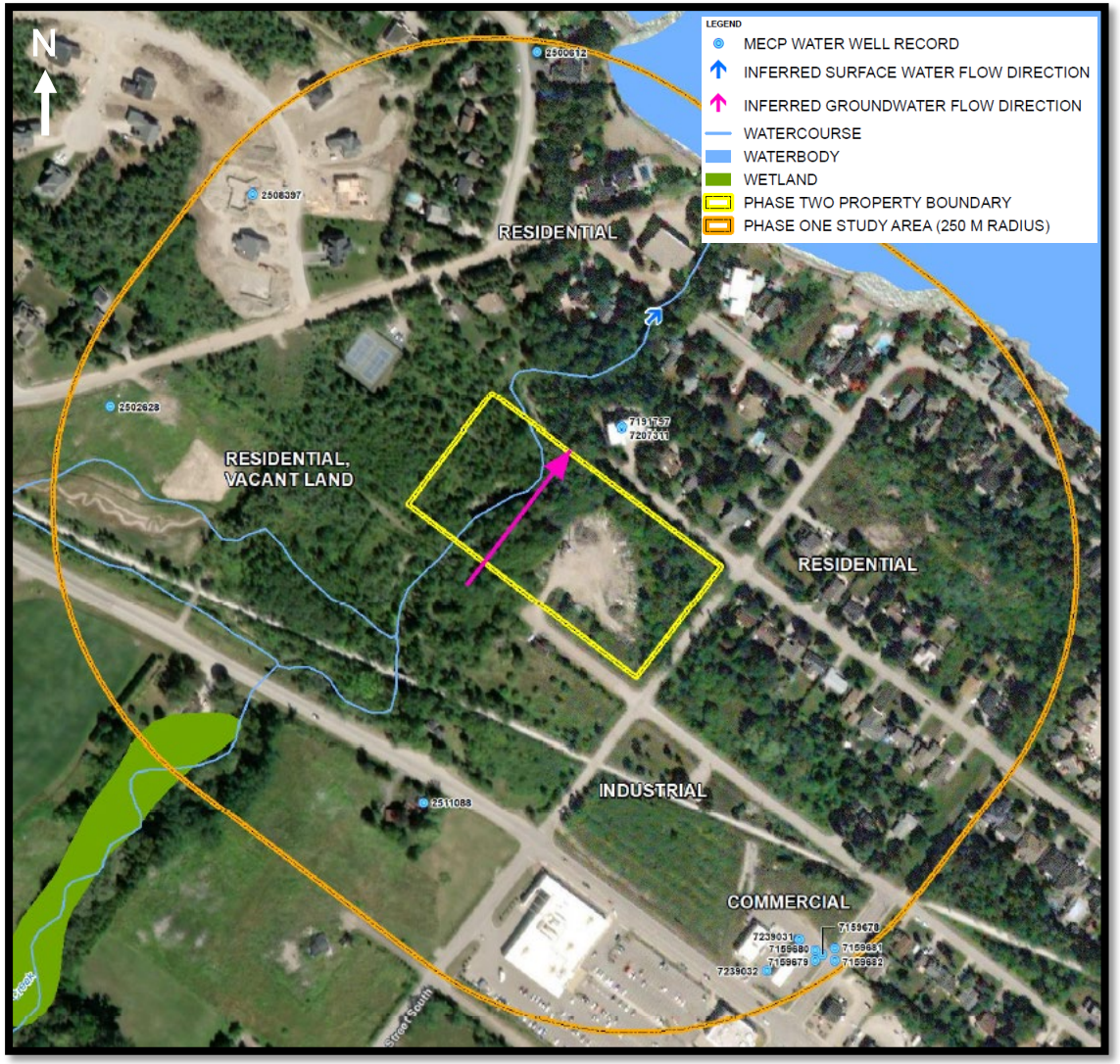
Introduction

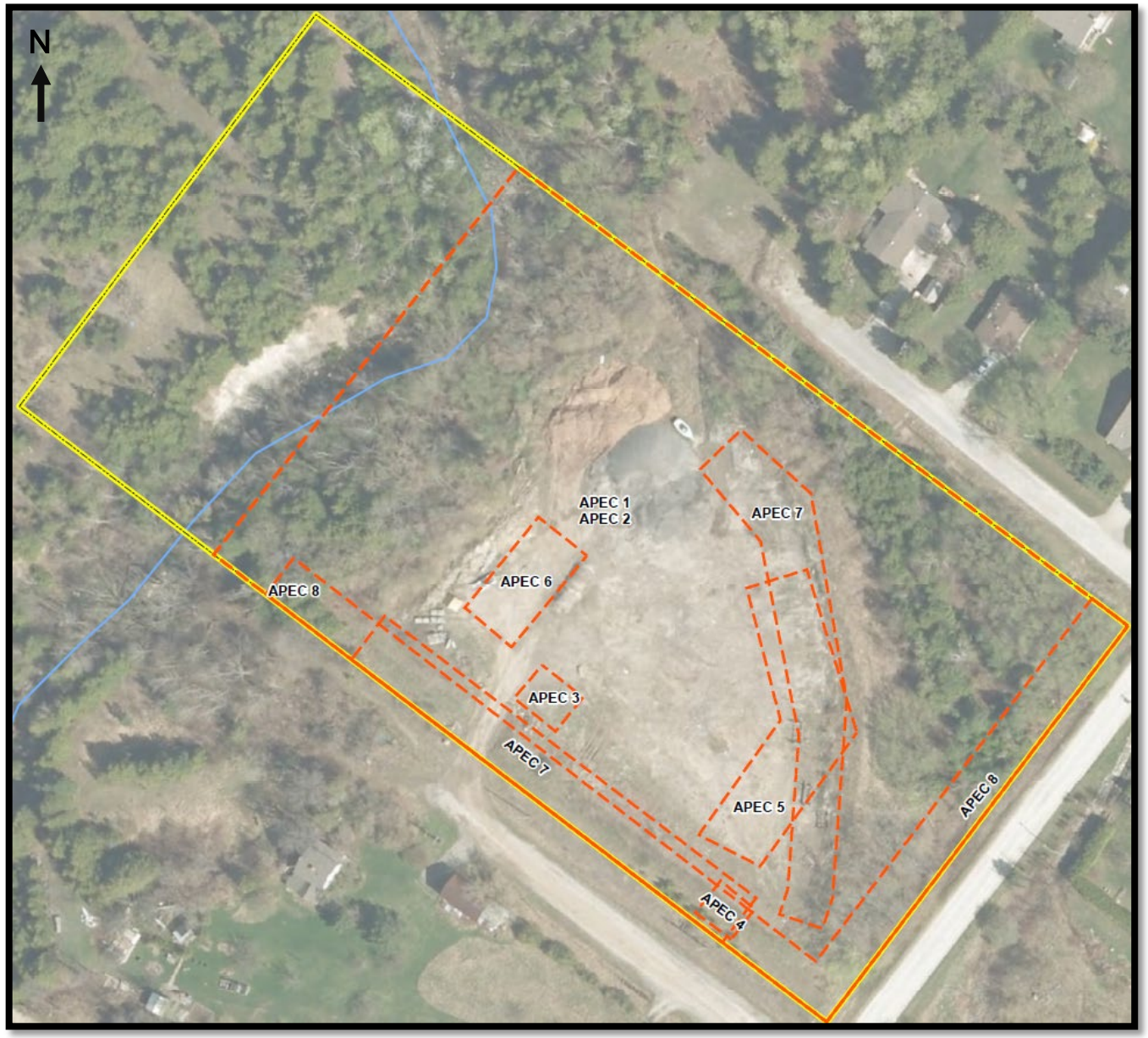
- King St W and Lansdowne St N
- Phase One ESA - June 2022
- Phase Two ESA - November 2022



Areas of Potential Environment Concern (APECs)

1	Former use of site as landfill from 1953 (earliest possible date) to 1969
2	Current and former use of site for aggregate storage, fill placement, snow storage
3	Current storage of several drums
4	Presence of an on-site pole-mounted transformer
5	Current and historical storage of boat cribs, boats and other non-deleterious materials
6	Current and former storage and parking of snowploughs
7	Importation of fill material of poor quality for berm construction
8	Former presence of orchards on surrounding properties

APEC Locations



Phase Two ESA Scope of Work

- HSSE Plan, utility locates
- Borehole advancement
- Monitoring Well/Gas Probe Installation
- Soil sampling
- Landfill gas monitoring
- Groundwater monitoring and sampling
- Surface water sampling
- Survey
- Report

Contaminants of Concern/Sampling Parameters

Petroleum Hydrocarbons (PHC)

Volatile Organic Compounds (VOC)

Metals, Inorganics, Other Regulated Parameters (ORP)

Polycyclic Aromatic Hydrocarbons (PAH)

Polychlorinated Biphenyls (PCB)

Organochlorine Pesticides (OCP)

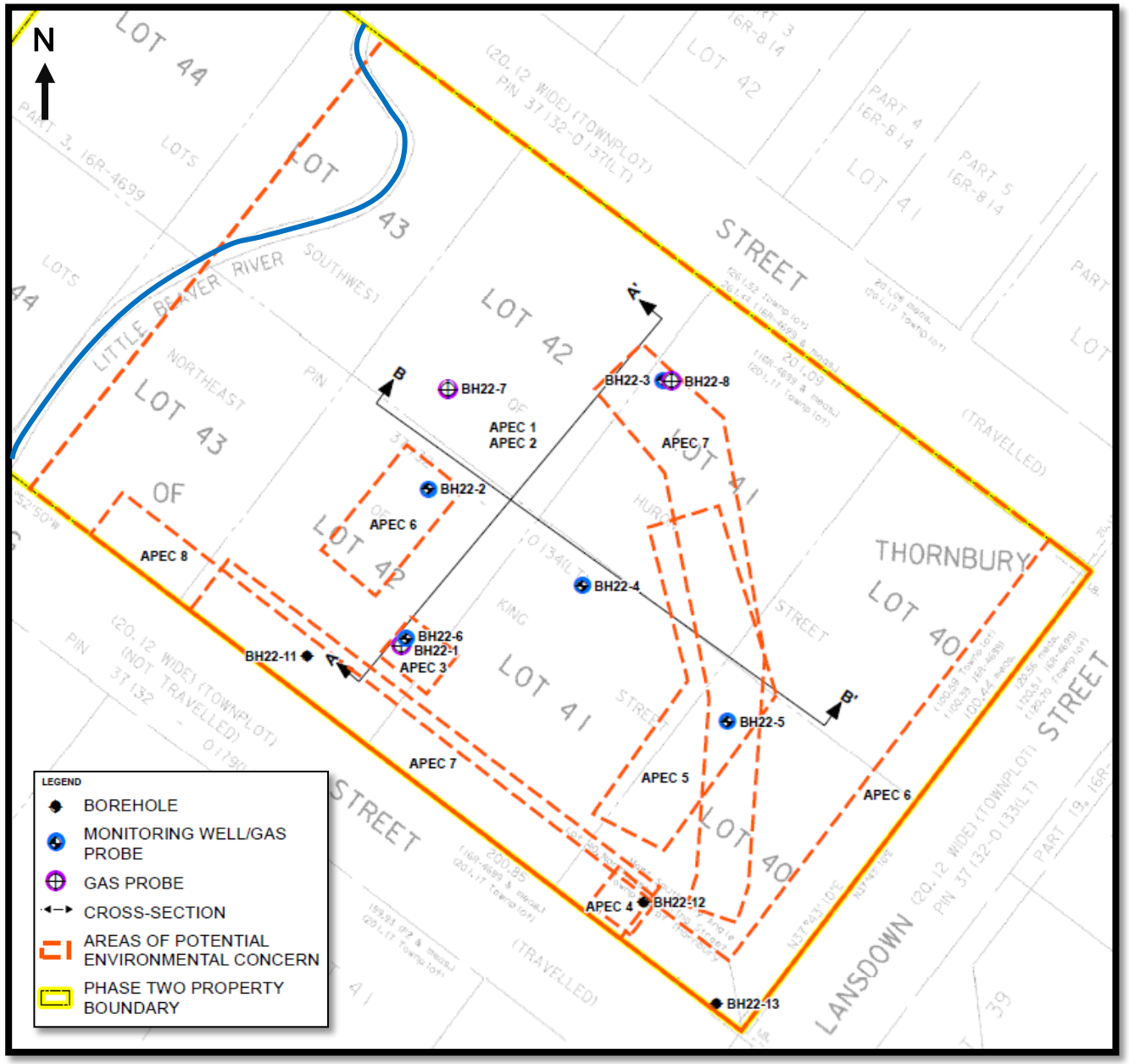
Environmental Standards

Table 8 RPI and ICC SCS (potable water, within 30 m of water body)

PWQO (for surface water)

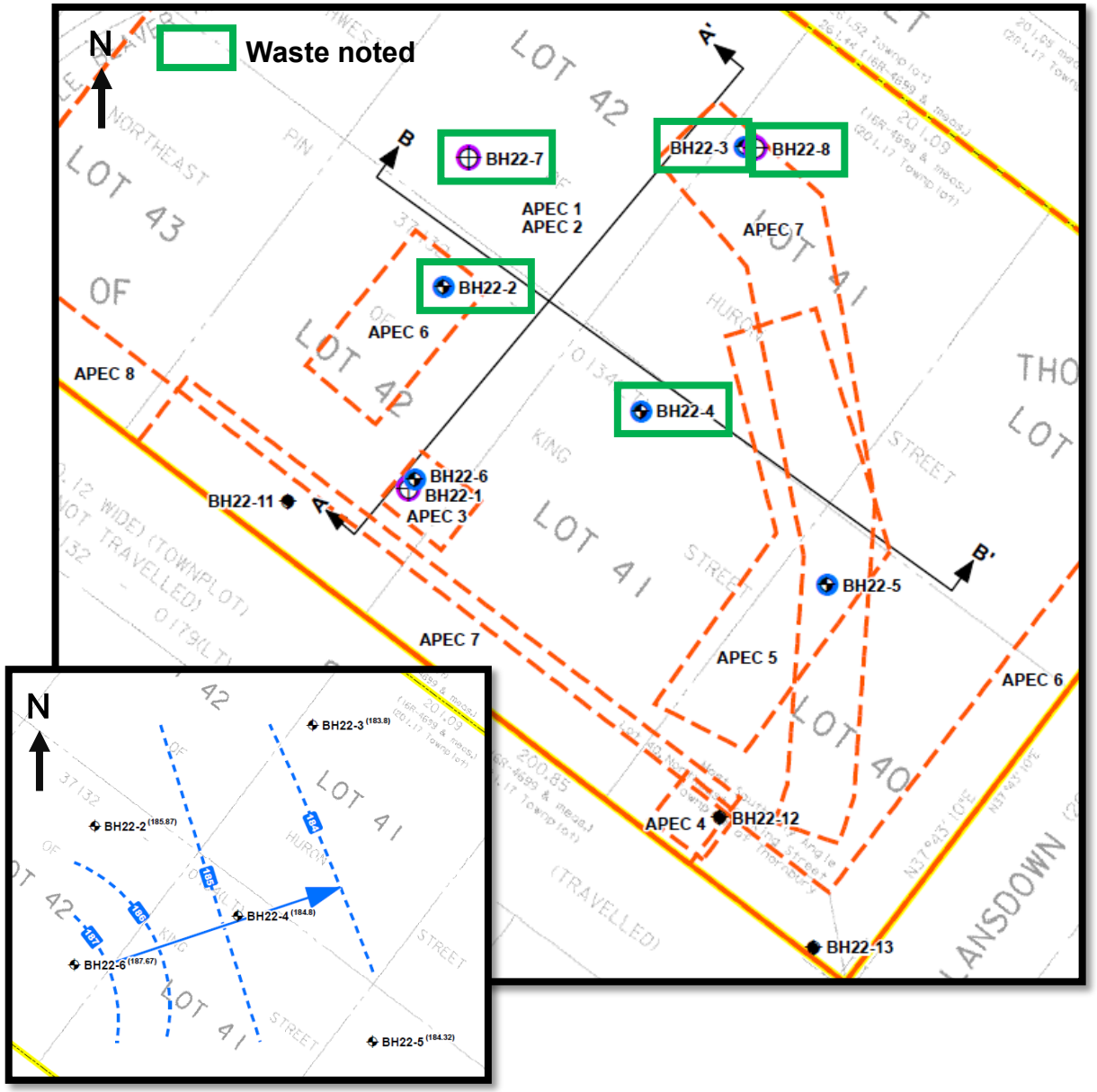
Site Instrumentation

- 11 BHs advanced in March 2022
- 5 BHs completed as groundwater monitoring wells
- 3 BHs completed as landfill gas probes
- Monitoring wells and gas probes used for landfill gas monitoring
- Monitoring wells used for groundwater monitoring and sampling



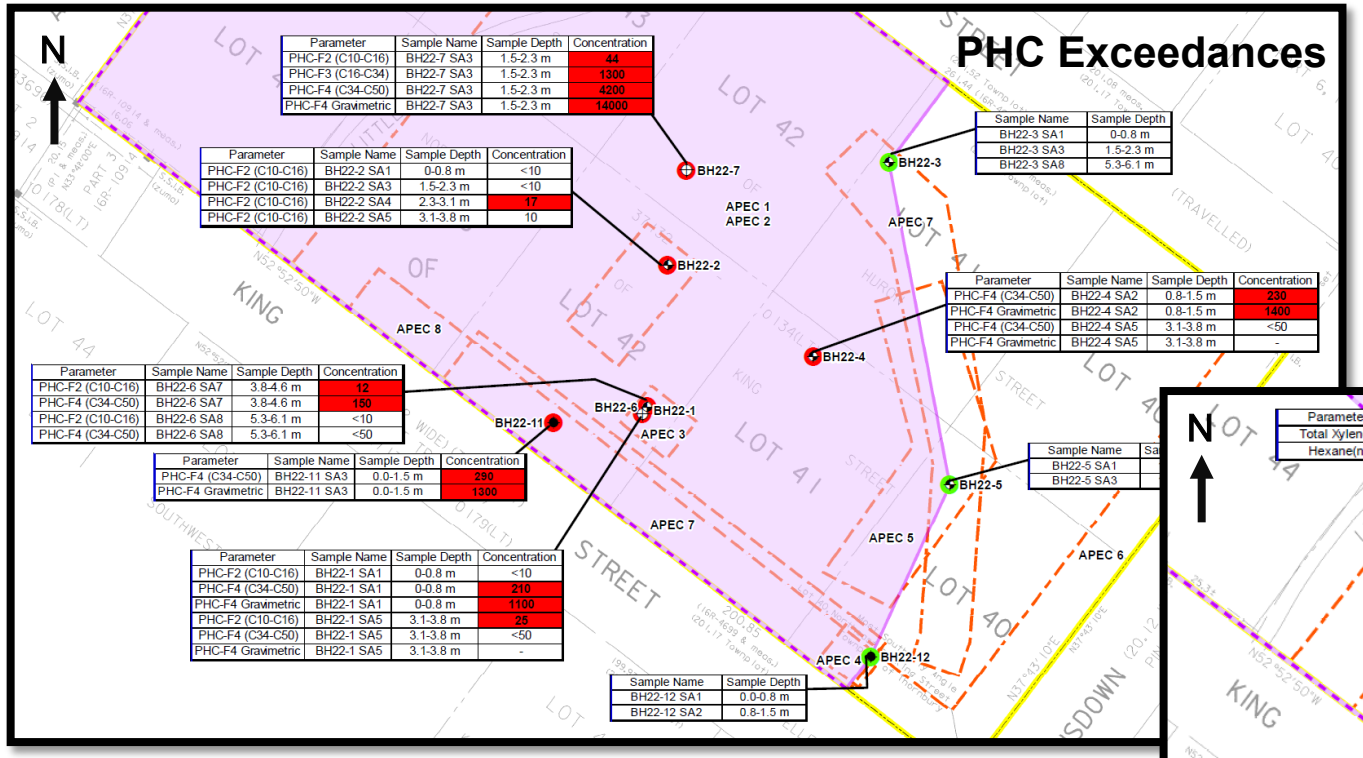
Review and Evaluation

- Coarse, surficial fill underlain by clayey silt to silty clay
- Waste material at BH22-2, BH22-3, BH22-4, BH22-7, BH22-8 (max depth of 3.81 mbgs)
- Water levels: 1.2 to 4.5 mbgs
- Groundwater flow direction to the NE (localized component to creek)



Soil Results

Parameter Group	Number of soil samples analysed	Number of soil samples with exceedances of Table 8 RPI and ICC SCS
PHC	19, plus 2 duplicates	7, plus 1 duplicate
VOC and BTEX	17, plus 2 duplicates	3
Metals/Hydride Forming Metals	16, plus 2 duplicates	1
ORP	16, plus 2 duplicates	3, plus 1 duplicate
PAH	15, plus 2 duplicates	3
OCP	3	0
PCB	3	0



Parameter	Sample Name	Sample Depth	Concentration
PHC-F2 (C10-C16)	BH22-7 SA3	1.5-2.3 m	44
PHC-F3 (C16-C34)	BH22-7 SA3	1.5-2.3 m	1300
PHC-F4 (C34-C50)	BH22-7 SA3	1.5-2.3 m	4200
PHC-F4 Gravimetric	BH22-7 SA3	1.5-2.3 m	14000

Sample Name	Sample Depth
BH22-3 SA1	0-0.8 m
BH22-3 SA3	1.5-2.3 m
BH22-3 SA8	5.3-6.1 m

Parameter	Sample Name	Sample Depth	Concentration
PHC-F2 (C10-C16)	BH22-2 SA1	0-0.8 m	<10
PHC-F2 (C10-C16)	BH22-2 SA3	1.5-2.3 m	<10
PHC-F2 (C10-C16)	BH22-2 SA4	2.3-3.1 m	17
PHC-F2 (C10-C16)	BH22-2 SA5	3.1-3.8 m	10

Parameter	Sample Name	Sample Depth	Concentration
PHC-F4 (C34-C50)	BH22-4 SA2	0.8-1.5 m	230
PHC-F4 Gravimetric	BH22-4 SA2	0.8-1.5 m	1400
PHC-F4 (C34-C50)	BH22-4 SA5	3.1-3.8 m	<50
PHC-F4 Gravimetric	BH22-4 SA5	3.1-3.8 m	-

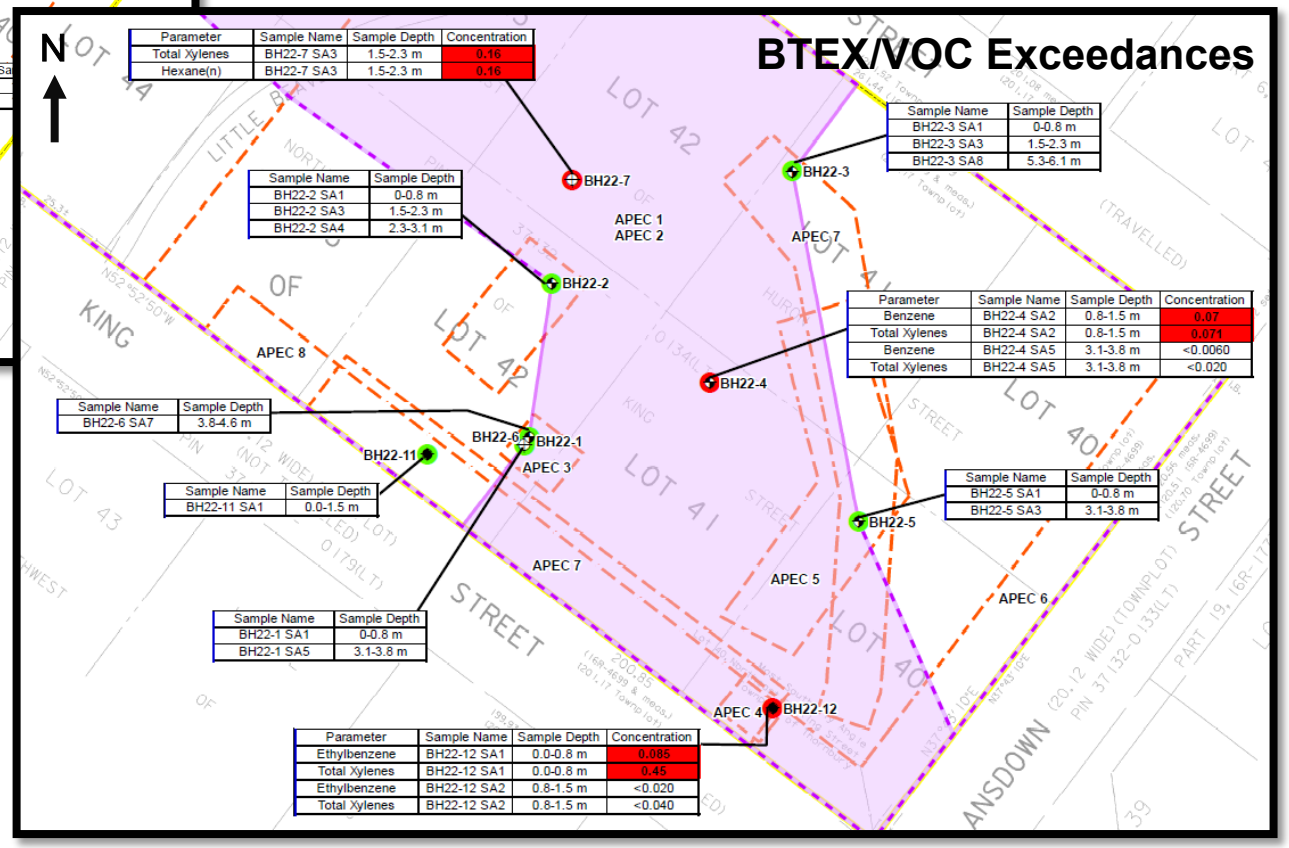
Parameter	Sample Name	Sample Depth	Concentration
PHC-F2 (C10-C16)	BH22-6 SA7	3.8-4.6 m	12
PHC-F4 (C34-C50)	BH22-6 SA7	3.8-4.6 m	150
PHC-F2 (C10-C16)	BH22-6 SA8	5.3-6.1 m	<10
PHC-F4 (C34-C50)	BH22-6 SA8	5.3-6.1 m	<50

Parameter	Sample Name	Sample Depth	Concentration
PHC-F4 (C34-C50)	BH22-11 SA3	0.0-1.5 m	290
PHC-F4 Gravimetric	BH22-11 SA3	0.0-1.5 m	1300

Sample Name	Sample Depth
BH22-5 SA1	
BH22-5 SA3	

Parameter	Sample Name	Sample Depth	Concentration
PHC-F2 (C10-C16)	BH22-1 SA1	0-0.8 m	<10
PHC-F4 (C34-C50)	BH22-1 SA1	0-0.8 m	210
PHC-F4 Gravimetric	BH22-1 SA1	0-0.8 m	1100
PHC-F2 (C10-C16)	BH22-1 SA5	3.1-3.8 m	25
PHC-F4 (C34-C50)	BH22-1 SA5	3.1-3.8 m	<50
PHC-F4 Gravimetric	BH22-1 SA5	3.1-3.8 m	-

Sample Name	Sample Depth
BH22-12 SA1	0.0-0.8 m
BH22-12 SA2	0.8-1.5 m



Parameter	Sample Name	Sample Depth	Concentration
Total Xylenes	BH22-7 SA3	1.5-2.3 m	0.16
Hexane(n)	BH22-7 SA3	1.5-2.3 m	0.16

Sample Name	Sample Depth
BH22-3 SA1	0-0.8 m
BH22-3 SA3	1.5-2.3 m
BH22-3 SA8	5.3-6.1 m

Sample Name	Sample Depth
BH22-2 SA1	0-0.8 m
BH22-2 SA3	1.5-2.3 m
BH22-2 SA4	2.3-3.1 m

Parameter	Sample Name	Sample Depth	Concentration
Benzene	BH22-4 SA2	0.8-1.5 m	0.07
Total Xylenes	BH22-4 SA2	0.8-1.5 m	0.071
Benzene	BH22-4 SA5	3.1-3.8 m	<0.0060
Total Xylenes	BH22-4 SA5	3.1-3.8 m	<0.020

Sample Name	Sample Depth
BH22-6 SA7	3.8-4.6 m

Sample Name	Sample Depth
BH22-11 SA1	0.0-1.5 m

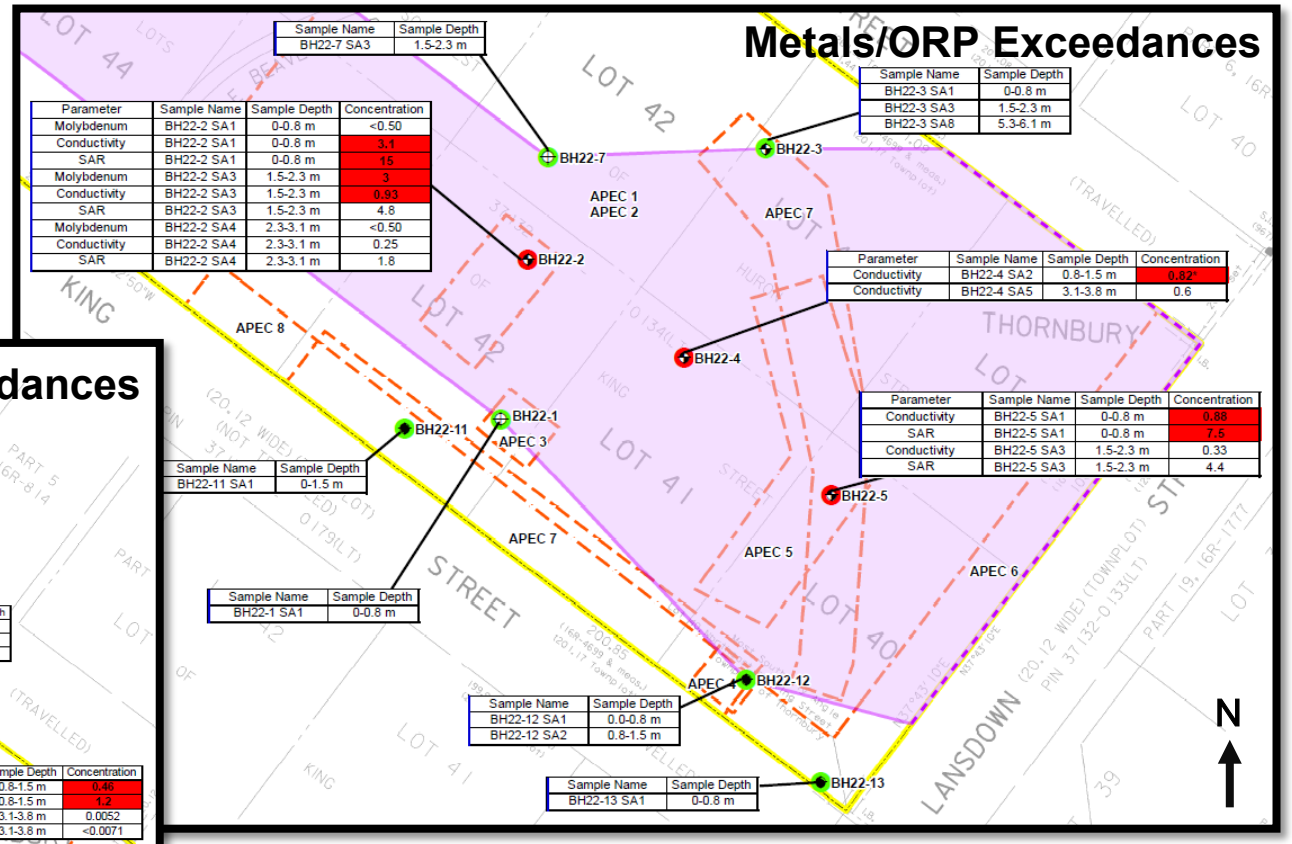
Sample Name	Sample Depth
BH22-5 SA1	0-0.8 m
BH22-5 SA3	3.1-3.8 m

Sample Name	Sample Depth
BH22-1 SA1	0-0.8 m
BH22-1 SA5	3.1-3.8 m

Parameter	Sample Name	Sample Depth	Concentration
Ethylbenzene	BH22-12 SA1	0.0-0.8 m	0.085
Total Xylenes	BH22-12 SA1	0.0-0.8 m	0.45
Ethylbenzene	BH22-12 SA2	0.8-1.5 m	<0.020
Total Xylenes	BH22-12 SA2	0.8-1.5 m	<0.040

Soil Results

Soil Results



Sample Name	Sample Depth
BH22-7 SA3	1.5-2.3 m

Parameter	Sample Name	Sample Depth	Concentration
Molybdenum	BH22-2 SA1	0-0.8 m	<0.50
Conductivity	BH22-2 SA1	0-0.8 m	3.1
SAR	BH22-2 SA1	0-0.8 m	15
Molybdenum	BH22-2 SA3	1.5-2.3 m	3
Conductivity	BH22-2 SA3	1.5-2.3 m	0.93
SAR	BH22-2 SA3	1.5-2.3 m	4.8
Molybdenum	BH22-2 SA4	2.3-3.1 m	<0.50
Conductivity	BH22-2 SA4	2.3-3.1 m	0.25
SAR	BH22-2 SA4	2.3-3.1 m	1.8

Sample Name	Sample Depth
BH22-3 SA1	0-0.8 m
BH22-3 SA3	1.5-2.3 m
BH22-3 SA8	5.3-6.1 m

Parameter	Sample Name	Sample Depth	Concentration
Conductivity	BH22-4 SA2	0.8-1.5 m	0.82
Conductivity	BH22-4 SA5	3.1-3.8 m	0.6

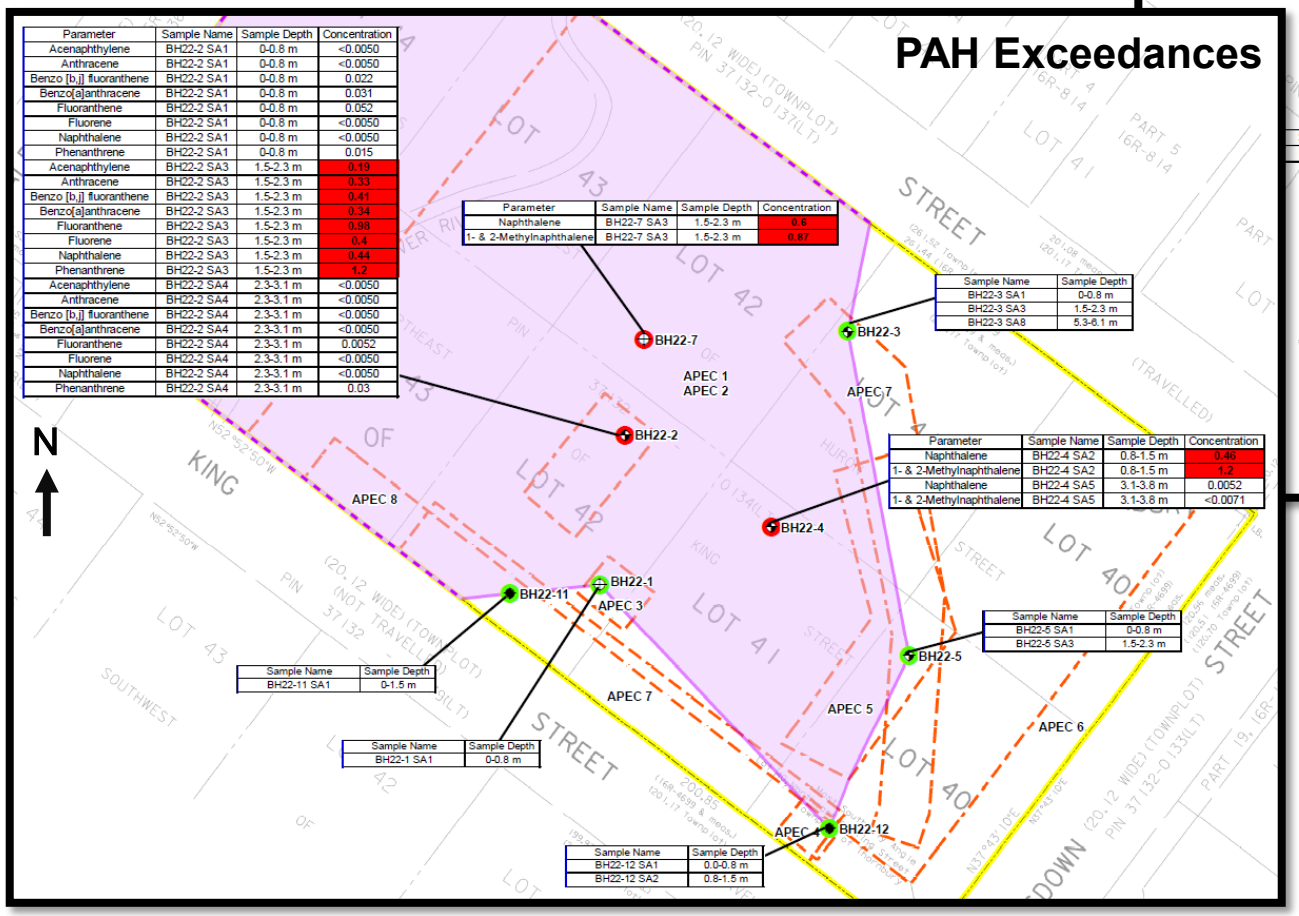
Parameter	Sample Name	Sample Depth	Concentration
Conductivity	BH22-5 SA1	0-0.8 m	0.88
SAR	BH22-5 SA1	0-0.8 m	7.5
Conductivity	BH22-5 SA3	1.5-2.3 m	0.33
SAR	BH22-5 SA3	1.5-2.3 m	4.4

Sample Name	Sample Depth
BH22-11 SA1	0-1.5 m

Sample Name	Sample Depth
BH22-1 SA1	0-0.8 m

Sample Name	Sample Depth
BH22-12 SA1	0.0-0.8 m
BH22-12 SA2	0.8-1.5 m

Sample Name	Sample Depth
BH22-13 SA1	0-0.8 m



Parameter	Sample Name	Sample Depth	Concentration
Acenaphthylene	BH22-2 SA1	0-0.8 m	<0.0050
Anthracene	BH22-2 SA1	0-0.8 m	<0.0050
Benzo [b,j] fluoranthene	BH22-2 SA1	0-0.8 m	0.022
Benzo[a]anthracene	BH22-2 SA1	0-0.8 m	0.031
Fluoranthene	BH22-2 SA1	0-0.8 m	0.052
Fluorene	BH22-2 SA1	0-0.8 m	<0.0050
Naphthalene	BH22-2 SA1	0-0.8 m	<0.0050
Phenanthrene	BH22-2 SA1	0-0.8 m	0.015
Acenaphthylene	BH22-2 SA3	1.5-2.3 m	0.19
Anthracene	BH22-2 SA3	1.5-2.3 m	0.33
Benzo [b,j] fluoranthene	BH22-2 SA3	1.5-2.3 m	0.41
Benzo[a]anthracene	BH22-2 SA3	1.5-2.3 m	0.34
Fluoranthene	BH22-2 SA3	1.5-2.3 m	0.98
Fluorene	BH22-2 SA3	1.5-2.3 m	0.4
Naphthalene	BH22-2 SA3	1.5-2.3 m	0.44
Phenanthrene	BH22-2 SA3	1.5-2.3 m	1.2
Acenaphthylene	BH22-2 SA4	2.3-3.1 m	<0.0050
Anthracene	BH22-2 SA4	2.3-3.1 m	<0.0050
Benzo [b,j] fluoranthene	BH22-2 SA4	2.3-3.1 m	<0.0050
Benzo[a]anthracene	BH22-2 SA4	2.3-3.1 m	<0.0050
Fluoranthene	BH22-2 SA4	2.3-3.1 m	0.0052
Fluorene	BH22-2 SA4	2.3-3.1 m	<0.0050
Naphthalene	BH22-2 SA4	2.3-3.1 m	<0.0050
Phenanthrene	BH22-2 SA4	2.3-3.1 m	0.03

Parameter	Sample Name	Sample Depth	Concentration
Naphthalene	BH22-7 SA3	1.5-2.3 m	0.6
1- & 2-Methylnaphthalene	BH22-7 SA3	1.5-2.3 m	0.87

Sample Name	Sample Depth
BH22-3 SA1	0-0.8 m
BH22-3 SA3	1.5-2.3 m
BH22-3 SA8	5.3-6.1 m

Parameter	Sample Name	Sample Depth	Concentration
Naphthalene	BH22-4 SA2	0.8-1.5 m	0.46
1- & 2-Methylnaphthalene	BH22-4 SA2	0.8-1.5 m	1.2
Naphthalene	BH22-4 SA5	3.1-3.8 m	0.0052
1- & 2-Methylnaphthalene	BH22-4 SA5	3.1-3.8 m	<0.0071

Sample Name	Sample Depth
BH22-5 SA1	0-0.8 m
BH22-5 SA3	1.5-2.3 m

Sample Name	Sample Depth
BH22-11 SA1	0-1.5 m

Sample Name	Sample Depth
BH22-1 SA1	0-0.8 m

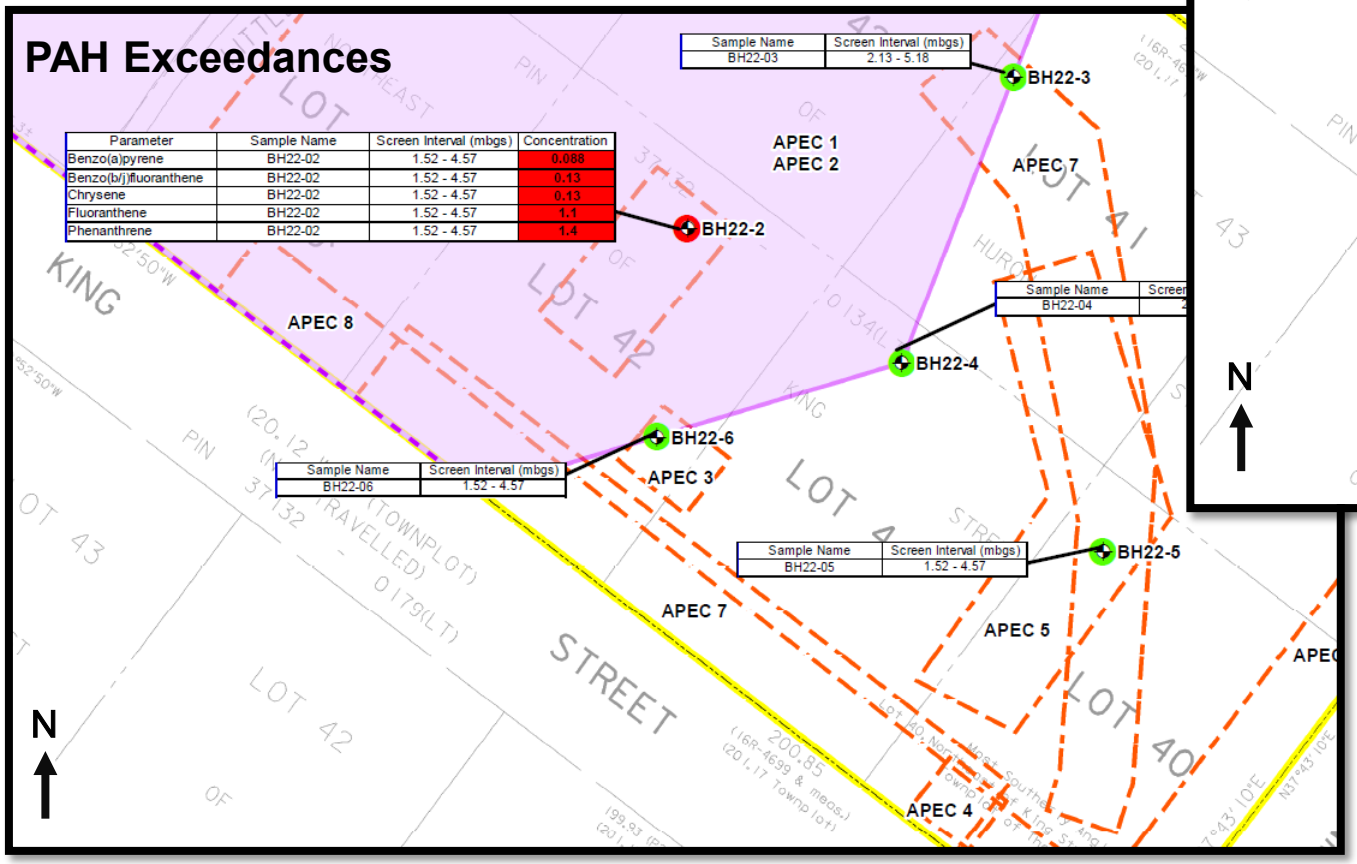
Sample Name	Sample Depth
BH22-12 SA1	0.0-0.8 m
BH22-12 SA2	0.8-1.5 m

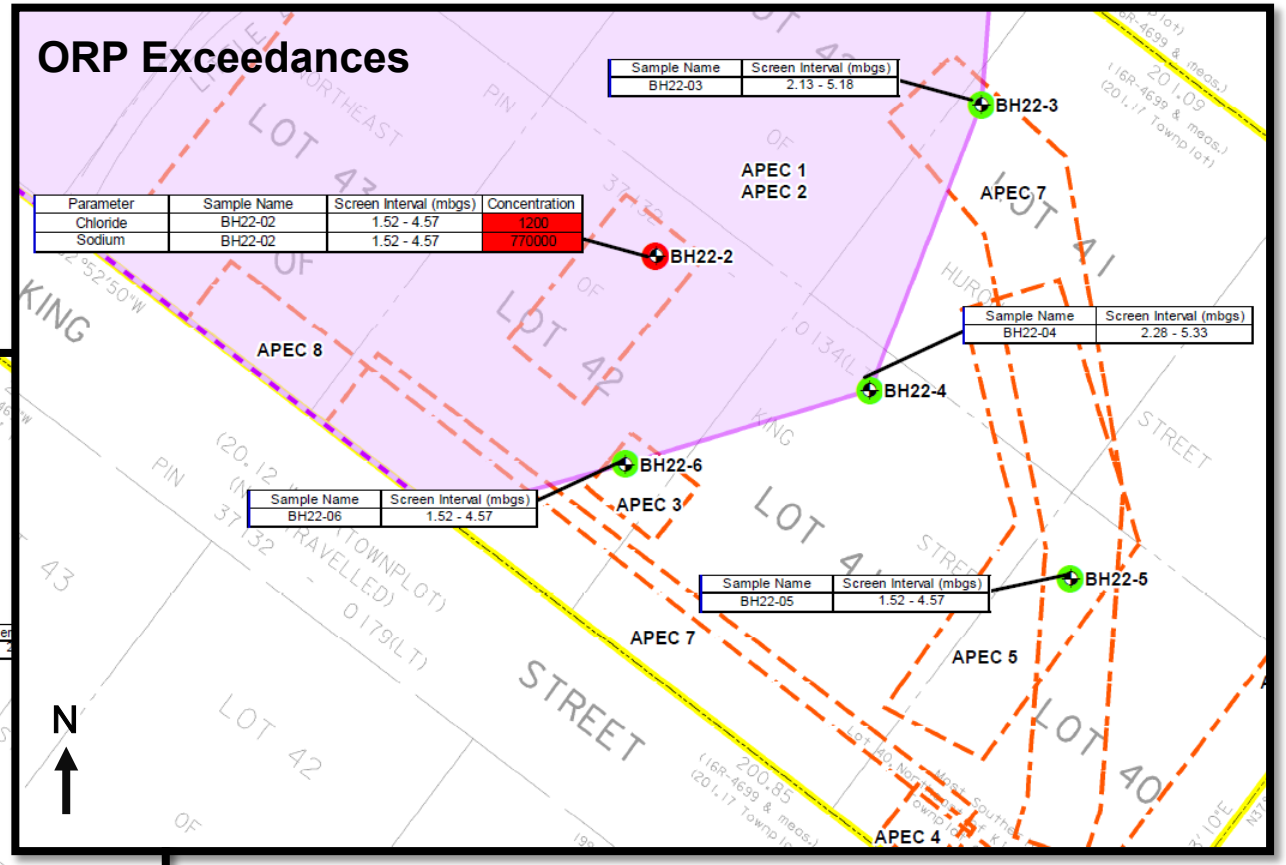
Groundwater Results

Parameter Group	Number of GW samples analysed	Number of GW samples with exceedances of Table 8 RPI and ICC SCS
PHC	5, plus 1 duplicate	0
VOC and BTEX	5, plus 1 duplicate	0
Metals/Hydride Forming Metals	5, plus 1 duplicate	0
ORP	5, plus 1 duplicate	1
PAH	5, plus 1 duplicate	1

Note: samples collected using low flow sampling technique

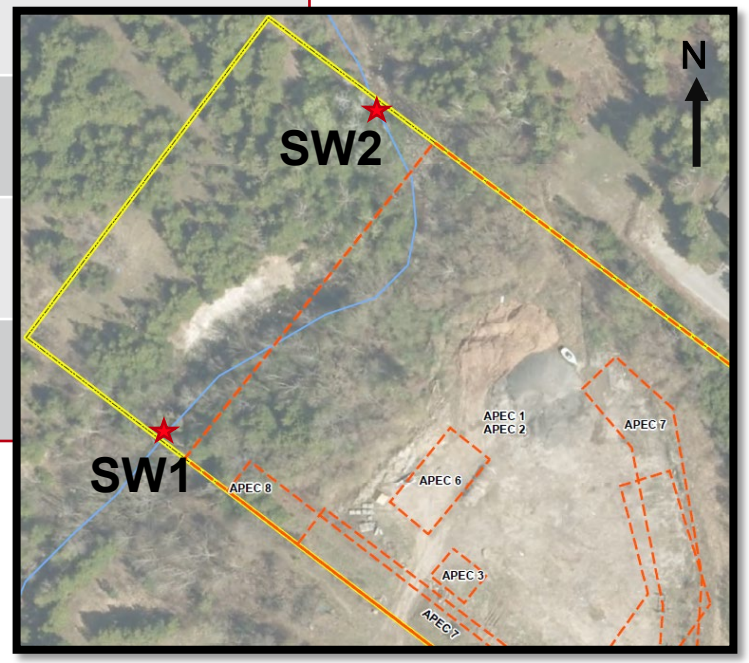
Groundwater Results





Surface Water Results

Parameter Group	Number of SW samples analysed	Number of SW samples with exceedances of PWQO/Table 8 RPI and ICC SCS
PHC	2, plus 1 duplicate	0
VOC and BTEX	2, plus 1 duplicate	0
Metals/Hydride Forming Metals	2, plus 1 duplicate	0
ORP	2, plus 1 duplicate	0
PAH	2, plus 1 duplicate	0



Landfill Gas Results

- Standard for landfill gas based on Lower Explosive Limit (LEL) of methane in air (5 %)
- Methane in soil can accumulate in enclosed spaces, open flame/spark may cause explosion
- Methane detected at 5 locations in March 2022, 3 locations in May 2022, 2 locations in September 2022
- Maximum concentration of 16.2% LEL (BH22-3)
- Readings greater than 5% LEL observed at BH22-3 (within waste), BH22-4 (within waste), BH22-5

There is potential for explosive gas on site; however, since there are no buildings and the landfill cap is coarse textured, there does not appear to be an immediate danger of landfill gas build up on site.

Additional landfill gas investigations at site boundaries required to assess potential off-site methane migration.

WSP Golder recommends no unshielded sparking devices, open flames or smoking on site. Use of a four-gas monitor is recommended during future construction activities if waste material is excavated.

1	Former use of site as landfill
2	Use of site for aggregate storage, fill placement, snow storage
3	Storage of several drums
4	Presence of pole-mounted transformer
5	Storage of boat cribs, boats and other non-deleterious materials
6	Storage and parking of snowploughs
7	Importation of fill material for berm construction
8	Former presence of orchards on surrounding properties

Conclusions

- Impacts noted:
  - APEC 1: Landfill gas impacts
  - APECs 1 and/or 2: PHC, BTEX, VOC, conductivity, SAR and PAH soil impacts
  - APECs 1 and/or 2: Sodium, chloride and PAH groundwater impacts
  - APEC 3: PHC soil impacts
  - APEC 6: PHC soil impacts
  - APEC 7: PHC and BTEX soil impacts
- No soil or groundwater impacts associated with APECs 4, 5 and 8
- Surface water impacts not observed at two sampling locations
- Risk assessment or remediation required prior to submission of Record of Site Condition (RSC) (if required)
- Additional delineation required prior to risk assessment or remediation

Recommendations/Next Steps – Waste Delineation and Groundwater

- Delineation of waste using test pitting
- Re-sample all monitoring wells using low flow sampling technique
- Installation of monitoring well at or near BH22-7 to assess groundwater quality based on measured soil exceedances
- Lateral and vertical delineation of soil impacts and groundwater impacts (if necessary)

Recommendations/Next Steps – Waste Area and Berm Assessment

- Based on waste area of 50 m by 50 m and thickness of 3 m, waste material may occupy a volume of 7,500 cubic m (cursory estimate, delineation of waste required to generate robust estimate)
- Based on berm area of 110 m by 10 m and height of 2-3 m, berm material may occupy a volume of 2,200 to 3,300 cubic m (cursory estimate, berms along King St W only)
- Soil samples from berms along King St W exceed Table 8 RPI and ICC SCS for on site use but meet Table 3.1 RPI and ICC ESQS for beneficial off-site reuse
- Delineation of soil impacts within berms may decrease volume to be removed from site
- No waste observed at soil sampling locations within berms

Recommendations/Next Steps - Continued

	Remediation	Risk Assessment	Sale of Property
Description, Pros/Cons	• Remove defined waste, soil berms, areas with soil exceedances • Transport waste to landfill • Berm soil material may be beneficially reused • Limited future groundwater monitoring (2 rounds, quarterly, minimum timeframe 6 months)	• Detailed delineation of impacts required (additional investigations) • Establishment of site-specific standards required in consideration of Little Beaver Creek and Intake Protection Zone 2 • On-going monitoring required (frequency and duration unknown)	• Sale of property in current state (as is) • No additional environmental work required if sold as is
Liability Considerations	• Known impacts would be removed from site	• Known impacts remaining on site would be risk mitigated	• Dependent on purchase of sale agreement • Requires legal opinion

Thank you

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