AEC 6

AEC 6: Former Fuel Aboveground Storage Tanks in Town Site

Area Description			
Location	Adjacent to 15 former residences located in town site.		
Topography	Generally flat with a slight slope to northeast.		
Surface Drainage	Northeast.		
Background	Town site residences were heated with oil furnaces. Fuel oil was stored in above ground storage tanks (ASTs) adjacent to each residence.		
Historical Assessment Information			
Previous Phase II Environmental Site Assessment Results (EBA, 2008)	Number of test pits	0	
	Number of surface soil samples	0	
	Number of soil samples analyzed	0	
	Number of soil samples with petroleum hydrocarbon impacts	0	
	Number of soil samples with metal impacts	0	
Comments: No prior assessment completed.			
2017/2018 Environmental Site Assessment Details			
Environmental Site Assessment Scope			
Utility Locate SOP followed?	Yes – de-energized power to this portion of Site during 2017 investigation.		
EM 31 Geophysics Complete?	N/A		
Number of test pits advanced	16 (2017), 4 (2018)		
Number of boreholes advanced	0		
Number of hand auger locations advanced	0		
Number of soil samples submitted for laboratory chemical analysis	17 (2017), 8 (2018)		
Number of boreholes completed as groundwater monitoring wells	0		
Number of historical groundwater monitoring wells	2 (down-gradient)		
Number of groundwater samples collected	2 (2017), 2 (2018)		
Number of sediment and surface soil samples collected	N/A		
Geophysics Findings			
N/A			
Soil Investigation and Conditions			
Maximum Depth of Investigation	2.0 mbgs (September 18, 2017)		
General Stratigraphy			
Description	**Depth from (mbgs)**	**Depth to (mbgs)**	**Observations**
SAND, silty, trace gravel to gravelly (Fill)	0	2.0	Fill soil with organics. Concrete slab or wood planks sometimes observed at surface.
Combustible Vapour Concentrations (CVC)			
Ranged from less than 10 parts per million by volume (ppmv) to 311 ppmv in soil sample 17A6TP16-1.			
Groundwater Conditions			
Depth to Groundwater	About 10-15 mbgs; inferred from groundwater contours developed for Site.		
Free Product	None observed in two down-gradient monitoring wells.		

AEC 6: Former Fuel Aboveground Storage Tanks in Town Site

2017/2018 Environmental Site Assessment Results Summary

- Figure A6-1 shows test pit locations.
- Figure A6-2 shows groundwater monitoring well locations and groundwater elevations.
- Table A6-1 summarizes soil lab results relative to guidelines and management limits.
- Table A6-2 summarizes groundwater lab results relative to guidelines.

General Site Observations

- Former AST locations based on concrete AST pads, brackets, and/or fuel lines.
- Soil excavated during test pitting did not exhibit obvious signs of environmental impact (e.g., staining or odour), with exception of test pit 17A6TP16 which had an elevated CVC reading.
- Wood planks observed at or near surface (presumably used in past as a foundation for ASTs).

Soil: Petroleum Hydrocarbons (PHCs, PAHs)

2017

- Laboratory results all *greater* than guidelines, with exception of following samples which all contained PHC and PAH less than the CCME/CSR guidelines:
- Sample 17A6TP1-1 at a depth of 1.5 mbgs
- Sample 17A6TP7-1 at a depth of 0.4 mbgs
- Sample 17A6TP11-1 at a depth of 0.35 mbgs
- Sample 17A6TP13-1 at a depth of 0.30 mbgs
- Sample 17A6TP15-1 at a depth of 0.4 mbgs
- Concentrations of PHCs were less than the management limits except for the PHC F2 concentration at sample 17A6TP16at a depth of 0.40 mbgs

2018

- Test pits 18A6TP17 to 18A6TP20 were excavated at 3 m to 10 m step-out distances from 17A6TP16 to delineate the PHC management limit exceedance found at 0.4 mbgs. Laboratory results from the two soil samples tested for PHCs F2-F4 at each of the four test pit locations were less than the management limits.

Soil: Metals

- One sample from 17A6TP16 at 2.0 mbgs submitted for metals analysis.
- The following metals exceeded guidelines: arsenic, barium, copper, molybdenum, and selenium.
- No exceedances of preliminary background concentrations.

Soil: Routine (pH)

Laboratory results less than guidelines.

Soil: Other PCOCs

N/A

Groundwater: Petroleum Hydrocarbons

2017

- Laboratory results for PHCs and PAHs were less than guidelines.
- Tetra Tech also reviewed results from NATC database for Well 4-27-19, which is located down-gradient of north side of town site. There were two results from 2015; PHCs tested were below detection limits and guidelines.

2018

- Laboratory results for PHCs and PAHs were less than detection limits and guidelines.
- No samples were collected from 4-27-19 as a part of the SNP program in 2018.

Groundwater: Metals/Routine Parameters

2017

- Laboratory chemical results less than guidelines with exception of:
- Dissolved fluoride concentration at 17Duplicate3 (GH12-I) was equal to guidelines; but below preliminary background concentration.
- Dissolved sulphate concentration at GH12-J (and duplicate) greater than guidelines; however below preliminary background concentration.
- Dissolved cadmium concentrations in both monitoring wells greater than guidelines, and also above preliminary background concentrations.

AEC 6: Former Fuel Aboveground Storage Tanks in Town Site

- Dissolved selenium concentration at GH12-J greater than guidelines.

2018

- Laboratory chemical results less than guidelines with exception of:
  - Sulphate concentration at GH12-J exceeded guideline, but was below preliminary background concentrations.
  - Cadmium exceeded preliminary background concentrations at GH12-J.
  - Copper and iron exceeded guidelines at GH12-I, but were below preliminary background concentrations.
  - Selenium exceeded guidelines at GH12-J, but was below preliminary background concentrations.

Groundwater: Other PCOCs

N/A

Sediment: Petroleum Hydrocarbons

N/A

Sediment: Metals

N/A

Sediment: Other PCOCs

N/A

Surface Water: Petroleum Hydrocarbons

N/A

Surface Water: Metals/Nutrients

N/A

Surface Water: Other PCOCs

N/A

Grainsize Analysis

Soil sample 17A6TP16-3 at a depth of 4.0 mbgs classified as coarse-grained (75% >75 µm).

Environmental Concerns

Location in AEC	Potential Source(s)	Identified Contaminated Media	Parameters Assessed and Contaminant(s) of Concern (COCs; bold & underline)
Adjacent to each former residence	Fuel oil AST	Soil; groundwater	**Soil: <u>Petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs)</u>** **Groundwater: <u>Metals and Nutrients,</u>** PHCs, PAHs

Discussion (Significance of Results)

<u>Soils:</u>

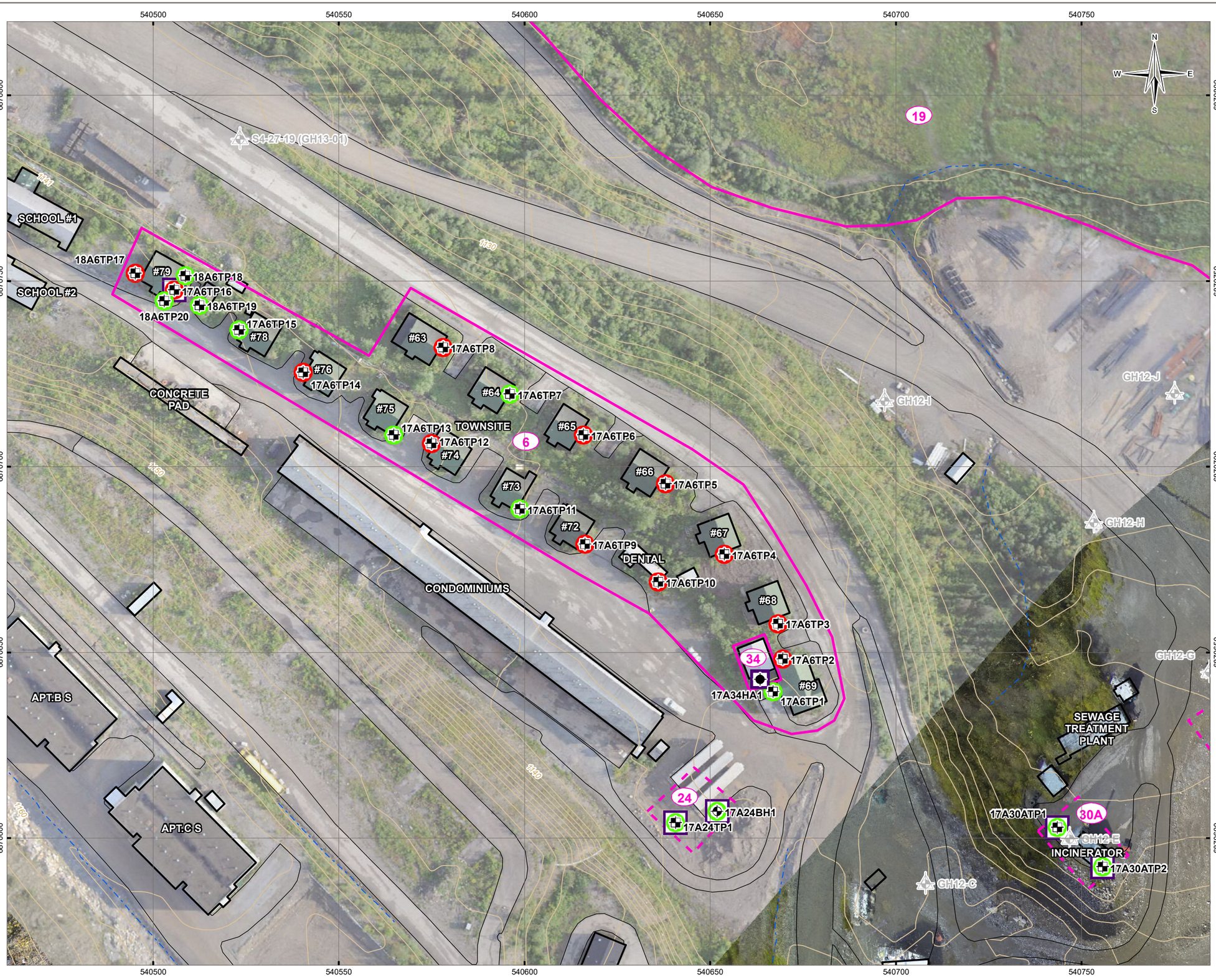
- Soils were assessed at the Phase II/III ESA level.
- PHC/PAH impacts were detected at concentrations greater than the CCME/CSR guidelines in 12 of 20 test pits advanced. Soil exceeding the CCME/CSR guidelines has not been vertically or horizontally delineated. Soil found to exceed the PHC management limits at 17A6TP16 has been horizontally delineated. Based on current assessment results, the estimated depth of PHC impacts greater than the management limits used to calculate the contaminated soil volume is 1.0 mbgs.
- Unclear whether impacts related to historical fuel storage or wood planks at site, as similar COPCs can be attributed to fuel and wood treatment.
- In most locations, it is unlikely that impacts have migrated significantly based on absence of obvious signs of environmental impact.

<u>Groundwater:</u>

- GH12-I and GH12-J monitoring wells are located down-gradient from AEC 6.
- Metals and routine parameters with exceedances of regulatory guidelines include: sulphate, cadmium, copper, and selenium.
- PHCs were detected at GH12-I in 2017 but not in 2018, however concentrations were all less than guidelines.
- PAHs were less than laboratory reportable detection limits and/or guidelines, and are no longer PCOCs in groundwater at this AEC.

AEC 6: Former Fuel Aboveground Storage Tanks in Town Site

Attachments
Figure A6-1 – Soil Results
Figure A6-2 – Groundwater Results
Table A6-1 – Soil Analytical Results
Table A6-2 – Groundwater Analytical Results
Test pit Logs
Photographs

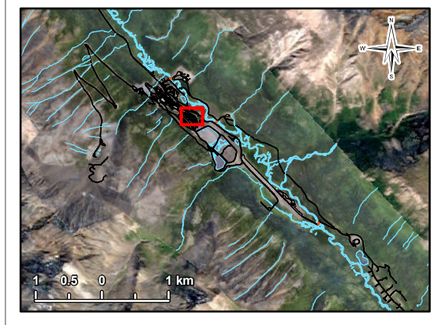


LEGEND

- Area of Environmental Concern (AEC)
- Area
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- Historical Monitoring Well

Soil/Sediment Analytical Results

- PHC Impacts
- No PHC Impact
- Metals exceedance of preliminary background concentrations, or in the absence of background concentrations, exceedance of CCME guidelines
- Building
- Road
- Ditch
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE
PHASE III ESA

AEC 6
Former Fuel Oil ASTs in Townsite
Soil and Sediment Results

PROJECTION UTM Zone 9		**DATUM** NAD83		**CLIENT** NORTH AMERICAN TUNGSTEN CORPORATION LTD
Scale: 1:1,000 — 20 10 0 20 — Metres				TETRA TECH
FILE NO. WENW03039-03_Summary_A6-1.mxd				
OFFICE Tt-VANC	**DWN** SL	**CKD** BB	**APVD** BB	**REV** 0
DATE June 22, 2020	**PROJECT NO.** ENW.WENW03039-03			**A6-1**

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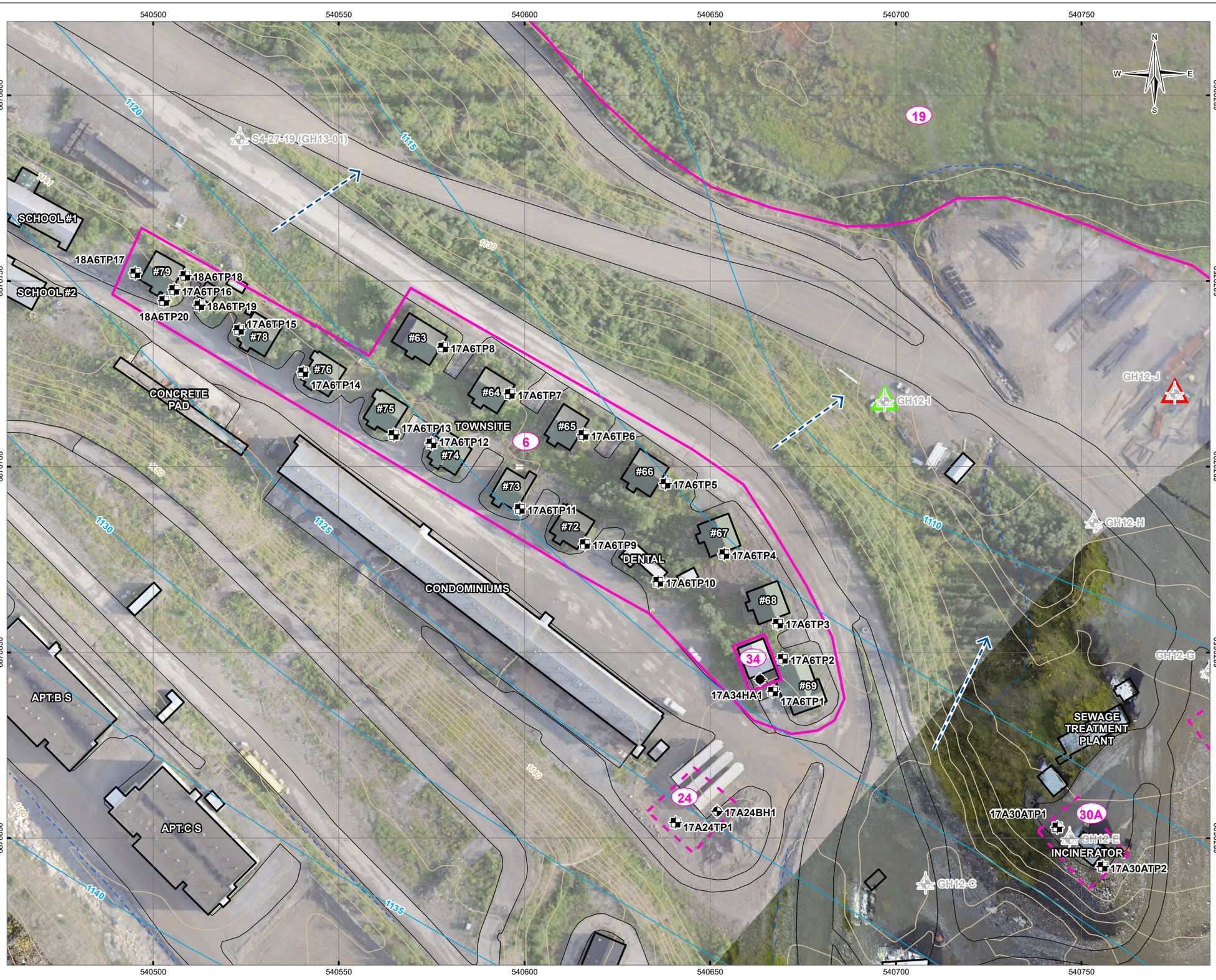


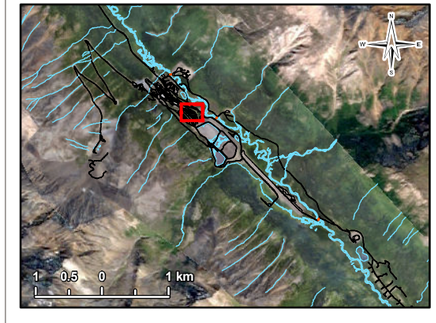
LEGEND

- Area of Environmental Concern (AEC)
- Area
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- Historical Monitoring Well
- Inferred Groundwater Flow Direction
- Groundwater Contour (5 m asl; Fall 2017)

2017/2018 Groundwater Analytical Results

- Samples contain parameters that exceeded the preliminary background concentrations, or in the absence of background concentrations, FIGWQG
- Samples contain parameters that met the preliminary background concentrations, or in the absence of background concentrations, FIGWQG
- Building
- Road
- Ditch
- Contour (2 m)

FIGWQG	Federal Interim Groundwater Quality Guidelines
CCME	Canadian Council of Ministers of the Environment
WQG	Water Quality Guidelines
AW	Freshwater Aquatic Life
EQGASW	Environmental Quality Guidelines for Alberta Surface Waters



NOTES
All locations and area boundaries are approximate.
Base data source:
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Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE
PHASE III ESA

AEC 6
Former Fuel Oil ASTs in Townsite
Groundwater and Surface Water Results

PROJECTION: UTM Zone 9		DATUM: NAD83			CLIENT: NORTH AMERICAN TUNGSTEN CORPORATION LTD
Scale: 1:1,000 (20 10 0 20 Metres)					TETRA TECH
FILE NO.: WENW03039-03_Summary_A6-2.mxd					
OFFICE: Tt-VANC	DWN: SL	CKD: BB	APVD: SS	REV: 0	A6-2
DATE: June 22, 2020	PROJECT NO.: ENW.WENW03039-03				

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Table A6-1: Soil Analytical Results

					AEC	AEC 6																						
					Location	TP1	TP2	TP3	TP4	TP5	TP6	TP7	TP8	TP9	TP10	TP11	TP12	TP13	TP14	TP15	TP16		TP17-2	TP17-3	TP18-2	TP18-3	TP19-2	TP19-3	TP20-2	BTP20-2	TP20-3
					Sample Depth	1.5 m	0.3 m	0.4 m	0.5 m	0.6 m	0.6 m	0.40 m	0.45 m	0.40 m	0.35 m	0.30 m	0.30 m	0.30 m	0.40 m	0.40 m	0.40 m	0.40 m	2.0 m	0.5 m	1 m	0.5 m	1 m	0.5 m	1 m	0.5 m	0.5 m	1 m
					Field ID	17A6TP1-1	17A6TP2-1	17A6TP3-1	17A6TP4-1	17A6TP5-1	17A6TP6-1	17A6TP7-1	17A6TP8-1	17A6TP9-1	17A6TP10-1	17A6TP11-1	17A6TP12-1	17A6TP13-1	17A6TP14-1	17A6TP15-1	17A6TP16-1	17A6TP16-3	18A6TP17-2	18A6TP17-3	18A6TP18-2	18A6TP18-3	18A6TP19-2	18A6TP19-3	18A6TP20-2	18A6BTP20-2	18A6TP20-3
					Sample Date	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	18-Sep-2017	21-Sep-2017	26-Jun-2018	26-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun-2018	27-Jun-2018
					Laboratory Report Number	8740248	8740253	8740256	8740258	8740260	8740263	8740267	8740268	8740270	8740271	8740272	8740275	8740277	8740289	8740294	8740299	8757643	18Y357306	18Y357306	18Y357306	18Y357306	18Y357306	18Y357306	18Y357306	18Y357306	18Y357306
					Laboratory Sample ID	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y262746	17Y264579	9372322	9372323	9372325	9372326	9372328	9372329	9372331	9372332	9372333
Parameter	**Unit**	**CCME[1,2] and NWT CSR[3]**	**Background Concentration[4]**	**Management Limits[5]**																										
Physical Parameters																														
pH	pH Units	6-8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	7.59	-	-	-	-	-	-	-	-	-
Moisture	%	-	-	-	10.3	15.8	10.4	15	13.3	24.8	14.4	20.8	7.6	7.4	8.1	7.3	8.1	8.9	9	19.5	11.5	8.2	29.3	8.9	7.9	8.7	5.2	11.2	7.5	4.8
Metals																														
Antimony	mg/kg	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.7	-	-	-	-	-	-	-	-	-
Arsenic	mg/kg	12	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**30.8**	-	-	-	-	-	-	-	-	-
Barium	mg/kg	500	946	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**739**	-	-	-	-	-	-	-	-	-
Beryllium	mg/kg	4	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.3	-	-	-	-	-	-	-	-	-
Cadmium	mg/kg	1.4	2.8	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	1.4	-	-	-	-	-	-	-	-	-
Chromium	mg/kg	64	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	38	-	-	-	-	-	-	-	-	-
Cobalt	mg/kg	40	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	15.5	-	-	-	-	-	-	-	-	-
Copper	mg/kg	63	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**126**	-	-	-	-	-	-	-	-	-
Lead	mg/kg	70	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	28	-	-	-	-	-	-	-	-	-
Mercury	mg/kg	6.6	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.24	-	-	-	-	-	-	-	-	-
Molybdenum	mg/kg	5	10	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**5.6**	-	-	-	-	-	-	-	-	-
Nickel	mg/kg	45	72	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	42.5	-	-	-	-	-	-	-	-	-
Selenium	mg/kg	1	1.7	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	**1.2**	-	-	-	-	-	-	-	-	-
Silver	mg/kg	20	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	<0.5	-	-	-	-	-	-	-	-	-
Thallium	mg/kg	1	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	0.6	-	-	-	-	-	-	-	-	-
Tin	mg/kg	5	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2.1	-	-	-	-	-	-	-	-	-
Uranium	mg/kg	23	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	3.2	-	-	-	-	-	-	-	-	-
Vanadium	mg/kg	130	160	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	119	-	-	-	-	-	-	-	-	-
Zinc	mg/kg	200	462	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	149	-	-	-	-	-	-	-	-	-
Particle Size																														
>75 µm	%	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	75	-	-	-	-	-	-	-	-	-
Grain Size	N/A	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	Coarse	-	-	-	-	-	-	-	-	-
Petroleum Hydrocarbons																														
Benzene	mg/kg	0.03	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-
Toluene	mg/kg	0.1	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	**0.18**	<0.05	0.07	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Ethylbenzene	mg/kg	0.082	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-
Xylene (m)	mg/kg	-	-	-	<0.02	0.02	0.02	<0.02	0.03	0.07	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	0.03	0.08	<0.02	0.03	<0.02	-	-	-	-	-	-	-	-	-
Xylene (o)	mg/kg	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	0.02	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-	-	-
Xylenes Total	mg/kg	0.1	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.09	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	0.08	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
F1 (C_6-C_{10})	mg/kg	30	-	-	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-	-	-
F1 (C_6-C_{10}) - BTEX	mg/kg	30	-	700	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-	-	-
F2 (C_{10}-C_{16})	mg/kg	150	-	1000	<20	**263**	**342**	**188**	104	47	88	**188**	<20	**930**	<20	<20	46	**668**	<20	**1090**	**227**	<20	**395**	<20	<20	<20	<20	<20	<20	<20
F3 (C_{16}-C_{34})	mg/kg	300	-	2500	<20	**421**	**396**	277	188	212	185	**538**	34	**442**	<20	70	65	152	<20	**716**	144	<20	**986**	<20	<20	<20	<20	36	<20	<20
F4 (C_{34}-C_{50})	mg/kg	2800	-	10,000	<20	<20	<20	<20	<20	<20	<20	<20	22	32	<20	39	<20	<20	<20	75	44	70	94	60	58	60	58	76	61	66
Polycyclic Aromatic Hydrocarbons (PAHs)																														
B(a)P Total Potency Equivalent	mg/kg	0.6	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
IACR (CCME)	mg/kg	1	-	-	<0.6	0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	-	-	-	-	-	-	-	-	-
Acenaphthene	mg/kg	-	-	-	<0.005	<0.05	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	-	-	-	<0.005	<0.05	<0.005	<0.05	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-
Anthracene	mg/kg	2.5	-	-	<0.004	<0.04	<0.004	<0.04	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.04	<0.004	<0.004	-	-	-	-	-	-	-	-	-
Benz(a)anthracene	mg/kg	0.1	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	-	-	-	-	-	-	-	-
Benzo(a) pyrene	mg/kg	0.1	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	-	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.1	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Benzo(b+j)fluoranthene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Benzo(j)fluoranthene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.1	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Chrysene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.1	-	-	<0.005	0.011	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-	-	-
Fluoranthene	mg/kg	50	-	-	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-	-	-
Fluorene	mg/kg	-	-	-	<0.02	<0.2	<0.02	<0.2	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.2	<0.02	<0.02	-	-	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	-	-	<0.02	0.03	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-	-	-
1-Methylnaphthalene	mg/kg	-	-	-	<0.005	<0.05	<0.005	0.12	0.045	0.026	<0.005	<0.005	<0.005	0.014	<0.005	<0.005	<0.005	0.029	0.13	<0.005	<0.005	-	-	-	-	-	-	-	-	-
2-Methylnaphthalene	mg/kg	-	-	-	<0.005	0.07	<0.005	0.22	0.147	0.062	<0.005	<0.005	<0.005	0.031	<0.005	<0.005	<0.005	0.075	0.36	0.013	<0.005	-	-	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.013	-	-	<0.005	*<0.05*	**0.078**	**0.08**	**0.053**	**0.024**	<0.005	<0.005	<0.005	**0.015**	<0.005	<0.005	<0.005	**0.028**	**0.09**	<0.005	<0.005	-	-	-	-	-	-	-	-	-
Phenanthrene	mg/kg	0.046	-	-	<0.02	*<0.2*	0.03	**0.4**	0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	*<0.2*	<0.02	<0.02	-	-	-	-	-	-	-	-	-
Pyrene	mg/kg	0.1	-	-	<0.01	0.02	0.02	<0.01	<0.01	<0.01	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	0.01	-	-	-	-	-	-	-	-	-	-

Notes:

[1] Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in Soil (CCME 2008), for coarse textured soils under Agricultural and Residential/Parkland soils

[2] Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999), for coarse textured soils under Agricultural and Residential/Parkland soils

[3] Northwest Territories Environmental Guideline for Contaminated Site Remediation (NWT CSR 2003), for coarse textured soils under Agricultural and Residential/Parkland land use

[4] Preliminary Background Concentration

[5] Canadian Council of Ministers of the Environment (CCME) (2008). Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil Technical Supplement, for coarse textured soil under Agricultural land use, management limit pathway only

BOLD - Exceeds most stringent CCME or NWT CSR standard/guideline

Red - Exceeds Preliminary Background Concentration

Shaded - Exceeds Management Limits

Italic - Laboratory detection limit is greater than one or more referenced guidelines

"-" Not analyzed or no applicable standard/guideline

Table A6-2: Groundwater Analtyical Results

				AEC	AEC 6							
				Location	GH12-I				GH12-J			
				Field ID	GH12-I	17DUPLICATE3	GH12-I	DUP3	GH12-J	17DUPLICATE2	GH12-J	
				Sample Date	4-Oct-2017	4-Oct-2017	30-Jun-2018	30-Jun-2018	3-Oct-2017	3-Oct-2017	30-Jun-2018	
				Laboratory Report Number	17V270219	17V270219	18Y358442	18Y358442	17Y268688	17Y268688	18Y358442	
				Laboratory Sample ID	8804763	8804787	9378822	9378840	8791184	8791170	9378823	
Parameter	**Unit**	**Federal Interim Guideline[1]**		**Preliminary Background Concentrations**								
		Agricultural	**Res / Park**									
Field Parameters												
Field Temperature	^{0}C	-	-	-	-	-	2.6	-	-	-	2.5	
Field pH	pH Units	6.5-9	6.5-9	-	-	-	7.37	-	-	-	7.26	
Field Conductivity	µS/cm	-	-	-	-	-	318.1	-	-	-	468.7	
Routine												
pH	pH Units	6.5-9	6.5-9	-	7.81	7.8	6.97	7.34	7.67	7.74	7.27	
Electrical Conductivity (EC)	µS/cm	-	-	-	394	391	346	387	501	499	507	
Total Dissolved Solids (TDS)	mg/L	3000	-	-	238	242	180	205	320	332	242	
Hardness as $CaCO_3$	mg/L	-	-	-	197	198	172	178	257	264	271	
Alkalinity (total as $CaCO_3$)	mg/L	-	-	-	122	119	120	122	166	165	166	
Bromide	mg/L	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	
Chloride	mg/L	100	120	-	0.91	0.89	0.83	0.78	1.42	1.42	1.73	
Fluoride	mg/L	0.12	0.12	0.39	0.11	0.12	0.11	0.12	0.04	0.04	0.04	
Sulphate	mg/L	100	100	182	89.7	89.8	64.1	61.1	**102**	**102**	**105**	
Nutrients												
Ammonia	mg/L	0.021-231 [2]	0.021-231 [2]	-	-	-	<0.01	<0.01	-	-	<0.01	
Nitrate (as NO_3-N)	mg/L	13	13	-	0.16	0.156	0.1	0.108	0.405	0.417	0.331	
Nitrite (as NO_2-N)	mg/L	0.06	0.06	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	
Nitrogen (Total)	mg/L	-	-	-	-	-	0.1	0.12	-	-	0.35	
Dissolved Metals												
Aluminum	mg/L	0.005 / 0.1 [3]	0.005 / 0.1 [3]	-	<0.002	<0.002	<0.002	<0.002	0.003	0.005	<0.002	
Antimony	mg/L	2	2	-	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	<0.0002	
Arsenic	mg/L	0.005	0.005	-	0.0002	0.0002	0.0002	0.0002	0.0001	0.0001	0.0001	
Barium	mg/L	0.5	0.5	-	0.0368	0.0381	0.034	0.0324	0.113	0.115	0.11	
Beryllium	mg/L	0.0053	0.0053	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	
Boron	mg/L	0.5	1.5	-	0.006	0.006	<0.002	0.005	0.008	0.007	0.004	
Cadmium	mg/L	0.00012	0.00012	0.000047	0.00004	0.00005	0.00004	0.00004	**0.00032**	**0.0003**	**0.00029**	
Calcium	mg/L	-	-	-	60.6	61.1	52.9	54.7	76.2	78	80.7	
Chromium	mg/L	0.0089	0.0089	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Cobalt	mg/L	0.05	-	-	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	<0.00005	
Copper	mg/L	0.002	0.002	-	0.0005	0.0005	**0.003**	0.0006	0.0005	0.0006	0.0002	
Iron	mg/L	0.3	0.3	-	<0.01	<0.01	**0.321**	<0.01	0.02	0.012	0.115	
Lead	mg/L	0.001-0.002 [4]	0.001-0.002 [4]	-	<0.00005	<0.00005	0.00011	<0.00005	<0.00005	<0.00005	<0.00005	
Lithium	mg/L	-	-	-	0.01	0.01	0.0095	0.0103	0.0068	0.0062	0.0066	
Magnesium	mg/L	-	-	-	11	11	9.73	10.1	16.2	16.7	16.8	
Manganese	mg/L	0.2	-	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Mercury	mg/L	0.000016	0.000016	-	**0.00002**	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	
Molybdenum	mg/L	0.073	0.073	-	0.00174	0.00188	0.00189	0.00183	0.00118	0.0012	0.00122	
Nickel	mg/L	0.025-0.083 [4]	0.025-0.083 [4]	-	0.0003	0.0003	0.0002	0.0002	0.0006	0.0006	0.0006	
Potassium	mg/L	-	-	-	0.696	0.677	0.632	0.676	0.893	0.871	0.886	
Selenium	mg/L	0.001	0.001	-	<0.0005	0.0006	<0.0005	0.0005	**0.0016**	**0.0016**	**0.0021**	
Silver	mg/L	0.00025	0.00025	-	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	<0.00002	
Sodium	mg/L	-	-	-	1.21	1.2	1.06	1.13	1.67	1.63	1.4	
Strontium	mg/L	-	-	-	-	-	0.0852	0.0792	-	-	0.0921	
Thallium	mg/L	0.0008	0.0008	-	<0.00001	<0.00001	<0.00001	<0.00001	<0.00001	0.00002	<0.00001	
Tin	mg/L	-	-	-	-	-	<0.00005	<0.00005	-	-	<0.00005	
Titanium	mg/L	0.1	0.1	-	0.0005	0.0006	0.0009	0.0009	<0.0005	<0.0005	0.001	
Tungsten	mg/L	-	-	-	-	-	0.00024	0.00029	-	-	0.00002	
Uranium	mg/L	0.01	0.015	-	0.00595	0.00592	0.00571	0.00624	0.00338	0.00346	0.00348	
Vanadium	mg/L	0.1		-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Zinc	mg/L	0.01	0.01	-	0.002	<0.002	0.004	<0.002	0.003	0.003	0.004	

Notes:

[1] Environment Canada (June 2016). Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites, for fine and coarse textured soil under Agricultural and Residential/Parkland land use

[2] Guideline varies with pH and temperature

[3] Guideline varies with pH

[4] Guideline varies hardness

"-" No applicable guideline or not analyzed

BOLD - Greater than Guideline

RED - Greater than Preliminary Background Concentration

TETRA TECH

Table A6-2: Groundwater Analtyical Results

				AEC	AEC 6							
				Location	GH12-I				GH12-J			
				Field ID	GH12-I	17DUPLICATE3	GH12-I	DUP3	GH12-J	17DUPLICATE2	GH12-J	
				Sample Date	4-Oct-2017	4-Oct-2017	30-Jun-2018	30-Jun-2018	3-Oct-2017	3-Oct-2017	30-Jun-2018	
				Laboratory Report Number	17V270219	17V270219	18Y358442	18Y358442	17Y268688	17Y268688	18Y358442	
				Laboratory Sample ID	8804763	8804787	9378822	9378840	8791184	8791170	9378823	
Parameter	**Unit**	**Federal Interim Guideline[1]**		**Preliminary Background Concentrations**								
		Agricultural	**Res / Park**									
Hydrocarbons												
Benzene	mg/L	0.088	0.14	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Toluene	mg/L	0.083	0.083	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Ethylbenzene	mg/L	3.2	11	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Xylene (m)	mg/L	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Xylene (o)	mg/L	-	-	-	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	<0.0005	
Xylenes Total	mg/L	3.9	3.9	-	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	<0.001	
Styrene	mg/L	0.072	0.072	-	-	-	-	-	-	-	-	
F1 (C_6-C_{10})	mg/L	-	-	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
F1 (C_6-C_{10}) - BTEX	mg/L	0.81	0.81	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
F2 (C_{10}-C_{16})	mg/L	1.3	1.3	-	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
F3 (C_{16}-C_{34})	mg/L	-	-	-	0.16	0.29	<0.1	<0.1	<0.1	<0.1	<0.1	
F4 (C_{34}-C_{50})	mg/L	-	-	-	<0.1	0.19	<0.1	<0.1	<0.1	<0.1	<0.1	
Polycyclic Aromatic Hydrocarbons (PAHs)												
Acenaphthene	mg/L	0.0058	0.0058	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-	
Acenaphthylene	mg/L	0.046	0.046	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-	
Acridine	mg/L	0.00005	0.00005	-	<0.00005	<0.00005	-	-	<0.00005	<0.00005	-	
Anthracene	mg/L	0.000012	0.000012	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benz(a)anthracene	mg/L	0.000018	0.000018	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benzo(a) pyrene	mg/L	0.00001	0.00001	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benzo(b)fluoranthene	mg/L	-	-	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benzo(b+j)fluoranthene	mg/L	0.00048	0.00048	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benzo(g,h,i)perylene	mg/L	0.00017	0.00017	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benzo(j)fluoranthene	mg/L	-	-	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Benzo(k)fluoranthene	mg/L	0.00048	0.00048	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Chrysene	mg/L	0.0001	0.0001	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Dibenz(a,h)anthracene	mg/L	0.00026	0.00026	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Fluoranthene	mg/L	0.00004	0.00004	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-	
Fluorene	mg/L	0.003	0.003	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-	
Indeno(1,2,3-c,d)pyrene	mg/L	0.00021	0.00021	-	<0.00001	<0.00001	-	-	<0.00001	<0.00001	-	
Naphthalene	mg/L	0.0011	0.0011	-	<0.00005	<0.00005	-	-	<0.00005	<0.00005	-	
Phenanthrene	mg/L	0.0004	0.0004	-	<0.00004	<0.00004	-	-	<0.00004	<0.00004	-	
Pyrene	mg/L	0.000025	0.000025	-	<0.00002	<0.00002	-	-	<0.00002	<0.00002	-	
Quinoline	mg/L	0.0034	0.0034	-	<0.0001	<0.0001	-	-	<0.0001	<0.0001	-	

Notes:

[1] Environment Canada (June 2016). Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites, for fine and coarse textured soil under Agricultural and Residential/Parkland land use
[2] Guideline varies with pH and temperature
[3] Guideline varies with pH
[4] Guideline varies hardness
"-" No applicable guideline or not analyzed
BOLD - Greater than Guideline
RED - Greater than Preliminary Background Concentration

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP1**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1134.154 m
Tungsten, Northwest Territories	UTM: 540666.923 E; 6870639.484 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	CONCRETE SLAB - (150 mm thick)						1134
		SAND (FILL) - silty, trace organics, trace rootlets, damp, loose, brown, coarse sand						
1		- no visible rootlets, no visible organics, grey, fine sand		1-1				1133
		END OF TESTPIT (1.5 metres) Note: Backfilled at completion						
2								1132
3								1131
4								1130
5								

TETRA TECH

Contractor: NATC	Completion Depth: 1.5 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: MH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP2**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1134.49 m
Tungsten, Northwest Territories	UTM: 540669.484 E; 6870648.295 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, trace gravel, trace organics, rootlets, damp, loose, brown, trace oxides, fine sand		2-1				1134
		END OF TESTPIT (0.3 metres) Note: Elevation approximately 0.6 metres below original grade Backfilled at completion						
1								1133
2								1132
3								1131
4								1130
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.3 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP3**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1134.739 m
Tungsten, Northwest Territories	UTM: 540668.281 E; 6870657.802 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	WOODEN PLANKS - (250 mm thick)						1134
		SAND - silty, trace gravel, damp, loose, brown, fine to medium sand		3-1				
		END OF TESTPIT (0.4 metres) Note: Backfilled at completion						
1								1133
2								1132
3								1131
4								1130
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.4 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP4**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1135.091 m
Tungsten, Northwest Territories	UTM: 540653.767 E; 6870676.5 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	WOODEN PLANKS - (250 mm thick)						1135
		SAND - silty, some gravel, trace organics, trace rootlets, damp, loose, brown, fine sand		4-1				
		END OF TESTPIT (0.5 metres) Note: Backfilled at completion						
1								1134
2								1133
3								1132
4								1131
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.5 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP5**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1134.786 m
Tungsten, Northwest Territories	UTM: 540637.933 E; 6870695.485 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, trace gravel, damp, loose, brown, fine sand, (300 mm thick)						1134
		WOODEN PLANKS - (250 mm thick)						
		SAND (FILL) - silty, trace gravel, damp, loose, brown, fine sand		5-1				
		END OF TESTPIT (0.65 metres) Note: Backfilled at completion						
1								1133
2								1132
3								1131
4								1130
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.65 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP6**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1135.268 m
Tungsten, Northwest Territories	UTM: 540615.857 E; 6870708.558 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	WOODEN PLANKS - (300 mm thick)						1135
		SAND (FILL) - silty, trace to some gravel, trace organics, trace rootlets, damp, loose, dark brown to black, fine sand		6-1				
		END OF TESTPIT (0.6 metres) Note: Backfilled at completion						
1								1134
2								1133
3								1132
4								1131
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.6 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP7**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1136.165 m
Tungsten, Northwest Territories	UTM: 540596.075 E; 6870719.594 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, some gravel, trace roots, organics, damp, loose, grey brown, fine sand		7-1				1136
		END OF TESTPIT (0.5 metres) Note: Backfilled at completion						
1								1135
2								1134
3								1133
4								1132
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.5 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP8**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1136.557 m
Tungsten, Northwest Territories	UTM: 540578.051 E; 6870732.105 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, trace to some gravel, damp to moist, loose, brown, fine sand - dark brown to black		8-1				1136
		END OF TESTPIT (0.5 metres) Note: Backfilled at completion						
1								1135
2								1134
3								1133
4								1132
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.5 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP9**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1135.522 m
Tungsten, Northwest Territories	UTM: 540616.284 E; 6870679.194 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, some gravel, damp, loose, brown, fine sand		9-1				1135
		END OF TESTPIT (0.4 metres) Note: Backfilled at completion						
1								1134
2								1133
3								1132
4								1131
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.4 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP10**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	
Tungsten, Northwest Territories	UTM: 540636 E; 6870669 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Depth (ft)
0								0
	Backhoe	SAND (FILL) - gravelly, trace to some silt, trace organics, trace rootlets, damp, loose, brown, fine to medium sand, trace oxides		10-1				1
		END OF TESTPIT (0.35 metres) Note: Backfilled at completion						2
1								3
								4
								5
2								6
								7
								8
								9
3								10
								11
								12
4								13
								14
								15
5								16

TETRA TECH

Contractor: NATC	Completion Depth: 0.35 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP11**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1136.253 m
Tungsten, Northwest Territories	UTM: 540598.755 E; 6870688.653 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, some gravel, trace organics, trace rootlets, damp to moist, loose, brown		11-1				1136
		END OF TESTPIT (0.4 metres) Note: Backfilled at completion						
1								1135
2								1134
3								1133
4								1132
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.4 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP12**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1138.405 m
Tungsten, Northwest Territories	UTM: 540574.977 E; 6870706.256 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	GRAVEL (FILL) - some sand, trace silt, trace rootlets, damp, loose, grey, (100 mm thick)						1138
		SAND (FILL) - gravelly, some silt, damp, loose, grey		12-1				
		END OF TESTPIT (0.35 metres) Note: Backfilled at completion						
1								1137
2								1136
3								1135
4								1134
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.35 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP13**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1139.279 m
Tungsten, Northwest Territories	UTM: 540564.764 E; 6870708.593 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - gravelly, trace to some silt, damp to moist, loose, grey, coarse sand		13-1				1139
		END OF TESTPIT (0.35 metres) Note: Backfilled at completion						
1								1138
2								1137
3								1136
4								1135
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.35 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: 17A6TP14

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1140.926 m
Tungsten, Northwest Territories	UTM: 540540.401 E; 6870725.421 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - some gravel, trace silt, trace rootlets, trace organics, damp to moist, loose, grey		14-1	■			
		END OF TESTPIT (0.4 metres) Note: Backfilled at completion						
1								1140
2								1139
3								1138
4								1137
5								1136

TETRA TECH

Contractor: NATC	Completion Depth: 0.4 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP15**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1141.347 m
Tungsten, Northwest Territories	UTM: 540523.12 E; 6870736.871 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - gravelly, trace to some silt, damp, loose, grey, fine to medium sand		15-1	■			1141
		END OF TESTPIT (0.4 metres) Note: Backfilled at completion						
1								1140
2								1139
3								1138
4								1137
5								

TETRA TECH

Contractor: NATC	Completion Depth: 0.4 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 18
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A6TP16**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1141.178 m
Tungsten, Northwest Territories	UTM: 540505.69 E; 6870747.629 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0		SAND (FILL) - gravelly, trace to some silt, damp, loose, grey, fine sand		16-1	312			1141
1	Backhoe	- pocket of sand around buried utility		16-2				1140
2		- silty		16-3		25% particles <75 µm (ie. smaller than sand particle)		1139
		END OF TESTPIT (2.0 metres) Note: Backfilled at completion						
3								1138
4								1137
5								

TETRA TECH

Contractor: NATC	Completion Depth: 2 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 18
Logged By: NH	Completion Date: 2017 September 21
Reviewed By: JW	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A6TP17**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1142.209 m
Cantung, Northwest Territories	UTM: 540495.163 E; 6870752.058 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL (FILL) - some sand, trace silt, well graded, moist, light brown, medium angular gravel, (200 mm thick)		17-1			1142.2
0.2		SAND (FILL) - some gravel, well graded, moist, brown, fine to medium sand					1142.0
0.4				17-2			1141.8
0.6							1141.6
0.8							1141.4
				17-3			
1.0		END OF TESTPIT (1.00 metre) Location: Southwest corner of house, opposite side of house to the tank Note: Testpit location surveyed by Tetra Tech on August 28, 2018					1141.2
1.2							1141.0
1.4							1140.8
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 1 m
Drilling Rig Type: Backhoe	Start Date: 2018 June 26
Logged By: BB	Completion Date: 2018 June 26
Reviewed By: SS	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A6TP18**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1141.035 m
Cantung, Northwest Territories	UTM: 540508.652 E; 6870751.398 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL (FILL) - some sand, trace silt, well graded, moist, light brown, medium angular gravel, (100 mm thick)		18-1			1141.0
0.2		SAND (FILL) - some gravel, well graded, moist, brown, wood inclusions (lumber), pieces of construction siding, fine to coarse sand					1140.8
0.4				18-2			1140.6
0.6							1140.4
0.8							1140.2
				18-3			
1.0		END OF TESTPIT (1.00 metre) Location: Northeast corner of house, 5 m from 17TP16 Note: Testpit location surveyed by Tetra Tech on August 28, 2018					1140.0
1.2							1139.8
1.4							1139.6
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 1 m
Drilling Rig Type: Backhoe	Start Date: 2018 June 27
Logged By: BB	Completion Date: 2018 June 27
Reviewed By: SS	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A6TP19**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1141.371 m
Cantung, Northwest Territories	UTM: 540512.495 E; 6870743.424 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL (FILL) - some sand, well graded, moist, brown, medium angular gravel, (300 mm thick)		19-1			1141.2
0.2							
		SAND (FILL) - gravelly, trace silt, well graded, moist, brown, fine to coarse sand		19-2			1141.0
0.4							
							1140.8
0.6							
							1140.6
0.8				19-3			
							1140.4
1.0		END OF TESTPIT (1.00 metre) Location: southeast of 17A6PT16, near garage Note: Testpit location surveyed by Tetra Tech on August 28, 2018					
							1140.2
1.2							
							1140.0
1.4							
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 1 m
Drilling Rig Type: Backhoe	Start Date: 2018 June 27
Logged By: BB	Completion Date: 2018 June 27
Reviewed By: SS	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A6TP20**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1141.646 m
Cantung, Northwest Territories	UTM: 540503.024 E; 6870744.675 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL (FILL) - some sand, well graded, moist, brown, medium angular gravel, (250 mm thick)		20-1			1141.6
0.2							1141.4
		SAND (FILL) - gravelly, trace silt, well graded, moist, brown, fine to coarse sand		20-2			
0.4							1141.2
0.6							1141.0
0.8				20-3			1140.8
1.0		END OF TESTPIT (1.00 metre) Location: 3 m southwest of 17A6TP16 Note: Testpit location surveyed by Tetra Tech on August 28, 2018					1140.6
1.2							1140.4
1.4							1140.2
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 1 m
Drilling Rig Type: Backhoe	Start Date: 2018 June 27
Logged By: BB	Completion Date: 2018 June 27
Reviewed By: SS	Page 1 of 1

Photo 1: Looking northwest across town site.
(September 21, 2017)

Photo 2: Excavating at former AST location at town site House #66.
(September 18, 2017)

AEC 7

AEC 7: Town Site Road Materials

Area Description	
Location	Roads around the town site homes and road between mine site buildings (office, admin, rec center and firehall). Area of investigation does not cover other mine site roads.
Topography	Flat, minor uphill grade from town site to mine site.
Surface Drainage	Northeast.
Background	Waste rock was used along with gravel fill materials to construct the roads which are paved with asphalt. The source of waste rock and fill and their quantities is unknown. It is not known if the material used for construction of the townsite roads were analyzed for ARD potential prior to be placed during construction.

Historical Assessment Information

EBA (2008) did not investigate the town site roads. EBA (2008) reports that interviews with individuals with purported knowledge of the Property indicate that waste rock rather than ore was used as a base for many roads at the Property and that a salt derivative has been used for deicing roads at the Property. EBA did not investigate soil or groundwater quality beneath the Property roads because the quality of these media was inferred to be comparable to the background soil and groundwater quality near the Property.

Gartner Lee (2002) reported that waste rock was being crushed in crushing plant during visit for use in road/yard construction and road maintenance. Asphalt around town site contains oxidizing sulphides (called “red-eye”).

2017 Environmental Site Assessment Details

Environmental Site Assessment Scope

Utility Locate SOP followed?	N/A
EM 31 Geophysics Complete?	No
Number of test pits advanced	0
Number of boreholes advanced	0
Number of hand auger locations advanced	0
Number of soil/rock samples collected for acid rock drainage/metal leaching	3
Number of soil samples submitted for laboratory chemical analysis	0
Number of soil/rock samples submitted for acid rock drainage analysis	1
Number of boreholes completed as groundwater monitoring wells	0
Number of historical groundwater monitoring wells	0
Number of groundwater samples collected	0
Number of sediment and surface soil samples collected	0

Geophysics Findings

N/A

Soil Investigation and Conditions

N/A	Surface visual investigation only.

General Stratigraphy

Description	Depth from (mbg)	Depth to (mbg)	Observations
N/A	N/A	N/A	Unknown depth. Observed fill and waste rock materials of various fraction sizes in paved road.

Combustible Vapour Concentrations (CVCs)

N/A

AEC 7: Town Site Road Materials

Groundwater Conditions	
Depth to Groundwater	N/A
Free Product	N/A

2017 Environmental Site Assessment Results Summary

General Site Observations

- Roads are generally constructed from a mix of fill and waste rock which has been combined into a mixed road surface which was paved with asphalt. No tailings were observed but may be present in small quantities.
- Sample TSR-01 is an example in front of fire hall where road surface has opened, due to heaving, exposing underlying materials.
- . The roads have a 0-1 m wide shoulder of unpaved material.
- The proportion of fill and waste rock materials is unknown and difficult to estimate.
- Oxidized fragments in the road surface, and referred to as “red-eye”, are likely sulphide-bearing waste rock material which has partially weathered and oxidized.
- The “red-eye” fragments vary in proportion from 10-50% by surface area of road depending on location within the investigation area.

Soil: Petroleum Hydrocarbons, Metals/Routine Parameters, Other PCOCs

N/A

Soil: Metals

N/A – not tested during this program; historical data for waste rock and fill material are available.

Soil: Other PCOCs

N/A

Soil: Acid Rock Drainage

(see Geochemistry Report, Tetra Tech, 2019g)

Groundwater: Petroleum Hydrocarbons, Metals/Routine Parameters, Other PCOCs

N/A

Sediment: Petroleum Hydrocarbons, Metals/Routine Parameters, Other PCOCs

N/A

Surface Water: Petroleum Hydrocarbons, Metals/Routine Parameters, Other PCOCs

N/A

Grainsize Analysis

N/A

Environmental Concerns

Location in AEC	Potential Source(s)	Identified Contaminated Media	Parameters Assessed and Contaminant(s) of Concern (COCs; bold & underline)
Roads and building pad foundation around buildings	Waste rock	Road materials	Limited potential for acid generation and metal leaching from mine rock material contained in roads.

Discussion (Significance of the Results)

- See geochemistry report (Tetra Tech, 2020e)

Attachments

Figure A7-1 – Acid Rock Drainage Results

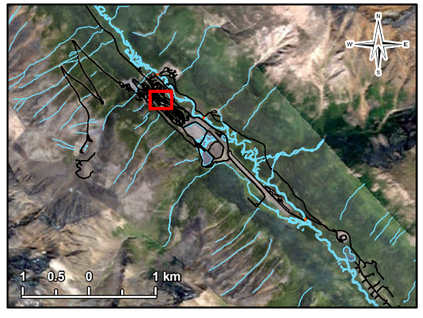
Photographs

LEGEND

- Area of Environmental Concern (AEC)
- 2017 Rock Sample for ARD/ML

Acid Rock Drainage (ARD) Analytical Results

- Paste pH >7
- Non Acid Generating (NAG)
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)



NOTES

All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE
PHASE III ESA

AEC 7
Road Materials
Acid Rock Drainage Results

PROJECTION UTM Zone 9		**DATUM** NAD83		**CLIENT** NORTH AMERICAN TUNGSTEN CORPORATION LTD
Scale: 1:1,000 — 20 10 0 20 — Metres				TETRA TECH
FILE NO. WENW03039-03_Summary_A7-1.mxd				
OFFICE Tt-VANC	**DWN** SL	**CKD** BB	**APVD** SK	**REV** 0
DATE June 22, 2020	**PROJECT NO.** ENW.WENW03039-03			**A7-1**

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Photo 1: Typical oxidizing sulphides (“red-eye”) from waste rock material used in asphalt around townsite. Mixed waste rock and fill material. (September 28, 2017)

Photo 2: Location of sample TSR-01 (alternatively 17A7-01) outside of firehall building. Exposed soil/fill material where road surface has heaved and opened up. (September 28, 2017)

Photo 3: Road area between House 64 and 65 where oxidation of road materials is slightly more pervasive. (September 28, 2017)

AEC 8

AEC 8: Polishing Pond

Area Description		
Location	Below the Fire Hall and Tailings Pond 2 on the Flat River floodplain.	
Topography	Generally flat on surface with a slight slope to the northeast beyond the pond.	
Surface Drainage	northeast into the Flat River.	
Background	AEC 8 is a historical sewage settling pond. In 1980s, pond ceased to be a sewage settling pond and is now fed by runoff from the mine and overland surface flow.	
Historical Assessment Information		
Previous Phase II Environmental Site Assessment Results (EBA, 2008)	Number of surface soil (sediment) samples	6
	Number of monitoring wells installed	1
	Number of soil (sediment) samples analyzed	6
	Number of soil (sediment) samples with petroleum hydrocarbons impacts	4
	Number of soil (sediment) samples with metal impacts	6
	Number of groundwater samples with metal impacts	1
Comments: Pond (lagoon) sediment contained PHCs and metals exceeding guidelines. Groundwater also contained metal exceeding guidelines (PHCs not assessed then).		
2017/2018 Environmental Site Assessment Details		
Environmental Site Assessment Scope		
Utility Locate SOP followed?		No
EM 31 Geophysics Complete?		No
Number of test pits advanced		0
Number of boreholes advanced		0
Number of hand auger locations advanced		0
Number of soil samples submitted for laboratory chemical analysis		0
Number of boreholes completed as monitoring wells		0
Number of existing monitoring wells		3
Number of groundwater samples collected		1 (2017), 1 (2018)
Number of sediment and surface water samples collected		3 (2017)
Geophysics (EM 31 Apparent Terrain Conductivity) Findings		
▪ N/A		
Sediment Investigation and Conditions		
Maximum Depth of Investigation	0.18 mbgs (October 3, 2017)	
Stratigraphy		

Description	Depth from (mbg)	Depth to (mbg)	Observations
Silt	0	0.05	Light brown, saturated.
Sand	0.05	0.18	Mine Tailings. Dark grey. Oxidized @ 0.11 mbg at 17A8SS1. Strong PHC odour at 17A8SS3.

Combustible Vapour Concentrations (CVC)
Ranged from less than the instrument detection limit to 40 ppm in sediment sample 17A8SS3.

AEC 8: Polishing Pond

Groundwater Conditions	
Depth to Groundwater	2.53 mbgs (October 4, 2017). 2.18 mbgs (June 27, 2018)
Free Product	PHC free product not observed.

2017/2018 Environmental Site Assessment Summary

- Figure A8-1 shows sediment sampling locations.
- Figure A8-2 shows groundwater and surface water sampling locations.
- Table A8-1 summarizes sediment lab results relative to guidelines.
- Table A8-2 summarizes groundwater lab results relative to guidelines.
- Table A8-3 summarizes surface water lab results relative to guidelines.

General Site Observations

- Surface water covered entire AEC at the time of the assessment (larger area than shown on Figures A8-1 and A8-2).
- Very slight sheen observed on the water surface.
- Strong PHC odour and sheen from sediments near the inlet channel (sample 17A8SS3).
- Groundwater monitoring well adjacent to pond (RMW6) was destroyed. Pipe cut off at surface.

Sediment: Petroleum Hydrocarbons (PHCs, PAHs)

- Laboratory results less than guidelines with exception of:
  - PHCs greater than guidelines at 17A8SS1 and 17A8SS3.
  - PAHs greater than guidelines at 17A8SS3.

Sediment: Metals

- Laboratory results less than guidelines with exception of:
  - Arsenic exceeded guidelines at 17A8SS1, 17A8SS2, and 17A8SS3 but all less than preliminary background concentration.
  - Cadmium exceeded guidelines at 17A8SS1, 17A8SS2, and 17A8SS3 and greater than preliminary background concentration.
  - Copper exceeded guidelines at 17A8SS1, 17A8SS2, and 17A8SS3 and greater than preliminary background concentration.
  - Mercury exceeded guidelines at 17A8SS3.
  - Zinc exceeded guidelines at 17A8SS1, 17A8SS2, and 17A8SS3 and greater than preliminary background concentration.

Sediment: Other PCOCs (Routine Parameters, Nutrients - Nitrogen, PCBs)

- Concentrations less than detection limits and/or guidelines.

Groundwater: Petroleum Hydrocarbons (PHCs and PAHs)

2017 and 2018

- Concentrations less than detection limits and guidelines.

Groundwater: Metals/Routine Parameters

2017

- Laboratory results less than guidelines with exception of:
  - pH, fluoride, sulphate and dissolved metals: aluminum, beryllium, cadmium, chromium, copper, iron, silver, and zinc greater than guidelines at RMW1.
  - Sulphate, dissolved cadmium and dissolved iron greater than guidelines at S4-27-9.
  - Fluoride greater than guidelines at S4-27-9 but less than background quality.

2018

- S4-27-9 was not sampled as a part of the 2018 SNP program.
- Laboratory results less than guidelines with exception of:
  - pH was significantly outside (less than) guidelines at RMW1.
  - TDS, fluoride, sulphate and dissolved metals: aluminum, beryllium, cadmium, chromium, cobalt, copper, iron, manganese, nickel, selenium, silver, uranium, and zinc greater than guidelines at RMW1.

AEC 8: Polishing Pond

- Fluoride, sulphate, and dissolved cadmium, greater than preliminary background concentrations at RMW1.

Groundwater: Other PCOCs (Cyanide, Phenols and VOCs)

- Laboratory results less than detection limits and guidelines with exception of:
  - Detection limit for VOC 1,2-dibromoethane was greater than guidelines.

Surface Water: Petroleum Hydrocarbons

- All PHCs and PAHs concentrations less than detection limits and guidelines.

Surface Water: Metals/Routine Parameters

- Laboratory results less than guidelines with exception of:
  - Fluoride, total boron and total iron at 17A8SW1.
  - Fluoride, total suspended solids (TSS), total boron and total iron at 17A8SW2.
  - Fluoride, TSS, and total iron at 17A8SW2.

Surface Water: Other PCOCs (Cyanide, Nutrients, BOD, Bacteriological, and PCBs)

- Laboratory chemical less than the guidelines.

Environmental Concerns

Location in AEC	Potential Source(s)	Identified Contaminated Media	Parameters Assessed and Contaminant(s) of Concern (COCs; bold & underline)
Surface of whole area	PHCs, glycols and VOCs from the mining operations, metals in tailings, nutrients in sediment from historic sewage	Sediment; Groundwater; Surface Water	**Sediment: metals, petroleum hydrocarbons (PHCs), polycyclic aromatic hydrocarbons (PAHs),** polychlorinated biphenyls (PCBs) **Groundwater: dissolved metals, routine parameters,** nutrients, cyanide, PHCs, glycols, PAHs, phenols, VOCs **Surface Water: total metals, routine parameters,** cyanide, nutrients, Biological Oxygen Demand (BOD), biological, PHCs, PAHs, PCBs

Discussion (Significance of the Results)

Sediment:

- Based on the current results there appears to be one PHC affected area:
  - Sediments near the inlet channel from the mine discharge (source of PHCs not obvious; could be from upland sources).
- PHCs and PAHs impacts measured near the inlet channel have not been vertically or horizontally delineated.
- Cadmium and zinc concentrations similar at all three testing locations. The concentrations were similar to other tailings samples at other locations on the site.
- Arsenic, cadmium, and mercury concentrations were highly variable at the three locations. This was also commonly identified in other tailings samples at the site.
- PCBs not detected and no longer considered a PCOC in soil at AEC 8.

Groundwater:

2017

- Groundwater monitoring wells are located down-gradient and cross-gradient from the AEC.
- Monitoring well RMW6 is destroyed and there was no historical data available for SNC well S4-27-1.
- Monitoring well RMW1 contained very little water and was slow to recharge.
- Based on the logs, and groundwater elevations, we infer that the MWs all completed in the same hydrostratigraphic unit.
- Several metals parameters exceeded regulatory guidelines at RMW1. This may be in part due to poor quality of the sample from a poor recharging in the well or from its closer proximity to Tailings Pond 2. Well S4-27-9 which is located closer to the polishing pond, had fewer exceedances in 2017 (only sulphate, cadmium and iron).
- PCHs, PAHs, phenols and VOCs less than laboratory detection limits and/or guidelines; no longer COCs in groundwater at AEC8.

AEC 8: Polishing Pond

2018

- Monitoring well RMW1 contained very little water and was slow to recharge.
- Several metals parameters exceeded regulatory guidelines at RMW1. This may be in part due to poor quality of the sample from a poor recharging in the well or from its closer proximity to Tailings Pond 2.

Surface Water:

2017

- Total coliforms were present in all surface water samples. *E. coli* present at 17A8SW2; however there are no applicable guidelines for these parameters at the site.
- TSS, total boron and total iron marginally exceed the guidelines. Fluoride is the only parameter that is exceeds the guidelines by more than one order of magnitude.
- PHCs, PAHs, BOD, and PCBs all less than laboratory detection limits and/or guidelines; no longer PCOCs in surface water at AEC8.

Attachments

Figure A8-1 – Soil and Sediment Results

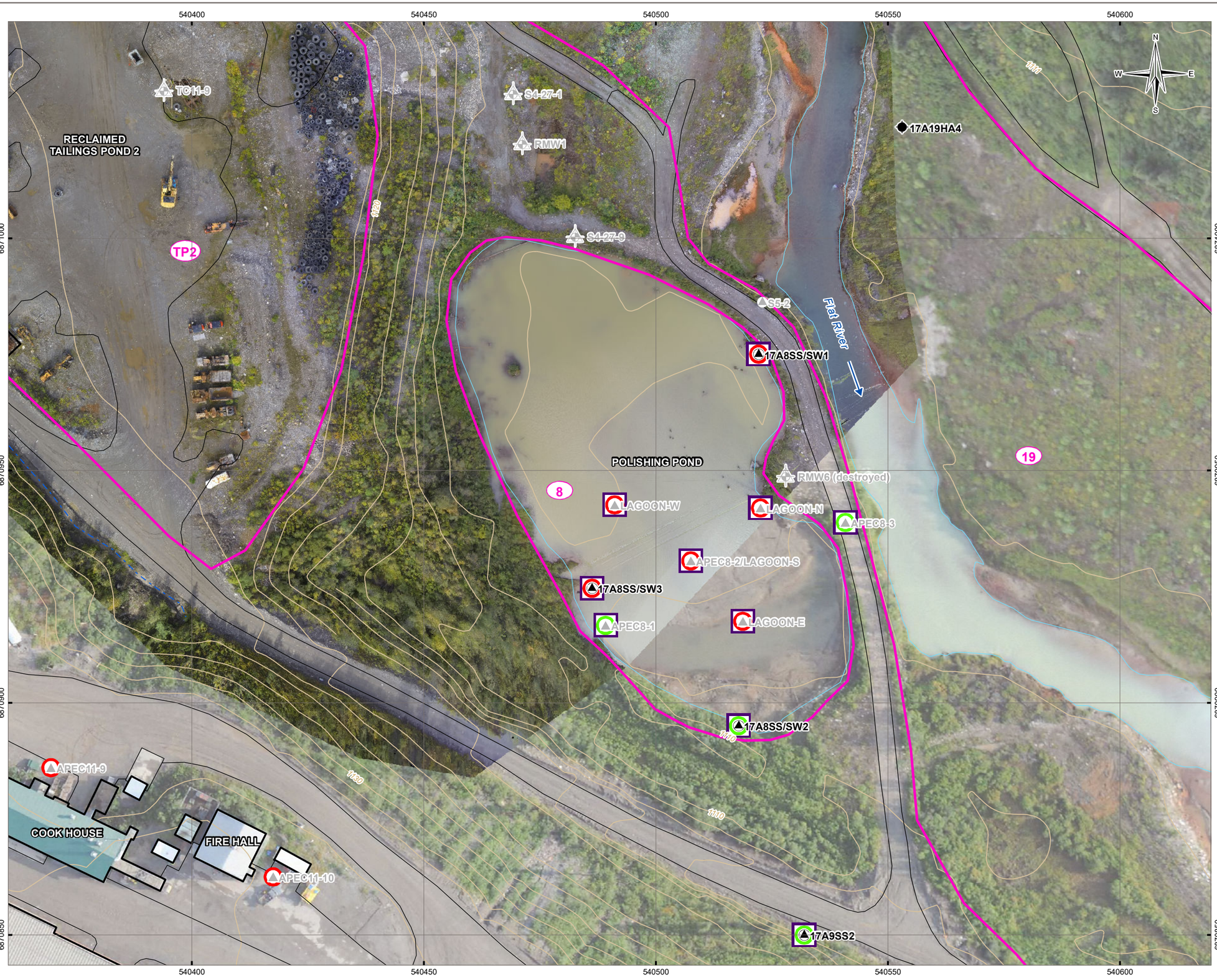
Figure A8-2 – Groundwater and Surface Water Results

Table A8-1 – Sediment Analytical Results

Table A8-2 – Groundwater Analytical Results

Table A8-3 – Surface Water Analytical Results

Photographs

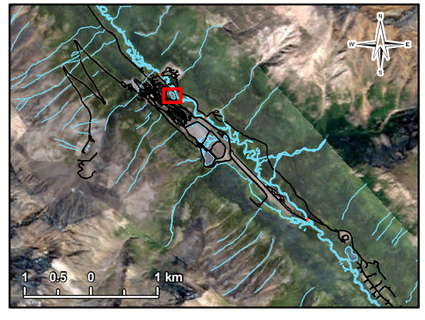


LEGEND

- Area of Environmental Concern (AEC)
- 2017 Hand Auger (HA)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Historical Monitoring Well
- Historical Shallow Soil Sample
- Historical Surface Water Sample

Soil/Sediment Analytical Results

- PHC Impacts
- No PHC Impact
- Metals exceedance of preliminary background concentrations, or in the absence of background concentrations, exceedance of CCME guidelines
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 8 Polishing Pond Soil and Sediment Results

PROJECTION UTM Zone 9	**DATUM** NAD83			**CLIENT** NORTH AMERICAN TUNGSTEN CORPORATION LTD
Scale: 1:800 (10 5 0 10 Metres)				TETRA TECH
FILE NO. WENW03039-03_Summary_A8-1.mxd				
OFFICE Tt-VANC	**DWN** SL	**CKD** BB	**APVD** BB	**REV** 0
DATE June 22, 2020	**PROJECT NO.** ENW.WENW03039-03			A8-1

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LEGEND

- Area of Environmental Concern (AEC)
- 2017 Hand Auger (HA)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Historical Monitoring Well
- Historical Shallow Soil Sample
- Historical Surface Water Sample
- Inferred Groundwater Flow Direction
- Groundwater Contour (1 m asl; Fall 2017)

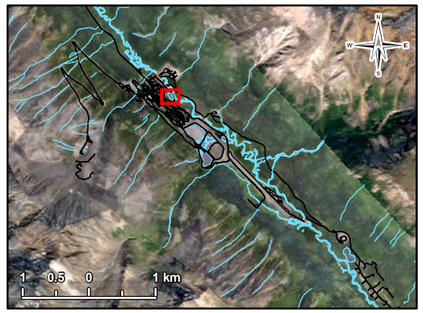
2017/2018 Groundwater Analytical Results

- Samples contain parameters that exceeded the preliminary background concentrations, or in the absence of background concentrations, FIGWQG

2018 Surface Water Analytical Results

- Samples contain parameters that met the Flat River WQOs, or in the absence of WQOs, CCME WQG for the protection of AW or EQGASW
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)

FIGWQG	Federal Interim Groundwater Quality Guidelines
CCME	Canadian Council of Ministers of the Environment
WQG	Water Quality Guidelines
AW	Freshwater Aquatic Life
EQGASW	Environmental Quality Guidelines for Alberta Surface Waters



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 8
Polishing Pond
Groundwater and Surface Water Results

PROJECTION: UTM Zone 9	DATUM: NAD83	CLIENT: NORTH AMERICAN TUNGSTEN CORPORATION LTD	
Scale: 1:800 (10 5 0 10 Metres)		TETRA TECH	
FILE NO.: WENW03039-03_Summary_A8-2.mxd			
OFFICE: Tt-VANC	DWN: SL / CKD: BB / APVD: SS / REV: 0		A8-2
DATE: June 22, 2020	PROJECT NO.: ENW.WENW03039-03		

Table A8-1 - Sediment Analytical Results

Parameter	Unit	Canada Wide PHC - Res/Park Coarse[1]	Canada Wide PHC - Agricultural Coarse[1]	CCME Sediment - Fresh ISQG[2]	CCME Sediment - Fresh PEL[3]	AEC 8			
						17A8SS1	17A8SS2	17A8SS3	17A8SSDUP1 (17A8SS3)
						2017-10-03	2017-10-03	2017-10-03	2017-10-03
	Sediment Type					Sand, fine, orange, (Tailings)	Sand, fine, grey (Tailings)	Sand, fine, grey (Tailings)	
Routine / Salinity									
pH	pH Units	NG	NG	NG	NG	7.45	7.1	7.54	7.33
Moisture	%	NG	NG	NG	NG	55	33.4	24.3	28.2
Nutrients									
Nitrogen (Total)	%	NG	NG	NG	NG	0.15	0.22	0.03	0.03
Metals									
Antimony	mg/kg	NG	NG	NG	NG	0.9	3.2	0.6	0.5
Arsenic	mg/kg	NG	NG	5.9	17	**18.4**	**32.7**	**8.1**	**7.6**
Barium	mg/kg	NG	NG	NG	NG	281	3740	191	193
Beryllium	mg/kg	NG	NG	NG	NG	2.2	1	1.6	1.5
Cadmium	mg/kg	NG	NG	0.6	3.5	**1.06**	**1.97**	**2.21**	**2.09**
Chromium	mg/kg	NG	NG	37.3	90	12	21	21	19
Cobalt	mg/kg	NG	NG	NG	NG	16.1	16.6	23.4	22.5
Copper	mg/kg	NG	NG	35.7	197	**423**	**175**	**1160**	**1130**
Lead	mg/kg	NG	NG	35	91.3	10.8	20.2	16.5	13.7
Mercury	mg/kg	NG	NG	0.17	0.486	0.08	0.12	**0.5**	**0.2**
Molybdenum	mg/kg	NG	NG	NG	NG	2.6	6.1	5.6	5.1
Nickel	mg/kg	NG	NG	NG	NG	22.7	53.3	16.1	15.4
Phosphorus	mg/kg	NG	NG	NG	NG	309	656	512	603
Selenium	mg/kg	NG	NG	NG	NG	1.8	1.5	3.3	3.2
Silver	mg/kg	NG	NG	NG	NG	<0.5	<0.5	0.6	0.6
Thallium	mg/kg	NG	NG	NG	NG	0.2	0.3	0.5	0.5
Tin	mg/kg	NG	NG	NG	NG	2.3	1.1	4.5	4.1
Uranium	mg/kg	NG	NG	NG	NG	2.7	3.8	2.4	2.4
Vanadium	mg/kg	NG	NG	NG	NG	22	76	30	30
Zinc	mg/kg	NG	NG	123	315	**225**	**307**	**296**	**274**
Hydrocarbons									
Benzene	mg/kg	NG	NG	NG	NG	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	NG	NG	NG	NG	<0.01	<0.01	<0.01	<0.01
Xylene (m)	mg/kg	NG	NG	NG	NG	<0.02	<0.02	<0.02	<0.02
Xylene (o)	mg/kg	NG	NG	NG	NG	<0.02	<0.02	<0.02	<0.02
Xylenes Total	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.05	<0.05
F1 (C6-C10)	mg/kg	NG	NG	NG	NG	<10	<10	<10	<10
F1 (C6-C10 / BTEX CORRECTED)	mg/kg	30	130	NG	NG	<10	<10	<10	<10
F2 (C10-C16)	mg/kg	150	150	NG	NG	<40	<20	115	***164***
F3 (C16-C34)	mg/kg	300	1300	NG	NG	***466***	86	***4680***	***5950***
F4: (C34-C50)	mg/kg	2800	5600	NG	NG	181	26	***3640***	***6040***
Polycyclic Aromatic Hydrocarbons (PAHs)									
IACR (CCME)	mg/kg	NG	NG	NG	NG	<0.6	<0.6	<3	<3
B(a)P Total Potency Equivalent	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.2	<0.2
1-Methylnaphthalene	mg/kg	NG	NG	NG	NG	<0.005	<0.005	<0.02	<0.02
2-methylnaphthalene	mg/kg	NG	NG	0.0202	0.201	<0.005	<0.005	<0.02	<0.02
Acenaphthene	mg/kg	NG	NG	0.00671	0.0889	<0.005	<0.005	*<0.02*	*<0.02*
Acenaphthylene	mg/kg	NG	NG	0.00587	0.128	<0.005	<0.005	*<0.02*	*<0.02*
Anthracene	mg/kg	NG	NG	0.0469	0.245	<0.004	<0.004	<0.02	<0.02
Benz(a)anthracene	mg/kg	NG	NG	0.0317	0.385	<0.03	<0.03	*<0.2*	*<0.2*
Benzo(a) pyrene	mg/kg	NG	NG	0.0319	0.782	<0.03	<0.03	*<0.2*	*<0.2*
Benzo(b)fluoranthene	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.2	<0.2
Benzo(b+j)fluoranthene	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.2	<0.2
Benzo(k)fluoranthene	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.2	<0.2
Chrysene	mg/kg	NG	NG	0.0571	0.862	<0.05	<0.05	*<0.2*	*<0.2*
Dibenz(a,h)anthracene	mg/kg	NG	NG	0.00622	0.135	<0.005	<0.005	*<0.02*	*<0.02*
Fluoranthene	mg/kg	NG	NG	0.111	2.355	0.01	<0.01	**0.24**	**0.19**
Fluorene	mg/kg	NG	NG	0.0212	0.144	<0.02	<0.02	*<0.1*	*<0.1*
Indeno(1,2,3-c,d)pyrene	mg/kg	NG	NG	NG	NG	<0.02	<0.02	<0.1	<0.1
Naphthalene	mg/kg	NG	NG	0.0346	0.391	<0.005	<0.005	<0.02	<0.02
Phenanthrene	mg/kg	NG	NG	0.0419	0.515	<0.02	<0.02	*<0.1*	*<0.1*
Pyrene	mg/kg	NG	NG	0.053	0.875	<0.01	<0.01	**0.29**	**0.33**
Benzo(j)fluoranthene	ug/g	NG	NG	NG	NG	<0.05	<0.05	<0.2	<0.2
Polychlorinated Biphenyls (PCBs)									
Aroclor 1242	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.05	<0.05
Aroclor 1254	mg/kg	NG	NG	0.06	0.34	<0.05	<0.05	<0.05	<0.05
Aroclor 1260	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.05	<0.05
PCBs (Sum of total)	mg/kg	NG	NG	NG	NG	<0.05	<0.05	<0.05	<0.05
					Sample Code	8800408	8800418	8800421	8800425
					Lab Report Number	17Y269763	17Y269763	17Y269763	17Y269763

Notes:

[1] - Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (CCME 2008)

[2] - Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life - Interim Sediment Quality Guidelines (ISQG) for Freshwater (CCME 1999)

[3] - Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life - Probable Effect Level (PEL) for Freshwater (CCME 1999)

Italic and Underlined - Laboratory detection limit is greater than standard or guideline shown

NG - No guideline

Bold and Underline - Exceeds CCME ISQG

Bold and Shaded - Exceeds CCME PEL and ISQG

Bold in Italics - Exceeds CCME Canada-Wide Standards for Petroleum Hydrocarbon Guideline

N/A - Not applicable

"-" Not analyzed

Table A8-2: Groundwater Analtyical Results

				AEC	AEC 8	
				Location	RMW1	
				Field ID	RMW1	RMW1
				Sample Date	5-Oct-2017	2-Jul-2018
				Laboratory Report Number	17V270219	18Y358442
				Laboratory Sample ID	8804715	9378777
Parameter	**Unit**	**Federal Interim Guideline[1]**		**Preliminary Background Concentrations**		
		Agricultural	**Res / Park**			
Field Parameters						
Field Temperature	^{0}C	-	-	-	6.6	6.7
Field pH	pH Units	6.5-9	6.5-9	-	**3.3**	**2.55**
Field Conductivity	µS/cm	-	-	-	-	6242
Routine						
pH	pH Units	6.5-9	6.5-9	-	**3.03**	**2.58**
Electrical Conductivity (EC)	µS/cm	-	-	-	7540	6330
Total Dissolved Solids (TDS)	mg/L	3000	-	-	**11,800**	**8960**
Hardness as $CaCO_3$	mg/L	-	-	-	2020	2530
Alkalinity (total as $CaCO_3$)	mg/L	-	-	-	<1	<1
Bromide	mg/L	-	-	-	<0.5	0.08
Chloride	mg/L	100	120	-	9.2	3.98
Fluoride	mg/L	0.12	0.12	0.39	**4.6**	**16**
Sulphate	mg/L	100	100	182	**8970**	**17,700**
Nutrients						
Ammonia	mg/L	0.021-231 [2]	0.021-231 [2]	-	-	0.41
Nitrate (as NO_3-N)	mg/L	13	13	-	<0.05	<0.05
Nitrite (as NO_2-N)	mg/L	0.06	0.06	-	<0.05	<0.005
Nitrogen (Total)	mg/L	-	-	-	-	1.15
Cyanide						
Cyanide (SAD)	mg/L	-	-	-	<0.002	<0.002
Cyanide (WAD)	mg/L	-	-	-	<0.002	-
Dissolved Metals						
Aluminum	mg/L	0.005 / 0.1 [3]	0.005 / 0.1 [3]	-	**46.4**	**259**
Antimony	mg/L	2	2	-	<0.0002	<0.0002
Arsenic	mg/L	0.005	0.005	-	0.0029	0.0049
Barium	mg/L	0.5	0.5	-	0.0157	0.003
Beryllium	mg/L	0.0053	0.0053	-	**0.0344**	**0.136**
Boron	mg/L	0.5	1.5	-	0.2	0.274
Cadmium	mg/L	0.00012	0.00012	0.000047	**0.00309**	**0.022**
Calcium	mg/L	-	-	-	372	420
Chromium	mg/L	0.0089	0.0089	-	**0.0092**	**0.0651**
Cobalt	mg/L	0.05	-	-	**0.0912**	**0.356**
Copper	mg/L	0.002	0.002	-	**3.69**	**21.8**
Iron	mg/L	0.3	0.3	-	**2780**	**1250**
Lead	mg/L	0.001-0.002 [4]	0.001-0.002 [4]	-	0.0002	0.00024
Lithium	mg/L	-	-	-	0.481	0.802
Magnesium	mg/L	-	-	-	266	360
Manganese	mg/L	0.2	-	-	**15.7**	**24.1**
Mercury	mg/L	0.000016	0.000016	-	<0.00001	<0.00001
Molybdenum	mg/L	0.073	0.073	-	0.00041	0.00015
Nickel	mg/L	0.025-0.083 [4]	0.025-0.083 [4]	-	0.07	**0.256**
Potassium	mg/L	-	-	-	23.9	4.3
Selenium	mg/L	0.001	0.001	-	0.0008	**0.0026**
Silver	mg/L	0.00025	0.00025	-	0.00011	**0.00044**
Sodium	mg/L	-	-	-	11.4	27.9
Strontium	mg/L	-	-	-	-	0.556
Thallium	mg/L	0.0008	0.0008	-	0.00019	0.00048
Tin	mg/L	-	-	-	-	0.00019
Titanium	mg/L	0.1	0.1	-	0.0043	0.0115
Tungsten	mg/L	-	-	-	-	0.0119
Uranium	mg/L	0.01	0.015	-	0.00955	**0.0389**
Vanadium	mg/L	0.1		-	0.0046	0.0128
Zinc	mg/L	0.01	0.01	-	**0.72**	**1.68**

Notes:

[1] Environment Canada (June 2016). Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites, for fine and coarse textured soil under Agricultural and Residential/Parkland land use

[2] Guideline varies with pH and temperature

[3] Guideline varies with pH

[4] Guideline varies hardness

"-" No applicable guideline or not analyzed

BOLD - Greater than Guideline

RED - Greater than Preliminary Background Concentration

Italic - Detection limit greater than guideline

Table A8-2: Groundwater Analtyical Results

				AEC	AEC 8	
				Location	RMW1	
				Field ID	RMW1	RMW1
				Sample Date	5-Oct-2017	2-Jul-2018
				Laboratory Report Number	17V270219	18Y358442
				Laboratory Sample ID	8804715	9378777
Parameter	**Unit**	**Federal Interim Guideline[1]**		**Preliminary Background Concentrations**		
		Agricultural	**Res / Park**			
Hydrocarbons						
Benzene	mg/L	0.088	0.14	-	<0.0005	<0.0005
Toluene	mg/L	0.083	0.083	-	<0.0005	<0.0005
Ethylbenzene	mg/L	3.2	11	-	<0.0005	<0.0005
Xylene (m)	mg/L	-	-	-	<0.0005	<0.0005
Xylene (o)	mg/L	-	-	-	<0.0005	<0.0005
Xylenes Total	mg/L	3.9	3.9	-	<0.001	<0.001
Styrene	mg/L	0.072	0.072	-	<0.0005	-
F1 (C_6-C_{10})	mg/L	-	-	-	<0.1	<0.1
F1 (C_6-C_{10}) - BTEX	mg/L	0.81	0.81	-	<0.1	<0.1
F2 (C_{10}-C_{16})	mg/L	1.3	1.3	-	<0.1	<0.1
F3 (C_{16}-C_{34})	mg/L	-	-	-	<0.1	<0.1
F4 (C_{34}-C_{50})	mg/L	-	-	-	<0.1	<0.1
VH_{6-10}	mg/L	-	-	-	<0.1	-
VPH	mg/L	-	-	-	<0.1	-
Glycols						
Diethylene glycol	mg/L	-	-	-	<5	-
Ethylene glycol	mg/L	190	190	-	<10	-
Propylene glycol	mg/L	500	500	-	<10	-
Tetraethylene Glycol	mg/L	-	-	-	<10	-
Triethylene Glycol	mg/L	-	-	-	<10	-
Polycyclic Aromatic Hydrocarbons (PAHs)						
Acenaphthene	mg/L	0.0058	0.0058	-	<0.00002	-
Acenaphthylene	mg/L	0.046	0.046	-	<0.00002	-
Acridine	mg/L	0.00005	0.00005	-	<0.00005	-
Anthracene	mg/L	0.000012	0.000012	-	<0.00001	-
Benz(a)anthracene	mg/L	0.000018	0.000018	-	<0.00001	-
Benzo(a) pyrene	mg/L	0.00001	0.00001	-	<0.00001	-
Benzo(b)fluoranthene	mg/L	-	-	-	<0.00001	-
Benzo(b+j)fluoranthene	mg/L	0.00048	0.00048	-	<0.00001	-
Benzo(g,h,i)perylene	mg/L	0.00017	0.00017	-	<0.00001	-
Benzo(j)fluoranthene	mg/L	-	-	-	<0.00001	-
Benzo(k)fluoranthene	mg/L	0.00048	0.00048	-	<0.00001	-
Chrysene	mg/L	0.0001	0.0001	-	<0.00001	-
Dibenz(a,h)anthracene	mg/L	0.00026	0.00026	-	<0.00001	-
Fluoranthene	mg/L	0.00004	0.00004	-	<0.00002	-
Fluorene	mg/L	0.003	0.003	-	<0.00002	-
Indeno(1,2,3-c,d)pyrene	mg/L	0.00021	0.00021	-	<0.00001	-
Naphthalene	mg/L	0.0011	0.0011	-	<0.00005	-
Phenanthrene	mg/L	0.0004	0.0004	-	<0.00004	-
Pyrene	mg/L	0.000025	0.000025	-	<0.00002	-
Quinoline	mg/L	0.0034	0.0034	-	<0.0001	-
Phenols						
Phenols	mg/L	-	-	-	0.005	-

Notes:

[1] Environment Canada (June 2016). Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites, for fine and coarse textured soil under Agricultural and Residential/Parkland land use

[2] Guideline varies with pH and temperature

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[4] Guideline varies hardness

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Table A8-2: Groundwater Analtyical Results

				AEC	AEC 8	
				Location	RMW1	
				Field ID	RMW1	RMW1
				Sample Date	5-Oct-2017	2-Jul-2018
				Laboratory Report Number	17V270219	18Y358442
				Laboratory Sample ID	8804715	9378777
Parameter	**Unit**	**Federal Interim Guideline[1]**		**Preliminary Background Concentrations**		
		Agricultural	**Res / Park**			
Volatile Organic Compounds (VOCs)						
Acetone	mg/L	13	13	-	<0.01	-
Bromodichloromethane	mg/L	8.5	8.5	-	<0.001	-
Bromoform	mg/L	0.38	0.38	-	<0.001	-
Bromomethane	mg/L	0.0056	0.0056	-	<0.001	-
2-Butanone (MEK)	mg/L	150	150	-	<0.01	-
Carbon tetrachloride	mg/L	0.00056	0.00056	-	<0.0005	-
Chlorobenzene	mg/L	0.0013	0.0013	-	<0.001	-
Chloroethane	mg/L	-	-	-	<0.001	-
Chloroform	mg/L	0.0018	0.0018	-	<0.001	-
Chloromethane	mg/L	-	-	-	<0.001	-
Dibromochloromethane	mg/L	0.1	1.1	-	<0.001	-
1,2-Dibromoethane	mg/L	0.00025	0.00025	-	*<0.0003*	-
1,2-Dichlorobenzene	mg/L	0.0007	0.0007	-	<0.0005	-
1,3-Dichlorobenzene	mg/L	0.042	0.042	-	<0.0005	-
1,4-Dichlorobenzene	mg/L	0.026	0.026	-	<0.0005	-
1,1-Dichloroethane	mg/L	0.32	0.32	-	<0.001	-
1,2-Dichloroethane	mg/L	0.005	0.01	-	<0.001	-
1,1-Dichloroethene	mg/L	0.039	0.039	-	<0.001	-
1,2-Dichloroethene (cis)	mg/L	0.0016	0.0016	-	<0.001	-
1,2-Dichloroethene (trans)	mg/L	0.0016	0.0016	-	<0.001	-
1,2-Dichloropropane	mg/L	0.016	0.016	-	<0.001	-
1,3-Dichloropropene [cis]	mg/L	-	-	-	<0.001	-
1,3-Dichloropropene [trans]	mg/L	-	-	-	<0.001	-
Methyl t-Butyl Ether (MTBE)	mg/L	-	-	-	<0.001	-
Methylene Chloride	mg/L	0.05	0.098	-	<0.001	-
4-Methyl-2-pentanone (MIBK)	mg/L	58	58	-	<0.01	-
1,1,1,2-Tetrachloroethane	mg/L	0.0033	0.0034	-	<0.001	-
1,1,2,2-Tetrachloroethane	mg/L	0.0032	0.0032	-	<0.0008	-
Tetrachloroethene	mg/L	0.012	0.012	-	<0.001	-
1,2,4-Trichlorobenzene	mg/L	0.0054	0.0054	-	<0.001	-
1,1,1-Trichloroethane	mg/L	0.64	0.64	-	<0.001	-
1,1,2-Trichloroethane	mg/L	0.0047	0.0047	-	<0.001	-
Trichloroethene	mg/L	0.02	0.02	-	<0.001	-
Trichlorofluoromethane	mg/L	-	-	-	<0.001	-
Trihalomethanes	mg/L	-	-	-	<0.002	-
Vinyl chloride	mg/L	0.0011	0.0011	-	<0.001	-

Notes:

[1] Environment Canada (June 2016). Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites, for fine and coarse textured soil under Agricultural and Residential/Parkland land use

[2] Guideline varies with pH and temperature

[3] Guideline varies with pH

[4] Guideline varies hardness

"-" No applicable guideline or not analyzed

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Table A8-3: Surface Water Anlaytical Results

Parameter	Unit	RDL	CCME - AW (Freshwater) [1]	Environmental Quality Guidelines for Alberta Surface Waters [2]	Discharge Quality Criteria [3]	AEC 8							
						17A8SW1		17A8SW2		17A8SW3		17A8SWDUP1 (17A8SW3)	
						2017-10-03	2017-10-05	2017-10-03	2017-10-05	2017-10-03	2017-10-05	2017-10-03	2017-10-05
Field Parameters													
Field Temperature	℃		NG	NG	NG	5.2	-	5.2	-	5.3	-	-	-
Field pH	pH Units		6.5-9	6.5-9	6.5-9	8.12	-	8.13	-	8.14	-	-	-
Field Conductivity	µS/cm		NG	NG	NG	1437	-	1453	-	1466	-	-	-
Cyanide													
Cyanide (SAD)	mg/L	0.002	NG	NG	NG	-	<0.002	-	<0.002	-	<0.002	-	<0.002
Cyanide (WAD)	mg/L	0.002	NG	NG	NG	-	<0.002	-	<0.002	-	<0.002	-	<0.002
Routine / Salinity													
pH	pH Units	0.01	6.5-9	6.5-9	6.5-9	8.01	-	8.04	-	8.08	-	8.07	-
Electrical Conductivity (EC)	µS/cm	1	NG	NG	NG	1420	-	1420	-	1450	-	1430	-
Total Suspended Solids (TSS)	mg/L	2	NG	NG	7	-	4	-	7	-	5	-	**8**
Total Dissolved Solids (TDS)	mg/L	5	NG	NG	NG	1090	-	1080	-	1090	-	1100	-
Hardness as CaCO3	mg/L	0.1	NG	NG	NG	654	-	654	-	674	-	658	-
Hardness as CaCO3 (Filtered)	mg/L	0.1	NG	NG	NG	-	-	-	-	-	-	-	-
Alkalinity (total as CaCO3)	mg/L	1	NG	NG	NG	125	-	123	-	126	-	127	-
Bromide	mg/L	0.05	NG	NG	NG	<0.05	-	<0.05	-	<0.05	-	<0.05	-
Calcium Carbonate	mg/L	0.05	NG	NG	NG	200	-	200	-	206	-	201	-
Chloride	mg/L	0.05	120	120	366	12.2	-	12.2	-	12.3	-	12.3	-
Fluoride	mg/L	0.02	0.12	NG	2.98	**3.03**	-	**3.04**	-	**3.07**	-	**3.04**	-
Sulphate	mg/L	0.5	NG	309 - 429 [7a]	NG	655	-	653	-	667	-	660	-
Nutrients													
Ammonia	mg/L	0.01	0.019 [4]	0.018 [4]	3.85	-	-	-	-	-	-	-	-
Nitrate (as NO3-N)	mg/L	0.005	13	3	8.9	0.52	-	0.538	-	0.539	-	0.533	-
Nitrite (as NO2-N)	mg/L	0.005	0.06	0.06 - 0.60 [5]	0.18	0.006	-	0.006	-	0.007	-	0.006	-
Nitrogen (Total)	mg/L	0.05	NG	NG	NG	0.78	-	0.71	-	0.75	-	0.72	-
Demand Parameters													
Biochemical Oxygen Demand (BOD)	mg/L	4	NG	NG	NG	-	<4	-	<4	-	4	-	<4
Biological													
Total Coliforms	MPN/100mL	1	NG	NG	NG	57.3	-	68.3	-	222	-	79.4	-
E. Coli	MPN/100mL	1	NG	NG	NG	<1	-	2	-	<1	-	<1	-
Total Metals													
Aluminum	mg/L	0.005	0.1 [6]	0.1 [6]	0.6	0.039	-	0.053	-	0.071	-	0.034	-
Antimony	mg/L	0.0005	NG	NG	NG	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Arsenic	mg/L	0.0001	0.005	0.005	0.013	0.0005	-	0.0007	-	0.0007	-	0.0008	-
Barium	mg/L	0.0005	NG	NG	NG	0.0095	-	0.0095	-	0.009	-	0.0077	-
Beryllium	mg/L	0.00005	NG	NG	NG	<0.005	-	<0.005	-	<0.005	-	<0.005	-
Boron - soluble	mg/L	0.005	1.5	1.5	4.6	**1.52**	-	**1.73**	-	1.09	-	0.981	-
Cadmium	mg/L	0.00001	0.001	0.00026 - 0.077[6]	0.0005	0.00003	-	0.00004	-	0.00004	-	0.00004	-
Chromium	mg/L	0.0005	NG	0.001	0.002	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Cobalt	mg/L	0.00005	NG	0.0025	NG	0.00046	-	0.0005	-	0.00054	-	0.0005	-
Copper	mg/L	0.0005	0.0028 - 0.004 [7]	0.020 - 0.062 [7]	0.006	0.0015	-	0.0014	-	0.0017	-	0.0013	-
Iron	mg/L	0.01	0.3	0.3	3.3	**1.5**	-	**1.79**	-	**2.95**	-	**2.12**	-
Lead	mg/L	0.00005	0.0042 - 0.007 [7]	0.0042 - 0.007 [7]	0.015	0.00007	-	0.00009	-	0.00011	-	0.00006	-
Lithium	mg/L	0.0005	NG	NG	NG	1.24	-	1.32	-	1.02	-	0.818	-
Magnesium	mg/L	0.05	NG	NG	NG	37.5	-	37.6	-	38.8	-	37.8	-
Manganese	mg/L	0.001	NG	NG	NG	0.727	-	0.738	-	0.845	-	0.797	-
Mercury	mg/L	0.00001	0.000026	0.000005	0.000069	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Molybdenum	mg/L	0.0001	0.073	0.073	0.22	0.0027	-	0.0024	-	0.0025	-	0.0025	-
Nickel	mg/L	0.0005	0.1126 - 0.150 [7]	0.570 - 1.52 [7]	0.371	0.0012	-	0.001	-	0.0009	-	0.0009	-
Phosphorus	mg/L	0.005	0.010 - 0.020 [8]	NG	NG	0.008	-	0.008	-	0.009	-	0.009	-
Potassium	mg/L	0.1	NG	NG	NG	3.55	-	3.61	-	3.67	-	3.66	-
Selenium	mg/L	0.0005	0.001	0.001	0.002	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Silver	mg/L	0.00002	0.00025	0.0001	0.0003	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Sodium	mg/L	0.1	NG	NG	NG	77.3	-	77.7	-	79.7	-	78.4	-
Thallium	mg/L	0.00002	0.0008	0.0008	0.0024	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Titanium	mg/L	0.001	NG	NG	NG	0.003	-	0.004	-	0.005	-	0.003	-
Uranium	mg/L	0.00001	0.015	0.015	0.041	0.0111	-	0.00939	-	0.00886	-	0.00861	-
Vanadium	mg/L	0.001	NG	NG	NG	<0.001	-	<0.001	-	<0.001	-	<0.001	-
Zinc	mg/L	0.005	0.03	0.03	0.075	0.014	-	0.016	-	0.025	-	0.02	-
Hydrocarbons													
Benzene	mg/L	0.0005	0.37	0.04	NG	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Volatile Hydrocarbons (VH6-10)	mg/L	0.1	NG	NG	NG	-	-	-	-	-	-	-	-
Toluene	mg/L	0.0005	0.002	0.0005	NG	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Ethylbenzene	mg/L	0.0005	0.09	0.09	NG	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Xylene (m)	mg/L	0.0005	NG	NG	NG	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Xylene (o)	mg/L	0.0005	NG	NG	NG	<0.0005	-	<0.0005	-	<0.0005	-	<0.0005	-
Xylenes Total	mg/L	0.001	NG	0.03	NG	<0.001	-	<0.001	-	<0.001	-	<0.001	-
F1 (C6-C10)	mg/L	0.1	NG	0.15	NG	<0.1	-	<0.1	-	<0.1	-	<0.1	-
TVH: (C6-C10 / BTEX CORRECTED)	mg/L	0.1	NG	0.15	NG	<0.1	-	<0.1	-	<0.1	-	<0.1	-
F2 (C10-C16)	mg/L	0.1	NG	0.11	NG	<0.1	-	<0.1	-	<0.1	-	<0.1	-
F3 TEH: (C16-C34)	mg/L	0.1	NG	NG	NG	<0.1	-	<0.1	-	<0.1	-	<0.1	-
F4: (C34-C50)	mg/L	0.1	NG	NG	NG	<0.1	-	<0.1	-	<0.1	-	<0.1	-
VPHs	mg/L	0.1	NG	NG	NG	-	-	-	-	-	-	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)													
Acenaphthene	mg/L	0.00002	0.0058	0.0058	NG	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Acenaphthylene	mg/L	0.00002	NG	NG	NG	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Acridine	mg/L	0.00005	0.0044	0.0044	NG	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-
Anthracene	mg/L	0.00001	0.000012	0.000012	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Benz(a)anthracene	mg/L	0.00001	0.000018	0.000018	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Benzo(a) pyrene	mg/L	0.00001	0.000015	0.000015	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Benzo(b)fluoranthene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Benzo(b+j)fluoranthene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Benzo(g,h,i)perylene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Benzo(k)fluoranthene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Chrysene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Dibenz(a,h)anthracene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Fluoranthene	mg/L	0.00002	0.00004	0.00004	NG	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Fluorene	mg/L	0.00002	0.003	0.003	NG	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NG	NG	NG	<0.00001	-	<0.00001	-	<0.00001	-	<0.00001	-
Naphthalene	mg/L	0.00005	0.0011	0.001	NG	<0.00005	-	<0.00005	-	<0.00005	-	<0.00005	-
Phenanthrene	mg/L	0.00004	0.0004	0.0004	NG	<0.00004	-	<0.00004	-	<0.00004	-	<0.00004	-
Pyrene	mg/L	0.00002	0.000025	0.000025	NG	<0.00002	-	<0.00002	-	<0.00002	-	<0.00002	-
Quinoline	mg/L	0.0001	0.0034	0.0034	NG	<0.0001	-	<0.0001	-	<0.0001	-	<0.0001	-
Benzo(j)fluoranthene	ug/L	0.01	NG	NG	NG	<0.01	-	<0.01	-	<0.01	-	<0.01	-
Polychlorinated Biphenyls (PCBs)													
Aroclor 1242	mg/L	0.000009	NG	NG	NG	-	<0.000009	-	<0.000009	-	<0.000009	-	<0.000009
Aroclor 1254	mg/L	0.000009	NG	NG	NG	-	<0.000009	-	<0.000009	-	<0.000009	-	<0.000009
Aroclor 1260	mg/L	0.000009	NG	NG	NG	-	<0.000009	-	<0.000009	-	<0.000009	-	<0.000009
PCBs (Sum of total)	mg/L	0.000009	NG	NG	NG	-	<0.000009	-	<0.000009	-	<0.000009	-	<0.000009
					Sample ID	8791074	8804716	8791097	8804727	8791098	8804728	8791099	8804729
					Lab Report Number	17Y268658	17V270284	17Y268658	17V270284	17Y268658	17V270284	17Y268658	17V270284

Notes:

[1] Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG), for the protection of freshwater aquatic life.
[2] Environmental Quality Guidelines for Alberta Surface Waters, July 2014 for the protection of freshwater aquatic life - Guidelines only apply in the absence of CCME EQG.
[3] Flat River Water Quality Objectives. Mackenzie Valley Land and Water Board, 2017.
[4] Guideline is dependant upon the pH value and temperature. The most stringent concentration has been applied.
[5] Guideline is dependant upon the chloride concentration.
[6] Guideline is dependant upon the pH value.
[7] Guideline is based on the Hardness value.
7a Guideline requires a site specific concentration based on Hardness concentration that exceeds the range provided in the guideline.
[8] Guideline shown is based on the typical range of total phosphorous concentrations of a mesotrophic water body.
RDL - Reported Detection Limit
NG - No guideline
mg/L - milligrams per litre.
BOLD Black and Shaded - Concentration exceeds the CCME EWQ for the protection of freshwater aquatic life.
BOLD Red and Shaded - Concentration exceeds the Environmental Quality Guidelines for Alberta Surface Waters for the protection of freshwater aquatic life in the absence of CCME EQG.
BOLD Black, Underline, and Shaded - Concentration exceeds the Discharge Quality Criteria
Italic - Detection limit greater than minimum referenced guideline value
Blank - Not analyzed

Photo 1: Facing southwest at Polishing Pond. (October 5, 2017)

Photo 2: Facing southeast at mine site. Polish Pond visible at the centre of the photo and adjacent to the Flat River. (October 1, 2017)

Photo 3: Facing northeast at mine site. Polishing Pond visible at the right side of image below the access road. (September 28, 2017)

Photo 4: Facing west at mine site. Polishing Pond is located in centre of photo (circled). Photo provided by NATC. (May 29, 2014)

AEC 9

AEC 9: Ditches

Area Description		
Ditch Locations	▪ Pug Road ditch below the Main Portal area ▪ Lower Road near the Polishing Pond ▪ Nahanni Range Road near Area 22 ▪ Upper Mill Access Road down-gradient from AEC 33	
Topography	Follows site topography, generally northeast toward the Flat River.	
Surface Drainage	Various: 17A9SS1 and 17A9SS2 flow south; 17A9SS3, 17A33SS1 and 17A33SS2 flow north.	
Background	AEC 9 consists of various road ditches around site. Ditches discharge to tributaries that eventually flow into Flat River or Polishing Pond. Potential for sediment and water in the ditches to be impacted by land use activities at the AECs or from spills of environmentally hazardous products and liquids.	
Historical Assessment Information		
Previous Phase II Environmental Site Assessment Results (EBA, 2008)	Number of surface soil (sediment) samples	1
	Number of surface water samples	2
	Number of soil (sediment) samples analyzed for metals and petroleum hydrocarbons	1
	Number of soil (sediment) samples with metal impacts	1
	Number of surface water samples with petroleum hydrocarbons impacts	0
Comments: One surface water sample collected from ditch adjacent to and west of access road below the New Tank Farm. One surface water sample and sediment sample collected near the confluence of Sardine Creek and a primary stormwater drainage ditch. Sediment sample had metal concentrations greater than guidelines, but PHCs and glycols less than guidelines. Surface water samples in ditches contained PHCs and PCBs less than guidelines. Surface water samples were analyzed for dissolved metals (not appropriate to evaluate potential risk; need total metals).		
2017 Environmental Site Assessment Details		
Environmental Site Assessment Scope		
Utility Locate SOP followed?		N/A
EM 31 Geophysics Completed?		No
Number of test pits		0
Number of hand augers		0
Number of boreholes		0
Number of soil samples submitted for laboratory analysis		0
Number of boreholes completed as monitoring wells		N/A
Number of existing monitoring wells		N/A
Number of groundwater samples collected		N/A
Number of sediment and surface water samples collected		5 Sediment, 2 Surface Water
Geophysics (EM 31 Apparent Terrain Conductivity) Findings		
N/A		
Soil Investigation and Conditions		
Maximum Depth of Investigation	N/A	

AEC 9: Ditches

Stratigraphy

Description	Depth from (mbgs)	Depth to (mbgs)	Observations
SAND, some gravel	0	0.15	Poorly graded sand, some gravel and occasional small cobbles. Mostly fine to medium sand at 17A9SS2.

Combustible Vapour Concentrations (CVC)

0 ppm in all samples

Groundwater Conditions

Depth to Groundwater	N/A
Free Product	N/A

2017 Environmental Site Assessment Summary

- Figure A9-1 shows sediment testing locations.
- Figure A9-2 shows surface water sample locations.
- Table A9-1 summarizes sediment chemical results relative to guidelines.
- Table A9-2 summarizes surface water chemical results relative to guidelines.

General Site Observations

- Most ditches did not contain water at time of 2017 ESA field program.
- Water in ditch at 17A9SS1 is mine discharge from the Main Portal – tested as part of AEC 46 and AEC UG.

Soil: Petroleum Hydrocarbons (PHCs, PAHs)

N/A

Soil: Metals

N/A

Soil: Other PCOCs

N/A

Groundwater: Petroleum Hydrocarbons

N/A

Groundwater: Metals/Routine Parameters

N/A

Groundwater: Other PCOCs

N/A

Sediment: Petroleum Hydrocarbons (PHCs and PAHs)

- Laboratory results less than guidelines with exception of:
  - Sample 17A9SS1 contained PHCs greater than guidelines.
  - Sample 17A33SS1 contained PHCs greater than guidelines.
  - Sample 17A33SS2 contained PHCs greater than guidelines.

Sediment: Metals

- Various exceedances of guidelines for arsenic, cadmium, copper, and zinc.
- Laboratory results less than guidelines, except for cadmium, copper, and zinc in all samples (17A33SS1, 17A33SS2, 17A9SS1, 17A9SS2, 17A9SS3)

Sediment: Other PCOCs (PAHs and glycols)

- Laboratory results less than the laboratory detection limits and guidelines.

Sediment: Other PCOCs (pH)

- Laboratory result within guidelines.

Surface Water: Petroleum Hydrocarbons (PHCs and PAHs)

- Laboratory results less than the laboratory detection limits and guidelines.

AEC 9: Ditches

Surface Water: Metals/Nutrients

- Laboratory results less than guidelines with exception of:
  - Fluoride at 17A33SW2 equal to the guideline

Surface Water: Other PCOCs (BOD, Routine Parameters)

- Laboratory chemical results less than guidelines.

Grainsize Analysis

N/A

Environmental Concerns

Location in AEC	Potential Source(s)	Identified Contaminated Media	Potential Contaminant(s) of Concern (PCOCs) and Contaminant(s) of Concern (COCs; bold & underline)
Ditches Around Mine	Environmentally hazardous substances seeping into the ditches, spills, and leaching metals.	Sediment and Surface Water	**Sediment: Metals, petroleum hydrocarbons (PHCs)**, glycols, polycyclic aromatic hydrocarbons (PAHs) **Surface Water: Metals, routine parameters,** nutrients, biological oxygen demand (BOD), **petroleum hydrocarbons (PHCs)**, glycols, polycyclic aromatic hydrocarbons (PAHs)

Discussion (Significance of the Results)

Sediment:

- There was no visual indication of PHCs during sample collection; but they were present at three locations.
- PHCs at AEC 33 are likely due to historic fuel spills at the up-gradient ASTs.
- PHCs at 17A9SS1 are likely caused from fuel spills and stained surface soil at AEC 17 located up-gradient from this testing location.
- Glycols and PAHs were not detected and are no longer considered PCOCs in soil at AEC 9.
- Various metals exceeded both CCME and proposed background concentrations. There is likely multiple site-wide sources of metals exceedances that have migrated to the ditch from overland flow at the AECs.

Surface Water:

- Metals and routine parameters met CCME guidelines and Flat River WQOs, with the exception of fluoride which was equal to the guideline value.
- PHCs and PAHs concentrations lower than the laboratory reportable detection limits and are no longer PCOCs in surface water for this AEC.

Further Assessment

- Further assess the PHC impacts identified in sediment.

Attachments

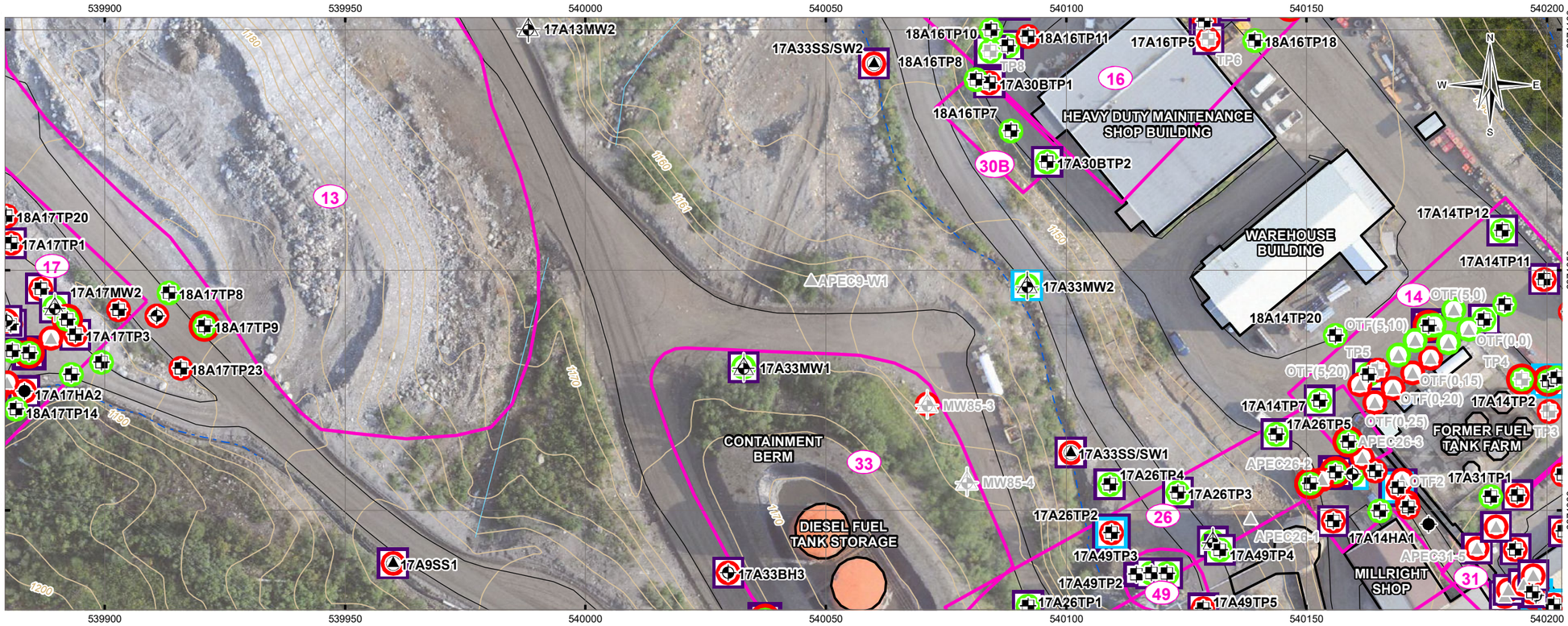
Figure A9-1 – Soil and Sediment Results

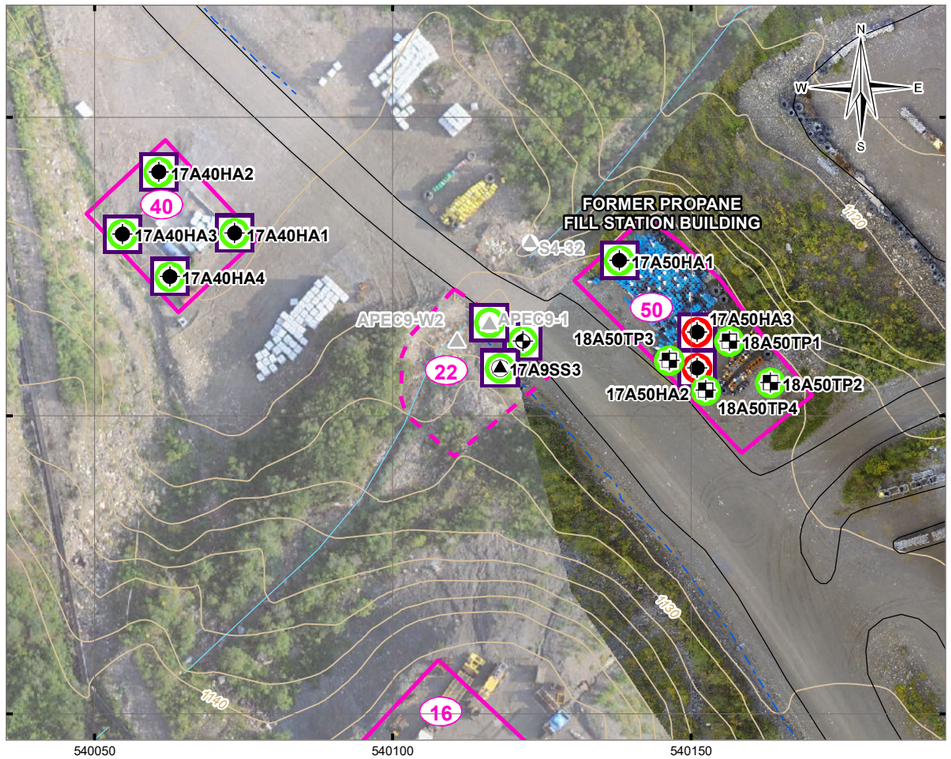
Figure A9-2 – Groundwater and Surface Water Results

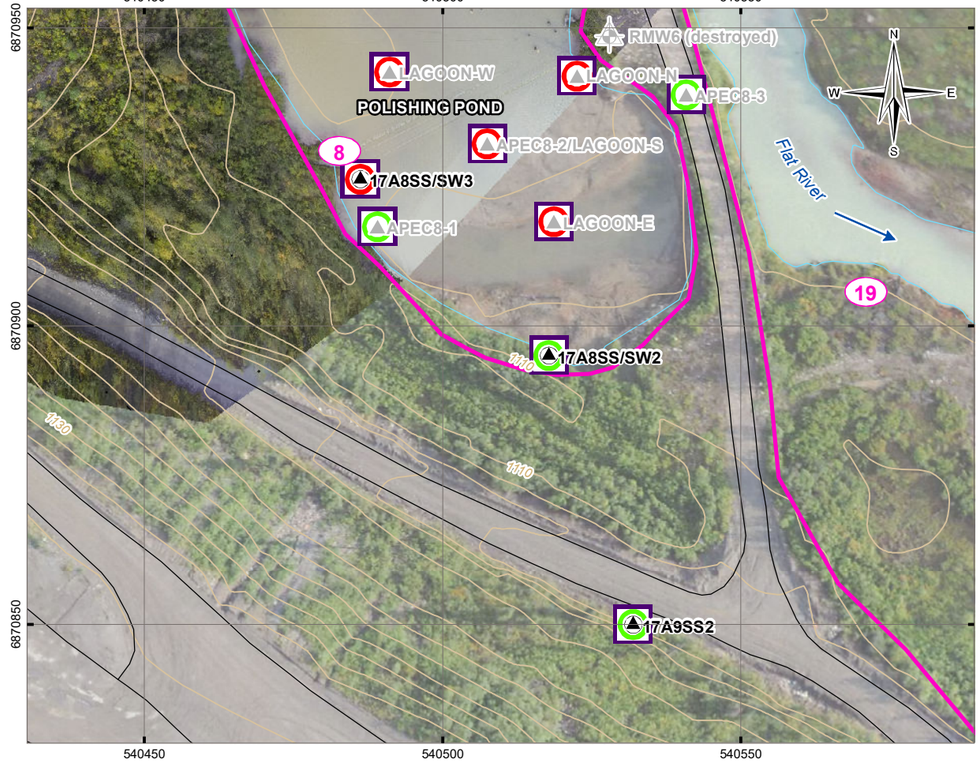
Table A9-1 – Sediment Analytical Results

Table A9-2 – Surface Water Analytical Results

Photographs





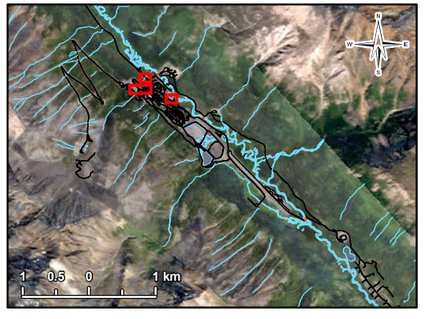


LEGEND

- Area of Environmental Concern (AEC)
- Area
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Historical Monitoring Well
- Historical Testpit
- Historical Shallow Soil Sample
- Historical Surface Water Sample

Soil/Sediment Analytical Results

- PHC Impacts
- PHC Impacts, vertically delineated
- No PHC Impact
- Metals exceedance of preliminary background concentrations, or in the absence of background concentrations, exceedance of CCME guidelines
- Metals exceedance, vertically delineated
- No metals exceedance of CCME guidelines or preliminary background concentrations
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE
PHASE III ESA

AEC 9
Ditches
Soil and Sediment Results

PROJECTION UTM Zone 9	**DATUM** NAD83	**CLIENT** NORTH AMERICAN TUNGSTEN CORPORATION LTD	
Scale: 1:1,000 — 20 10 0 20 — Metres		TETRA TECH	
FILE NO. WENW03039-03_Summary_A9-1.mxd			
OFFICE Tt-VANC	**DWN** SL / **CKD** BB / **APVD** BB / **REV** 0		A9-1
DATE June 22, 2020	**PROJECT NO.** ENW.WENW03039-03		

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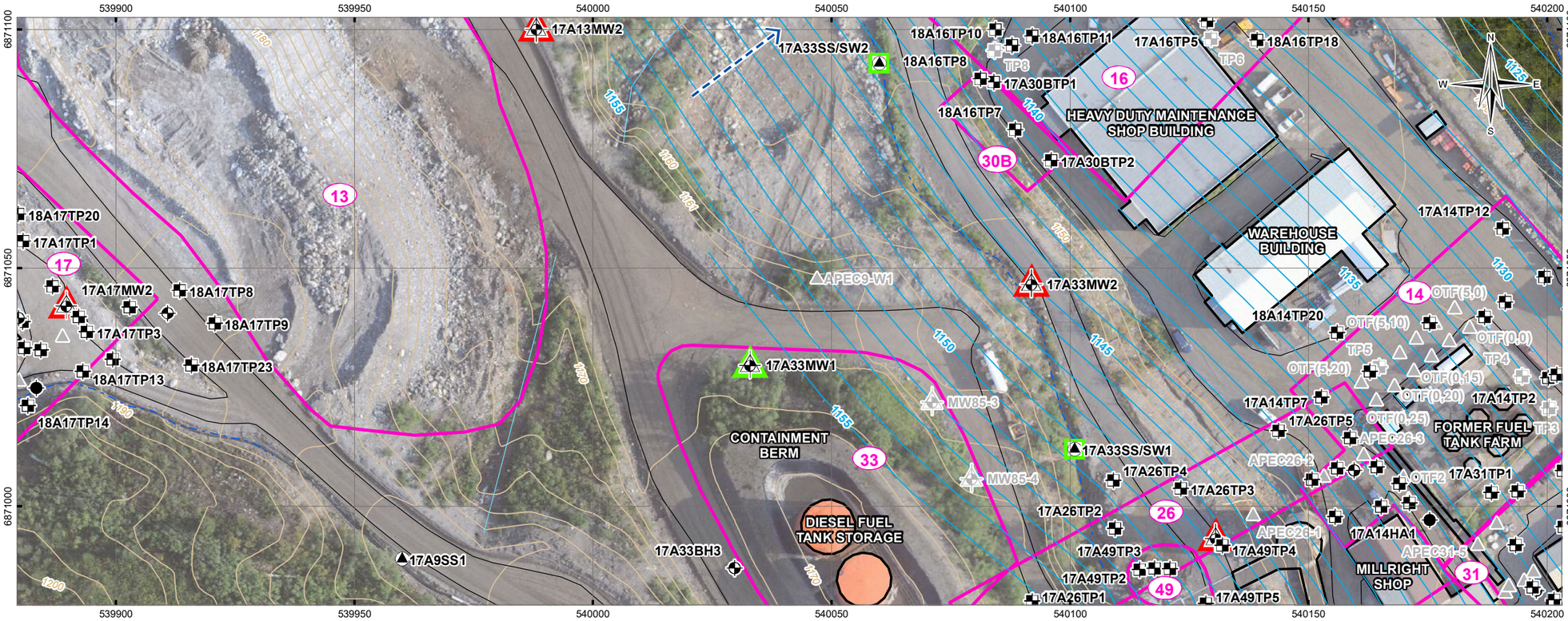
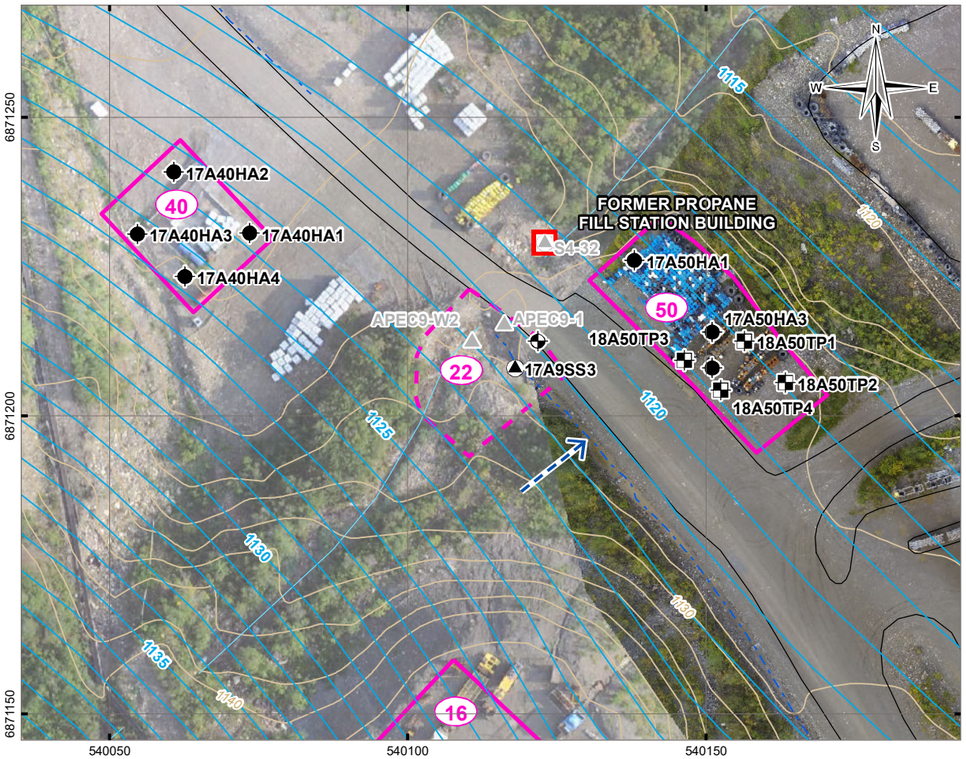
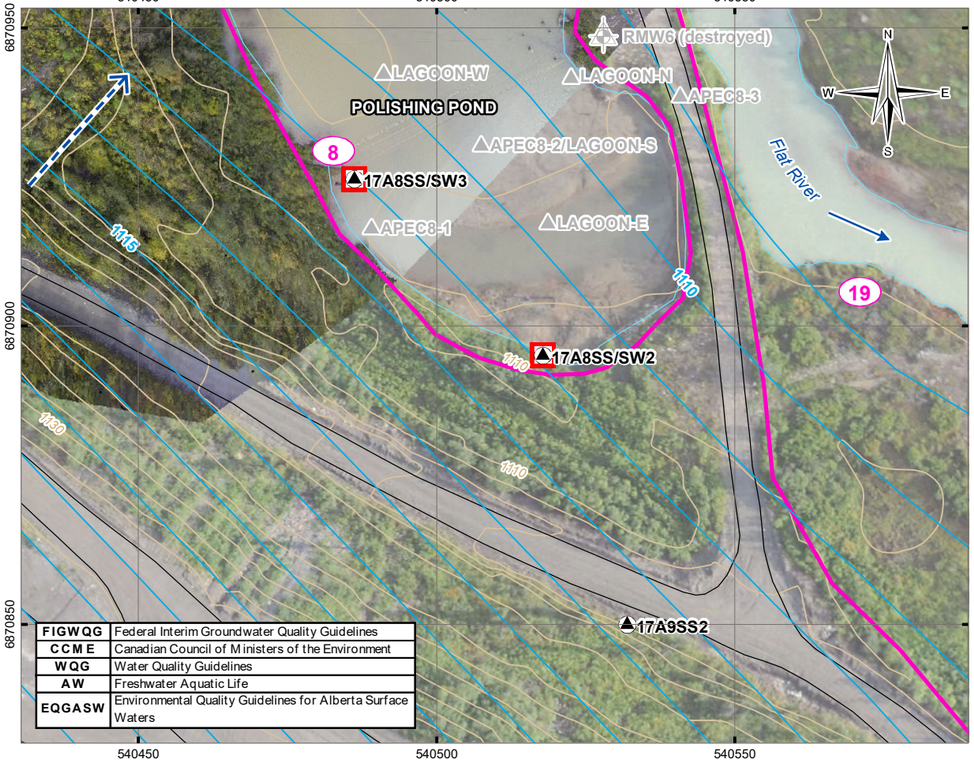






FIGWQG	Federal Interim Groundwater Quality Guidelines
CCME	Canadian Council of Ministers of the Environment
WQG	Water Quality Guidelines
AW	Freshwater Aquatic Life
EQGASW	Environmental Quality Guidelines for Alberta Surface Waters

LEGEND

- Area of Environmental Concern (AEC) Area
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Historical Monitoring Well
- Historical Testpit
- Historical Shallow Soil Sample
- Historical Surface Water Sample
- Inferred Groundwater Flow Direction
- Groundwater Contour (1 m asl; Fall 2017)

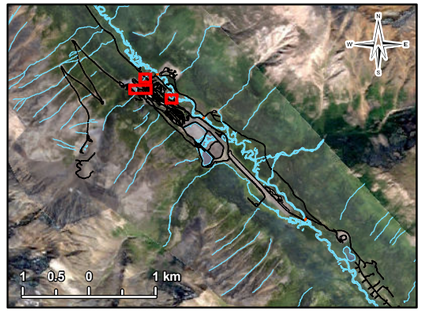
2017/2018 Groundwater Analytical Results

- Samples contain parameters that exceeded the preliminary background concentrations, or in the absence of background concentrations, FIGWQG
- Samples contain parameters that met the preliminary background concentrations, or in the absence of background concentrations, FIGWQG

2018 Surface Water Analytical Results

- Samples contain parameters that met the Flat River WQOs, or in the absence of WQOs, CCME WQG for the protection of AW or EQGASW
- Samples contain parameters that met the Flat River WQOs, or in the absence of WQOs, CCME WQG for the protection of AW or EQGASW

- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 9 Ditches Groundwater and Surface Water Results

PROJECTION: UTM Zone 9	DATUM: NAD83				CLIENT: NORTH AMERICAN TUNGSTEN CORPORATION LTD
Scale: 1:1,000 (20 10 0 20 Metres)					TETRA TECH
FILE NO.: WENW03039-03_Summary_A9-2.mxd					
OFFICE: Tt-VANC	DWN: SL	CKD: BB	APVD: SS	REV: 0	A9-2
DATE: June 22, 2020	PROJECT NO.: ENW.WENW03039-03				

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Table A9-1: Sediment Analytical Results

Parameter	Unit	Canada Wide PHC - Res/Park Coarse[1]	Canada Wide PHC - Agricultural Coarse[1]	CCME Sediment - Fresh ISQG[2]	CCME Sediment - Fresh PEL[3]	Proposed Preliminary Background Concentration for Flat River	AEC 33		AEC 9		
							17A33SS1	17A33SS2	17A9SS1	17A9SS2	17A9SS3
							2017-10-05	2017-10-05	2017-10-05	2017-10-05	2017-10-05
						Sediment Type	Sand, gravelly, grey	Sand, gravelly, grey	Sand, some gravel, grey	Sand, medium, dark grey	Sand, trace gravel, brown
Routine / Salinity											
pH	pH Units	NG	NG	NG	NG	-	7.79	7.77	8.13	7.98	8.26
Moisture	%	NG	NG	NG	NG	-	37.7	25.6	16.7	17.2	9.78
Nutrients											
Nitrogen (Total)	%	NG	NG	NG	NG	-	-	-	-	-	-
Metals											
Antimony	mg/kg	NG	NG	NG	NG	-	3.2	0.9	1.2	3.3	3.0
Arsenic	mg/kg	NG	NG	5.9	17	56.7	**25.7**	**14.1**	**14.2**	**21.9**	**26.5**
Barium	mg/kg	NG	NG	NG	NG	-	288	643	686	2720	3270
Beryllium	mg/kg	NG	NG	NG	NG	-	3.7	1.3	1.3	0.8	0.7
Cadmium	mg/kg	NG	NG	0.6	3.5	1.04	**7.05**	**3.17**	**2.39**	**2.98**	**2.51**
Chromium	mg/kg	NG	NG	37.3	90	-	25	16	21	21	21
Cobalt	mg/kg	NG	NG	NG	NG	-	35.3	14.9	17.2	16.5	13.4
Copper	mg/kg	NG	NG	35.7	197	39.8	**1700**	**693**	**526**	**218**	**183**
Lead	mg/kg	NG	NG	35	91.3	-	29.4	12.2	13.8	19.9	16.5
Mercury	mg/kg	NG	NG	0.17	0.486	-	**3.1**	**1.8**	**1.16**	**0.71**	**0.51**
Molybdenum	mg/kg	NG	NG	NG	NG	-	9.1	4.4	5.4	6.5	5.7
Nickel	mg/kg	NG	NG	NG	NG	-	39.6	18.9	27.3	53.6	54.6
Phosphorus	mg/kg	NG	NG	NG	NG	-	-	-	-	-	-
Selenium	mg/kg	NG	NG	NG	NG	-	5.3	2.2	2.2	1.9	1.6
Silver	mg/kg	NG	NG	NG	NG	-	1.5	<0.5	<0.5	<0.5	<0.5
Thallium	mg/kg	NG	NG	NG	NG	-	0.9	0.4	0.4	0.4	0.3
Tin	mg/kg	NG	NG	NG	NG	-	9.4	3.5	2.8	1.3	0.9
Uranium	mg/kg	NG	NG	NG	NG	-	3.3	2.3	3.1	2.3	1.6
Vanadium	mg/kg	NG	NG	NG	NG	-	73	34	59	79	62
Zinc	mg/kg	NG	NG	123	315	202	**738**	**315**	**278**	**343**	**313**
Hydrocarbons											
Benzene	mg/kg	NG	NG	NG	NG	-	<0.005	<0.005	<0.005	<0.005	<0.005
Toluene	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
Ethylbenzene	mg/kg	NG	NG	NG	NG	-	<0.01	<0.01	<0.01	<0.01	<0.01
Xylene (m)	mg/kg	NG	NG	NG	NG	-	<0.02	<0.02	<0.02	<0.02	<0.02
Xylene (o)	mg/kg	NG	NG	NG	NG	-	<0.02	<0.02	<0.02	<0.02	<0.02
Xylenes Total	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
F1 (C6-C10)	mg/kg	NG	NG	NG	NG	-	<10	<10	<10	<10	<10
F1 (C6-C10 / BTEX CORRECTED)	mg/kg	30	130	NG	NG	-	<10	<10	<10	<10	<10
F2 (C10-C16)	mg/kg	150	150	NG	NG	-	26	<20	<20	<20	<20
F3 (C16-C34)	mg/kg	300	1300	NG	NG	-	***948***	***632***	***392***	88	122
F4: (C34-C50)	mg/kg	2800	5600	NG	NG	-	536	346	240	67	71
Glycols											
Diethylene glycol	mg/kg	NG	NG	NG	NG	-	<10	<10	<10	-	-
Ethylene glycol	mg/kg	NG	NG	NG	NG	-	<10	<10	<10	-	-
Propylene glycol	mg/kg	NG	NG	NG	NG	-	<10	<10	<10	-	-
Tetraethylene Glycol	mg/kg	NG	NG	NG	NG	-	<10	<10	<10	-	-
Triethylene Glycol	mg/kg	NG	NG	NG	NG	-	<10	<10	<10	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)											
IACR (CCME)	mg/kg	NG	NG	NG	NG	-	<0.6	<0.6	<0.6	<0.6	<0.6
B(a)P Total Potency Equivalent	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
1-Methylnaphthalene	mg/kg	NG	NG	NG	NG	-	<0.005	<0.005	<0.005	<0.005	<0.005
2-methylnaphthalene	mg/kg	NG	NG	0.0202	0.201	-	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthene	mg/kg	NG	NG	0.00671	0.0889	-	<0.005	<0.005	<0.005	<0.005	<0.005
Acenaphthylene	mg/kg	NG	NG	0.00587	0.128	-	<0.005	<0.005	<0.005	<0.005	<0.005
Anthracene	mg/kg	NG	NG	0.0469	0.245	-	<0.004	<0.004	<0.004	<0.004	<0.004
Benz(a)anthracene	mg/kg	NG	NG	0.0317	0.385	-	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(a) pyrene	mg/kg	NG	NG	0.0319	0.782	-	<0.03	<0.03	<0.03	<0.03	<0.03
Benzo(b)fluoranthene	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(b+j)fluoranthene	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(g,h,i)perylene	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
Benzo(k)fluoranthene	mg/kg	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
Chrysene	mg/kg	NG	NG	0.0571	0.862	-	<0.05	<0.05	<0.05	<0.05	<0.05
Dibenz(a,h)anthracene	mg/kg	NG	NG	0.00622	0.135	-	<0.005	<0.005	<0.005	<0.005	<0.005
Fluoranthene	mg/kg	NG	NG	0.111	2.355	-	<0.01	<0.01	<0.01	<0.01	<0.01
Fluorene	mg/kg	NG	NG	0.0212	0.144	-	<0.02	<0.02	<0.02	<0.02	<0.02
Indeno(1,2,3-c,d)pyrene	mg/kg	NG	NG	NG	NG	-	<0.02	<0.02	<0.02	<0.02	<0.02
Naphthalene	mg/kg	NG	NG	0.0346	0.391	-	<0.005	<0.005	<0.005	<0.005	<0.005
Phenanthrene	mg/kg	NG	NG	0.0419	0.515	-	<0.02	<0.02	<0.02	<0.02	<0.02
Pyrene	mg/kg	NG	NG	0.053	0.875	-	0.01	<0.01	<0.01	<0.01	<0.01
Benzo(j)fluoranthene	ug/g	NG	NG	NG	NG	-	<0.05	<0.05	<0.05	<0.05	<0.05
						Sample Code	8806713	8806714	8806715	8806716	8806717
						Lab Report Number	17V270515	17V270515	17V270515	17V270515	17V270515

Notes:

[1] - Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards for Petroleum Hydrocarbons (PHC) in Soil (CCME 2008)

[2] - Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life - Interim Sediment Quality Guidelines (ISQG) for Freshwater (CCME 1999)

[3] - Canadian Council of Ministers of the Environment (CCME) Sediment Quality Guidelines for the Protection of Aquatic Life - Probable Effect Level (PEL) for Freshwater (CCME 1999)

Italic - Laboratory detection limit is greater than Tier 1 guideline

NG - No guideline

Bold and Underline - Exceeds CCME ISQG

Bold and Shaded - Exceeds CCME PEL and ISQG

Bold - Exceeds CCME Canada-Wide Standards for Petroleum Hydrocarbon Guideline

Red - Exceeds proposed preliminary background concentration for Flat River sediment

Italic and Underline - pH value greater than Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health

N/A - Not applicable

"-" Not analyzed

Cyanide (SAD) - Strong Acid Dissociable

Cyanide (WAD) - Weak Acid Dissociable

Table A9-2: Surface Water Anlaytical Results

Parameter	Unit	RDL	CCME - AW (Freshwater) [1]	Environmental Quality Guidelines for Alberta Surface Waters [2]	Flat River Water Quality Objectives [3]	A9 / A33	
						17A33SW1	17A33SW2
						2017-10-05	2017-10-05
Field Parameters							
Field Temperature	℃	-	NG	NG	NG	2.6	3.0
Field pH	pH Units	-	6.5-9	6.5-9	6.5-9	7.99	8.09
Field Conductivity	µS/cm	-	NG	NG	NG	456	462
Routine / Salinity							
pH	pH Units	0.01	6.5-9	6.5-9	6.5-9	7.87	7.92
Electrical Conductivity (EC)	µS/cm	1	NG	NG	NG	455	460
Total Suspended Solids (TSS)	mg/L	2	NG	NG	6	<2	<2
Total Dissolved Solids (TDS)	mg/L	5	NG	NG	NG	275	280
Hardness as CaCO3	mg/L	0.1	NG	NG	NG	243	244
Hardness as CaCO3 (Filtered)	mg/L	0.1	NG	NG	NG	-	-
Alkalinity (total as CaCO3)	mg/L	1	NG	NG	NG	122	114
Bromide	mg/L	0.05	NG	NG	NG	<0.05	<0.05
Chloride	mg/L	0.05	120	120	NG	0.26	0.28
Fluoride	mg/L	0.02	0.12	NG	NG	0.11	0.12
Sulphate	mg/L	0.5	NG	309 - 429	NG	117	127
Nutrients							
Ammonia	mg/L	0.01	1.04	1.04	1.27	-	-
Nitrate (as NO3-N)	mg/L	0.005	13	3	3	0.268	0.26
Nitrite (as NO2-N)	mg/L	0.005	0.06	0.06 - 0.60 [5]	0.06	<0.005	<0.005
Nitrogen (Total)	mg/L	0.05	NG	NG	NG	-	-
Demand Parameters							
Biochemical Oxygen Demand (BOD)	mg/L	4	NG	NG	NG	<4	<4
Total Metals							
Aluminum	mg/L	0.005	0.1 [6]	0.1 [6]	0.3	0.015	0.012
Antimony	mg/L	0.0005	NG	NG	NG	<0.0005	<0.0005
Arsenic	mg/L	0.0001	0.005	0.005	0.005	0.0006	0.0005
Barium	mg/L	0.0005	NG	NG	NG	0.0067	0.0084
Beryllium	mg/L	0.00005	NG	NG	NG	<0.00005	<0.00005
Boron - soluble	mg/L	0.005	1.5	1.5	1.5	<0.005	<0.005
Cadmium	mg/L	0.00001	0.001	0.00026 - 0.077 [6]	0.00035	<0.00001	0.00002
Chromium	mg/L	0.0005	NG	0.001	0.001	<0.0005	<0.0005
Cobalt	mg/L	0.00005	NG	0.0025	NG	<0.00005	<0.00005
Copper	mg/L	0.0005	0.0028 - 0.004 [7]	0.020 - 0.062 [7]	0.0042	<0.0005	<0.0005
Iron	mg/L	0.01	0.3	0.3	1.3	0.086	0.047
Lead	mg/L	0.00005	0.0042 - 0.007 [7]	0.0042 - 0.007 [7]	0.005	<0.00005	<0.00005
Lithium	mg/L	0.0005	NG	NG	NG	0.0056	0.005
Magnesium	mg/L	0.05	NG	NG	NG	14.9	14.9
Manganese	mg/L	0.001	NG	NG	NG	<0.001	<0.001
Mercury	mg/L	0.00001	0.000026	0.000005	0.000026	<0.00001	<0.00001
Molybdenum	mg/L	0.0001	0.073	0.073	0.073	0.0007	0.0006
Nickel	mg/L	0.0005	0.1126 - 0.150 [7]	0.570 - 1.52 [7]	0.125	<0.0005	<0.0005
Phosphorus	mg/L	0.005	0.004 - 0.010 [8]	NG	NG	-	-
Potassium	mg/L	0.1	NG	NG	NG	1.4	1.41
Selenium	mg/L	0.0005	0.001	0.001	0.001	<0.0005	<0.0005
Silver	mg/L	0.00002	0.00025	0.0001	NG	<0.00002	<0.00002
Sodium	mg/L	0.1	NG	NG	NG	1.13	1.04
Thallium	mg/L	0.00002	0.0008	0.0008	0.0008	<0.00002	<0.00002
Titanium	mg/L	0.001	NG	NG	NG	0.001	0.001
Uranium	mg/L	0.00001	0.015	0.015	0.015	0.00162	0.00151
Vanadium	mg/L	0.001	NG	NG	NG	<0.001	<0.001
Zinc	mg/L	0.005	0.03	0.03	0.03	<0.005	<0.005
Hydrocarbons							
Benzene	mg/L	0.0005	0.37	0.04	NG	<0.0005	<0.0005
Volatile Hydrocarbons (VH6-10)	mg/L	0.1	NG	NG	NG	-	-
Toluene	mg/L	0.0005	0.002	0.0005	NG	<0.0005	<0.0005
Ethylbenzene	mg/L	0.0005	0.09	0.09	NG	<0.0005	<0.0005
Xylene (m)	mg/L	0.0005	NG	NG	NG	<0.0005	<0.0005
Xylene (o)	mg/L	0.0005	NG	NG	NG	<0.0005	<0.0005
Xylenes Total	mg/L	0.001	NG	0.03	NG	<0.001	<0.001
F1 (C6-C10)	mg/L	0.1	NG	0.15	NG	<0.1	<0.1
TVH: (C6-C10 / BTEX CORRECTED)	mg/L	0.1	NG	0.15	NG	<0.1	<0.1
F2 (C10-C16)	mg/L	0.1	NG	0.11	NG	<0.1	<0.1
TEH: (C16-C34)	mg/L	0.1	NG	NG	NG	<0.1	<0.1
F4: (C34-C50)	mg/L	0.1	NG	NG	NG	<0.1	<0.1
VPHs	mg/L	0.1	NG	NG	NG	-	-
Polycyclic Aromatic Hydrocarbons (PAHs)							
Acenaphthene	mg/L	0.00002	0.0058	0.0058	NG	<0.00002	<0.00002
Acenaphthylene	mg/L	0.00002	NG	NG	NG	<0.00002	<0.00002
Acridine	mg/L	0.00005	0.0044	0.0044	NG	<0.00005	<0.00005
Anthracene	mg/L	0.00001	0.000012	0.000012	NG	<0.00001	<0.00001
Benz(a)anthracene	mg/L	0.00001	0.000018	0.000018	NG	<0.00001	<0.00001
Benzo(a) pyrene	mg/L	0.00001	0.000015	0.000015	NG	<0.00001	<0.00001
Benzo(b)fluoranthene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Benzo(b+j)fluoranthene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Benzo(g,h,i)perylene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Benzo(k)fluoranthene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Chrysene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Dibenz(a,h)anthracene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Fluoranthene	mg/L	0.00002	0.00004	0.00004	NG	<0.00002	<0.00002
Fluorene	mg/L	0.00002	0.003	0.003	NG	<0.00002	<0.00002
Indeno(1,2,3-c,d)pyrene	mg/L	0.00001	NG	NG	NG	<0.00001	<0.00001
Naphthalene	mg/L	0.00005	0.0011	0.001	NG	<0.00005	<0.00005
Phenanthrene	mg/L	0.00004	0.0004	0.0004	NG	<0.00004	<0.00004
Pyrene	mg/L	0.00002	0.000025	0.000025	NG	<0.00002	<0.00002
Quinoline	mg/L	0.0001	0.0034	0.0034	NG	<0.0001	<0.0001
Benzo(j)fluoranthene	ug/L	0.01	NG	NG	NG	<0.01	<0.01
Volatile Organic Compounds (VOCs)							
Calcium Carbonate	mg/L	0.05	NG	NG	NG	72.7	73.3
					Sample ID	8804735	8804741
					Lab Report Number	17V270284	17V270284

Notes:

[1] Canadian Council of Ministers of the Environment (CCME) Environmental Quality Guidelines (EQG), for the protection of freshwater aquatic life.
[2] Environmental Quality Guidelines for Alberta Surface Waters, July 2014 for the protection of freshwater aquatic life - Guidelines only apply in the absence of CCME EQG.
[3] Flat River Water Quality Objectives. Mackenzie Valley Land and Water Board, 2017.
[4] Guideline is dependant upon the pH value and temperature. The most stringent concentration has been applied.
[5] Guideline is dependant upon the chloride concentration.
[6] Guideline is dependant upon the pH value.
[7] Guideline is based on the Hardness value.
[8] Guideline shown is based on the typical range of total phosphorous concentrations of a oligatrophic water body.
RDL - Reported Detection Limit
NG - No guideline
mg/L - milligrams per litre.
BOLD Black and Shaded - Concentration exceeds the CCME EWQ for the protection of freshwater aquatic life.
BOLD Red and Shaded - Concentration exceeds the Environmental Quality Guidelines for Alberta Surface Waters for the protection of freshwater aquatic life in the absence of CCME EQG.
BOLD Black, Underline, and Shaded - Concentration exceeds the Flat River Water Quality Objectives
Italic - Detection limit greater than minimum referenced guideline value
Blank - Not analyzed

Photo 1: Stream near Recreation Centre.
(October 3, 2017)

Photo 2: Ditch outside of Main Portal.
(October 3, 2017)

Photo 3: Facing southeast. Culvert 16 – see Figure 5-6. (October 5, 2017)

Photo 4: Facing northwest, upstream of ditch 13&14 – see Figure 5-6. (October 5, 2017)

AEC 10

AEC 10: Historical Staining Near Powerhouse and Powerhouse Sump

Area Description		
Location	Northeast of the Mill Building and north and west of the Power Generator.	
Topography	Generally flat with a slight slope to the northeast.	
Surface Drainage	Northeast	
Background	The Powerhouse provides electricity for the Mine by converting diesel fuel to electricity using generators. The Powerhouse is also used to heat a loop of glycol lines that provide heat to some of the buildings located in the Mine. Stained surface soils have been historically observed adjacent to the southeast of the Powerhouse Building. A sump is located in the Powerhouse, near the northeast wall of the building.	
Historical Assessment Information		
Previous Phase II Environmental Site Assessment Results (EBA, 2008)	Number of test pits	1
	Number of surface soil samples	5
	Number of soil samples analyzed	6
	Number of soil samples with petroleum hydrocarbon impacts	6
	Number of soil samples with metal impacts	5
Comments: Five PHC surface stain sites (APEC 11A) sampled by EBA (2008) are now captured within AEC 10 (APEC11A-E, APEC11A-N, APEC 11A-1B, APEC11A-W, and APEC11-7). All soil samples exceeded PHC guidelines, and all soil samples (except APEC11-7) exceeded metal guidelines. Groundwater was not assessed in these areas during the study.		
2017/2018 Environmental Site Assessment Details		
Environmental Site Assessment Scope		
Utility Locate SOP followed?		Yes
EM 31 geophysics complete?		Yes
Number of test pits advanced		3 (2017); 6 (2018)
Number of boreholes advanced		1
Number of hand auger locations advanced		0
Number of soil samples submitted for laboratory chemical analysis		7 (2017), 13 (2018)
Number of boreholes completed as groundwater monitoring wells		0
Number of historical groundwater monitoring wells		0
Number of groundwater samples collected		N/A
Number of sediment and surface soil samples collected		0
Geophysics (EM 31 Apparent Terrain Conductivity) Survey		
▪ Survey was completed from the Powerhouse to the Heavy Duty Maintenance Shop Building (see Figure A10-3). ▪ Background apparent terrain conductivity values generally between 5 to 20 mS/m (represented by cool colours on Figure A10-3). ▪ Areas of higher-than-background apparent terrain conductivity values indicated by the warm colours shown on Figure A10-3). ▪ Areas with data affected by buried cables and utilidors marked with a thick black rectangle. ▪ Areas with negative and higher than background apparent terrain conductivity values are consistent with data caused by surface metals and utilities. ▪ Negative (pink) apparent terrain conductivity values are possibly caused by concrete made with rebar on the surface. ▪ Conductive (red) values are possibly caused by surface metal or conductive pore fluids due to leaching.		

AEC 10: Historical Staining Near Powerhouse and Powerhouse Sump

Soil Investigation and Conditions			
Maximum Depth of Investigation	12.2 mbgs (September 23, 2017)		
General Stratigraphy			
Description	**Depth from (mbgs)**	**Depth to (mbgs)**	**Observations**
Layered sand, silt, gravel, and cobbles	0	3.9	Fill soil. Petroleum hydrocarbon staining and odour observed in 17A10BH1, 17A10TP3 and 18A10TP6.
Layered silt, sand, and gravel	3.9	12.2	Native soil. Petroleum hydrocarbon staining and odour observed in 17A10BH1 (9.5 – 11.0 mbgs).
Combustible Vapour Concentrations (CVC)			
Ranged from less than 10 parts per million by volume (ppmv) to 291 ppmv (soil sample 17A10BH1-2)			
Groundwater Conditions			
Depth to Groundwater	N/A		
Free Product	N/A		

2017/2018 Environmental Site Assessment Results Summary

- Figure A10-1 shows the borehole and test pit locations.
- Figure A10-2 shows groundwater lab results from neighbouring AEC 32 and the inferred direction of groundwater flow.
- Table A10-1 summarizes soil chemical results relative to guidelines and management limits.

General Site Observations

- No obvious surface stains were observed at the AEC.
- PHC staining observed in 17A10TP3 at a depth of 0.25 mbgs.
- Slight hydrocarbon odour was observed at 18A10TP3 from 0.15 to 0.9 mbgs.
- PHC staining observed in 17A10BH1 at a depth of 9.5 mbgs and at 17A10BH2 at a depth of 13.55 mbgs.
- Sump partially filled with liquid at the time of the assessment, and the integrity could not be assessed.

Soil: Petroleum Hydrocarbons (PHCs)

2017

- Laboratory results less than guidelines with exception of:
  - Sample 17A10BH1-2 at a depth of 10.5 mbgs contained PHCs greater than the CCME/CSR guidelines.
  - Sample 17A10TP2-1 at a depth of 0.25 mbgs contained PHCs greater than g the CCME/CSR guidelines.

2018

- Three test pits 18A10TP4 to 18A10TP6 were excavated at approximately 6 to 7 m step-out distances from 2008 soil sample APEC11-7 to delineate the PHC management limit exceedance found at 0.2 mbgs. Laboratory results from the two soil samples tested for PHCs F2-F4 at each of the three test pit locations were less than the management limits.

Soil: Metals

2017

- Various exceedances of CCME CEQGs for arsenic, barium, cadmium, copper, molybdenum, nickel, selenium, and zinc.
- Copper exceeded CCME CEQG in 17A10TP2 at 1.0 mbgs, 17A10TP3 at 2.0 and 3.0 mbgs.
- The following parameters exceeded preliminary background concentrations:
  - Arsenic (17A10TP3 at 3.0 mbgs).
  - Barium (17A10TP1 at 1.0 mbgs, 17A10TP3 at 2.0 and 3.0 mbgs).
  - Cadmium (17A10TP3 at 2.0 and 3.0 mbgs).
  - Nickel (17A10TP3 at 2.0 mbgs).

AEC 10: Historical Staining Near Powerhouse and Powerhouse Sump

- Selenium (17A10TP2 at 0.25 mbgs and 17A10TP3 at 3.0 mbgs).
- Zinc (17A10TP3 at 2.0 mbgs).

2018

(see discussion of risk-based metals delineation by Risk Management Unit (RMU) in report Appendix H)

Soil: Other PCOCs (glycols, PAHs, PCBs, VOCs)

- Laboratory results less than detection limits and/or guidelines.

Soil: Routine (pH)

- Laboratory results within guidelines with exception of:
  - Sample 17A10BH1-1 at a depth of 1.97 mbgs - pH value outside guideline range.

Groundwater: Petroleum Hydrocarbons

N/A

Groundwater: Metals/Routine Parameters

N/A

Groundwater: Other PCOCs

N/A

Sediment: Petroleum Hydrocarbons

N/A

Sediment: Metals

N/A

Sediment: Other PCOCs

N/A

Surface Water: Petroleum Hydrocarbons

N/A

Surface Water: Metals/Nutrients

N/A

Surface Water: Other PCOCs

N/A

Grain size Analysis

- Soil sample 17A10TP2-1 at a depth of 0.25 mbgs classified as coarse-grained (75% >75 µm).
- Soil sample 17A10TP3-3 at a depth of 2.0 mbgs classified as coarse-grained (87% >75 µm).
- Soil sample 18A10TP4-3 at a depth of 1.0 mbgs classified as coarse-grained (74% >75 µm).

Environmental Concerns

Location in AEC	Potential Source(s)	Identified Contaminated Media	Parameters Assessed and Contaminant(s) of Concern (COCs; bold & underline)
Area southeast and northeast of the Powerhouse	Releases from chemicals stored at Powerhouse and leaks from sum	Soil; groundwater (investigated as part of AEC 32 assessment)	**Soil: <u>metals, petroleum hydrocarbons (PHCs)</u>**, glycols, **<u>polycyclic aromatic hydrocarbons (PAHs),</u>** volatile organic compounds (VOCs).

Discussion (Significance of the Results)

<u>Soils:</u>

- There appear to be two separate intervals of PHC impacts:
  - A deeper PHC affected area near the Powerhouse (observed between depths of 9.5 and 11.0 mbgs); and
  - A shallow PHC affected area associated with fill soil.
- The deep impacts identified were also encountered at AEC 32 (Powerhouse Fuel Storage), located adjacent southeast of AEC 10. These results suggest that the depth impacts at AEC 10 and 32 are related.
- The deep PHC impacts measured in borehole 17A10BH1 were vertically delineated. Based on AEC 32 results, the estimated average thickness of deep PHC impacts at AEC 10 and AEC 32 is 2.5 m.

AEC 10: Historical Staining Near Powerhouse and Powerhouse Sump

- The shallow PHC impact measured in test pit 17A10TP2 was not vertically delineated, however based on visual observations appears to be limited to a depth of 1.0 mbgs.
- Soil found to exceed the PHC management limits at APEC11-7 has been horizontally delineated. Given that the exceedance is associated with a surficial stain, the estimated depth of PHC impacts greater than the management limits used to calculate the contaminated soil volume is 0.5 mbgs.
- Glycols, PCB, PAH, and VOC values did not exceed guidelines and are no longer considered PCOCs in soil at this AEC.
- Multiple metals exceeded CCME CEQGs and preliminary background concentrations.
- Lowest metals concentrations in sample from borehole 17A10BH1.
- Highest metals concentrations and most exceedances in samples from 17A10TP2 and 17A10TP3.

Attachments

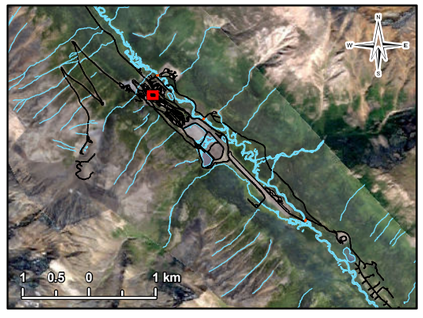
Figure A10-1 – Soil Results
Figure A10-2 – Powerhouse Groundwater and Surface Water Results
Figure A10-3 – AEC 10 Powerhouse EM31 Apparent Terrain Conductivity Survey
Table A10-1 – Soil Analytical Results
Borehole and Test pit Logs
Photographs

LEGEND

- Area of Environmental Concern (AEC)
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- Historical Testpit
- Historical Shallow Soil Sample

Soil/Sediment Analytical Results

- PHC Impacts
- PHC Impacts, vertically delineated
- No PHC Impact
- Metals exceedance of preliminary background concentrations, or in the absence of background concentrations, exceedance of CCME guidelines
- Metals exceedance, vertically delineated
- No metals exceedance of CCME guidelines or preliminary background concentrations
- Building
- Road
- Ditch
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 10
Power House
Soil and Sediment Results

PROJECTION UTM Zone 9	**DATUM** NAD83	**CLIENT** NORTH AMERICAN TUNGSTEN CORPORATION LTD	
Scale: 1:400 (5 2.5 0 5 Metres)		TETRA TECH	
FILE NO. WENW03039-03_Summary_A10-1.mxd			
OFFICE Tt-VANC	**DWN** SL / **CKD** BB / **APVD** BB / **REV** 0		A10-1
DATE June 22, 2020	**PROJECT NO.** ENW.WENW03039-03		

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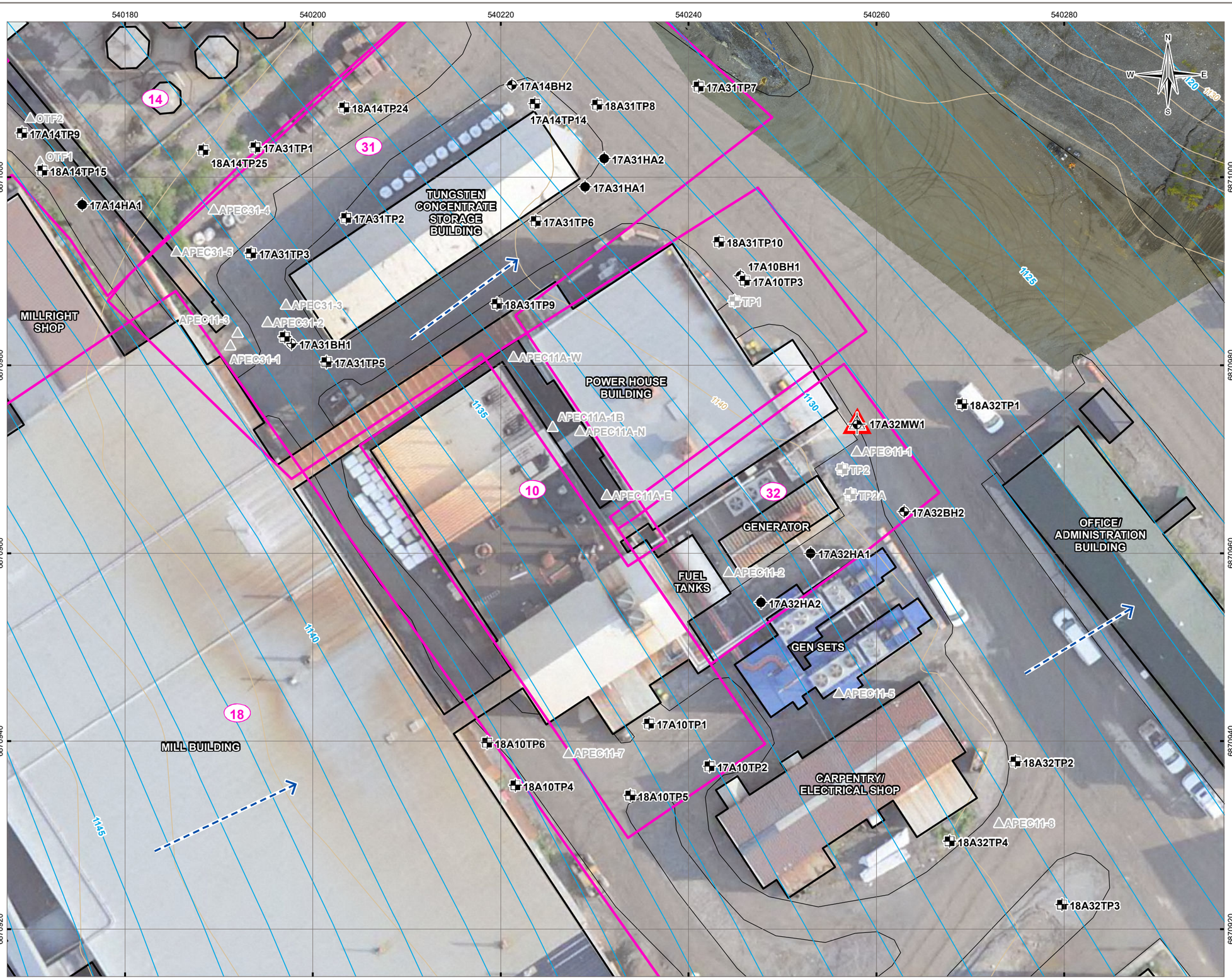


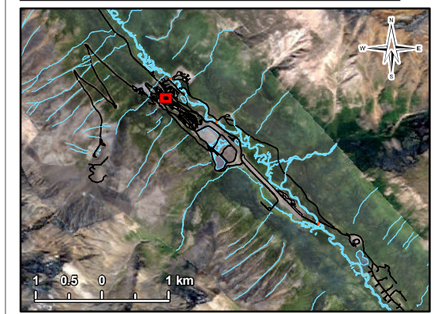
LEGEND

- Area of Environmental Concern (AEC)
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- Historical Testpit
- Historical Shallow Soil Sample
- Inferred Groundwater Flow Direction
- Groundwater Contour (1 m asl; Fall 2017)

2017/2018 Groundwater Analytical Results

- Samples contain parameters that exceeded the preliminary background concentrations, or in the absence of background concentrations, FIGWQG
- Building
- Road
- Ditch
- Contour (2 m)

FIGWQG	Federal Interim Groundwater Quality Guidelines
CCME	Canadian Council of Ministers of the Environment
WQG	Water Quality Guidelines
AW	Freshwater Aquatic Life
EQGASW	Environmental Quality Guidelines for Alberta Surface Waters



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE
PHASE III ESA

AEC 10
Power House
Groundwater and Surface Water Results

PROJECTION: UTM Zone 9		DATUM: NAD83			CLIENT: NORTH AMERICAN TUNGSTEN CORPORATION LTD
Scale: 1:400 (5 2.5 0 5 Metres)					TETRA TECH
FILE NO.: WENW03039-03_Summary_A10-2.mxd					
OFFICE: Tt-VANC	DWN: SL	CKD: BB	APVD: SS	REV: 0	A10-2
DATE: June 22, 2020	PROJECT NO.: ENW.WENW03039-03				

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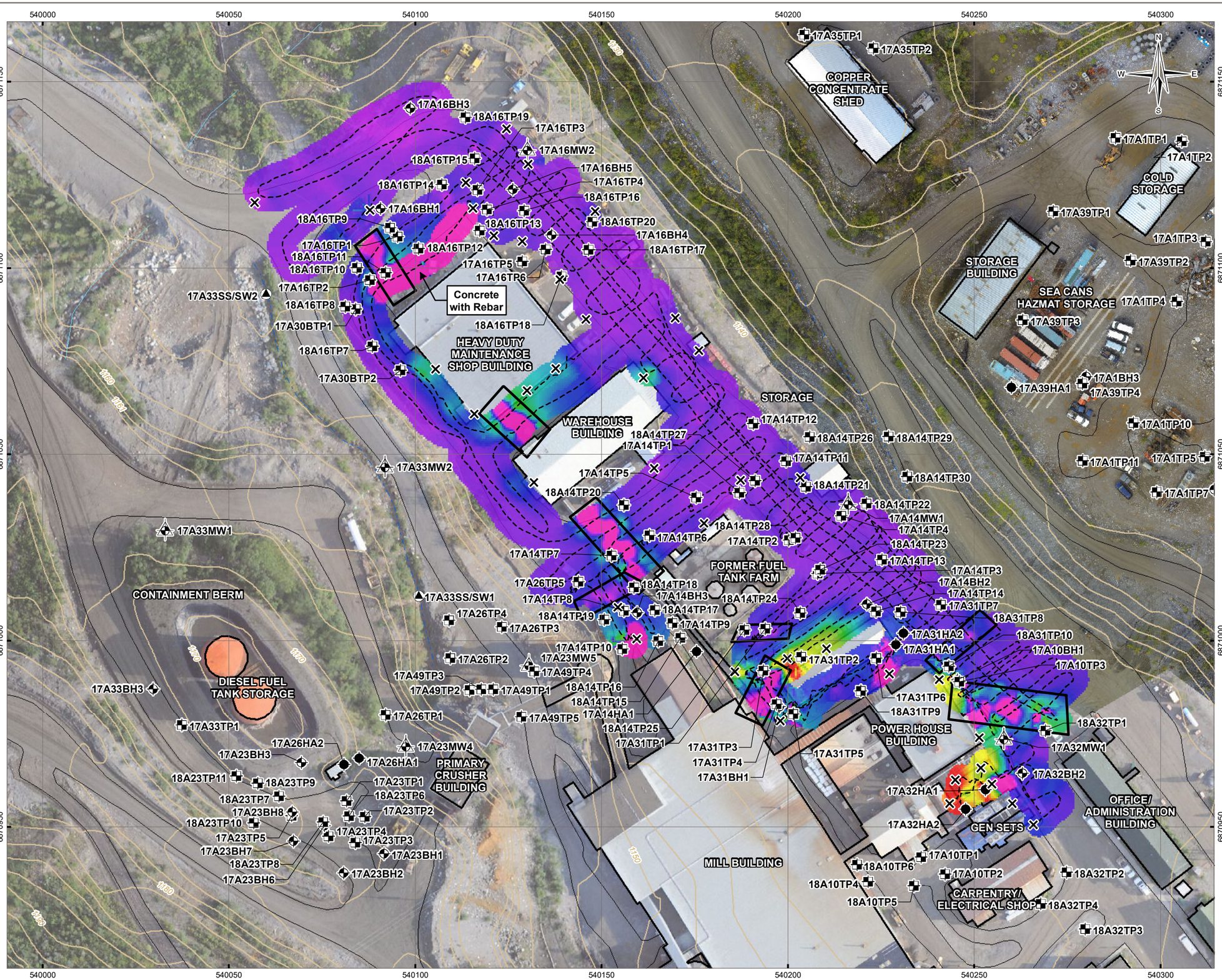

LEGEND

- Survey Track
- Surface Metal
- Potential Buried Cables/Utilidor
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)

Apparent Terrain Conductivity (mS/m)

500 / 200 / 150 / 100 / 50 / 0

NOTES

All locations and area boundaries are approximate.
Negative apparent terrain conductivity values likely due to EM field created by a utility or metal response.
EM31 S/N: 8411031 | Data collected: September 8, 2017.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 10 Power House EM31 Apparent Terrain Conductivity Survey

PROJECTION	DATUM	CLIENT
UTM Zone 9	NAD83	NORTH AMERICAN TUNGSTEN CORPORATION LTD

Scale: 1:1,000
20 10 0 20
Metres

TETRA TECH

FILE NO.
WENW03039-03_Summary_A10-3.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	DSM	SS	0

DATE
June 22, 2020

PROJECT NO.
ENW.WENW03039-03

A10-3

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Table A10-1: Soil Analytical Results

AEC					AEC 10													
Location					BH1			TP1	TP2	TP3		TP6-1	TP6-3	TP4-1	TP4-1	TP4-3	TP5-1	TP5-3
Sample Depth					1.97 m	10.5 m	11.6 m	1.0 m	0.25 m	2.0 m	3.0 m	0.2 m	1 m	0.2 m	0.2 m	1 m	0.2 m	1 m
Field ID					17A10BH1-1	17A10BH1-2	17A10BH1-3	17A10TP1-2	17A10TP2-1	17A10TP3-3	17A10TP3-4	18A10TP6-1	18A10TP6-3	18A10TP4-1	18A10BTP4-1	18A10TP4-3	18A10TP5-1	18A10TP5-3
Sample Date					23-Sep-2017	23-Sep-2017	23-Sep-2017	22-Sep-2017	22-Sep-2017	22-Sep-2017	22-Sep-2017	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018
Laboratory Report Number					8774135	8774137	8774139	8756238	8756244	8756282	8756284	18Y358151	18Y358151	18Y358151	18Y358151	18Y358151	18Y358151	18Y358151
Laboratory Sample ID					17Y266562	17Y266562	17Y266562	17Y264351	17Y264351	17Y264351	17Y264351	9376873	9376875	9376876	9376882	9376878	9376879	9376881
Parameter	**Unit**	**CCME[1,2] and NWT CSR[3]**	**Background Concentration[4]**	**Management Limits[5]**														
Physical Parameters																		
pH	pH Units	6-8	-	-	**5.33**	-	-	7.72	7.37	7.55	7.18	-	-	-	-	-	-	-
Moisture	%	-	-	-	10.9	13.9	10.1	10.6	4.47	5.99	7.11	8.1	13.7	12.5	4.8	14.9	8.0	10.9
Carbon																		
Carbon	%	-	-	-	3.86	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide																		
Cyanide (SAD)	mg/kg	-	-	-	<100	-	-	-	-	-	-	-	-	-	-	-	-	-
Cyanide (WAD)	mg/kg	0.9	-	-	*<100*	-	-	-	-	-	-	-	-	-	-	-	-	-
Metals																		
Antimony	mg/kg	20	-	-	3.6	-	-	3.5	1.4	3.9	4.3	-	-	-	-	-	-	-
Arsenic	mg/kg	12	64	-	**22.3**	-	-	**49.5**	10.9	**38.4**	**341**	-	-	-	-	-	-	-
Barium	mg/kg	500	946	-	315	-	-	**2350**	**503**	**3120**	**1250**	-	-	-	-	-	-	-
Beryllium	mg/kg	4	-	-	0.5	-	-	0.6	1	0.6	0.6	-	-	-	-	-	-	-
Cadmium	mg/kg	1.4	2.8	-	1.24	-	-	**1.8**	**1.87**	**3.09**	**3.23**	-	-	-	-	-	-	-
Chromium	mg/kg	64	-	-	23	-	-	26	27	27	23	-	-	-	-	-	-	-
Cobalt	mg/kg	40	-	-	15.8	-	-	19.3	21.2	23.4	24.7	-	-	-	-	-	-	-
Copper	mg/kg	63	-	-	22.6	-	-	55.8	**973**	**79.4**	**388**	-	-	-	-	-	-	-
Lead	mg/kg	70	-	-	33.6	-	-	24.4	20.9	44.9	37.4	-	-	-	-	-	-	-
Mercury	mg/kg	6.6	-	-	0.03	-	-	0.11	2.92	0.3	0.46	-	-	-	-	-	-	-
Molybdenum	mg/kg	5	10	-	4.9	-	-	4.8	**7.1**	**5.7**	**6.1**	-	-	-	-	-	-	-
Nickel	mg/kg	45	72	-	**49.3**	-	-	**66.3**	29.3	**85.7**	**70.6**	-	-	-	-	-	-	-
Selenium	mg/kg	1	1.7	-	**1.6**	-	-	0.9	**2.6**	**1.5**	**2.2**	-	-	-	-	-	-	-
Silver	mg/kg	20	-	-	<0.5	-	-	<0.5	0.6	<0.5	<0.5	-	-	-	-	-	-	-
Thallium	mg/kg	1	-	-	0.2	-	-	0.4	0.4	0.4	0.4	-	-	-	-	-	-	-
Tin	mg/kg	5	-	-	<0.2	-	-	0.6	3.4	0.3	0.8	-	-	-	-	-	-	-
Uranium	mg/kg	23	-	-	1.4	-	-	2.4	2.8	2	2.1	-	-	-	-	-	-	-
Vanadium	mg/kg	130	160	-	76	-	-	87	38	73	75	-	-	-	-	-	-	-
Zinc	mg/kg	200	462	-	**248**	-	-	**398**	**279**	**525**	**457**	-	-	-	-	-	-	-
Particle Size																		
>75 µm	%	-	-	-	-	-	-	-	75	87	-	-	-	-	-	74	-	-
Grain Size	N/A	-	-	-	-	-	-	-	Coarse	Coarse	-	-	-	-	-	Coarse	-	-
Petroleum Hydrocarbons																		
Benzene	mg/kg	0.03	-	-	<0.005	**0.092**	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
Toluene	mg/kg	0.1	-	-	<0.05	**0.11**	<0.05	<0.05	<0.05	<0.05	0.07	-	-	-	-	-	-	-
Ethylbenzene	mg/kg	0.082	-	-	<0.01	0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-
Xylenes (m & p)	mg/kg	-	-	-	-	-	-	<0.02	<0.02	<0.02	0.06	-	-	-	-	-	-	-
Xylene (m)	mg/kg	-	-	-	<0.02	0.05	<0.02	<0.02	<0.02	<0.02	0.06	-	-	-	-	-	-	-
Xylene (o)	mg/kg	-	-	-	<0.02	0.02	<0.02	<0.02	<0.02	<0.02	0.03	-	-	-	-	-	-	-
Xylenes Total	mg/kg	0.1	-	-	<0.05	0.07	<0.05	<0.05	<0.05	<0.05	0.09	-	-	-	-	-	-	-
F1 (C_6-C_{10})	mg/kg	30	-	-	<10	**64**	<10	<10	<10	<10	<10	-	-	-	-	-	-	-
F1 (C_6-C_{10}) - BTEX	mg/kg	30	-	700	<10	**63**	<10	<10	<10	<10	<10	-	-	-	-	-	-	-
F2 (C_{10}-C^{16})	mg/kg	150	-	1000	<20	**521**	<20	<20	<20	<20	<20	<20	38	<20	<20	<20	<20	<20
F3 (C_{16}-C_{34})	mg/kg	300	-	2500	<20	115	<20	<20	**558**	51	<20	**588**	**436**	**730**	**611**	129	**375**	<20
F4 (C_{34}-C_{50})	mg/kg	2800	-	10,000	<20	<20	<20	<20	373	28	<20	427	169	483	359	67	130	<20
VH_{6-10}	mg/kg	-	-	-	-	-	-	<10	<10	<10	<10	-	-	-	-	-	-	-
VPH_{6-10}	mg/kg	-	-	-	-	-	-	<10	<10	<10	<10	-	-	-	-	-	-	-
Glycols																		
Diethylene glycol	mg/kg	-	-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-
Ethylene glycol	mg/kg	960	-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-
Propylene glycol	mg/kg	-	-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-
Tetraethylene Glycol	mg/kg	-	-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-
Triethylene Glycol	mg/kg	-	-	-	-	<10	<10	<10	<10	<10	<10	-	-	-	-	-	-	-

Notes:

[1] Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in Soil (CCME 2008), for coarse textured soils under Agricultural and Residential/Parkland soils

[2] Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999), for coarse textured soils under Agricultural and Residential/Parkland soils

[3] Northwest Territories Environmental Guideline for Contaminated Site Remediation (NWT CSR 2003), for coarse textured soils under Agricultural and Residential/Parkland land use

[4] Preliminary Background Concentration

[5] Canadian Council of Ministers of the Environment (CCME) (2008). Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil Technical Supplement, for coarse textured soil under Agricultural land use, management limit pathway only

BOLD - Exceeds most stringent CCME or NWT CSR standard/guideline

Red - Exceeds Preliminary Background Concentration

Shaded - Exceeds Management Limits

Italic - Laboratory detection limit is greater than one or more referenced guidelines

"-" Not analyzed or no applicable standard/guideline

Table A10-1: Soil Analytical Results

AEC					AEC 10													
Location					BH1			TP1	TP2	TP3		TP6-1	TP6-3	TP4-1	TP4-1	TP4-3	TP5-1	TP5-3
Sample Depth					1.97 m	10.5 m	11.6 m	1.0 m	0.25 m	2.0 m	3.0 m	0.2 m	1 m	0.2 m	0.2 m	1 m	0.2 m	1 m
Field ID					17A10BH1-1	17A10BH1-2	17A10BH1-3	17A10TP1-2	17A10TP2-1	17A10TP3-3	17A10TP3-4	18A10TP6-1	18A10TP6-3	18A10TP4-1	18A10BTP4-1	18A10TP4-3	18A10TP5-1	18A10TP5-3
Sample Date					23-Sep-2017	23-Sep-2017	23-Sep-2017	22-Sep-2017	22-Sep-2017	22-Sep-2017	22-Sep-2017	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018	3-Jul-2018
Laboratory Report Number					8774135	8774137	8774139	8756238	8756244	8756282	8756284	18Y358151	18Y358151	18Y358151	18Y358151	18Y358151	18Y358151	18Y358151
Laboratory Sample ID					17Y266562	17Y266562	17Y266562	17Y264351	17Y264351	17Y264351	17Y264351	9376873	9376875	9376876	9376882	9376878	9376879	9376881
Parameter	**Unit**	**CCME[1,2] and NWT CSR[3]**	**Background Concentration[4]**	**Management Limits[5]**														
Polycyclic Aromatic Hydrocarbons (PAHs)																		
B(a)P Total Potency Equivalent	mg/kg	0.6	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
IACR (CCME)	mg/kg	1	-	-	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	<0.6	-	-	-	-	-	-	-
Acenaphthene	mg/kg	-	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
Acenaphthylene	mg/kg	-	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
Anthracene	mg/kg	2.5	-	-	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	<0.004	-	-	-	-	-	-	-
Benz(a)anthracene	mg/kg	0.1	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	-	-	-	-	-	-
Benzo(a) pyrene	mg/kg	0.1	-	-	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	-	-	-	-	-	-	-
Benzo(b)fluoranthene	mg/kg	0.1	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Benzo(b+j)fluoranthene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Benzo(e)pyrene	mg/kg	-	-	-	-	-	-	<0.03	<0.03	<0.03	<0.03	-	-	-	-	-	-	-
Benzo(g,h,i)perylene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Benzo(j)fluoranthene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Benzo(k)fluoranthene	mg/kg	0.1	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Chrysene	mg/kg	-	-	-	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Dibenz(a,h)anthracene	mg/kg	0.1	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
Fluoranthene	mg/kg	50	-	-	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-
Fluorene	mg/kg	-	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg	0.1	-	-	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-
1-Methylnaphthalene	mg/kg	-	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
2-Methylnaphthalene	mg/kg	-	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
Naphthalene	mg/kg	0.013	-	-	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	-	-	-	-	-	-	-
Phenanthrene	mg/kg	0.046	-	-	<0.02	0.04	<0.02	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-
Pyrene	mg/kg	0.1	-	-	<0.01	0.03	<0.01	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-
Polychlorinated Biphenyls (PCBs)																		
Aroclor 1242	mg/kg	-	-	-	<0.05	-	-	-	-	<0.05	<0.05	-	-	-	-	-	-	-
Aroclor 1254	mg/kg	-	-	-	<0.05	-	-	-	-	<0.05	<0.05	-	-	-	-	-	-	-
Aroclor 1260	mg/kg	-	-	-	<0.05	-	-	-	-	<0.05	<0.05	-	-	-	-	-	-	-
Aroclor 1262	mg/kg	-	-	-	-	-	-	-	-	<0.05	<0.05	-	-	-	-	-	-	-
PCBs (Sum of total)	mg/kg	0.5	-	-	<0.05	-	-	-	-	<0.05	<0.05	-	-	-	-	-	-	-
Volatile Organic Compounds (VOCs)																		
Acetone	mg/kg	-	-	-	<0.5	-	-	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
Bromodichloromethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Bromoform	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Bromomethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
2-Butanone	mg/kg	-	-	-	<0.5	-	-	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
Carbon tetrachloride	mg/kg	0.1	-	-	<0.02	-	-	<0.02	<0.02	<0.02	<0.02	-	-	-	-	-	-	-
Chlorobenzene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Chloroethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Chloroform	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Chloromethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Dibromochloromethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2-Dibromoethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2-Dichlorobenzene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,3-Dichlorobenzene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,4-Dichlorobenzene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,1-Dichloroethane	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2-Dichloroethane	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,1-Dichloroethene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2-Dichloroethene (cis)	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2-Dichloroethene (trans)	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2-Dichloropropane	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,3-Dichloropropene [cis]	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,3-Dichloropropene [trans]	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Methyl t-Butyl Ether (MTBE)	mg/kg	-	-	-	<0.1	-	-	<0.1	<0.1	<0.1	<0.1	-	-	-	-	-	-	-
Methylene Chloride	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
4-Methyl-2-pentanone	mg/kg	-	-	-	<0.5	-	-	<0.5	<0.5	<0.5	<0.5	-	-	-	-	-	-	-
Styrene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,1,1,2-Tetrachloroethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,1,2,2-Tetrachloroethane	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Tetrachloroethene	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,2,4-Trichlorobenzene	mg/kg	0.05	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,1,1-Trichloroethane	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
1,1,2-Trichloroethane	mg/kg	0.1	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Trichloroethene	mg/kg	0.1	-	-	<0.01	-	-	<0.01	<0.01	<0.01	<0.01	-	-	-	-	-	-	-
Trichlorofluoromethane	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-
Vinyl chloride	mg/kg	-	-	-	<0.05	-	-	<0.05	<0.05	<0.05	<0.05	-	-	-	-	-	-	-

Notes:

[1] Canadian Council of Ministers of the Environment (CCME) Canada-Wide Standards (CWS) for Petroleum Hydrocarbons (PHC) in Soil (CCME 2008), for coarse textured soils under Agricultural and Residential/Parkland soils

[2] Canadian Council of Ministers of the Environment (CCME) Canadian Environmental Quality Guidelines (CEQG) - Canadian Soil Quality Guidelines for the Protection of Environmental and Human Health (CCME 1999), for coarse textured soils under Agricultural and Residential/Parkland soils

[3] Northwest Territories Environmental Guideline for Contaminated Site Remediation (NWT CSR 2003), for coarse textured soils under Agricultural and Residential/Parkland land use

[4] Preliminary Background Concentration

[5] Canadian Council of Ministers of the Environment (CCME) (2008). Canada-Wide Standards for Petroleum Hydrocarbons (PHCs) in Soil Technical Supplement, for coarse textured soil under Agricultural land use, management limit pathway only

BOLD - Exceeds most stringent CCME or NWT CSR standard/guideline

Red - Exceeds Preliminary Background Concentration

Shaded - Exceeds Management Limits

Italic - Laboratory detection limit is greater than one or more referenced guidelines

"-" Not analyzed or no applicable standard/guideline

North American Tungsten Corporation Ltd.

Borehole No: 17A10BH1

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1139.495 m
Tungsten, Northwest Territories	UTM: 540245.5 E; 6870989.5 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0		SAND (FILL) - gravelly, some silt, trace cobbles, damp, greyish brown, medium sand						1139
1		- hydrocarbon odour for 500 mm						1138
2				1-1				1137
3		COBBLES AND SAND (FILL) - some gravel, damp, brown						1136
4		SILT (POSSIBLE TAILINGS) - trace gravel, damp - organics, black SAND - gravelly, trace silt, damp, grey, fine to coarse sand						1135
5		SAND AND GRAVEL - damp, light brown, fine to coarse sand and gravel GRAVEL - sandy, some silt, trace cobbles, damp, grey, mottled, medium gravel						1134
6	Sonic	SAND - gravelly, trace silt, damp, grey, fine to coarse sand SILT - some sand, some gravel, damp						1133
7		SAND - gravelly, some silt, trace cobbles, damp, brown, fine to coarse sand - 150 mm thick silt layer - some gravel						1132
8		- oxidized gravel and sand						1131
9								1130
10		SILT AND SAND - gravelly, trace cobbles, wet, brown - blackish blue staining, hydrocarbon odour		1-2				1129
11								1128
12		SILT - gravelly, some sand, trace cobbles, damp, brown to grey		1-3				1127
13		END OF BOREHOLE (12.19 metres) Note: Backfilled at completion						1126
14								1125
15								

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 12.19 m
Drilling Rig Type: Track Mounted	Start Date: 2017 September 23
Logged By: MH	Completion Date: 2017 September 23
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Borehole No: **17A10TP1**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1141.102 m
Tungsten, Northwest Territories	UTM: 540235.789 E; 6870941.877 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Backhoe	SAND (FILL) - silty, some gravel to gravelly, damp, dense, grey, coarse sand		1-1				1141
1		GRAVEL (FILL) - sandy, some silt, trace to some cobbles, damp, dense, grey, subangular gravel		1-2				1140
2		SAND (FILL) - some gravel to gravelly, trace cobbles, damp, firm, brown, coarse sand		1-3				1139
3		END OF TESTPIT (3.0 metres) Note: Backfilled at completion		1-4				1138
4								1137
5								1136
6								1135
7								1134
8								1133
9								1132
10								1131
11								1130
12								1129
13								1128
14								1127
15								

TETRA TECH

Contractor: NATC	Completion Depth: 3 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 22
Logged By: NH	Completion Date: 2017 September 22
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Borehole No: **17A10TP2**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1141.016 m
Tungsten, Northwest Territories	UTM: 540242.223 E; 6870937.323 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0								1141
	Backhoe	SAND (FILL) - gravelly, silty, damp, dense, reddish brown, fine sand		2-1		25% particles <75 µm (ie. smaller than sand particle)		
1		- some gravel, trace silt, trace cobbles, soft, brown, coarse sand		2-2				1140
		- trace to some boulders, medium to coarse sand						
2				2-3				1139
3				2-4				1138
		END OF TESTPIT (3.0 metres) Note: Backfilled at completion						
4								1137
5								1136
6								1135
7								1134
8								1133
9								1132
10								1131
11								1130
12								1129
13								1128
14								1127
15								

TETRA TECH

Contractor: NATC	Completion Depth: 3 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 22
Logged By: NH	Completion Date: 2017 September 22
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Testpit No: **17A10TP3**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1139.495 m
Tungsten, Northwest Territories	UTM: 540246 E; 6870989 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	Backfill	Elevation (m)
0	Excavated	SAND (FILL) - silty, some gravel, damp, brown						1139
		- grey staining, hydrocarbon odour		1-1	■			
		GRAVEL (FILL) - sandy, some cobbles, damp, dense, brown						
1		SAND (FILL) - silty, trace gravel, organics, damp, soft, dark brown		1-2	■			1138
		- some gravel, trace silt, no visible organics, brown, coarse sand						
		GRAVEL (FILL) - sandy, some silt, trace cobbles, damp, soft, brown		1-3	■	13% particles <75 µm (ie. smaller than sand particle)		1137
2								
3				1-4	■			
		END OF TESTPIT (3.0 metres) Note: Backfilled at completion						1136
4								
								1135
5								

TETRA TECH

Contractor: NATC	Completion Depth: 3 m
Drilling Rig Type: Rubber Tire backhoe	Start Date: 2017 September 22
Logged By: NH	Completion Date: 2017 September 22
Reviewed By: JW	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A10TP4**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1140.757 m
Cantung, Northwest Territories	UTM: 540226.261 E; 6870928.285 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL AND SAND (FILL) - well graded, ,damp, grey, fine to coarse sand, angular to subangular gravel, (80 mm thick)					
		SAND AND GRAVEL (FILL) - trace cobbles, well graded, damp, light brown, metal siding pieces, fine to coarse sand		4-1			1140.6
0.2							
							1140.4
0.4				4-2			
							1140.2
0.6							
							1140.0
0.8							
				4-3			1139.8
1.0		END OF TESTPIT (1.00 metre) Location: 6 m south southwest of 2008 soil sample APEC11-7 Note: Testpit location surveyed by Tetra Tech on August 28, 2018					
							1139.6
1.2							
							1139.4
1.4							
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 1 m
Drilling Rig Type: Backhoe	Start Date: 2018 July 2
Logged By: BB	Completion Date: 2018 July 2
Reviewed By: SS	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A10TP5**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1141.633 m
Cantung, Northwest Territories	UTM: 540234.694 E; 6870931.488 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL (FILL) - sandy, well graded, damp, light grey, fine to coarse angular to subangular gravel, (200 mm thick)		5-1			1141.6
0.2		SAND AND GRAVEL (FILL) - well graded, damp, light brown, lumber inclusions, fine to coarse sand, angular cobbles to 250 mm diameter					1141.4
0.4				5-2			1141.2
0.6							1141.0
0.8							1140.8
1.0				5-3			
		END OF TESTPIT (1.00 metre) Location: 7 m west of 2008 sample location APEC11-7 Note: Testpit location surveyed by Tetra Tech on August 28, 2018					1140.6
1.2							1140.4
1.4							1140.2
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 1 m
Drilling Rig Type: Backhoe	Start Date: 2018 July 3
Logged By: BB	Completion Date: 2018 July 3
Reviewed By: SS	Page 1 of 1

North American Tungsten Corp.

Testpit No: **18A10TP6**

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-03
Location: Cantung Mine	Ground Elev: 1162.468 m
Cantung, Northwest Territories	UTM: 540221.969 E; 6870953.147 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 100 200 300 400	Notes and Comments	Elevation (m)
0							
	Excavated	GRAVEL AND SAND (FILL) - well graded, damp, grey, fine to medium angular gravel, (150 mm thick)		3-1			1162.4
0.2		SAND (FILL) - gravelly, trace cobbles, well graded, damp, light brown, fine to coarse sand, subrounded cobbles to 200 mm diameter, slight hydrocarbon odour					1162.2
0.4				3-2			1162.0
0.6							1161.8
0.8				3-3			1161.6
		END OF TESTPIT (0.90 metres) Location: 6 m northwest of 2008 sample location APEC11-7 Note: Testpit location surveyed by Tetra Tech on August 28, 2018					
1.0							1161.4
1.2							1161.2
1.4							1161.0
1.5							

TETRA TECH

Contractor: NATC	Completion Depth: 0.9 m
Drilling Rig Type: Backhoe	Start Date: 2018 July 3
Logged By: BB	Completion Date: 2018 July 3
Reviewed By: SS	Page 1 of 1

Photo 1: Looking south towards Power Building.
(October 2, 2017)

Photo 2: Looking northwest towards Power Building. Gen Sets visible on the left.
(October 2, 2017)

Photo 3: 17A10TP1 (September 22, 2017)

Photo 4: 17A10TP2 (September 22, 2017)

AEC 13

AEC 13: Waste Rock Piles

Area Description	
Location	Northeast of Main Portal (3950 Level).
Topography	Steep slope to northeast between roads that bound the AEC to southwest and northeast.
Surface Drainage	Northeast.
Background	Waste rock from the underground mine was stockpiled at this location.

Environmental Concerns			
Location in AEC	**Potential Source(s)**	**Identified Contaminated Media**	**Parameters Assessed and Contaminant(s) of Concern (COCs; bold & underline)**
Entire AEC	Waste Rock	Rock; Groundwater	**Groundwater: Metals; Rock**: Potential Acid-rock drainage - low pH leachate potential; metal leaching potential (see Tetra Tech, 2019g)

Historical Assessment Information		
Previous Phase II Environmental Site Assessment Results (EBA, 2008)	Not in scope for EBA, 2008	
Sampling and characterization programs of waste rock piles were completed in 1997 (Aur Resources 1997), 2006 (MESH 2006b and 2007) and 2012 (Phase 2014a). As well as NATCL routine sampling since 2007. Note: this is characterization on all waste rock piles, not exclusively AEC13.	Number of Rinse pH/EC analyses	55
	Number of ABA analyses	63
	Number of multi-element ICP analyses	63
	Number of shake flask extraction analyses	22
	Number of field barrel analyses	N/A

Comments:

Five field barrel tests completed on waste rock materials collected from underground and open pit.

Geochemical test work shows waste rock (from all areas of mine) for the most part typically classified as NAG (68% of samples tested) or Uncertain (18% of samples). Waste rock samples with total sulphur contents less than 0.5% were typically NAG. Rinse pH values were consistently neutral to slightly alkaline indicating existing buffering capacity and no signs of increased acidity within the waste rock. The high proportion of carbonates in the waste rock provide a long lag period to the onset of acidic conditions.

Waste rock was consistently elevated in solid Cu and W, and slightly elevated in Bi, As, Fe, Cr and Zn in some samples, as compared to average crustal abundances of similar rock types. No significant variations in metal content were observed between the different waste rock dump locations.

Waste rock leachate, as characterized by shake flask leach extraction testing, indicate that soluble trace metal concentrations at neutral pH are expected to be generally low but may contain somewhat elevated soluble sulphate concentrations (range of 300 to 1,300 mg/L in leach tests). Explosives residues from blasting are also expected to be at low soluble concentrations.

2017/2018 Environmental Site Assessment Details	
Environmental Site Assessment Scope	
Utility Locate SOP followed?	Yes
EM 31 Geophysics Complete?	N/A
Number of test pits advanced	0
Number of boreholes advanced	2
Number of hand auger locations advanced	0
Number of rock samples collected for acid rock drainage/metal leaching	9
Number of rock samples submitted for acid rock drainage analysis	4
Number of rock samples submitted for metal leaching extraction tests	4
Number of boreholes completed as groundwater monitoring wells	2
Number of historical groundwater monitoring wells	0

AEC 13: Waste Rock Piles

Number of groundwater samples collected			1 (2017), 1 (2018)
Number of sediment and surface soil samples collected			N/A
Geophysics Findings			
N/A			
Soil Investigation and Conditions			
Maximum Depth of Investigation	13.72 mbgs (September 19, 2017)		
General Stratigraphy			
Description	**Depth from (mbgs)**	**Depth to (mbgs)**	**Observations**
Waste Rock	0	4.0	Ice/frost encountered from 2.5 m to 7.62 mbgs in 17BH01.
Various Layers of Sand, Silt, and Boulders	4.0	5.0 – 7.0	Native Soil
Bedrock (17BH02 only)	5.0	13.72	-
Combustible Vapour Concentrations (CVCs)			
Less than instrument detection limit.			
Groundwater Conditions			
Depth to Groundwater	8.12 mbgs (September 26, 2017), 7.92 mbgs (June 30, 2018) at 17A13MW2		
Free Product	Not Present		

2017/2018 Environmental Site Assessment Results Summary

- Figure A13-1 shows borehole locations.
- Figure A13-2 shows monitoring well locations.
- Figure A13-3 shows ARD/ML sample locations.
- Table A13-1 summarizes groundwater lab results relative to guidelines.
- Table A13-2 summarizes rock acid-base accounting results (with sample descriptions).
- Table A13-3 summarizes rock metal leaching results relative to guidelines.

General Site Observations

- Waste rock piles contain a mix of all mine waste rock types (volume of each rock type not determined).
- Material in waste rock piles in various stages of oxidation and weathering.
- Waste rock material is currently exposed.
- No surface leachate was observed or sampled.
- Safe accessibility limited - sample collection only at edges of waste rock piles. Regardless, we consider samples representative of material throughout waste rock piles.
- Water in ditch/creek adjacent to Sample 17A13-06 at pH 8.60. This creek passes closes to waste rock pile, but captures water from above waste rock piles.

Soil: Petroleum Hydrocarbons (PHC)

N/A

Soil: Metals

N/A

Soil: Other PCOCs

N/A

Rock: Acid Rock Drainage

- See geochemistry report (Tetra Tech 2020e)

AEC 13: Waste Rock Piles

Rock: Trace Element/Metals Analysis

N/A – not tested during this program; historical data available.

Rock: Metal Leaching

- See geochemistry report (Tetra Tech 2020e).

Groundwater: Petroleum Hydrocarbons

- N/A

Groundwater: Metals/Routine Parameters

2017

- Laboratory results less than guidelines with exception of:
  - Selenium at 17A13MW2 greater than guidelines.
  - Fluoride and sulphate at 17A13MW2 greater than guidelines but less than preliminary background quality.

2018

- Laboratory results less than guidelines with exception of:
  - Fluoride, sulphate, and manganese at 17A13MW2 greater than guidelines.
  - Sulphate at 17A13MW2 greater than guidelines and preliminary background quality.

Groundwater: Other PCOCs

- Laboratory results for nutrients (i.e., nitrate-N and nitrite-N) less than guidelines.

Sediment: Petroleum Hydrocarbons

N/A

Sediment: Metals

N/A

Sediment: Other PCOCs

N/A

Surface Water: Petroleum Hydrocarbons

N/A

Surface Water: Metals/Nutrients

N/A

Surface Water: Other PCOCs

N/A

Grainsize Analysis

N/A

Discussion (Significance of Results)

Rock:

- Historical data for waste rock materials are available and were considered and relied upon here.
- Variable waste rock mine material is present in AEC13 stockpiles. Some waste rock types have potential for ARDML (see Geochemistry report; Tetra Tech, 2019g).
- The 2017 investigation program noted variable levels of weathering and alteration. The most significant alteration is in areas of skarnified swiss-cheese limestone.

Groundwater:

2017

- Groundwater flow direction in area of AEC13 is northeast towards Flat River.
- Monitoring well 17A13MW2 completed in bedrock and located downgradient of southern part of waste rock pile.
- Elevated selenium at 17A13MW2 may indicate that there is selenium leaching occurring.
- Monitoring well 17A13MW1 completed within waste rock pile and underlying overburden. It was dry when installed (September 2017). Permafrost observed at this location.
- Infiltrating groundwater within waste rock pile drains rapidly. Samples can only be obtained during or right after precipitation events, or during a time of year when water levels are higher. Sampling 17A13MW1 would provide better data to assess for potential metals impacts to subsurface from waste rock pile.

AEC 13: Waste Rock Piles

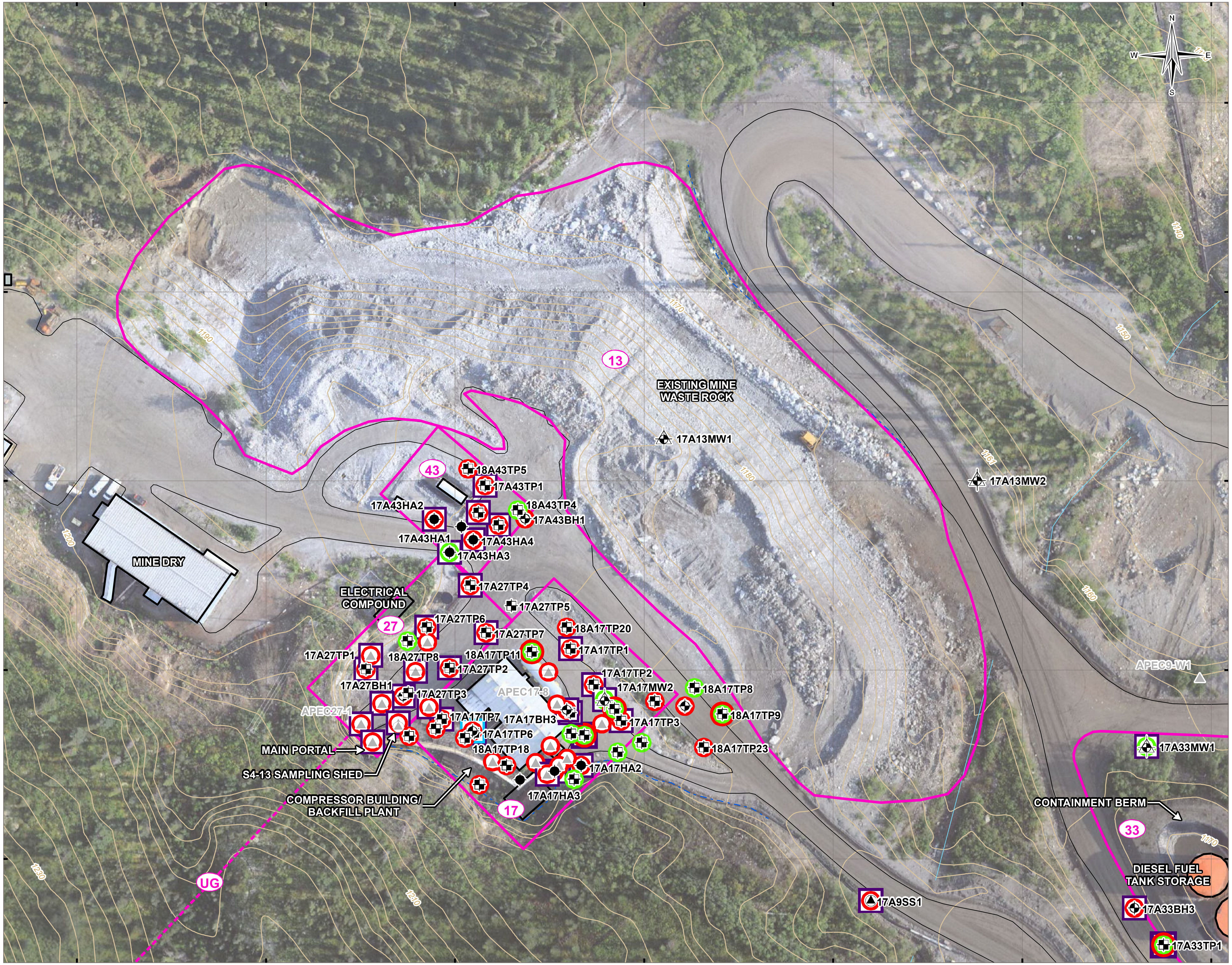
Presence of waste rock pile near monitoring well 17A13MW2 appears to have minimal impact on quality of groundwater within bedrock because metals concentrations met guidelines except for selenium.

2018

- Selenium below detection limit at monitoring well 17A13MW2.
- Monitoring well 17A13MW1 was found to be dry in June 2018.
- Infiltrating groundwater within waste rock pile drains rapidly. Samples can only be obtained during or right after precipitation events, or during a time of year when water levels are higher. Sampling 17A13MW1 would provide better data to assess for potential metals impacts to subsurface from waste rock pile.
- Presence of waste rock pile near monitoring well 17A13MW2 appears to have minimal impact on quality of groundwater within bedrock because metals concentrations met guidelines except for manganese.

Attachments

Figure A13-1 – Soil and Sediment Results
Figure A13-2 – Groundwater and Surface Water Results
Figure A13-3 – Waste Rock Acid Rock Drainage Results
Table A13-1 – Groundwater Analytical Results
Borehole Logs
Photographs

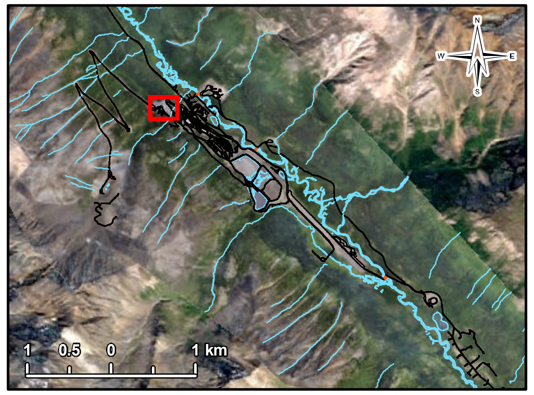


LEGEND

- Area of Environmental Concern (AEC)
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Historical Shallow Soil Sample
- Historical Surface Water Sample

Soil/Sediment Analytical Results

- PHC Impacts
- PHC Impacts, vertically delineated
- No PHC Impact
- Metals exceedance of preliminary background concentrations, or in the absence of background concentrations, exceedance of CCME guidelines
- No metals exceedance of CCME guidelines or preliminary background concentrations
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 13 Waste Rock Soil and Sediment Results

PROJECTION	DATUM	CLIENT
UTM Zone 9	NAD83	NORTH AMERICAN TUNGSTEN CORPORATION LTD

Scale: 1:1,000

20 10 0 20

Metres

TETRA TECH

FILE NO.				
WENW03039-03_Summary_A13-1.mxd				
OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	BB	BB	0

DATE	PROJECT NO.
June 22, 2020	ENW.WENW03039-03

A13-1

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539750 539800 539850 539900 539950 540000 540050

6871200 6871150 6871100 6871050 6871000

13
EXISTING MINE WASTE ROCK
17A13MW1
43
18A43TP5
17A43TP1
17A43HA2
18A43TP4
17A43BH1
17A43HA1
17A43HA4
17A43HA3
MINE DRY
17A27TP4
17A27TP5
ELECTRICAL COMPOUND
17A27TP6
27
17A27TP7
18A17TP20
17A27TP1
APEC27-7
APEC17-10
17A17TP1
17A27TP2
APEC17-9
APEC27-3
17A17MW2
18A17TP8
APEC27-2
APEC17-8
APEC27-6
18A17TP9
APEC27-1
17A17BH3
17A17TP3
APEC17-7
MAIN PORTAL
APEC17-11
18A17TP18
18A17TP23
S4-13 SAMPLING SHED
17A17HA2
17A17HA3
COMPRESSOR BUILDING/ BACKFILL PLANT
17
UG
17A13MW2
APEC9-W1
17A33MW1
CONTAINMENT BERM
33
DIESEL FUEL TANK STORAGE
17A9SS1
17A33BH3
17A33TP1

1130 1135 1140 1145 1150 1155 1160 1165 1170 1175 1180 1185 1190 1195 1200

N S W E

LEGEND

- Area of Environmental Concern (AEC)
- 2017 Monitoring Well (MW)
- 2017 Borehole (BH)
- 2017 Hand Auger (HA)
- 2017/2018 Testpit (TP)
- 2017 Surface Water/Sediment Sample (SW/SS)
- Historical Shallow Soil Sample
- Historical Surface Water Sample
- Inferred Groundwater Flow Direction
- Groundwater Contour (1 m asl; Fall 2017)

2017/2018 Groundwater Analytical Results

- Samples contain parameters that exceeded the preliminary background concentrations, or in the absence of background concentrations, FIGWQG
- Samples contain parameters that met the preliminary background concentrations, or in the absence of background concentrations, FIGWQG
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)

FIGWQG	Federal Interim Groundwater Quality Guidelines
CCME	Canadian Council of Ministers of the Environment
WQG	Water Quality Guidelines
AW	Freshwater Aquatic Life
EQGASW	Environmental Quality Guidelines for Alberta Surface Waters

NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 13 Waste Rock Groundwater and Surface Water Results

PROJECTION: UTM Zone 9	DATUM: NAD83	CLIENT: NORTH AMERICAN TUNGSTEN CORPORATION LTD			
Scale: 1:1,000 (20 10 0 20 Metres)		TETRA TECH			
FILE NO.: WENW03039-03_Summary_A13-2.mxd					
OFFICE: Tt-VANC	DWN: SL	CKD: BB	APVD: SS	REV: 0	A13-2
DATE: June 22, 2020	PROJECT NO.: ENW.WENW03039-03				

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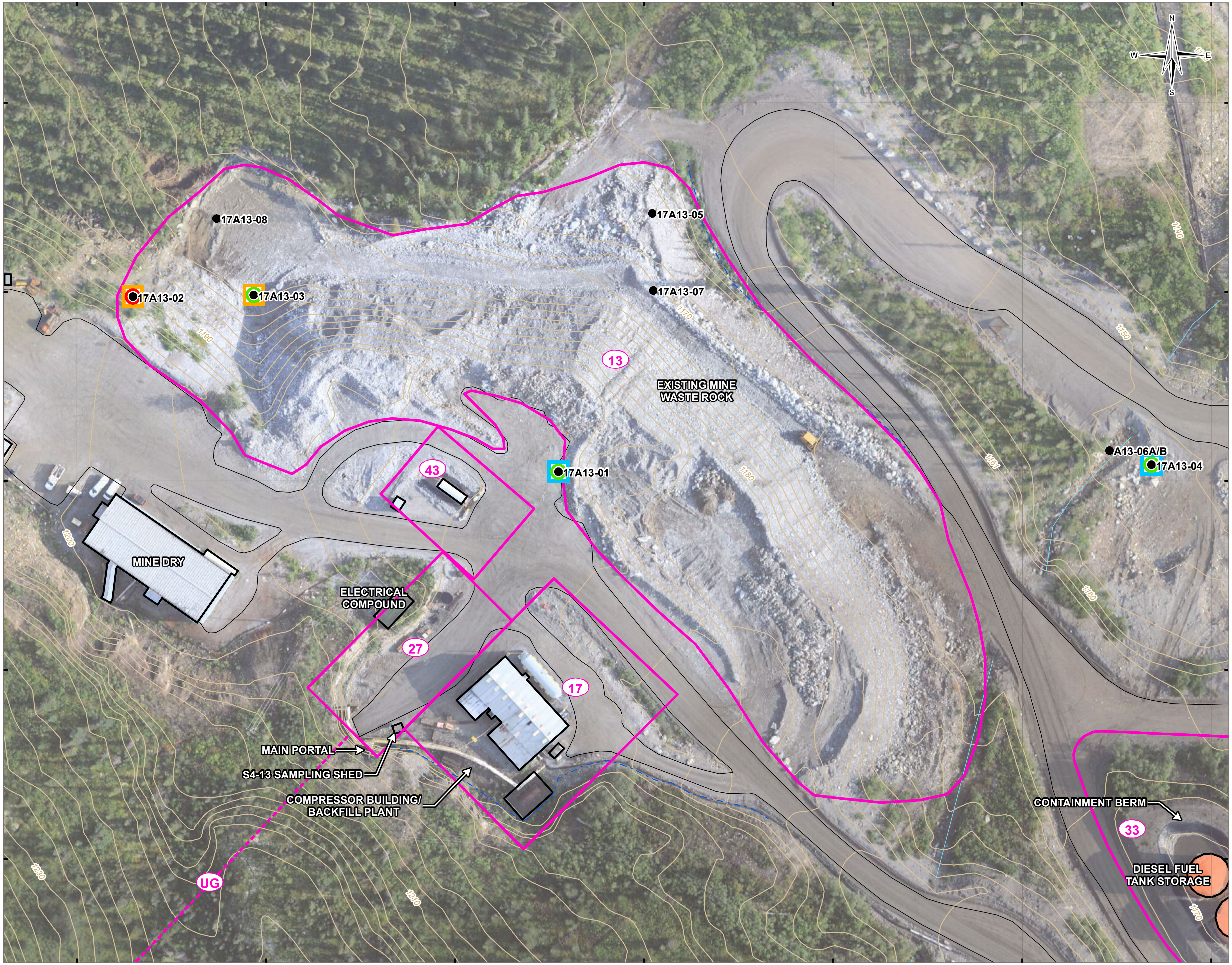
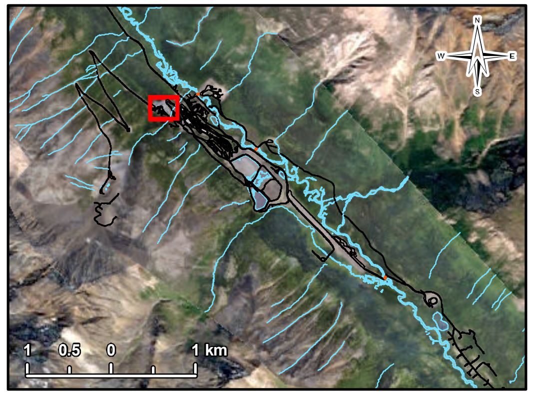


LEGEND

- Area of Environmental Concern (AEC)
- 2017 Rock Sample for ARD/ML

Acid Rock Drainage (ARD) Analytical Results

- Paste pH <7
- Paste pH >7
- Potentially Acid Generating (PAG)/Uncertain
- Non Acid Generating (NAG)
- Building
- Road
- Ditch
- Watercourse
- Contour (2 m)



NOTES
All locations and area boundaries are approximate.
Base data source:
Data provided by INAC (2013).
Drone imagery at the borrow pit, tailings ponds, and interceptor ditch collected in 2018.

STATUS
ISSUED FOR USE

CANTUNG MINE PHASE III ESA

AEC 13 Waste Rock Acid Rock Drainage Results

PROJECTION	DATUM	CLIENT
UTM Zone 9	NAD83	NORTH AMERICAN TUNGSTEN CORPORATION LTD

Scale: 1:1,000

20 10 0 20
Metres

TETRA TECH

FILE NO.
WENW03039-03_Summary_A13-3.mxd

OFFICE	DWN	CKD	APVD	REV
Tt-VANC	SL	BB	SK	0

DATE	PROJECT NO.
June 22, 2020	ENW.WENW03039-03

A13-3

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Table A13-1: Groundwater Analtyical Results

				AEC	AEC 13	
				Location	17A13MW2	
				Field ID	17A13MW2	17A13MW2
				Sample Date	28-Sep-2017	30-Jun-2018
				Laboratory Report Number	17Y266476	18Y358442
				Laboratory Sample ID	8773164	9378830
Parameter	**Unit**	**Federal Interim Guideline[1]**		**Preliminary Background Concentrations**		
		Agricultural	**Res / Park**			
Field Parameters						
Field Temperature	^{0}C	-	-	-	3.8	2.5
Field pH	pH Units	6.5-9	6.5-9	-	8.41	7.26
Field Conductivity	µS/cm	-	-	-	-	998
Routine						
pH	pH Units	6.5-9	6.5-9	-	7.58	7.41
Electrical Conductivity (EC)	µS/cm	-	-	-	1320	1050
Total Dissolved Solids (TDS)	mg/L	3000	-	-	1040	735
Hardness as $CaCO_3$	mg/L	-	-	-	738	547
Alkalinity (total as $CaCO_3$)	mg/L	-	-	-	285	270
Bromide	mg/L	-	-	-	0.05	<0.05
Chloride	mg/L	100	120	-	7.19	3.07
Fluoride	mg/L	0.12	0.12	0.39	**0.13**	**0.17**
Sulphate	mg/L	100	100	182	**130**	332
Nutrients						
Ammonia	mg/L	0.021-231 [2]	0.021-231 [2]	-	-	0.11
Nitrate (as NO_3-N)	mg/L	13	13	-	0.828	0.039
Nitrite (as NO_2-N)	mg/L	0.06	0.06	-	0.025	<0.005
Nitrogen (Total)	mg/L	-	-	-	-	0.26
Dissolved Metals						
Aluminum	mg/L	0.005 / 0.1 [3]	0.005 / 0.1 [3]	-	0.008	<0.002
Antimony	mg/L	2	2	-	0.0006	<0.0002
Arsenic	mg/L	0.005	0.005	-	0.0014	0.0006
Barium	mg/L	0.5	0.5	-	0.0352	0.0257
Beryllium	mg/L	0.0053	0.0053	-	<0.00001	<0.00001
Boron	mg/L	0.5	1.5	-	0.047	0.057
Cadmium	mg/L	0.00012	0.00012	0.000047	<0.00001	0.00001
Calcium	mg/L	-	-	-	166	156
Chromium	mg/L	0.0089	0.0089	-	<0.0005	<0.0005
Cobalt	mg/L	0.05	-	-	0.00022	0.0004
Copper	mg/L	0.002	0.002	-	0.0013	0.0003
Iron	mg/L	0.3	0.3	-	0.019	0.015
Lead	mg/L	0.001-0.002 [4]	0.001-0.002 [4]	-	<0.00005	<0.00005
Lithium	mg/L	-	-	-	0.0347	0.0337
Magnesium	mg/L	-	-	-	78.5	38.2
Manganese	mg/L	0.2	-	-	0.025	**0.239**
Mercury	mg/L	0.000016	0.000016	-	<0.00001	<0.00001
Molybdenum	mg/L	0.073	0.073	-	0.00158	0.00111
Nickel	mg/L	0.025-0.083 [4]	0.025-0.083 [4]	-	0.0016	0.0014
Potassium	mg/L	-	-	-	5.47	2.88
Selenium	mg/L	0.001	0.001	-	**0.0021**	<0.0005
Silver	mg/L	0.00025	0.00025	-	<0.00002	<0.00002
Sodium	mg/L	-	-	-	34.6	30.3
Strontium	mg/L	-	-	-	-	0.35
Thallium	mg/L	0.0008	0.0008	-	0.00004	0.00001
Tin	mg/L	-	-	-	-	<0.00005
Titanium	mg/L	0.1	0.1	-	0.0008	0.0016
Tungsten	mg/L	-	-	-	-	0.00049
Uranium	mg/L	0.01	0.015	-	0.00373	0.00653
Vanadium	mg/L	0.1		-	<0.0005	<0.0005
Zinc	mg/L	0.01	0.01	-	<0.002	<0.002
Hydrocarbons						
Benzene	mg/L	0.088	0.14	-	-	<0.0005
Toluene	mg/L	0.083	0.083	-	-	<0.0005
Ethylbenzene	mg/L	3.2	11	-	-	<0.0005
Xylene (m)	mg/L	-	-	-	-	<0.0005
Xylene (o)	mg/L	-	-	-	-	<0.0005
Xylenes Total	mg/L	3.9	3.9	-	-	<0.001
F1 (C_6-C_{10})	mg/L	-	-	-	-	<0.1
F1 (C_6-C_{10}) - BTEX	mg/L	0.81	0.81	-	-	<0.1
F2 (C_{10}-C_{16})	mg/L	1.3	1.3	-	-	0.15
F3 (C_{16}-C_{34})	mg/L	-	-	-	-	0.2
F4 (C_{34}-C_{50})	mg/L	-	-	-	-	0.22

Notes:

[1] Environment Canada (June 2016). Guidance Document on Federal Interim Groundwater Quality Guidelines (FIGQG) for Federal Contaminated Sites, for fine and coarse textured soil under Agricultural and Residential/Parkland land use

[2] Guideline varies with pH and temperature

[3] Guideline varies with pH

[4] Guideline varies hardness

"-" No applicable guideline or not analyzed

BOLD - Greater than Guideline

RED - Greater than Preliminary Background Concentration

North American Tungsten Corporation Ltd.

Borehole No: 17A13BH1/MW1

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1172.399 m
Tungsten, Northwest Territories	UTM: 539905.189 E; 6871111.39 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	MW1	Elevation (m)
0	Sonic	WASTE ROCK - cobbles, boulders, some sand and gravel, grey, fine to coarse rock						1172
1								
2								1171
3		ICE						1170
4		WASTE ROCK - mixed with ice - granite boulder						1169
5		SAND AND SILT - some gravel, brown, oxidized streaks, fine sand, medium to coarse gravel		1-1				1168
6		BOULDER - very hard SILT - sandy, streaked brown and black, reddish tinge, very fine sand, permafrost		1-2				1167
7		SAND - some silt, some gravel, brown, permafrost						1166
8		END OF BOREHOLE (7.62 metres) Monitoring well installed to 6.10 metres Screen interval - 3.05 to 6.10 metres						1165
9								1164
10								1163
11								1162
12								1161
13								1160
14								1159
15								1158

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 7.62 m
Drilling Rig Type: Track Mounted	Start Date: 2017 September 19
Logged By: MG	Completion Date: 2017 September 19
Reviewed By: JW	Page 1 of 1

North American Tungsten Corporation Ltd.

Borehole No: 17A13BH2/MW2

Project: Phase III Environmental Site Assessment	Project No: ENW.WENW03039-02 Task 002.2.2.6
Location: Cantung Mine	Ground Elev: 1164.925 m
Tungsten, Northwest Territories	UTM: 539988.082 E; 6871100.374 N; Z 9

Depth (m)	Method	Soil Description	Sample Type	Sample Number	Vapour readings (ppmv) 50 100 150 200	Notes and Comments	MW2	Elevation (m)
0		SAND AND GRAVEL - trace silt, occasional cobbles, moist, brown, fine to coarse sand and gravel						
1								1164
2		- boulders						1163
3		GRAVEL - some sand, grey and brown, fine to coarse gravel, medium to coarse sand						1162
4		SILT - some sand, trace clay, moist, light brown		2-1				1161
		SAND - some silt, some gravel, trace cobbles, moist, brown, fine to coarse sand						
5								1160
		BEDROCK - brown and white rock, mostly white rock		2-2				
6								1159
7	Sonic							1158
8								1157
9				2-3				1156
10								1155
11		- some streaking on rocks						1154
12								1153
13		- softer, breaks into smaller pieces						1152
14		END OF BOREHOLE (13.72 metres) water - 8.72 metres on September 28, 2017 Monitoring well installed to 13.72 metres Screen interval - 10.67 to 13.72 metres						1151
15								1150

Sept28/17 ▼

Sept28/17 ▼

TETRA TECH

Contractor: Boart Longyear	Completion Depth: 13.72 m
Drilling Rig Type: Track Mounted	Start Date: 2017 September 19
Logged By: MG	Completion Date: 2017 September 19
Reviewed By: JW	Page 1 of 1

Photo 1: Location of Sample 17A13-02. Heavily oxidized, mixed calc-silicate and swiss cheese limestone, fine grained, highly weathered (to residual soil in areas), moderate to strong visible pyrrhotite. (September 29, 2017)

Photo 2: Location of Sample 17A13-04. Typical mixed lithology fragments observed throughout waste rock piles. Various fraction sizes and stages of alteration and weathering. (September 29, 2017)

Photo 3: Overview photo of waste rock piles. Looking up to mine portal from Sample 17A13-05. Note the variability of fraction sizes and rock types. (September 29, 2017)

Photo 4: Arrow indicates location of waste rock pile. Photo provided by NATC. (August 13, 2013)

Photo 5: Sample 17A13-06A/B location. Trench developed in oxidized and reworked soils and waste rock. Mixed lithology sands and gravels with waste rock cobbles and boulders. Adjacent to stream crossing underneath road. Potential water sampling location to capture leachate at toe of waste rock piles. (September 29, 2017)