

Technical Memorandum

To: Tim Crowley
Public Works, City of Hamilton

From: Lance Lombard; Suzy Baird; Michael Coveney, PhD
Wood Environment & Infrastructure Solutions (Wood)

Date: October 8, 2021

Ref: WW20101062 City of Hamilton – Chedoke Creek Remediation Project

Re: MECP Request for Additional information – Comparison of Existing Sediment Surface and Target Surface Contaminant Concentrations

COMPARISON OF EXISTING SEDIMENT SURFACE AND TARGET SURFACE CONTAMINANT CONCENTRATIONS

The attached tables have been prepared in response to the MECP's request to provide a side-by-side comparison of contaminants within the current sediment surface and contaminants that may be exposed by dredging to the recommended elevation targets. As discussed in the September 17, 2021 Supplemental Technical Memorandum titled *Comparison of Sediment Contaminants in Surficial and Deep Layers in Chedoke Creek and Princess Point Sediment Cores and Recommended Dredge Target Modifications*, comparisons were made using data collected from transects CC-C13, CC-C17, CC-C19, CC-C20, CC-C23, and CC-C26 within Zones 2 and 3.

Table 1 provides a comparison of all available nutrient, metal, and PAH analyte data collected at each of the above transects for the existing surface interval (0 – 15 cm) and the respective proposed dredge target interval. Table 2a provides the Several Effect Level (SEL) hazard quotients (HQs) for metals in the existing and proposed surface intervals. Table 2b provides the Probable Effect Level (PEL) HQs for metals in the existing and proposed surface intervals. Similarly, Tables 3a and 3b provide the SEL and PEL HQs for PAHs for both the existing and proposed surface intervals.

Table 1. Analytical concentrations in existing and proposed surficial intervals at select locations in Chedoke Creek.

Location	CC-C13		CC-C17		CC-C19		CC-C20		CC-C23		CC-C26	
	Existing (0-15 cm)	Proposed (90-105 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (105-120)	Existing (0-15 cm)	Proposed (120-135)	Existing (0-15 cm)	Proposed (120-135 cm)
Nutrients (ug/g)												
Total Ammonia-N	<20	135	46	<20	67	61	150	38	61	135	35	220
Total Kjeldahl Nitrogen [a]	302	3220	594	184	1290	682	1390	1030	1710	2140	479	608
Phosphorus [b]	1100	1200	890	760	1200	1100	1500	1100	780	990	950	980
Acid Extractable Metals (ug/g)												
Aluminum	8600	16000	8400	5900	9000	8300	14000	8500	8200	8800	5300	7300
Antimony	0.45	0.99	0.78	<0.20	4.7	1.3	2	2.1	0.45	1.1	0.41	1.2
Arsenic	4.5	6.7	3.9	2.5	5.4	4.9	7.6	5	3.8	4.4	3.1	4.3
Barium	110	160	100	47	170	130	250	120	84	120	68	97
Beryllium	0.48	0.73	0.46	0.27	0.46	0.45	0.65	0.43	0.4	0.46	0.31	0.38
Bismuth	<1.0	<1.0	<1.0	<1.0	1.2	<1.0	1.2	<1.0	<1.0	<1.0	<1.0	<1.0
Boron	22	13	18	5.1	21	18	25	15	14	14	15	31
Cadmium	0.58	0.51	1.1	1.3	15	11	30	9.5	0.39	3	0.56	3.8
Calcium	67000	47000	68000	62000	64000	64000	64000	55000	71000	62000	73000	63000
Chromium	25	29	24	11	39	29	61	29	18	25	18	27
Cobalt	8.4	11	7.8	5.2	11	10	16	11	7.2	9.8	5.5	9.1
Copper	52	65	74	31	93	83	130	79	47	86	90	71
Iron	25000	33000	22000	15000	22000	21000	28000	20000	21000	20000	18000	19000
Lead	37	54	27	24	120	77	140	92	52	120	70	110
Magnesium	23000	13000	23000	8700	20000	15000	15000	15000	18000	14000	16000	15000
Manganese	580	760	510	470	510	590	660	600	450	470	430	480
Molybdenum	0.81	1.3	0.85	<0.50	1	0.84	1.2	1	0.71	0.76	0.62	1
Nickel	21	29	20	12	38	32	58	31	19	35	12	30
Potassium	1900	2200	1700	960	1700	1600	2200	1300	1500	1600	1200	1400
Selenium	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50	<0.50
Silver	<0.20	0.79	0.41	0.25	3.1	3	6	2.8	1.1	1.1	<0.20	1.5
Sodium	260	340	260	140	350	270	330	160	390	210	220	240
Strontium	100	94	110	110	110	110	120	93	120	130	120	110
Thallium	0.11	0.21	0.14	<0.050	0.13	0.12	0.17	0.11	0.12	0.11	0.095	0.1
Tin	4.1	19	4.8	2.4	17	13	23	16	3.4	11	6.7	12
Uranium	0.58	0.71	0.62	0.44	0.58	0.55	0.69	0.54	0.54	0.58	0.54	0.48
Vanadium	23	31	20	15	23	22	29	21	20	19	23	19
Zinc	220	290	230	70	390	280	440	260	180	230	200	240
Mercury	0.092	0.075	0.093	<0.050	0.29	0.22	0.45	0.29	1.2	0.19	0.12	0.31
PAHs (ug/g)												
Acenaphthene	<0.050	<0.10	0.081	0.0069	0.26	0.1	0.53	0.16	<0.10	<0.10	<0.050	0.69
Acenaphthylene	<0.050	<0.10	<0.050	<0.0050	<0.050	<0.050	<0.20	<0.050	<0.10	<0.10	<0.050	<0.050
Anthracene	<0.050	<0.10	0.37	0.019	0.31	0.12	0.43	0.23	<0.10	0.21	<0.050	1.2
Benzo(a)anthracene	0.061	0.19	1.8	0.059	0.6	0.31	0.92	0.53	0.16	0.42	0.15	1.9
Benzo(a)pyrene	0.056	0.22	1.1	0.071	0.5	0.31	0.84	0.53	0.16	0.44	0.16	1.7
Benzo(b)fluoranthene	0.085	0.38	1.8	0.14	0.79	0.47	1.4	0.78	0.28	0.59	0.26	2.4
Benzo(g,h,i)perylene	<0.050	0.2	0.51	0.077	0.34	0.3	0.64	0.37	0.12	0.43	0.14	1
Benzo(k)fluoranthene	<0.050	0.13	0.64	0.05	0.22	0.16	0.49	0.26	<0.10	0.21	0.092	0.92
Chrysene	0.084	0.16	1.5	0.063	0.66	0.33	0.95	0.53	0.17	0.5	0.2	1.7
Dibenzo(a,h)anthracene	<0.050	<0.10	0.15	0.013	0.069	0.071	0.14	0.097	<0.10	<0.10	<0.050	0.29
Fluoranthene	0.28	0.64	4.5	0.26	2.2	0.85	2.9	1.5	0.63	1.4	0.57	6
Fluorene	<0.050	<0.10	0.066	0.0075	0.37	0.12	0.6	0.19	<0.10	0.13	<0.050	0.89
Indeno(1,2,3-cd)pyrene	<0.050	0.2	0.56	0.062	0.38	0.29	0.65	0.38	0.11	0.42	0.15	1
Methylnaphthalene, 2-(1-) [c]	<0.071	<0.14	<0.071	<0.0071	1	0.25	2.1	0.26	<0.14	<0.071	<0.071	0.34
1-Methylnaphthalene	<0.050	<0.10	<0.050	<0.0050	0.42	0.13	0.94	0.13	<0.10	<0.10	<0.050	0.12
2-Methylnaphthalene	<0.050	<0.10	<0.050	<0.0050	0.61	0.12	1.2	0.13	<0.10	<0.10	<0.050	0.21
Naphthalene	<0.050	<0.10	<0.050	<0.0050	<0.050	<0.050	<0.20	<0.050	<0.10	<0.10	<0.050	0.37
Phenanthrene	0.14	0.29	1.5	0.069	1.7	0.62	2.9	1	0.22	0.74	0.21	5.6
Pyrene	0.21	0.44	3.2	0.19	1.6	0.69	2	1.2	0.44	1.1	0.42	3.8

[a] Total Kjeldahl Nitrogen (TKN) result based on calculation.

[b] Acid extractable phosphorus.

[c] Methylnaphthalene, 2-(1-) result based on calculation.

"<" indicates that parameter not detected.

Table 2a. Severe Effect Level (SEL) hazard quotients (HQs) for metals in existing and proposed surficial intervals at select locations in Chedoke Creek.

HQ (SEL)												
Location	CC-C13		CC-C17		CC-C19		CC-C20		CC-C23		CC-C26	
Interval	Existing (0-15 cm)	Proposed (90-105 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (105-120 cm)	Existing (0-15 cm)	Proposed (120-135 cm)	Existing (0-15 cm)	Proposed (120-135 cm)
Arsenic	0.1	0.2	0.1	0.1	0.2	0.1	0.2	0.2	0.1	0.1	0.1	0.1
Cadmium	0.1	0.1	0.1	0.1	1.5	1.1	3.0	1.0	0.0	0.3	0.1	0.4
Chromium	0.2	0.3	0.2	0.1	0.4	0.3	0.6	0.3	0.2	0.2	0.2	0.2
Copper	0.5	0.6	0.7	0.3	0.8	0.8	1.2	0.7	0.4	0.8	0.8	0.6
Lead	0.1	0.2	0.1	0.1	0.5	0.3	0.6	0.4	0.2	0.5	0.3	0.4
Mercury	0.0	0.0	0.0	0.0	0.1	0.1	0.2	0.1	0.6	0.1	0.1	0.2
Nickel	1.2	1.7	1.2	0.7	2.2	1.9	3.4	1.8	1.1	2.1	0.7	1.8
Zinc	0.3	0.4	0.3	0.1	0.5	0.3	0.5	0.3	0.2	0.3	0.2	0.3

Table 2b. Probable Effect Level (PEL) hazard quotients (HQs) for metals in existing and proposed surficial intervals at select locations in Chedoke Creek.

HQ (PEL)												
Location	CC-C13		CC-C17		CC-C19		CC-C20		CC-C23		CC-C26	
Interval (cm)	Existing (0-15 cm)	Proposed (90-105 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (105-120 cm)	Existing (0-15 cm)	Proposed (120-135 cm)	Existing (0-15 cm)	Proposed (120-135 cm)
Arsenic	0.3	0.4	0.2	0.1	0.3	0.3	0.4	0.3	0.2	0.3	0.2	0.3
Cadmium	0.2	0.1	0.3	0.4	4.3	3.1	8.6	2.7	0.1	0.9	0.2	1.1
Chromium	0.3	0.3	0.3	0.1	0.4	0.3	0.7	0.3	0.2	0.3	0.2	0.3
Copper	0.3	0.3	0.4	0.2	0.5	0.4	0.7	0.4	0.2	0.4	0.5	0.4
Lead	0.4	0.6	0.3	0.3	1.3	0.8	1.5	1.0	0.6	1.3	0.8	1.2
Mercury	0.2	0.2	0.2	0.1	0.6	0.5	0.9	0.6	2.5	0.4	0.2	0.6
Nickel	NO PEL AVAILABLE											
Zinc	0.7	0.9	0.7	0.2	1.2	0.9	1.4	0.8	0.6	0.7	0.6	0.8

Notes:

Cell shading: light green=HQs<0.5, darker green=HQs between 0.5 and 1 (0.5≤HQ≤1.0), orange=HQs greater than 1.0.

Method detection limit used for undetected concentrations (indicated with "<" in Table 1).

Criteria Sources: Provincial Sediment Quality Guidelines (PSQG) Severe Effect Levels (SELs) or the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CSQG)

Probable Effect Levels (PELs).

Table 3a. Severe Effect Level (SEL) hazard quotients (HQs) for PAHs in existing and proposed surficial intervals at select locations in Chedoke Creek.

HQ (SEL)												
Location	CC-C13		CC-C17		CC-C19		CC-C20		CC-C23		CC-C26	
Interval (cm)	Existing (0-15 cm)	Proposed (90-105 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (105-120 cm)	Existing (0-15 cm)	Proposed (120-135 cm)	Existing (0-15 cm)	Proposed (120-135 cm)
Acenaphthene	NO SEL AVAILABLE											
Acenaphthylene	NO SEL AVAILABLE											
Anthracene	1.35E-04	2.70E-04	1.00E-03	5.14E-05	8.38E-04	3.24E-04	1.16E-03	6.22E-04	2.70E-04	5.68E-04	1.35E-04	3.24E-03
Benzo(a)anthracene	4.12E-05	1.28E-04	1.22E-03	3.99E-05	4.05E-04	2.09E-04	6.22E-04	3.58E-04	1.08E-04	2.84E-04	1.01E-04	1.28E-03
Benzo(a)pyrene	3.89E-05	1.53E-04	7.64E-04	4.93E-05	3.47E-04	2.15E-04	5.83E-04	3.68E-04	1.11E-04	3.06E-04	1.11E-04	1.18E-03
Benzo(ghi)perylene	1.56E-04	6.25E-04	1.59E-03	2.41E-04	1.06E-03	9.38E-04	2.00E-03	1.16E-03	3.75E-04	1.34E-03	4.38E-04	3.13E-03
Benzo(k)fluoranthene	3.73E-05	9.70E-05	4.78E-04	3.73E-05	1.64E-04	1.19E-04	3.66E-04	1.94E-04	7.46E-05	1.57E-04	6.87E-05	6.87E-04
Chrysene	1.83E-04	3.48E-04	3.26E-03	1.37E-04	1.43E-03	7.17E-04	2.07E-03	1.15E-03	3.70E-04	1.09E-03	4.35E-04	3.70E-03
Dibenzo(a,h)anthracene	3.85E-04	7.69E-04	1.15E-03	1.00E-04	5.31E-04	5.46E-04	1.08E-03	7.46E-04	7.69E-04	7.69E-04	3.85E-04	2.23E-03
Fluoranthene	2.75E-04	6.27E-04	4.41E-03	2.55E-04	2.16E-03	8.33E-04	2.84E-03	1.47E-03	6.18E-04	1.37E-03	5.59E-04	5.88E-03
Fluorene	3.13E-04	6.25E-04	4.13E-04	4.69E-05	2.31E-03	7.50E-04	3.75E-03	1.19E-03	6.25E-04	8.13E-04	3.13E-04	5.56E-03
Indeno(1,2,3-cd)pyrene	1.56E-04	6.25E-04	1.75E-03	1.94E-04	1.19E-03	9.06E-04	2.03E-03	1.19E-03	3.44E-04	1.31E-03	4.69E-04	3.13E-03
Naphthalene	NO SEL AVAILABLE											
Phenanthrene	1.47E-04	3.05E-04	1.58E-03	7.26E-05	1.79E-03	6.53E-04	3.05E-03	1.05E-03	2.32E-04	7.79E-04	2.21E-04	5.89E-03
Pyrene	2.47E-04	5.18E-04	3.76E-03	2.24E-04	1.88E-03	8.12E-04	2.35E-03	1.41E-03	5.18E-04	1.29E-03	4.94E-04	4.47E-03

Table 3b. Probable Effect Level (PEL) hazard quotients (HQs) for PAHs in existing and proposed surficial intervals at select locations in Chedoke Creek.

HQ (PEL)												
Location	CC-C13		CC-C17		CC-C19		CC-C20		CC-C23		CC-C26	
Interval (cm)	Existing (0-15 cm)	Proposed (90-105 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (75-90 cm)	Existing (0-15 cm)	Proposed (105-120 cm)	Existing (0-15 cm)	Proposed (120-135 cm)	Existing (0-15 cm)	Proposed (120-135 cm)
Acenaphthene	5.62E-04	1.12E-03	9.11E-04	7.76E-05	2.92E-03	1.12E-03	5.96E-03	1.80E-03	1.12E-03	1.12E-03	5.62E-04	7.76E-03
Acenaphthylene	3.91E-04	7.81E-04	3.91E-04	3.91E-05	3.91E-04	3.91E-04	1.56E-03	3.91E-04	7.81E-04	7.81E-04	3.91E-04	3.91E-04
Anthracene	2.04E-04	4.08E-04	1.51E-03	7.76E-05	1.27E-03	4.90E-04	1.76E-03	9.39E-04	4.08E-04	8.57E-04	2.04E-04	4.90E-03
Benzo(a)anthracene	1.58E-04	4.94E-04	4.68E-03	1.53E-04	1.56E-03	8.05E-04	2.39E-03	1.38E-03	4.16E-04	1.09E-03	3.90E-04	4.94E-03
Benzo(a)pyrene	7.16E-05	2.81E-04	1.41E-03	9.08E-05	6.39E-04	3.96E-04	1.07E-03	6.78E-04	2.05E-04	5.63E-04	2.05E-04	2.17E-03
Benzo(ghi)perylene	NO PEL AVAILABLE											
Benzo(k)fluoranthene	NO PEL AVAILABLE											
Chrysene	9.74E-05	1.86E-04	1.74E-03	7.31E-05	7.66E-04	3.83E-04	1.10E-03	6.15E-04	1.97E-04	5.80E-04	2.32E-04	1.97E-03
Dibenzo(a,h)anthracene	3.70E-04	7.41E-04	1.11E-03	9.63E-05	5.11E-04	5.26E-04	1.04E-03	7.19E-04	7.41E-04	7.41E-04	3.70E-04	2.15E-03
Fluoranthene	1.19E-04	2.72E-04	1.91E-03	1.10E-04	9.34E-04	3.61E-04	1.23E-03	6.37E-04	2.68E-04	5.94E-04	2.42E-04	2.55E-03
Fluorene	3.47E-04	6.94E-04	4.58E-04	5.21E-05	2.57E-03	8.33E-04	4.17E-03	1.32E-03	6.94E-04	9.03E-04	3.47E-04	6.18E-03
Indeno(1,2,3-cd)pyrene	NO PEL AVAILABLE											
Naphthalene	1.28E-04	2.56E-04	1.28E-04	1.28E-05	1.28E-04	1.28E-04	5.12E-04	1.28E-04	2.56E-04	2.56E-04	1.28E-04	9.46E-04
Phenanthrene	2.72E-04	5.63E-04	2.91E-03	1.34E-04	3.30E-03	1.20E-03	5.63E-03	1.94E-03	4.27E-04	1.44E-03	4.08E-04	1.09E-02
Pyrene	2.40E-04	5.03E-04	3.66E-03	2.17E-04	1.83E-03	7.89E-04	2.29E-03	1.37E-03	5.03E-04	1.26E-03	4.80E-04	4.34E-03

Notes:

Cell shading: light green=HQs<0.5, darker green=HQs between 0.5 and 1 (0.5≤HQ≤1.0), orange=HQs greater than 1.0.

Method detection limit used for undetected concentrations (indicated with "<" in Table 1).

Criteria Sources: Provincial Sediment Quality Guidelines (PSQG) Severe Effect Levels (SELs) or the Canadian Sediment Quality Guidelines for the Protection of Aquatic Life (CSQG) Probable Effect Levels (PELs).