22nd March 2018 Ref : IN7C/1880

MEMORANDUM

FROM: CONOR PARKER, CONTAMINATED SITES OFFICER, ENVIRONMENT CANTERBURY

SUBJECT: MATERIAL SAMPLING RESULTS FOR DISPOSAL OPTIONS: 122 RACECOURSE ROAD, AMBERLEY

The intent of this memo is to provide sampling results for sampled material at the location of a tyre fire. The information will be used to assess disposal options for the material.

Introduction:

A pile of over 500 tyres was burned on the evening of 26th February 2018. The location had been issued with abatement notices from Environment Canterbury in 2016 for the storage of those tyres. The fire was allowed to burn by the Fire Service until it was suffocated using locally sourced gravelly silt. Applying water may have spread any oil running from the tyres and encouraged the movement of contaminants into the ground and sensitive groundwater (residential groundwater takes were located nearby).

Objective:

The aim of this investigation was to find what concentrations the contaminants of concern are in different parts of the resulting waste pile and what disposal options are available based on waste acceptance criteria. The waste pile was comprised of underlying contaminated soil; ash/oil from burned tyres; wire from tyres and partially burned tyres; and overlying site sourced gravelly silt. The waste pile was approximately 30 metres long, 15 metres wide and 1 metre high.

Method:

A fresh pair of nitrile gloves were used when collecting each sample and sampling equipment was cleaned using a scrubbing brush and Decon90 in water between each sample. Samples were collected into laboratory provided jars and stored in chilled conditions. At each sampling location a plastic container (metals) and glass container (PAHs) of material will be collected (minimum sample required of 150 grams).

An excavator was used to expose material within the waste pile to ensure representative samples were collected. An excavation occurred from each of the four sides of the pile. At each of the four excavations a sample was collected from capping material, tyre ash, 0.0 - 0.1 m of underlying soil, and 0.2 - 0.3 m soil or nearest visually clean material. Samples were collected from the walls of the excavation.

Site observations:

The capped tyre pile was 33.5 metres long, 14.5 metres wide, and had a variable height averaged to 0.8 metres. The clay cap was 0.3 – 0.5 metres thick; the mixture of ash, burnt tyres and wire was 0.5 to 1.1 metres thick. Estimates of volumes of material (no bulking assumed) is provided below.

It is thought unlikely that overlying soil and contaminated material will be able to be kept separate in any removal activity. Whole and partially burned tyres and tyre wire may be able to be separated. No significant oil seeps were observed.

Material	**Thickness (m)**	**Volume (m^3)**
Overlying soil	0.40 (plus 4 sides)	210
Burned tyres	0.75	157
Underlying contaminated soil	0.10	49
Total	1.25	416

Figure 1: Excavation into pile showing capping material, burned tyres and underlying soil.

Results:

Samples were analysed at a laboratory for total matrix Polycylic Aromatic Hydrocarbons (PAHs) and a suite of seven metals that were composited in the lab. The composites were made from two samples of the same material from two of the four parts of the pile (RR1 and RR2, RR3 and RR4). Toxicity Characteristic Leaching Procedure (TCLP) was analysed for potential soil disposal to landfill and was performed on one composite (RR1 and RR2).

Table 1: Total matrix metals and PAHs from tyre pile

mg/kg	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	benzo(a)pyrene (equivalent)
Capping 1 & 2	4	<0.10	14	8	15.4	9	65	<0.03
Capping 3 & 4	7	0.11	15	13	32	8	155	0.03
Ash 1 & 2	13	0.45	14	51	44	7	13200	0.05
Ash 3 & 4	9	1.84	11	132	530	11	38000	<0.03
Surface soil 1 & 2	9	0.12	15	14	24	9	132	<0.03
Surface soil 3 & 4	3	<0.10	10	7	15.5	7	220	<0.03
Soil 0.2 m 1 & 2	5	<0.10	16	7	14.1	12	68	<0.03
Soil 0.2 m 3 & 4	4	<0.10	16	7	12.1	14	63	<0.03
Background YBST[1]	6.35	0.14	19.89	11.68	19.75	13.91	69.58	-
Control sample 25 July 2017	2	<0.10	10	4	10	7	48	-
Burwood (NES Recreation SCS)[2]	**80**	**400**	**2700**	**>10000**	**880**	**-**	**-**	**40**

[1] Tonkin and Taylor (2007). *Background concentrations of selected trace elements in Canterbury soils Addendum1: Additional samples and Timaru Specific background levels*. Report prepared for Environment Canterbury, Christchurch, New Zealand

[2] Soil Contaminant Standard for recreational land use - Ministry for the Environment 2011, *National Environmental Standard for Assessing and Managing Contaminants in Soil to Protect Human Health*

Table 2: Toxicity Characteristic Leaching Procedure (TCLP) Results from tyre pile

mg/L	Arsenic	Cadmium	Chromium	Copper	Lead	Nickel	Zinc	benzo(a)pyrene (equivalent)
Capping 1 & 2	<0.021	<0.0011	<0.011	<0.011	<0.0021	<0.011	0.197	<0.0010
Ash 1 & 2	0.089	0.0013	<0.011	<0.011	0.0122	0.015	**85**	<0.0010
Surface soil 1 & 2	0.087	<0.0011	<0.011	<0.011	0.0061	<0.011	0.69	<0.0010
Soil 0.2 m 1 & 2	<0.021	<0.0011	<0.011	<0.011	<0.0021	<0.011	<0.021	<0.0010
20x NZDWS[3]	0.2	0.08	1	40	0.2	1.6	30 ATO	0.014 BaP
Kate Valley Acceptance	**5**	**1**	**5**	**5**	**5**	**2**	**10**	**0.04 BaP**

[3]Ministry of Health 2008, *New Zealand Drinking Water Standards*

BaP – Benzo(a)Pyrene only

The results indicate that the ash from the burned tyres is highly elevated in zinc, above expected background concentrations[1] and local background concentrations as found in sampling of nearby land in July 2017. Lead and copper are also elevated compared to expected background concentrations within the ash.

Toxicity Characteristic Leaching Procedure (TCLP) compared to New Zealand Drinking Water Standards assuming 20x dilution indicates a risk to ground water for aesthetic purposes by zinc. Synthetic Precipitation Leaching Procedure (SPLP) would be a better assessment of this risk as TCLP is likely to be conservative.

Disposal Options:

The material is generally acceptable to Burwood or Kate Valley landfills; however, zinc TCLP result exceeded Kate Valley acceptance criteria. It is not thought likely that capping soil will be able to be separated from the burned material. This will result in a larger volume of material that requires disposal but will result in at least a 50% dilution of contaminants assuming the soil samples are representative of the pile and the material is evenly mixed. Burned tyre wire may be able to be separated to an alternative disposal option such as recycling.

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Certificate of Analysis

Client:	Environment Canterbury	**Lab No:**	1938878 SPv1
Contact:	Rowan Freeman	**Date Received:**	07-Mar-2018
	C/- Environment Canterbury	**Date Reported:**	19-Mar-2018
	PO Box 345	**Quote No:**	88510
	Christchurch 8140	**Order No:**	80748
		Client Reference:	122 Racecourse Road, Amberley
		Submitted By:	David Baker

Sample Type: Soil

Sample Name:		Composite of RR 1.1 Cap and RR 2.1 Cap	Composite of RR 1.2 Ash and RR 2.2 Ash	Composite of RR 1.3 Soil and RR 2.3 Soil	Composite of RR 1.4 Soil and RR 2.4 Soil	Composite of RR 3.1 Cap and RR 4.1 Cap
Lab Number:		1938878.17	1938878.18	1938878.19	1938878.20	1938878.21
Individual Tests						
Dry Matter	g/100g as rcvd	89	92	87	89	87
TCLP Weight of Sample Taken	g	100	100	100	50	-
TCLP Initial Sample pH	pH Units	8.6	7.0	6.7	6.3	-
TCLP Acid Adjusted Sample pH	pH Units	1.7	1.6	1.6	1.6	-
TCLP Extractant Type*		NaOH/Acetic acid at pH 4.93 +/- 0.05	NaOH/Acetic acid at pH 4.93 +/- 0.05	NaOH/Acetic acid at pH 4.93 +/- 0.05	NaOH/Acetic acid at pH 4.93 +/- 0.05	-
TCLP Extraction Fluid pH	pH Units	4.9	4.9	4.9	4.9	-
TCLP Post Extraction Sample pH	pH Units	5.4	5.1	5.0	5.0	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	4	13	9	5	7
Total Recoverable Cadmium	mg/kg dry wt	< 0.10	0.45	0.12	< 0.10	0.11
Total Recoverable Chromium	mg/kg dry wt	14	14	15	16	15
Total Recoverable Copper	mg/kg dry wt	8	51	14	7	13
Total Recoverable Lead	mg/kg dry wt	15.4	44	24	14.1	32
Total Recoverable Nickel	mg/kg dry wt	9	7	9	12	8
Total Recoverable Zinc	mg/kg dry wt	65	13,200	132	68	155
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	2.5	0.76	0.017	< 0.011	0.63
2-Methylnaphthalene	mg/kg dry wt	3.3	0.76	0.018	< 0.011	1.33
Perylene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.03	0.05	< 0.03	< 0.03	0.03
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.03	0.04	< 0.03	< 0.03	< 0.03
Acenaphthylene	mg/kg dry wt	0.080	0.092	< 0.012	< 0.011	< 0.012
Acenaphthene	mg/kg dry wt	0.69	0.35	< 0.012	< 0.011	0.043
Anthracene	mg/kg dry wt	0.034	0.28	0.013	< 0.011	< 0.012
Benzo[a]anthracene	mg/kg dry wt	0.016	0.050	< 0.012	< 0.011	0.020
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.012	0.029	< 0.012	< 0.011	0.025
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	0.013	0.050	< 0.012	< 0.011	< 0.012
Benzo[e]pyrene	mg/kg dry wt	< 0.012	0.045	< 0.012	< 0.011	< 0.012
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.012	0.011	< 0.012	< 0.011	< 0.012
Benzo[k]fluoranthene	mg/kg dry wt	< 0.012	0.015	< 0.012	< 0.011	< 0.012
Chrysene	mg/kg dry wt	0.011	0.068	< 0.012	< 0.011	0.015
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Fluoranthene	mg/kg dry wt	0.026	0.45	0.021	< 0.011	0.036
Fluorene	mg/kg dry wt	1.30	0.56	< 0.012	< 0.011	0.063

Sample Type: Soil						
Sample Name:		Composite of RR 1.1 Cap and RR 2.1 Cap	Composite of RR 1.2 Ash and RR 2.2 Ash	Composite of RR 1.3 Soil and RR 2.3 Soil	Composite of RR 1.4 Soil and RR 2.4 Soil	Composite of RR 3.1 Cap and RR 4.1 Cap
Lab Number:		1938878.17	1938878.18	1938878.19	1938878.20	1938878.21
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.012	< 0.011	< 0.012	< 0.011	< 0.012
Naphthalene	mg/kg dry wt	0.25	1.26	< 0.06	< 0.06	0.18
Phenanthrene	mg/kg dry wt	0.104	1.06	0.031	< 0.011	0.023
Pyrene	mg/kg dry wt	0.023	0.56	0.019	< 0.011	0.035

Sample Name:		Composite of RR 3.2 Ash and RR 4.2 Ash	Composite of RR 3.3 Soil and RR 4.3 Soil	Composite of RR 3.4 Soil and RR 4.4 Soil		
Lab Number:		1938878.22	1938878.23	1938878.24		
Individual Tests						
Dry Matter	g/100g as rcvd	94	83	91	-	-
Heavy Metals, Screen Level						
Total Recoverable Arsenic	mg/kg dry wt	9	3	4	-	-
Total Recoverable Cadmium	mg/kg dry wt	1.84	< 0.10	< 0.10	-	-
Total Recoverable Chromium	mg/kg dry wt	11	10	16	-	-
Total Recoverable Copper	mg/kg dry wt	132	7	7	-	-
Total Recoverable Lead	mg/kg dry wt	530	15.5	12.1	-	-
Total Recoverable Nickel	mg/kg dry wt	11	7	14	-	-
Total Recoverable Zinc	mg/kg dry wt	38,000	220	63	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
1-Methylnaphthalene	mg/kg dry wt	5.0	0.065	< 0.011	-	-
2-Methylnaphthalene	mg/kg dry wt	6.7	0.090	< 0.011	-	-
Perylene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	mg/kg dry wt	< 0.3	< 0.03	< 0.03	-	-
Benzo[a]pyrene Toxic Equivalence (TEF)	mg/kg dry wt	< 0.3	< 0.03	< 0.03	-	-
Acenaphthylene	mg/kg dry wt	0.30	< 0.012	< 0.011	-	-
Acenaphthene	mg/kg dry wt	1.01	0.018	< 0.011	-	-
Anthracene	mg/kg dry wt	0.21	< 0.012	< 0.011	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Benzo[e]pyrene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Chrysene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Fluoranthene	mg/kg dry wt	0.28	0.013	< 0.011	-	-
Fluorene	mg/kg dry wt	1.41	0.024	< 0.011	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.11	< 0.012	< 0.011	-	-
Naphthalene	mg/kg dry wt	5.9	0.06	< 0.06	-	-
Phenanthrene	mg/kg dry wt	1.10	0.022	< 0.011	-	-
Pyrene	mg/kg dry wt	0.38	0.020	< 0.011	-	-

Sample Type: Aqueous						
Sample Name:		Composite of RR 1.1 Cap and RR 2.1 Cap [TCLP Extract]	Composite of RR 1.2 Ash and RR 2.2 Ash [TCLP Extract]	Composite of RR 1.3 Soil and RR 2.3 Soil [TCLP Extract]	Composite of RR 1.4 Soil and RR 2.4 Soil [TCLP Extract]	
Lab Number:		1938878.25	1938878.26	1938878.27	1938878.28	
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Arsenic	g/m³	< 0.021	0.089	0.087	< 0.021	-
Total Cadmium	g/m³	< 0.0011	0.0013	< 0.0011	< 0.0011	-
Total Chromium	g/m³	< 0.011	< 0.011	< 0.011	< 0.011	-
Total Copper	g/m³	< 0.011	< 0.011	< 0.011	< 0.011	-

Sample Type: Aqueous						
Sample Name:		Composite of RR 1.1 Cap and RR 2.1 Cap [TCLP Extract]	Composite of RR 1.2 Ash and RR 2.2 Ash [TCLP Extract]	Composite of RR 1.3 Soil and RR 2.3 Soil [TCLP Extract]	Composite of RR 1.4 Soil and RR 2.4 Soil [TCLP Extract]	
Lab Number:		1938878.25	1938878.26	1938878.27	1938878.28	
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn						
Total Lead	g/m³	< 0.0021	0.0122	0.0061	< 0.0021	-
Total Nickel	g/m³	< 0.011	0.015	< 0.011	< 0.011	-
Total Zinc	g/m³	0.197	85	0.69	< 0.021	-
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq						
Acenaphthene*	g/m³	0.0090	0.00022	< 0.00010	< 0.00010	-
Acenaphthylene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Anthracene	g/m³	0.00011	< 0.00010	< 0.00010	< 0.00010	-
Benzo[a]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[a]pyrene (BAP)	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[b]fluoranthene + Benzo[j] fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[g,h,i]perylene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Benzo[k]fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Chrysene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Dibenzo[a,h]anthracene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Fluoranthene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Fluorene	g/m³	0.0089	< 0.0002	< 0.0002	< 0.0002	-
Indeno(1,2,3-c,d)pyrene	g/m³	< 0.00010	< 0.00010	< 0.00010	< 0.00010	-
Naphthalene	g/m³	0.0060	0.0013	< 0.0005	< 0.0005	-
Phenanthrene	g/m³	0.0010	< 0.0004	< 0.0004	< 0.0004	-
Pyrene	g/m³	< 0.0002	< 0.0002	< 0.0002	< 0.0002	-

Analyst's Comments

The matrix of sample 1938878.22 has affected the System Monitoring Compound Fluoranthene-d10 in the PAH analysis, whereby the recovery was 30%. Therefore the results may be underestimated.

Summary of Methods

The following table(s) gives a brief description of the methods used to conduct the analyses for this job. The detection limits given below are those attainable in a relatively clean matrix. Detection limits may be higher for individual samples should insufficient sample be available, or if the matrix requires that dilutions be performed during analysis.

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. (Free water removed before analysis, non-soil objects such as sticks, leaves, grass and stones also removed). US EPA 3550.	0.10 g/100g as rcvd	17-24
Composite Environmental Solid Samples*	Individual sample fractions mixed together to form a composite fraction.	-	1-16
Benzo[a]pyrene Potency Equivalency Factor (PEF) NES	BaP Potency Equivalence calculated from Benz(a)anthracene x 0.1 + Benzo(b)fluoranthene x 0.1 + Benzo(j)fluoranthene x 0.1 + Benzo(k)fluoranthene x 0.1 + Benzo(a)pyrene x 1 + Chrysene x 0.01 + Dibenz(a,h)anthracene x 1 + Fluoranthene x 0.01 + Indeno(1,2,3-c,d)pyrene x 0.1. Ministry for the Environment. 2011. Methodology for Deriving Standards for Contaminants in Soil to Protect Human Health. Wellington: Ministry for the Environment.	0.002 mg/kg dry wt	17-24
Benzo[a]pyrene Toxic Equivalence (TEF)	BaP Toxic Equivalence calculated from Benzo(a)anthracene x 0.1 + BaP x 1 + Benzo(b)fluoranthene x 0.1 + Benzo(k) fluoranthene x 0.1 + Chrysene x 0.01 + Dibenzo(a,h)anthracene x 1.1 + Indeno(1,2,3-c,d)pyrene x 0.1. Guidelines for assessing and managing contaminated gasworks sites in New Zealand (GMG) (MfE, 1997).	0.002 mg/kg dry wt	17-24
Heavy Metals, Screen Level	Dried sample, < 2mm fraction. Nitric/Hydrochloric acid digestion US EPA 200.2. Complies with NES Regulations. ICP-MS screen level, interference removal by Kinetic Energy Discrimination if required.	0.10 - 4 mg/kg dry wt	17-24
Polycyclic Aromatic Hydrocarbons Screening in Soil	Sonication extraction, Dilution or SPE cleanup (if required), GC-MS SIM analysis (modified US EPA 8270). Tested on as received sample. [KBIs:5786,2805,2695]	0.002 - 0.05 mg/kg dry wt	17-24

Sample Type: Soil			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
TCLP Profile*	Extraction at 30 +/- 2 rpm for 18 +/- 2 hours, (Ratio 1g sample : 20g extraction fluid). US EPA 1311	-	17-20
TCLP Profile			
TCLP Weight of Sample Taken	Gravimetric. US EPA 1311.	0.1 g	17-20
TCLP Initial Sample pH	pH meter. US EPA 1311.	0.1 pH Units	17-20
TCLP Acid Adjusted Sample pH	pH meter. US EPA 1311.	0.1 pH Units	17-20
TCLP Extractant Type*	US EPA 1311.	-	17-20
TCLP Extraction Fluid pH	pH meter. US EPA 1311.	0.1 pH Units	17-20
TCLP Post Extraction Sample pH	pH meter. US EPA 1311.	0.1 pH Units	17-20

Sample Type: Aqueous			
Test	**Method Description**	**Default Detection Limit**	**Sample No**
Individual Tests			
Total Digestion of Extracted Samples*	Nitric acid digestion. APHA 3030 E 22nd ed. 2012 (modified).	-	25-28
Heavy metals, totals, screen As,Cd,Cr,Cu,Ni,Pb,Zn	Nitric acid digestion, ICP-MS, screen level. APHA 3125 B 22nd ed. 2012.	0.0011 - 0.021 g/m^3	25-28
Polycyclic Aromatic Hydrocarbons Screening in Water, By Liq/Liq*	Liquid / liquid extraction, SPE (if required), GC-MS SIM analysis [KBIs:4736,2695]	0.00010 - 0.0005 g/m^3	25-28

These samples were collected by yourselves (or your agent) and analysed as received at the laboratory.

Samples are held at the laboratory after reporting for a length of time depending on the preservation used and the stability of the analytes being tested. Once the storage period is completed the samples are discarded unless otherwise advised by the client.

Ara Heron BSc (Tech)
Client Services Manager - Environmental