





Quantification of Catchpit Sediments and Contaminants

Data Collection

October TR 2009/123

Technical Report, first edition.

Reviewed by:	Approved for ARC publication by:
	
Name: Rajika Jayaratne	Name: Paul Metcalf
Position: Stormwater Advisor Stormwater Action Team	Position: Group Manager Environmental Programmes
Organisation: Auckland Regional Council	Organisation: Auckland Regional Council
Date: : 12 March 2010	Date: 29 April 2010

Recommended Citation:

MOORES, J.; HUNT, J.; PATTINSON, P., 2009. Quantification of Catchpit Sediments and Contaminants. Data Collection. Prepared by NIWA Ltd for Auckland Regional Council. Auckland Regional Council Technical Report 2009/123.

© 2009 Auckland Regional Council

This publication is provided strictly subject to Auckland Regional Council's (ARC) copyright and other intellectual property rights (if any) in the publication. Users of the publication may only access, reproduce and use the publication, in a secure digital medium or hard copy, for responsible genuine non-commercial purposes relating to personal, public service or educational purposes, provided that the publication is only ever accurately reproduced and proper attribution of its source, publication date and authorship is attached to any use or reproduction. This publication must not be used in any way for any commercial purpose without the prior written consent of ARC. ARC does not give any warranty whatsoever, including without limitation, as to the availability, accuracy, completeness, currency or reliability of the information or data (including third party data) made available via the publication and expressly disclaim (to the maximum extent permitted in law) all liability for any damage or loss resulting from your use of, or reliance on the publication or the information and data provided via the publication. The publication and information and data contained within it are provided on an "as is" basis.

Quantification of Catchpit Sediments and Contaminants. Data Collection

Jonathan Moores
Jeremy Hunt
Pete Pattinson

Prepared for
Auckland Regional Council

© All rights reserved. This publication may not be reproduced or copied in any form without the permission of the client. Such permission is to be given only in accordance with the terms of the client's contract with NIWA. This copyright extends to all forms of copying and any storage of material in any kind of information retrieval system.

NIWA Client Report: AKL-2007-093
December 2007

NIWA Project: ARC07141

National Institute of Water & Atmospheric Research Ltd
269 Khyber Pass Rd
P O Box 109695, Auckland, New Zealand
Phone +64-9-375 2050, Fax +64-9-375 2051
www.niwa.co.nz

Contents

1	Executive Summary	1
2	Introduction	3
3	Methods	5
3.1	Sampling locations	5
3.2	Sample collection	11
3.3	Sample processing	12
3.4	Sample analyses	13
3.4.1	Loss on ignition	13
3.4.2	Total petroleum hydrocarbons	14
3.4.3	Metals	14
4	Results	15
4.1	Particle size distribution	15
4.2	Organic content	15
4.3	Total petroleum hydrocarbons (TPHs)	20
4.4	Metals	20
4.5	Variability in repeat and split samples	23
4.5.1	Repeat samples	23
4.5.2	Split samples	23
5	References	25
6	Appendix 1: Catchpit Sample Processing and Analysis – Revised Methodology	26
7	Appendix 2: Site Details and Sample Descriptions	27
8	Appendix 3: TPH Concentrations and Chromatograms	58

Reviewed by:

A handwritten signature in black ink, appearing to read 'Jacquie Reed', with a stylized, cursive script.

Jacquie Reed

Approved for release by:

A handwritten signature in black ink, appearing to read 'K. Becker', with a stylized, cursive script.

Ken Becker

1 Executive Summary

Samples of solids were collected from 30 roadside catchpits in Auckland. Sampling locations were selected on the basis of vehicle count data, with six sites located on roads conveying < 1000 vehicles per day (vpd) and eight sites on roads carrying traffic in each of the ranges 1000-5000 vpd, 5000-20 000 vpd and > 20 000 vpd.

Each catchpit was carefully drained to ensure minimal disturbance of deposited solids. Once drained, a sample was collected from the catchpit using a custom-built long handled auger. This procedure was repeated a number of times until sufficient mass of sample (2 to 5 kg) had been collected.

Samples were dried, weighed, processed and analysed in order to determine:

- the particle size distribution;
- the proportion of organic and non-organic material;
- the concentrations of Total Petroleum Hydrocarbons (TPHs); and
- the concentrations of the metal contaminants copper, lead and zinc.

in each sample.

Three catchpits were sampled twice and three other samples were split in order to provide information on the variability of results arising as part of the sample collection and processing methods.

Samples were wet sieved into > 1 cm, 1 mm-1 cm and < 1 mm fractions. Following visual characterisation, material > 1 cm was excluded from further analyses. The < 1 mm fraction was further sieved into 0.5-1.0 mm, 0.2-0.5 mm and < 0.2 mm fractions for metal analysis.

The coarsest (1 mm to 1 cm) particle size fraction constituted more than two-thirds of the total dry weight of samples from five catchpits. The lowest proportion of coarse solids in any sample was 27 per cent. The finest (< 0.2 mm) particle size fraction constituted more than one-third of the total dry weight of four samples. The lowest proportion of fine solids in any one sample was 7 per cent.

All samples analysed for Loss on Ignition (LOI) have an organic content of less than 9 per cent. Approximately two-thirds of the samples had a higher organic content in the coarser (1 mm – 1 cm) of the two size fractions analysed. Relatively low proportions of organic matter (< 1 per cent) were found in one or both size fractions of samples taken from six catchpits.

Around two-thirds of the samples have TPH concentrations in the range 1000-4000 mg/kg. TPH concentrations in excess of 5000 mg/kg occur in six samples. Very low concentrations (< 89 mg/kg) of TPHs occur in two samples.

In most samples concentrations of zinc are higher than concentrations of lead and copper across all three size fractions. Concentrations of lead are higher than those of copper in approximately half of the samples.

Within each sample the highest metal concentrations most frequently occur on the finest size fraction (< 0.2 mm). Relatively high concentrations of copper (> 300 mg/kg), lead (> 600 mg/kg) and zinc concentrations (> 1000 mg/kg) occur in the >0.2 mm size fraction of samples from five, three and six catchpits respectively.

Lowest metal concentrations most frequently occur on the coarsest size fraction (0.5 - 1.0 mm). Around two-thirds of the coarse fraction samples have copper concentrations of less than 100 mg/kg, lead concentrations of less than 200 mg/kg and zinc concentrations of less than 300 mg/kg.

In the context of the full set of results, the analytical results for paired samples from the repeated and split sampling are in general agreement. Whilst some marked differences do exist between results for per cent of organic matter, these are a function of comparing one relatively small fraction with another. In absolute terms the differences are small. Presented in terms of the proportion of non-organic matter (ie the reverse), the results for these three pairs of repeat samples are in much closer agreement.

Similarly, there are marked differences in metal concentrations of some of the paired samples. Again, these are a function of comparing relatively small concentrations with one another. In the context of the full set of results, each pair of samples has either relatively low, moderate or relatively high metal concentrations. The exception to this are concentrations of copper split samples from catchpits 22 and 26. In each of these cases the copper concentrations in sample (1) is markedly higher than that in sub-sample (2).

2 Introduction

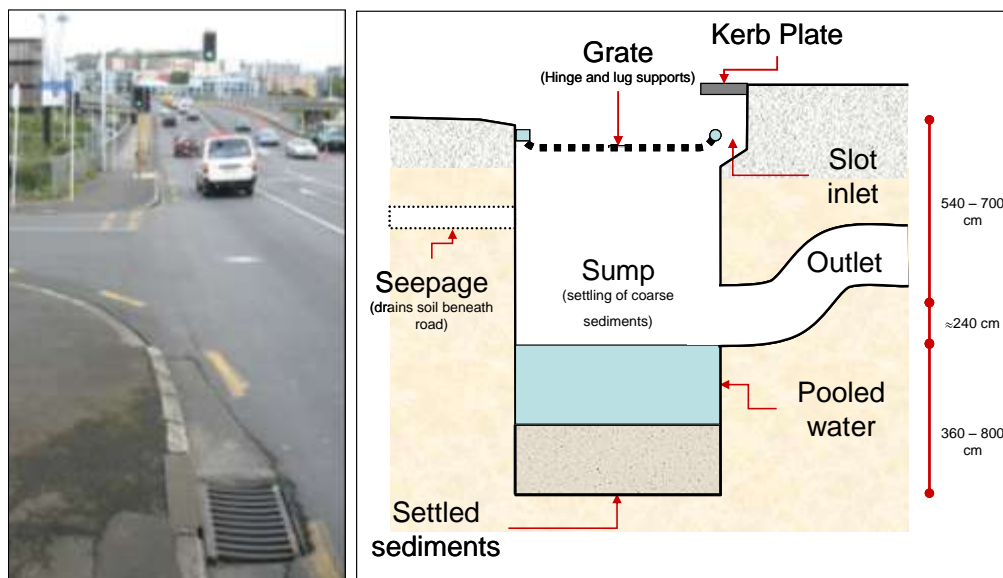
Catchpits are a standard component of most stormwater networks. They are the point to which stormwater running off roads and other impervious surfaces is concentrated and discharged to the reticulated pipe network. In addition to their role in the conveyance of stormwater, catchpits also provide for the removal of debris and contaminants from run-off prior to its discharge to the pipe system.

Figure 1 shows a photograph and cross-sectional plan of the type of catchpit commonly employed in Auckland. The largest debris is captured above the entry grate, whilst road sediments and other material enters the catchpit chamber or sump. As a result of turbulence in the chamber some of these solids remain in suspension and are discharged to the pipe network.

However, a portion of the solids entering the chamber are deposited on the bed of the catchpit or remain floating or suspended in the permanent water column below the invert of the outlet pipe. These solids are removed from the catchpits and disposed of to landfills by stormwater network operators or their contractors.

Figure 1

Roadside catchpit at Newton Rd, Auckland and cross section of the type of catchpit commonly employed in Auckland.



At a catchment or regional scale the capture of these solids and associated contaminants may represent an important part of the total contaminant budget. Attempts to estimate loads of contaminants being discharged to receiving environments should aim to account for the quantity of material captured by and removed from catchpits.

This report describes a study to quantify sediment and contaminant characteristics in samples of solids collected from thirty catchpits in Auckland. The objectives of the study are to determine:

- the particle size distribution;
- the proportion of organic and non-organic material;
- the concentrations of Total Petroleum Hydrocarbons (TPHs); and
- the concentrations of the metal contaminants copper, lead and zinc.

in samples of solids taken from catchpits located on roads conveying a broad range of traffic volumes. The output of the study is a set of results which are of value for contaminant load estimation and which will aid understanding of contaminant sources and transport processes in the Auckland region.

3 Methods

3.1 Sampling locations

Samples of solids were collected from 30 catchpits in Auckland (see Figures 2 and 3). Sampling locations were selected on the basis of vehicle count data, with six sites located on roads conveying < 1000 vehicles per day (vpd) and eight sites on roads carrying traffic in each of the ranges 1000-5000 vpd, 5000-20 000 vpd and >20 000 vpd. Vehicle count data was sourced from the relevant road controlling authority (Auckland City Council, 2007; Transit NZ, 2007).

Table 1 provides a description of each of the sampling locations, whilst site photographs are presented in Appendix 2.

Figure 2

Locator map of areas shown in Figure 3 (a to f).



Figure 3

(a to f) Location of catchpits sampled.

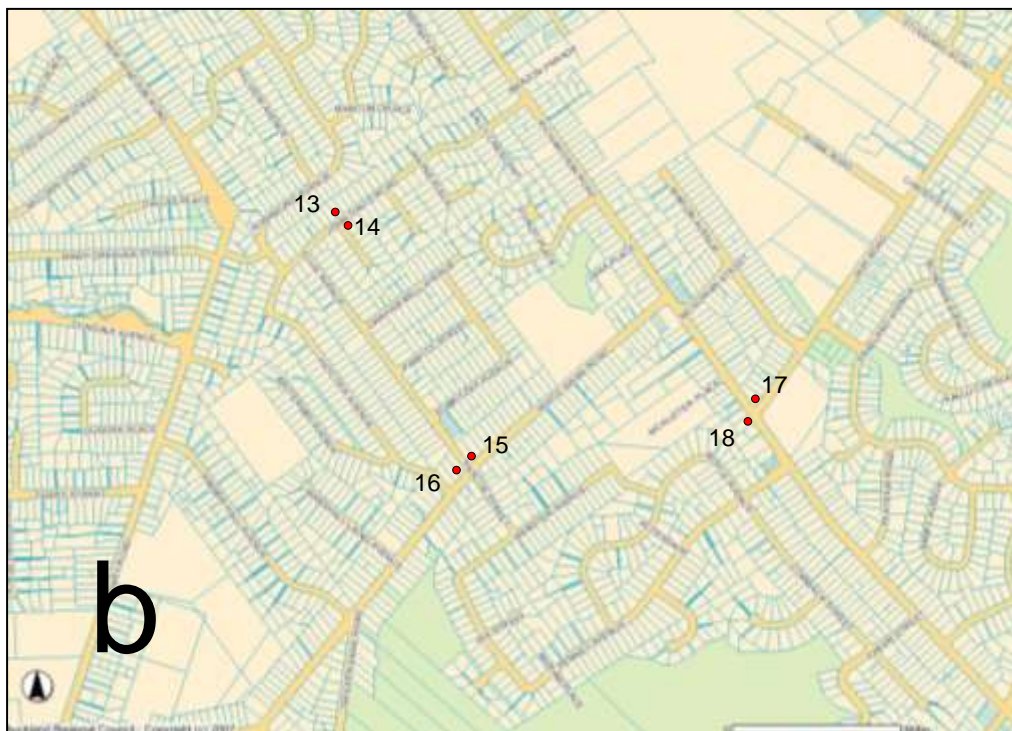


Figure 3 (cont.)

(a to f) Location of catchpits sampled.



Figure 3 (cont.)

(a to f) Location of catchpits sampled.



Table 1

Locations and traffic volumes of catchpits sampled.

Catchpit number	Date sampled	Road name	Location	Traffic direction	Traffic volume (vpd)	Location of traffic count
Roads < 1000 vpd						
1	13/06/2007	Glasgow Tce	cnr Boyle Cres	N	113	North of Carlton Gore Road At # 6, Northbound
2	13/06/2007	Glasgow Tce	cnr Boyle Cres	S	401	North of Carlton Gore Road At # 6, Southbound
7	13/06/2007	Rangitoto Ave	east of Rakau St	E	220	East of Rakau Street At # 19, Eastbound
8	13/06/2007	Rangitoto Ave	east of Rakau St	W	219	East of Rakau Street At # 19, Westbound
13	14/06/2007	John Davis Rd	opp Ball Place	E	873	West of Richardson Road, Eastbound
14	14/06/2007	John Davis Rd	cnr Ball Place	W	876	West of Richardson Road, Westbound
Roads 1000 - 5000 vpd						
16	14/06/2007	Ellis Ave	cnr White Swan Rd	N	1463	North of White Swan Road, Northbound
15	14/06/2007	Ellis Ave	cnr White Swan Rd	S	1355	North of White Swan Road, Southbound
3	13/06/2007	Carlton Gore Rd	cnr Seafield View Rd	E	1247	East of Grafton Road, Eastbound
4	13/06/2007	Carlton Gore Rd	opp Seafield View Rd	W	2293	East of Grafton Road, Westbound
11	13/06/2007	Carlton Gore Rd	cnr Kingdon St	W	2135	West of Kingdon Street, Westbound
12	13/06/2007	Carlton Gore Rd	cnr Morgan St	E	4514	West of Kingdon Street, Eastbound
10	13/06/2007	Mountain Rd	Auckland Grammar	N	4211	Between Gate 1&2 Auckland Grammar School, Northbound
9	13/06/2007	Mountain Rd	opp Auckland Grammar	S	4867	Between Gate 1&2 Auckland Grammar School, Southbound

Table 1 (cont)

Locations and traffic volumes of catchpits sampled.

Catchpit number	Date sampled	Road name	Location	Traffic direction	Traffic volume (vpd)	Location of traffic count
Roads 5000 – 20 000 vpd						
5	13/06/2007	Remuera Rd	cnr Belmont Terr	S	7172	South of Middleton Road, Southbound
6	13/06/2007	Remuera Rd	opp Belmont Terr	N	9490	South of Middleton Road, Northbound
17	14/06/2007	Richardson Rd	cnr May Rd	S	11817	South of White Swan Road At # 451, Southbound
18	14/06/2007	Richardson Rd	opp May Rd	N	12126	South of White Swan Road At # 451, Northbound
22	6/09/2007	Newton Rd	cnr Winchester Rd	S	16143	South of Ophir Street, Southbound
21	6/09/2007	Newton Rd	opp Winchester Rd	N	16500	South of Ophir Street, Northbound
27	7/09/2007	Manukau Rd	opp Rangiatea Rd	N	16742	North of Onslow Avenue At # 519, Northbound
26	7/09/2007	Manukau Rd	cnr Rangiatea Rd	S	18271	North of Onslow Avenue At # 519, Southbound
Roads > 20 000 vpd						
29	16/10/2007	Fanshawe St	intersection, SH 1 on ramp	E	20285	East of Beaumont Street, Eastbound
28	7/09/2007	SE Highway	Carbine Rd intersection	E	32503	East of Waipuna Road, Eastbound
24	16/10/2007	SH 16 NW M'way	Carrington Rd to G. North Rd	W	52680	N/W Motorway St Lukes Rd to Great North Rd (WBD)
19	6/09/2007	SH 16 NW M'way	G.North Rd to St Lukes Rd	E	49669	N/W Motorway St Lukes Rd to Great North Rd (EBD)
23	6/09/2007	SH 16 NW M'way	Newton Rd to St Lukes Rd	W	58900	N/W Motorway Newton Rd to St Lukes Rd (WBD)
20	6/09/2007	SH 16 NW M'way	after W.Springs on ramp	E	56750	N/W Motorway Newton Rd to St Lukes Rd (EBD)
30	7/09/2007	SH 1 S M'way	before Green Lane exit	N	74155	SH1 Ellerslie Panmure Highway to Green Lane East (NBD)
25	7/09/2007	SH 1 S M'way	before Green Lane exit	S	83550	SH1 Market Rd to Green Lane East (SBD)

Sources of traffic count data: ACC (2007), Transit NZ (2007).

3.2 Sample collection

Samples were collected at each of the selected catchpits in accordance with the following procedure.

Health and safety measures were implemented. These included placement of traffic cones, use of high visibility clothing and presence of two field staff for collection of samples from motorways and main roads.

The catchpit was drained with a 2 inch pump fitted with a custom-built plate over the pump hose inlet. The plate was placed upon the upper surface of the settled catchpit solids and provided for removal of water without disturbance of the solids. The catchpit was drained until a maximum of 10-20 mm depth of water remained above the deposited solids. Figure 4 shows the pump hose and plate attachment being lowered into a catchpit and the contents of the catchpit following completion of pumping.

Figure 4

(a) Pump inlet hose and plate attachment being lowered into a catchpit, and (b) contents of a catchpit on completion of pumping.



Once drained, a sample was collected from the catchpit using a custom-built long handled auger. By rotating the auger it was possible to penetrate to the base of the catchpit with relatively little disturbance of the settled solids. The auger was then gently lifted to remove a sample of the full profile of deposited solids. Figure 5 shows the auger before and after sampling. This procedure was repeated a number of times until sufficient mass of sample (2 to 5 kg) had been collected. Care was taken to ensure repeat sub-samples were well distributed across the surface of the deposited solids. A second complete sample was taken from three of the catchpits to assess variability in the characteristics of solids within these catchpits (see Section 3.3).

Sampling equipment was thoroughly rinsed with clean water following completion of sampling at each site. The samples were stored in acid washed plastic tubs with lids and transferred back to NIWA's Auckland office. On arrival, each sample was weighed

to establish that the wet weight requirement of 2 to 5 kg had been met, before transfer to the laboratory fridge for storage at around 4°C.

Figure 5

(a) Sampling auger before sampling, and (b) with a sample of catchpit solids.



3.3 Sample processing

On collection of the first batch of samples it became apparent that it would be necessary to revise both the sample processing methodology and the sample analyses specified in the RFP, largely due to the large volumes of leaves and other organic matter in the samples. ARC and NIWA agreed on a revised method (*pers. comm.*, M. Timperley, 29 June 2007), attached here as Appendix 1.

The method involved the following steps. Note that all laboratory equipment was pre-washed in acid baths, unless indicated otherwise.

The sample was removed from the fridge and emptied into a large shallow plastic bowl. The sample was well mixed to homogenise it and photographed (see Appendix 2).

A sub-sample of approximately one-quarter of the total volume of the sample was taken and wet-sieved through a 1 cm plastic sieve. This separated the sub-sample into two fractions, one with solids > 1 cm in diameter and one < 1 cm. A visual assessment of the contents of both of these two sub-samples was recorded (see Appendix 2). The description broadly characterises each sample in terms of the proportion of leaves and organic matter, stones and gravel, sand, mud, rubbish and other materials such as glass and cigarette butts.

The < 1 cm fraction was then wet-sieved through a 1 mm sieve. The 1 mm – 1 cm fraction was transferred to one or more glass jars and dried in the laboratory oven at a temperature of 60°C or less. When dry, these were weighed and a homogenised sub-sample of around 10 g was taken for loss on ignition (LOI) analysis.

The < 1 mm fraction was split into three further sub-samples: a, b and c.

Sub-sample (a) was transferred to an aluminium foil tray and dried in the laboratory oven at 35 °C. When dry, the sample was weighed, ground and a homogenised sub-sample of approximately 20 g taken for analysis of TPH concentration.

Sub-sample (b) was transferred to one or more plastic vials and dried in the laboratory oven at a temperature of 60 °C or less. When dry, the sample was weighed, ground and a homogenised sub-sample of approximately 10 g was taken for LOI analysis.

Sub-sample (c) was further wet-sieved into the following three fractions: 0.5 – 1 mm, 0.2 – 0.5 mm and < 0.2 mm. Each of these fractions was transferred to one or more glass jars and dried in the laboratory oven at a temperature of 60 °C or less. When dry, each sample was weighed, ground and a homogenised sub-sample of $1 \text{ g} \pm 0.001 \text{ g}$ taken for analysis of copper, lead and zinc concentrations.

This process was repeated for each of the 30 primary samples, the three secondary samples collected by repeat sampling and three further samples generated by splitting the primary sample in the lab. The three repeat samples were collected to characterise variability arising at the sampling stage, whilst the three split samples were taken to characterise variability arising at the sample processing stage. The repeat samples were collected at catchpits 8, 13 and 27, whilst the split samples were from catchpits 22, 26 and 30. Samples were chosen by selection of catchpit numbers at random.

On completion of processing the following sub-samples were ready for analysis:

- 36 samples of each of the 1 mm – 1 cm and < 1 mm fractions for LOI analysis (72 total);
- 36 samples of the < 1 mm fraction for TPH analysis; and
- 36 samples of each of the 0.5 – 1 mm, 0.2 – 0.5 mm and < 0.2 mm fractions for metals analysis (108 total).

Unused portions of each sample were retained for possible future analyses.

3.4 Sample analyses

3.4.1 Loss on ignition

LOI analysis provides a measure of the organic content of a sample of solids by comparing the weight of a sample before and after ignition of volatile compounds at an elevated temperature.

LOI analysis was performed at NIWA Hamilton. Each sample was dried at 110 °C, weighed and then ashed in the laboratory furnace at 450 °C for 24 hours. Samples were then reweighed to determine the mass of organic material lost.

3.4.2 Total petroleum hydrocarbons

Analysis of a sample for total petroleum hydrocarbons (TPH) concentrations provides a broad measure of hydrocarbon contamination. Sources of hydrocarbons in roadside catchpit sediments include fuel and lubricant leaks and exhaust emissions.

Samples were analysed for TPH concentrations at Hill Laboratories in Hamilton by Gas Chromatography – Flame Ionization Detection (GC-FID). This method characterises the concentrations of hydrocarbons in each of a number of different carbon chain length ranges (C7 – C9 to C30 – C44) and in total (C7 – C44). Hill Laboratories are accredited by International Accreditation New Zealand for these analyses in conformance with standard NZS/ISO/IEC 17025: 2005.

3.4.3 Metals

Sources of copper and zinc in roadside catchpit sediments include the wear of vehicle brake linings and tyres respectively. Stormwater originating from adjacent land uses but which is directed into the road drainage system can provide an additional source of these metals, for instance zinc arising from areas of galvanised roofs. Sources of lead include historic contamination of road dust from leaded petrol and contamination of soils from lead paint.

Samples were analysed for concentrations of copper, lead and zinc at Hill Laboratories in Hamilton. Metals were extracted using USEPA Method 200.2 for Total Recoverable Digestion. Analysis for metals was conducted by Inductively Coupled Plasma-Mass Spectrometry (ICP-MS). Hill Laboratories are accredited by International Accreditation New Zealand for these analyses in conformance with standard NZS/ISO/IEC 17025: 2005.

4 Results

4.1 Particle size distribution

The proportion of solids by dry weight in the four particle size classes 1 mm to 1 cm, 0.5 to 1 mm, 0.2 to 0.5 mm and < 0.2 mm are reported in Table 2. Figure 6 presents the results as a particle size distribution for solids less than 1 cm in diameter.

The proportion of solids with diameter 1 mm – 1 cm lies in the range 27 to 85 per cent. Samples with a relatively high proportion of these coarse solids were taken from catchpits 1, 2 (both Glasgow Terrace), 3 (Carlton Gore Rd), 23 (SH 16) and 30 (SH 30). The coarse (1 mm – 1 cm) fraction in samples from these catchpits constitutes more than two-thirds of the total dry weight of the sample. The sample collected from catchpit 28 (SE Highway) has the lowest proportion of coarse solids (27 per cent).

The proportion of solids with diameter < 0.5 mm (including the < 0.2 mm fraction) and < 0.2 mm lies in the ranges 13 to 55 per cent and 7 to 47 per cent respectively. Samples with a relatively high proportion of these finer particles were collected from catchpits 7, 8 (both Rangitoto Ave), 11 (Carlton Gore Rd) and 29 (Fanshawe St). The fine (< 0.2 mm) fraction in samples from these catchpits constitute more than one-third of the total dry weight of the sample. The sample collected from catchpit 20 (SH16, East bound after Western Springs on-ramp) has the lowest proportion of fine solids (7 per cent).

4.2 Organic content

The results of LOI analyses are presented in Table 3 and Figure 7. The results are expressed as the per cent reduction in mass after ashing sub-samples at 450 °C. This reduction in mass is a measure of the organic content of each sample.

All samples analysed for LOI have an organic content of less than 9 per cent. Approximately two-thirds of the samples have a higher organic content in the coarser (1 mm – 1 cm) of the two size fractions analysed. Of these, samples from catchpits 4, 12 (both Carlton Gore Rd), 9 (Mountain Rd), 18 (Richardson Rd) and 24 (SH 16) contain a relatively high proportion of organic matter (> 5 per cent). Of the samples with a greater organic content in the finer (< 1 mm) fraction, those from catchpits 2 (Glasgow Tce) and 23 (SH 16) contain more than 5 per cent organic matter.

There are relatively low proportions of organic matter (< 1 per cent) in one or both size fractions of samples taken from catchpits 1 (Glasgow Tce), 5 (Remuera Rd), 20 (SH 16), 25, 30 (both SH 1) and 27 (Manukau Rd).

Table 2

Proportion of catchpit sample solids in particle size classes 1 mm – 1 cm, 0.5 – 1 mm, 0.2 – 0.5 mm and < 0.2 mm.

Sample number	Road name	Proportion of total solids by dry weight			
		1 mm - 1 cm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm
Roads < 1000 vpd					
1	Glasgow Tce	85%	2%	4%	9%
2	Glasgow Tce	77%	5%	8%	10%
7	Rangitoto Ave	50%	6%	8%	37%
8a	Rangitoto Ave	44%	5%	5%	47%
8b	Rangitoto Ave	42%	6%	7%	45%
13a	John Davis Rd	53%	9%	14%	23%
13b	John Davis Rd	51%	12%	14%	23%
14	John Davis Rd	36%	14%	20%	30%
Roads 1000 – 5000 vpd					
16	Ellis Ave	59%	14%	9%	18%
15	Ellis Ave	61%	17%	9%	12%
3	Carlton Gore Rd	73%	8%	10%	9%
4	Carlton Gore Rd	60%	7%	12%	22%
11	Carlton Gore Rd	39%	9%	7%	45%
12	Carlton Gore Rd	36%	12%	23%	29%
10	Mountain Rd	46%	19%	21%	15%
9	Mountain Rd	62%	15%	13%	10%
Roads 5000 – 20 000 vpd					
5	Remuera Rd	37%	23%	27%	14%
6	Remuera Rd	48%	17%	22%	12%
17	Richardson Rd	40%	22%	19%	19%
18	Richardson Rd	53%	16%	12%	19%
22(1)	Newton Rd	51%	24%	11%	14%
22(2)	Newton Rd	50%	22%	16%	12%
21	Newton Rd	39%	25%	23%	13%
27a	Manukau Rd	49%	15%	16%	20%
27b	Manukau Rd	46%	16%	16%	21%
26(1)	Manukau Rd	44%	21%	20%	15%
26(2)	Manukau Rd	43%	22%	21%	15%
Roads > 20 000 vpd					
29	Fanshawe St	34%	12%	15%	39%
28	SE Highway	27%	18%	23%	32%
24	SH 16	46%	12%	13%	30%
19	SH 16	54%	14%	23%	9%
23	SH 16	77%	6%	7%	9%
20	SH 16	47%	27%	19%	7%
30(1)	SH 1	69%	15%	8%	8%
30(2)	SH 1	67%	15%	9%	8%
25	SH 1	58%	9%	23%	10%

Figure 6

Particle size distribution of catchpit solids samples, < 1 cm fraction.

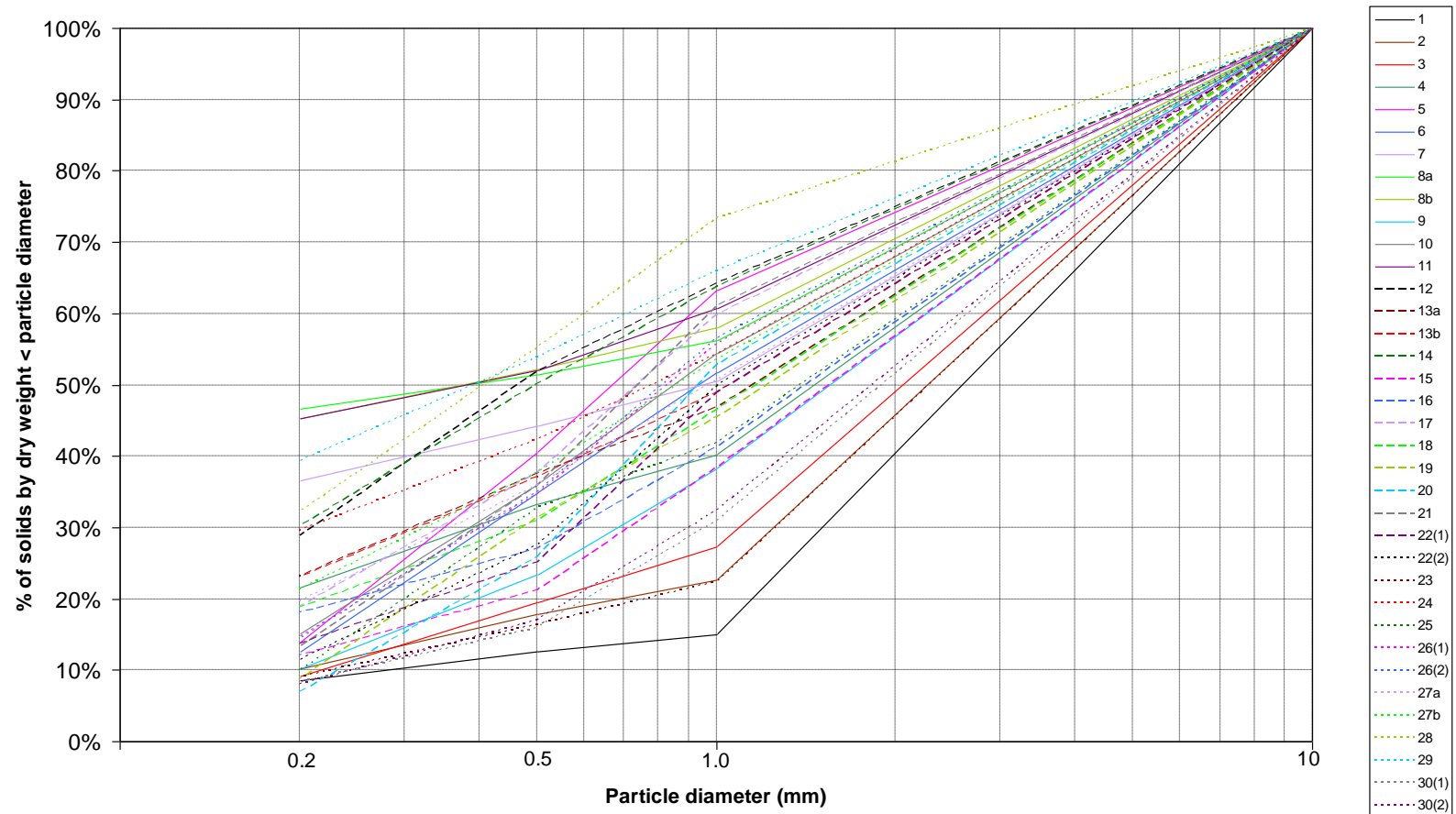


Table 3

Loss on Ignition (LOI) and concentrations of Total Petroleum Hydrocarbons (TPHs), copper, lead and zinc in samples of catchpit solids.

Sample number	Parameter	LOI		TPHs (C7-C44)	Copper			Lead			Zinc		
		1 mm - 1 cm	< 1 mm	< 1 mm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm
	%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Road name													
Roads < 1000 vpd													
1	Glasgow Tce	1.4	0.9	5900	42	67	120	450	650	660	360	480	1250
2	Glasgow Tce	2.3	7.1	6500	50	83	120	430	520	800	460	480	1190
7	Rangitoto Ave	2.2	1.7	2500	33	37	64	23	37	82	74	99	180
8a	Rangitoto Ave	2.8	3.0	3700	34	41	47	49	98	100	210	250	290
8b	Rangitoto Ave	4.5	3.3	3500	36	68	49	41	73	100	200	270	310
13a	John Davis Rd	2.4	2.7	900	39	100	200	230	200	690	180	220	710
13b	John Davis Rd	2.8	1.5	1100	39	51	180	370	210	640	170	200	650
14	John Davis Rd	3.8	2.9	750	68	71	190	83	67	220	180	160	490
Roads 1000 – 5000 vpd													
16	Ellis Ave	1.5	2.8	740	120	62	190	110	170	330	190	210	820
15	Ellis Ave	1.2	2.1	1900	41	62	150	93	150	250	240	290	1040
3	Carlton Gore Rd	3.5	3.5	6800	40	98	230	520	190	430	140	270	1050
4	Carlton Gore Rd	8.5	3.7	7500	61	100	220	190	330	610	270	380	930
11	Carlton Gore Rd	1.8	1.3	1400	35	180	84	14	39	41	100	130	190
12	Carlton Gore Rd	5.4	3.0	3400	160	160	380	170	130	250	460	470	1340
10	Mountain Rd	2.7	1.8	1900	39	170	260	48	69	240	150	230	810
9	Mountain Rd	7.5	2.8	< 36	60	71	200	56	120	240	140	180	820

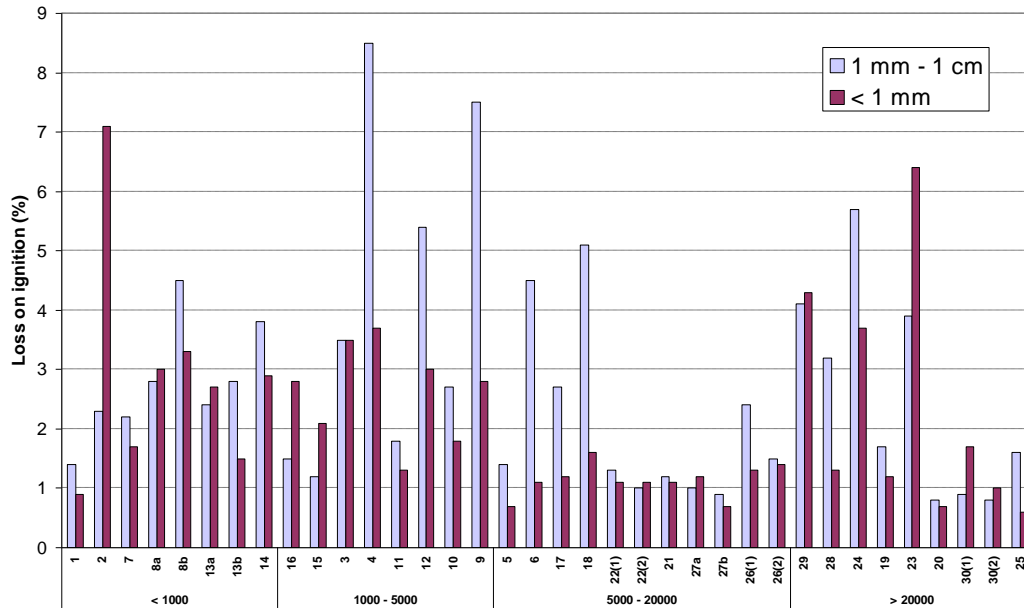
Table 3 (cont.)

Loss on Ignition (LOI) and concentrations of Total Petroleum Hydrocarbons (TPHs), copper, lead and zinc in samples of catchpit solids.

Sample number	Road Name	LOI		TPHs (C7-C44)	Copper			Lead			Zinc		
		1 mm - 1 cm	< 1 mm	< 1 mm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm	0.5 - 1 mm	0.2 - 0.5 mm	< 0.2 mm
		%	%	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
Roads 5000 – 20 000 vpd													
5	Remuera Rd	1.4	0.7	1600	160	75	170	52	89	260	140	180	610
6	Remuera Rd	4.5	1.1	1600	76	120	260	140	210	570	150	240	860
17	Richardson Rd	2.7	1.2	1600	350	370	510	170	330	440	180	310	900
18	Richardson Rd	5.1	1.6	2700	60	140	210	61	110	210	210	350	860
22(1)	Newton Rd	1.3	1.1	3000	180	140	220	140	97	210	260	260	850
22(2)	Newton Rd	1.0	1.1	2400	60	100	240	100	71	240	180	230	930
21	Newton Rd	1.2	1.1	2600	190	170	320	70	190	230	270	310	900
27a	Manukau Rd	1.0	1.2	910	140	56	80	25	39	84	160	140	300
27b	Manukau Rd	0.9	0.7	930	60	73	85	76	41	86	250	130	290
26(1)	Manukau Rd	2.4	1.3	1300	330	99	180	44	71	210	250	150	600
26(2)	Manukau Rd	1.5	1.4	2000	83	170	180	27	58	200	140	170	530
Roads > 20 000 vpd													
29	Fanshawe St	4.1	4.3	7000	290	130	160	460	240	280	980	380	410
28	SE Highway	3.2	1.3	< 89	320	120	190	180	77	86	1380	410	370
24	SH 16	5.7	3.7	4000	310	130	200	180	99	65	1070	390	360
19	SH 16	1.7	1.2	1500	59	51	260	88	35	94	230	180	810
23	SH 16	3.9	6.4	9500	55	85	280	41	24	79	160	180	820
20	SH 16	0.8	0.7	1400	55	82	350	28	59	190	280	190	810
30(1)	SH 1	0.9	1.7	2400	340	130	230	130	76	45	940	340	260
30(2)	SH 1	0.8	1.0	2900	270	78	110	130	39	37	980	230	230
25	SH 1	1.6	0.6	1700	67	83	390	82	44	200	260	230	1000

Figure 7

Loss on Ignition in samples of catchpit solids.



4.3 Total petroleum hydrocarbons (TPHs)

TPH (C7 – C44) concentrations in the < 1 mm fraction of each sample are reported in Table 3 and shown graphically in Figure 8. TPH Chromatograms and concentrations in seven carbon chain length ranges are contained in Appendix 3.

Around two-thirds of the samples have TPH concentrations in the range 1000-4000 mg/kg. The highest TPH concentrations (exceeding 5000 mg/kg) occur in samples taken from catchpits 1, 2 (both Glasgow Terrace), 3, 4 (both Carlton Gore Rd), 23 (North Western Motorway) and 29 (Fanshawe Street). Very low concentrations occur in samples taken from catchpits 9 (Mountain Rd) and 28 (South Eastern Highway).

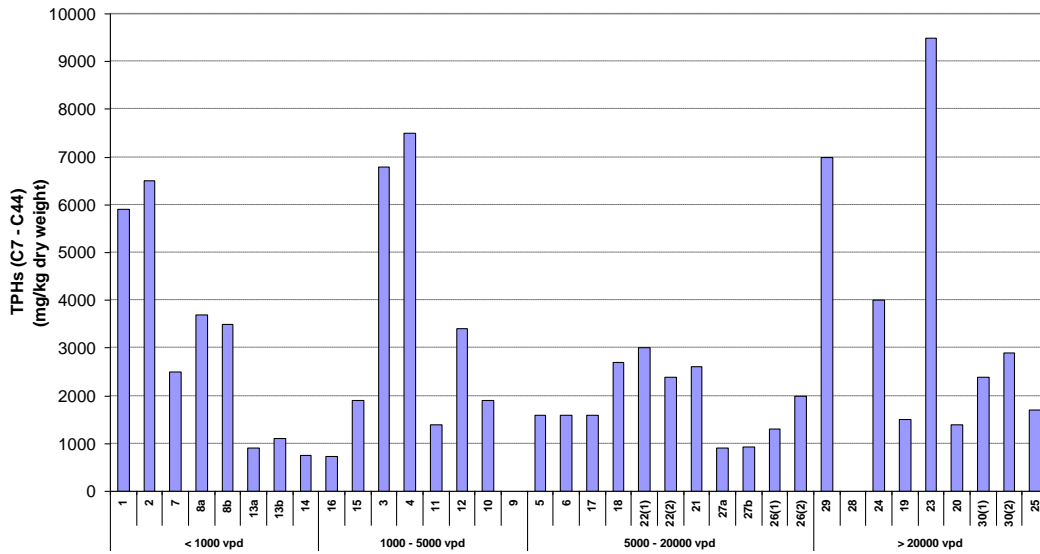
4.4 Metals

Concentrations of copper, lead and zinc on the 0.5 – 1 mm, 0.2 – 0.5 mm and < 0.2 mm fractions are presented in Table 3 and Figure 9.

In most samples concentrations of zinc are higher than concentrations of lead and copper across all three size fractions. Concentrations of lead are higher than those of copper in approximately half of the samples.

Figure 8

Dry weight concentrations of TPHs on catchpit solid samples, < 1mm fraction.



Within each sample the highest metal concentrations most frequently occur on the finest size fraction (< 0.2 mm). Relatively high copper concentrations (> 300 mg/kg) occur in the >0.2 mm size fraction of samples from catchpits 12 (Carlton Gore Rd), 17 (Richardson Rd), 20 (SH 16), 21 (Newton Rd) and 25 (SH 1). Relatively high lead concentrations (> 600 mg/kg) occur in the >0.2 mm size fraction of samples from catchpits 1 (Glasgow Tce), 4 (Carlton Gore Rd) and 13 (John Davis Rd). Relatively high zinc concentrations (> 1000 mg/kg) occur in the >0.2 mm size fraction of samples from catchpits 1, 2 (both Glasgow Tce), 3, 12 (both Carlton Gore Rd), 15 (Ellis Ave) and 25 (SH 1).

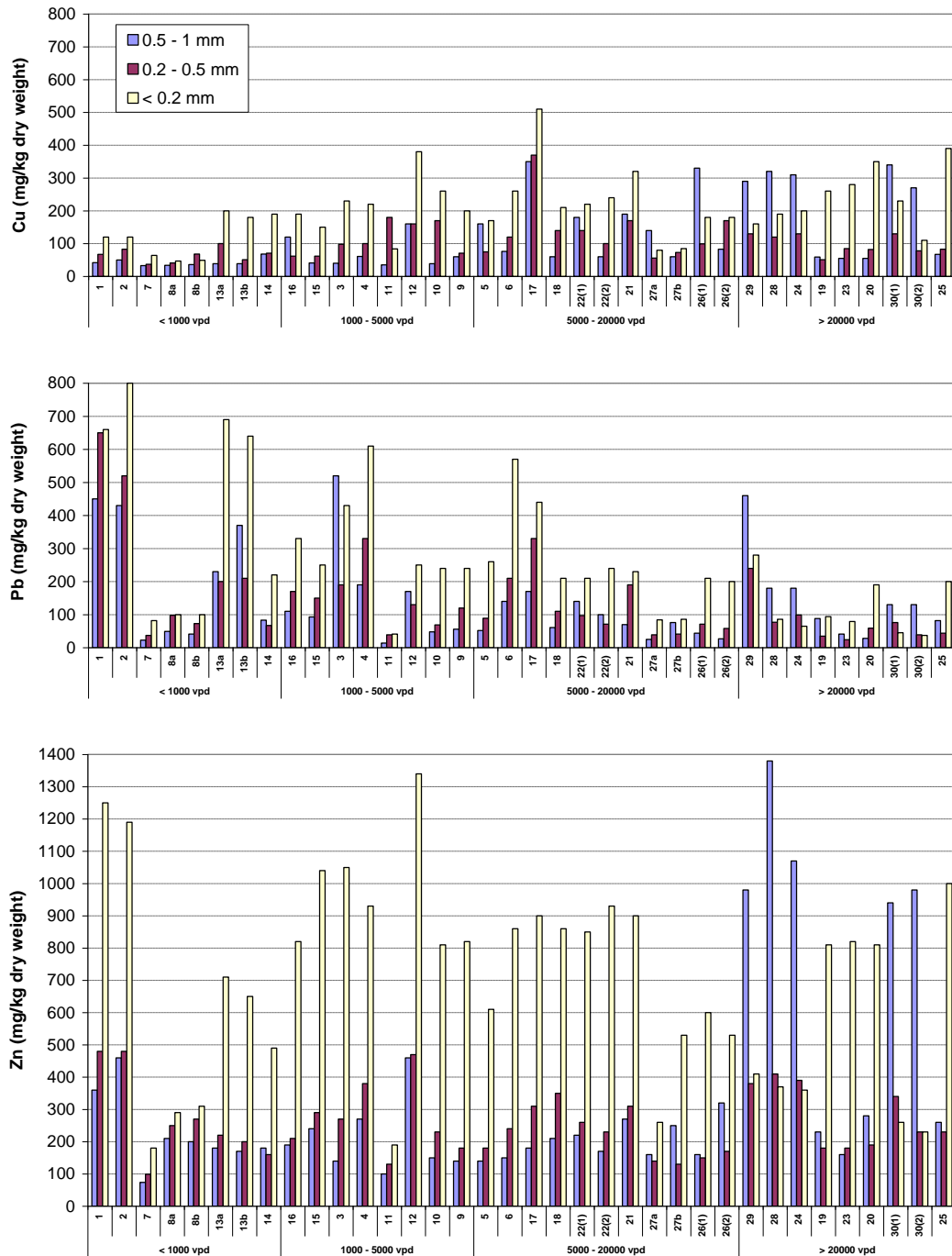
Relatively high metal concentrations also occur in the coarsest (0.5 – 1 mm) fraction of samples taken from a small number of catchpits. The coarse fractions in samples taken from catchpits 1, 2, 24, 28, 29 and 30 have relatively high concentrations of at least two of the three metals analysed for.

Lowest metal concentrations most frequently occur on the coarsest size fraction (0.5 - 1.0 mm). Around two-thirds of the coarse fraction samples have copper concentrations of less than 100 mg/kg, lead concentrations of less than 200 mg/kg and zinc concentrations of less than 300 mg/kg.

Samples from a small number of catchpits had relatively low concentrations of all three metals across all three size fractions. These samples were taken from catchpits 7, 8 (both Rangitoto Ave), 11 (Carlton Gore Rd) and 27 (Manukau Rd).

Figure 9

Dry weight concentrations of copper, lead and zinc on catchpit solid samples, fractions 0.5 – 1 mm, 0.2 – 0.5 mm and < 0.2 mm .



4.5 Variability in repeat and split samples

4.5.1 Repeat samples

Two samples were taken from each of catchpits 8, 13 and 27. The proportion of solids falling in each size fraction in each pair of samples correspond well, with a maximum difference of 3 per cent (see Table 2).

Of the six pairs of comparable results of the LOI analysis on these samples, three agree well (% organic content within 20 per cent of each other). The organic content measured in the remaining three pairs (8a and 8b, 1 mm – 1 cm; 13a and 13b, < 1 mm; and 27a and 27b, < 1mm) differs more markedly between paired samples. However, in absolute terms the differences are small. Presented in terms of the proportion of non-organic matter, the results for these three pairs of repeat samples are in relatively close agreement, being: 97.2 per cent (8a, 1 mm – 1 cm) and 95.5 per cent (8b, 1 mm – 1 cm); 97.3 per cent (13a, < 1 mm) and 98.5 per cent (13b, < 1 mm); and 98.8 per cent (27a, < 1 mm) and 99.3 per cent (27b, < 1mm).

The TPH concentrations on each pair of repeat samples are within 20 per cent agreement.

Of the 27 pairs of comparable results of the metals analysis (3 catchpits x 3 fractions x 3 metals), 19 agree well (within 20 per cent). Whilst the proportional difference between metal results for remaining 8 pairs is more marked (for example Pb concentrations on the 0.5 – 1.0 mm fraction are 25 mg/kg and 76 mg/kg for samples 27a and 27b respectively, a difference of 300 per cent), in the context of the full set of results, all paired samples are in broad general agreement. In other words, each pair of samples has relatively low, moderate or relatively high metal concentrations when compared to the range of results for the full set of samples.

4.5.2 Split samples

The samples collected from catchpits 22, 26 and 30 were split. The proportion of solids falling in each size fraction in each pair of split samples correspond well, with a maximum difference of 2 per cent, other than in one size fraction in sample 22 (see Table 2). The proportion of solids in the 0.2 – 0.5 mm fraction in this pair of samples was 11 per cent and 16 per cent.

Of the six pairs of comparable results of the LOI analysis on these samples, three agree well (within 20 per cent). The organic content measured in the remaining two pairs (26(1) and 26(2), 1 mm – 1 cm; and 30(1) and 30(2), < 1 mm) differs more markedly between paired samples in proportional terms. However, in absolute terms the differences are small. Presented in terms of the proportion of non-organic matter, the results for these three pairs of repeat samples are in relatively close agreement, being: 98.7 per cent (22(1), 1 mm – 1 cm) and 99.0 per cent (22(2), 1 mm – 1 cm); 97.6 per cent (26(1), 1 mm – 1 cm) and 98.5 per cent (26(2), 1 mm – 1 cm); and 98.3 per cent (30(1), < 1 mm) and 99.0 per cent (30(2), < 1 mm).

The TPH concentrations on each pair of split samples vary by as much as 35 per cent. However, in the context of the full set of results, the paired sample results are broadly similar (low to moderate concentrations).

Of the 27 pairs of comparable results of the metals analysis (three catchpits x 3 fractions x 3 metals), 14 agree well (within 20 per cent). In the context of the full set of results, the remaining paired samples are also in broad general agreement. As with the split samples, each pair of samples has relatively low, moderate or relatively high metal concentrations when compared to the range of results for the full set of samples.

The exception to this are concentrations of copper in the coarsest (0.5 – 1 mm) fraction of split samples from catchpits 22 and 26. In each of these cases the copper concentrations in sample (1) is markedly higher than that in sub-sample (2).

5 References

AUCKLAND CITY COUNCIL, 2007. Traffic flow data.

www.aucklandcity.govt.nz/auckland/transport/flow/default.asp. (accessed 28 October 2009).



TRANSIT NEW ZEALAND, 2006. *State Highway Traffic Volumes 2001 to 2005*. 20 pp.



6 Appendix 1: Catchpit Sample Processing and Analysis – Revised Methodology



1. Take a sub-sample (approx one quarter of total volume, if sample is well homogenised) from each catchpit sample.
2. Wet sieve with a 1 cm sieve (pale blue plastic tray) in large plastic tray / bowl.
3. Remove, dry and weigh the > 1 cm fraction.
4. Wet sieve the < 1 cm fraction with a 1 mm sieve.
5. Dry and weigh the 1 mm – 1 cm fraction and analyse for LOL.
6. Provide a visual description of everything > 1 cm.
7. Divide the < 1 mm fraction into three further sub-samples a, b and c:
 - a. Dry this sub-sample at 35 °C, weigh and analyse for TPH.
 - b. Dry this sample at 60 °C, weigh and analyse for LOI.
 - c. Wet sieve this sample into three further fractions, 0.5 – 1 mm, 0.2 – 0.5 mm and < 0.2 mm.
8. Dry each sub-samples generated from (c) above at 60 °C, weigh and analyse for Zn, Cu and Pb. Retain the unused portions for possible future work.
9. If the initial sub-sample contains too much fine material, ie the filtering of the <1mm fractions will take too long, then any of these fractions could be sub-sampled again so long as the weights of all fractions are recorded.



June 2008

7 Appendix 2: Site Details and Sample Descriptions

Catchpit number	1
Road name	Glasgow Terrace
Location	Cnr of Boyle Cres, outside 9A Glasgow Tce
Traffic direction (N, S, E or W bound)	N
Comments – field Lots of leaves, not much sediment.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 70% leaves, 5% roots/sticks, 5% stones, remainder unidentified. < 1 cm fraction comprises 90% stones, 5% brick/glass, 5% organic material. Rotting vegetation odour.	
Sample photograph: 	

Catchpit number	2
Road name	Glasgow Terrace
Location	Opposite catchpit number 1
Traffic direction (N, S, E or W bound)	S
Comments – field As catchpit 1, but more leaves.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 85% leaves, 5% roots/sticks, 5% gravel, remainder unidentified. < 1 cm fraction comprises 70% gravel, 15% mud, 15% organic material.	
Sample photograph: 	

Catchpit number	3
Road name	Carlton Gore Rd
Location	Cnr Seafield View Rd, outside 14 Carlton Gore
Traffic direction (N, S, E or W bound)	E
Comments – field Lots of vegetation, oil slick on surface, some gravel and silt.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 70% leaves, 15% pine needles, 5% stones, 5% sticks, 5% other (including plastic and cardboard). < 1 cm fraction comprises 60% fine gravel / stones, 20% mud, 10% leaves, 10% glass and other material.	
Sample photograph: 	

Catchpit number	4
Road name	Carlton Gore Rd
Location	Opposite catchpit 3
Traffic direction (N, S, E or W bound)	W
Comments – field As catchpit 3.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 97% leaves, 1% roots/sticks, 1% stones, 1% other. < 1 cm fraction comprises 45% stones, 35% mud, 10% organic material, 5% glass, 5% other. Rotting vegetation odour.	
Sample photograph: 	

Catchpit number	5
Road name	Remuera Rd
Location	Cnr Belmont Tce 3
Traffic direction (N, S, E or W bound)	S

Comments – field

Lots of leaves, some sediments.

Site photograph:





Description of sample:



> 1 cm fraction comprises 92% large leaves, 3% sticks, 3% stones, 2% other (cigarette butts, plastic).
 < 1 cm fraction comprises 80% sand/grit, 10% mud, 8% stones, 2% other.



Sample photograph:





Catchpit number	6
Road name	Remuera Rd
Location	Outside 77 Remuera Rd
Traffic direction (N, S, E or W bound)	N
Comments – field More sediments than leaves.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 50% stones, 40% leaves, 10% other. < 1 cm fraction comprises 80% sandy gravel, 20% mud, 10% stones, 10% glass & other.	
Sample photograph: 	



Catchpit number	7
Road name	Rangitoto Avenue
Location	Outside 20 Rangitoto Ave
Traffic direction (N, S, E or W bound)	E
Comments – field Dry, lots of leaves, shallow sediment, lots of gravel.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 60% gravel / large stones, 35% leaves, 5% other. < 1 cm fraction comprises 50% fine mud, 30% fine gravel, 15% decomposing leaves, 5% other.	
Sample photograph: 	

Catchpit number	8
Road name	Rangitoto Avenue
Location	Outside 23 Rangitoto Ave
Traffic direction (N, S, E or W bound)	W
Comments – field New type of grill. Road recently resealed with asphalt. Similar to catchpit number 7, strong oil/petrol smell.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 45% small stones / gravel, 30% leaves / organic matter, 18% sediments, 7% glass / other. < 1 cm fraction comprises 50% stones / gravel, 40% leaves, 10% sticks and other.	
Sample photograph: 	

Catchpit number	9
Road name	Mountain Road
Location	Outside 54 Mountain Rd
Traffic direction (N, S, E or W bound)	S
Comments – field Leaves and sediment. Strong odour.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 50% decomposing organic matter, 20% leaves, 10% sticks, 10% stones / glass, 10% other. < 1 cm fraction comprises 60% decomposing organic matter, 20% mud, 15% stones, 5% other.	
Sample photograph: 	

Catchpit number	10
Road name	Mountain Road
Location	Opposite catchpit number 9
Traffic direction (N, S, E or W bound)	N
Comments – field Leaves and sediment.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 50% leaves / organic matter, 40% stones, 5% glass, 5% other. < 1 cm fraction comprises 40% decomposing organic matter, 40% stones / sand, 15% mud, 5% glass.	
Sample photograph: 	

Catchpit number	11
Road name	Carlton Gore Road
Location	Cnr Kingdon Street
Traffic direction (N, S, E or W bound)	W
Comments – field Sediment.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 70% leaves, 25% stones, 5% sticks / other. < 1 cm fraction comprises 50% fine mud, 30% gravel / small stones, 20% decomposing organic matter. Oily surface.	
Sample photograph: 	

Catchpit number	12
Road name	Carlton Gore Road
Location	Outside 106 Carlton Gore Rd
Traffic direction (N, S, E or W bound)	E
Comments – field Little sediment.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 75% leaves, 10% stones, 5% glass, 5% cigarette butts, 5% rubbish. < 1 cm fraction comprises 50% decomposing organic matter, 25% fine mud, 20% sand/fine gravel, 5% other.	
Sample photograph: 	

Catchpit number	13
Road name	John Davis Road
Location	Outside 69 John Davis Rd
Traffic direction (N, S, E or W bound)	E

Comments – field

Site photograph:





Description of sample:

> 1 cm fraction comprises 70% leaves, 25% stones, 5% glass / plastic / other.
 < 1 cm fraction comprises 40% gravel, 30% fine mud, 30% decomposing organic matter.

Sample photograph:



Catchpit number	14
Road name	John Davis Road
Location	Outside 36 John Davis Rd
Traffic direction (N, S, E or W bound)	W
Comments – field	
<p>Site photograph:</p> 	
<p>Description of sample:</p> <p>> 1 cm fraction comprises 75% leaves, 10% stones, 10% grass / sticks, 5% other. < 1 cm fraction comprises 40% decomposing organic matter, 30% fine mud, 30% fine stones / gravel.</p>	
<p>Sample photograph:</p> 	

Catchpit number	15
Road name	Ellis Avenue
Location	Outside Unit 3 / 67 Ellis Ave
Traffic direction (N, S, E or W bound)	S
Comments – field Lots of sediment, very little vegetation. Clear water.	
Site photograph: <div data-bbox="513 611 1193 1115" data-label="Image"> </div>	
Description of sample: <p>> 1 cm fraction comprises 50% stones, 30% leaves / organic matter, 10% glass, 10% rubbish / other. < 1 cm fraction comprises 60% fine gravel / sand, 20% fine mud, 20% decomposing organic matter.</p>	
Sample photograph: <div data-bbox="518 1317 1197 1821" data-label="Image"> </div>	

Catchpit number	16
Road name	Ellis Avenue
Location	Opposite site 15
Traffic direction (N, S, E or W bound)	N

Comments – field

Lots of sediment, very little vegetation. Dirtier water than catchpit 15.

Site photograph:




Description of sample:

> 1 cm fraction comprises 80% stones, 15% leaves / organic matter, 5% other.
 < 1 cm fraction comprises 65% fine gravel / sand, 22% fine mud, 13% decomposing organic matter.

Sample photograph:



Catchpit number	17
Road name	Richardson Road
Location	Opposite 473 Richardson Rd
Traffic direction (N, S, E or W bound)	S
Comments – field Lots of sediment, dirty water.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 50% sticks / small twigs, 40% leaves, 5% stones, 5% glass / rubbish. < 1 cm fraction comprises 40% decomposing organic matter, 30% fine gravel / sand, 28% fine mud, 2% other.	
Sample photograph: 	

Catchpit number	18
Road name	Richardson Road
Location	Outside 473 Richardson Rd
Traffic direction (N, S, E or W bound)	N

Comments – field

About equal quantities sediment and vegetation.

Site photograph:



Description of sample:

> 1 cm fraction comprises 90% leaves / sticks, 7% stones, 3% glass / rubbish.
 < 1 cm fraction comprises 40% fine gravel / sand, 30% decomposing organic matter, 25% fine mud, 5% other.

Sample photograph:



Catchpit number	19
Road name	SH16 North-western Motorway
Location	approaching St Lukes Rd off ramp
Traffic direction (N, S, E or W bound)	E
Comments – field Lots of gravel, some sediment.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 90% stones / red chip, 6% leaves, 4% glass / rubbish. < 1 cm fraction comprises 60% stones / coarse sand, 30% fine mud, 10% decomposing organic matter.	
Sample photograph: 	

Catchpit number	20
Road name	SH16 North-western Motorway
Location	after Western Springs on ramp
Traffic direction (N, S, E or W bound)	E

Comments – field

Lots of gravel, some sediment.

Site photograph:





Description of sample:

> 1 cm fraction comprises 98% stones / gravel, 2% sticks / leaves.
 < 1 cm fraction comprises 75% gravel / coarse sand, 25% fine mud.

Sample photograph:



Catchpit number	21
Road name	Newton Rd
Location	Opposite Winchester Rd
Traffic direction (N, S, E or W bound)	N
Comments – field Lots of sediment, dirty water.	
Site photograph: (catchpit sampled prior to works shown here)	
	
Description of sample: > 1 cm fraction comprises 85% stones, 10% plastic, 5% sticks. < 1 cm fraction comprises 80% gravel / coarse sand, 15% fine mud, 5% organic matter.	
Sample photograph:	
	

Catchpit number	22
Road name	Newton Rd
Location	cnr Winchester Rd
Traffic direction (N, S, E or W bound)	S

Comments – field

Lots of sediment, very dirty water.

Site photograph:





Description of sample:



> 1 cm fraction comprises 85% stones, 10% organic matter, 5% glass / rubbish.
 < 1 cm fraction comprises 80% stones / coarse sand, 15% fine mud, 5% decomposing organic matter.

Sample photograph:



Catchpit number	23
Road name	SH16 North-western Motorway
Location	Between Newton Rd and St Lukes Rd
Traffic direction (N, S, E or W bound)	W
Comments – field Lots of leaves, clean water.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 85% leaves, 12% stones / red chip, 3% rubbish / cigarette butts. < 1 cm fraction comprises 50% decomposing organic matter, 40% stones / gravel, 10% fine mud.	
Sample photograph: 	

Catchpit number	24
Road name	SH16 North-western Motorway
Location	Between Carrington Rd and Gt North Rd
Traffic direction (N, S, E or W bound)	W
Comments – field Lots of sediments.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 80% leaves / grass / sticks, 10% stones, 10% rubbish / glass / cigarette butts. < 1 cm fraction comprises 65% decomposing organic matter, 25% fine gravel / sand, 10% fine mud.	
Sample photograph: 	

Catchpit number	25
Road name	SH1 Southern Motorway
Location	Approaching Green Lane exit
Traffic direction (N, S, E or W bound)	S
Comments – field Lots of gravel and sediments.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 60% gravel, 35% leaves / sticks, 5% rubbish / cigarette butts. < 1 cm fraction comprises 60% fine gravel, 20% sand, 10% fine mud, 10% organic matter.	
Sample photograph: 	

Catchpit number	26
Road name	Manukau Road
Location	Opposite Rangiatea Rd
Traffic direction (N, S, E or W bound)	S

Comments – field

Lots of sediments, relatively clean water.

Site photograph:






Description of sample:

> 1 cm fraction comprises 75% leaves / grass / sticks, 15% stones / gravel, 10% rubbish.
 < 1 cm fraction comprises 60% fine gravel / sand, 25% decomposing organic matter, 15% fine mud.
 Very oily.

Sample photograph:



Catchpit number	27
Road name	Manukau Road
Location	cnr Rangiatea Rd
Traffic direction (N, S, E or W bound)	N
Comments – field Lots of sediments and gravel.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 90% stones, 5% leaves / grass / sticks, 5% glass. < 1 cm fraction comprises 50% stones / fine gravel, 20% sand, 20% fine mud, 10% decomposing organic matter.	
Sample photograph: 	

Catchpit number	28
Road name	South Eastern Highway
Location	Approaching Carbine Rd intersection
Traffic direction (N, S, E or W bound)	E
Comments – field Lots of sediments, sludgy consistency.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 92% organic matter, 5% plastic / rubbish, 5% stones / gravel. < 1 cm fraction comprises 60% decomposing organic matter, 20% fine mud, 20% sand.	
Sample photograph: 	

Catchpit number	29
Road name	Fanshawe Street
Location	Approaching northern motorway on ramp
Traffic direction (N, S, E or W bound)	E

Comments – field

Lots of leaves, little sediment.

Site photograph:



Description of sample:

> 1 cm fraction comprises 95% leaves / grass / sticks, 4% plastic / rubbish, 1% stones.
 < 1 cm fraction comprises 80% decomposing organic matter, 10% sand / small stones, 10% fine mud.

Sample photograph:



Catchpit number	30
Road name	SH1 Southern Motorway
Location	Approaching Green Lane off ramp
Traffic direction (N, S, E or W bound)	N
Comments – field Lots of sediment / gravel, clean water.	
Site photograph: 	
Description of sample: > 1 cm fraction comprises 80% stones, 15% organic matter, 5% plastic / rubbish / glass. < 1 cm fraction comprises 60% small stones / gravel, 25% sand, 10% decomposing organic matter, 5% fine mud.	
Sample photograph: 	

8 Appendix 3: TPH Concentrations and Chromatograms

Refer to the "Lab number" reported in Table 4 to identify sample results shown in chromatograms.

Table 4

TPH concentrations in samples of catchpit solids by carbon chain length ranges and in total.

	Road name	Lab Number	TPH concentration (mg/kg)							
			C7 – C9	C10 – C11	C12 – C14	C15 – C20	C21 – C25	C26 – C29	C30 – C44	Total hydrocarbons (C7 – C44)
Roads < 1000 vpd										
1	Glasgow Tce	618689.109	40	16	< 13	110	270	600	4900	5900
2	Glasgow Tce	618689.110	< 25	< 25	< 25	< 25	220	590	5700	6500
7	Rangitoto Ave	618689.115	< 12	< 12	< 12	22	140	160	2200	2500
8a	Rangitoto Ave	618689.116	< 13	< 13	< 13	420	380	360	2600	3700
8b	Rangitoto Ave	618689.117	< 12	< 12	< 12	410	360	320	2500	3500
13a	John Davis Rd	618689.122	< 33	< 33	< 33	< 33	< 33	52	1000	900
13b	John Davis Rd	618689.123	< 34	< 34	< 34	< 34	< 34	78	1200	1100
14	John Davis Rd	618689.124	< 32	< 32	< 32	< 32	< 32	48	860	750
Roads 1000 – 5000 vpd										
16	Ellis Ave	618689.126	< 34	< 34	< 34	< 34	< 34	< 34	880	740
15	Ellis Ave	618689.125	< 33	< 33	< 33	< 33	160	270	1600	1900
3	Carlton Gore Rd	618689.111	140	37	19	1100	910	470	4100	6800
4	Carlton Gore Rd	618689.112	< 26	< 26	< 26	< 26	300	660	6600	7500
11	Carlton Gore Rd	618689.120	< 30	< 30	< 30	67	160	210	980	1400
12	Carlton Gore Rd	618689.121	< 32	< 32	< 32	< 32	310	790	2400	3400
10	Mountain Rd	618689.119	< 32	< 32	< 32	63	250	330	1200	1900
9	Mountain Rd	618689.118	< 13	< 13	< 13	< 13	< 13	< 13	< 20	< 36

Table 4 (cont.)

	Road name	Lab number	TPH concentration (mg/kg)							
			C7 – C9	C10 – C11	C12 – C14	C15 – C20	C21 – C25	C26 – C29	C30 – C44	Total hydrocarbons (C7 – C44)
Roads 5000 – 20 000 vpd										
5	Remuera Rd	618689.113	< 12	< 12	< 12	< 12	32	100	1500	1600
6	Remuera Rd	618689.114	< 12	< 12	< 12	< 12	80	120	1400	1600
17	Richardson Rd	618689.127	< 30	< 30	< 30	< 30	130	190	1200	1600
18	Richardson Rd	618689.128	< 30	< 30	< 30	< 30	250	480	2100	2700
22(1)	Newton Rd	618689.132	47	< 29	< 29	110	300	390	2100	3000
22(2)	Newton Rd	618689.133	< 27	< 27	< 27	83	210	280	1800	2400
21	Newton Rd	618689.131	< 31	< 31	< 31	56	240	370	1900	2600
27a	Manukau Rd	618689.139	< 26	< 26	< 26	< 26	46	75	760	910
27b	Manukau Rd	618689.140	< 28	< 28	< 28	< 28	41	65	790	930
26(1)	Manukau Rd	618689.137	< 29	< 29	< 29	< 29	120	230	880	1300
26(2)	Manukau Rd	618689.138	< 30	< 30	< 30	36	190	360	1400	2000
Roads > 20 000 vpd										
29	Fanshawe St	618689.142	50	43	< 32	340	610	930	5000	7000
28	SE Highway	618689.141	< 32	< 32	< 32	< 32	< 32	< 32	< 45	< 89
24	SH 16	618689.135	< 34	< 34	< 34	< 34	36	310	3800	4000
19	SH 16	618689.129	< 30	< 30	< 30	< 30	87	150	1200	1500
23	SH 16	618689.134	< 37	< 37	< 37	68	650	1300	7500	9500
20	SH 16	618689.130	< 28	< 28	< 28	< 28	58	120	1200	1400
30(1)	SH 1	618689.143	< 26	< 26	< 26	29	120	190	2000	2400
30(2)	SH 1	618689.144	< 32	< 32	< 32	34	150	240	2500	2900
25	SH 1	618689.136	29	< 29	< 29	< 29	110	190	1300	1700

Figure 10

Samples 618689-109 to 618689-111.

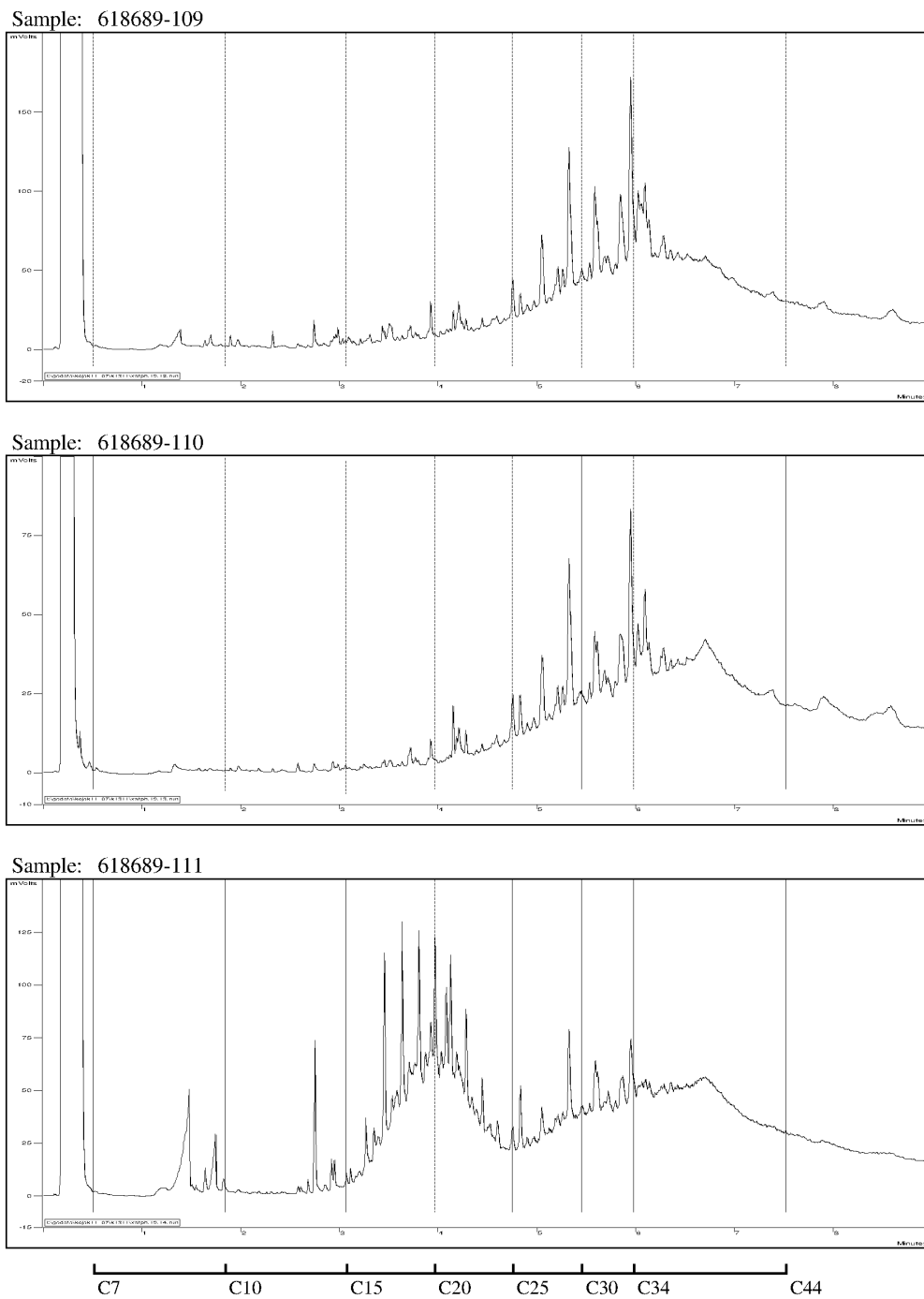
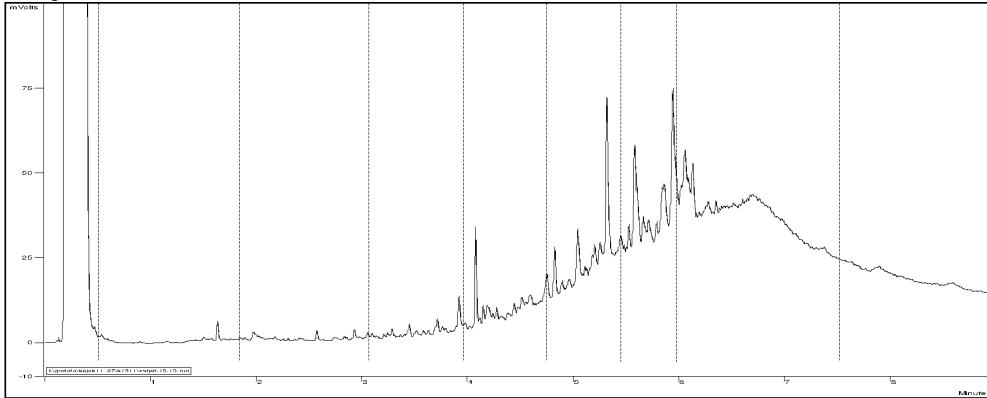


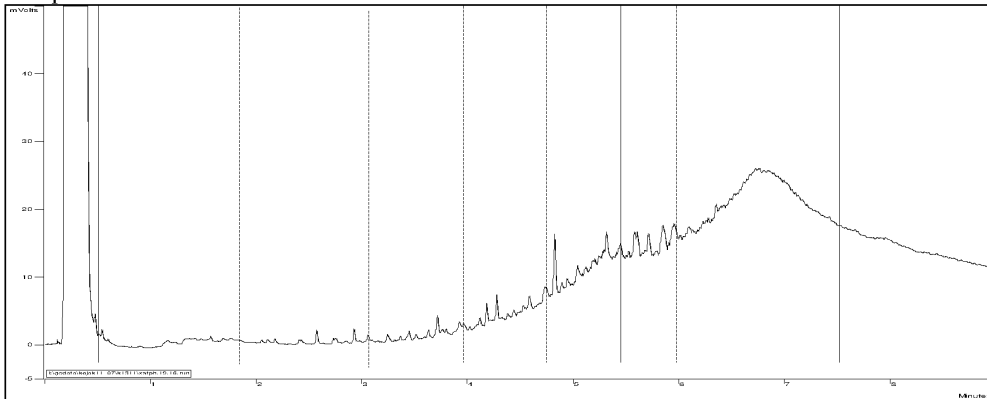
Figure 11

Samples 618689-112 to 618689-114.

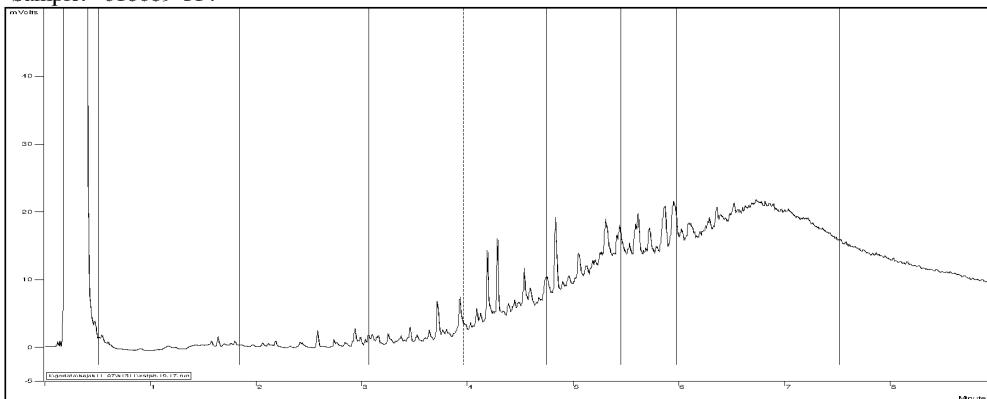
Sample: 618689-112



Sample: 618689-113



Sample: 618689-114



C7 C10 C15 C20 C25 C30 C34 C44

Figure 12

Samples 618689-115 to 618689-117.

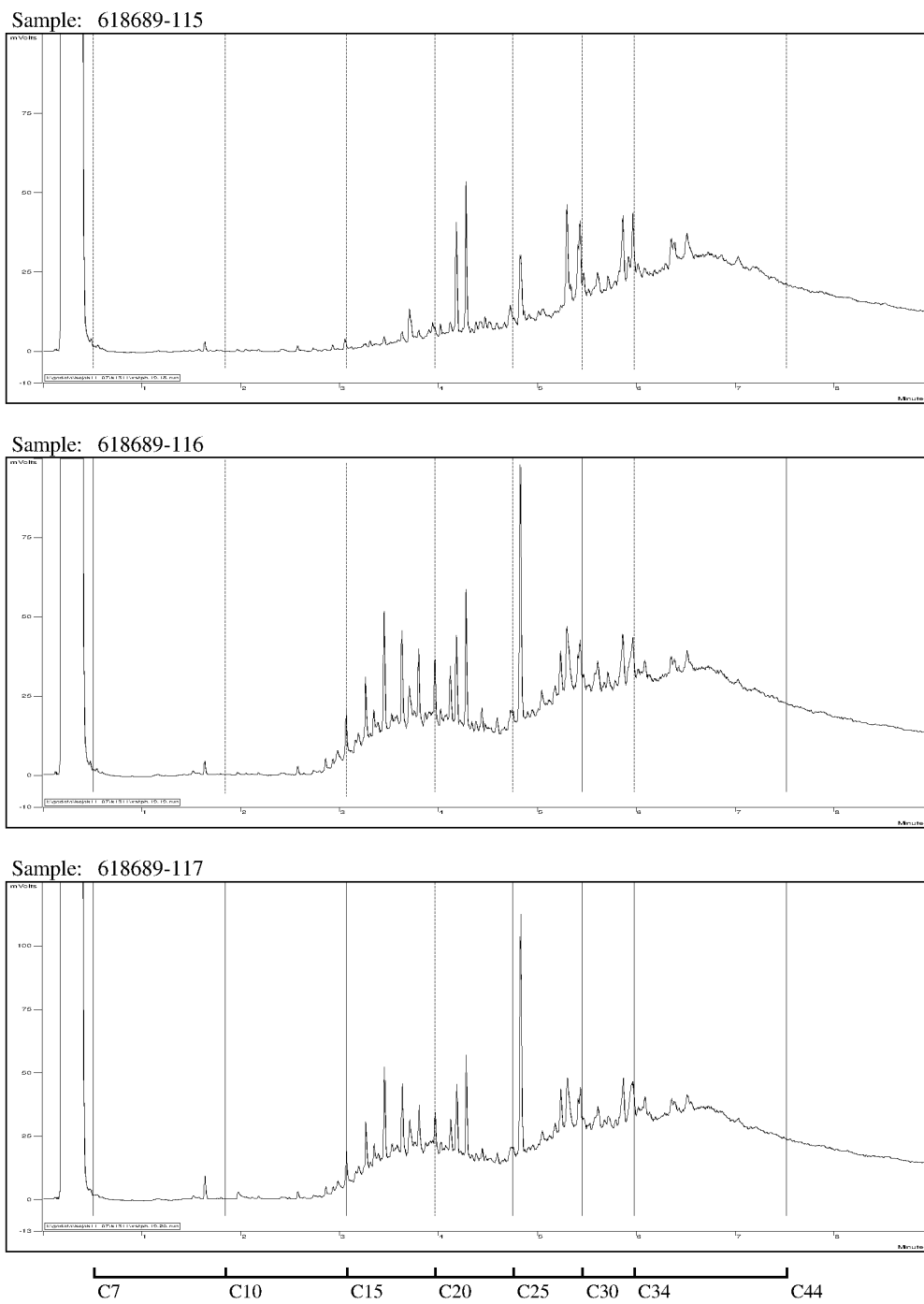
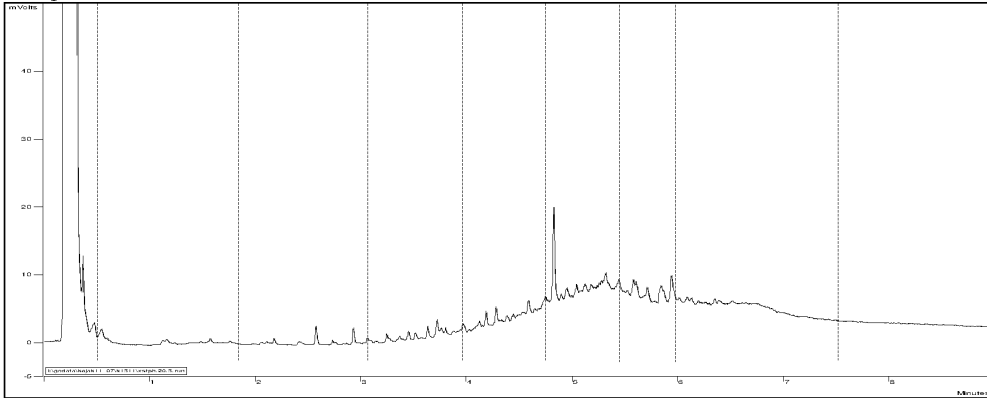


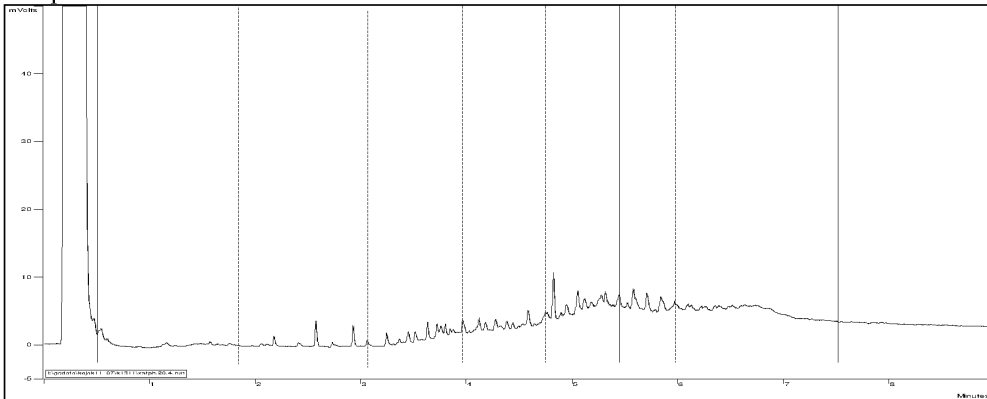
Figure 13

Samples 618689-119 to 618689-121.

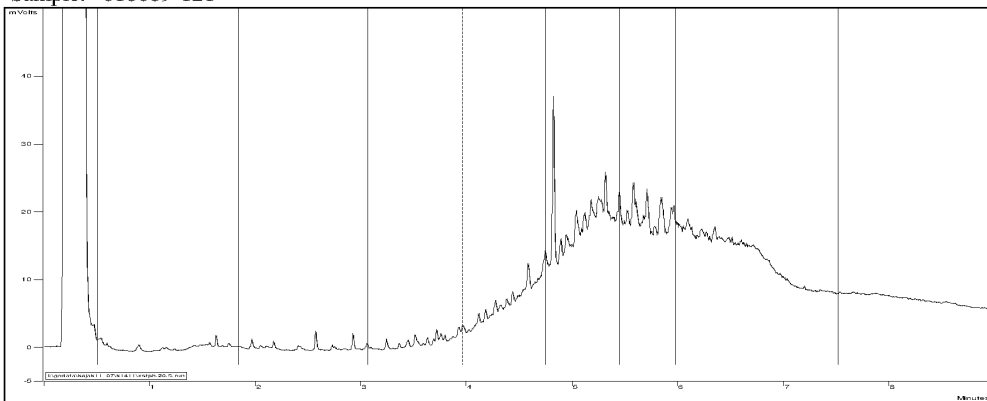
Sample: 618689-119



Sample: 618689-120



Sample: 618689-121



C7 C10 C15 C20 C25 C30 C34 C44

Figure 14

Samples 618689-122 to 618689-124.

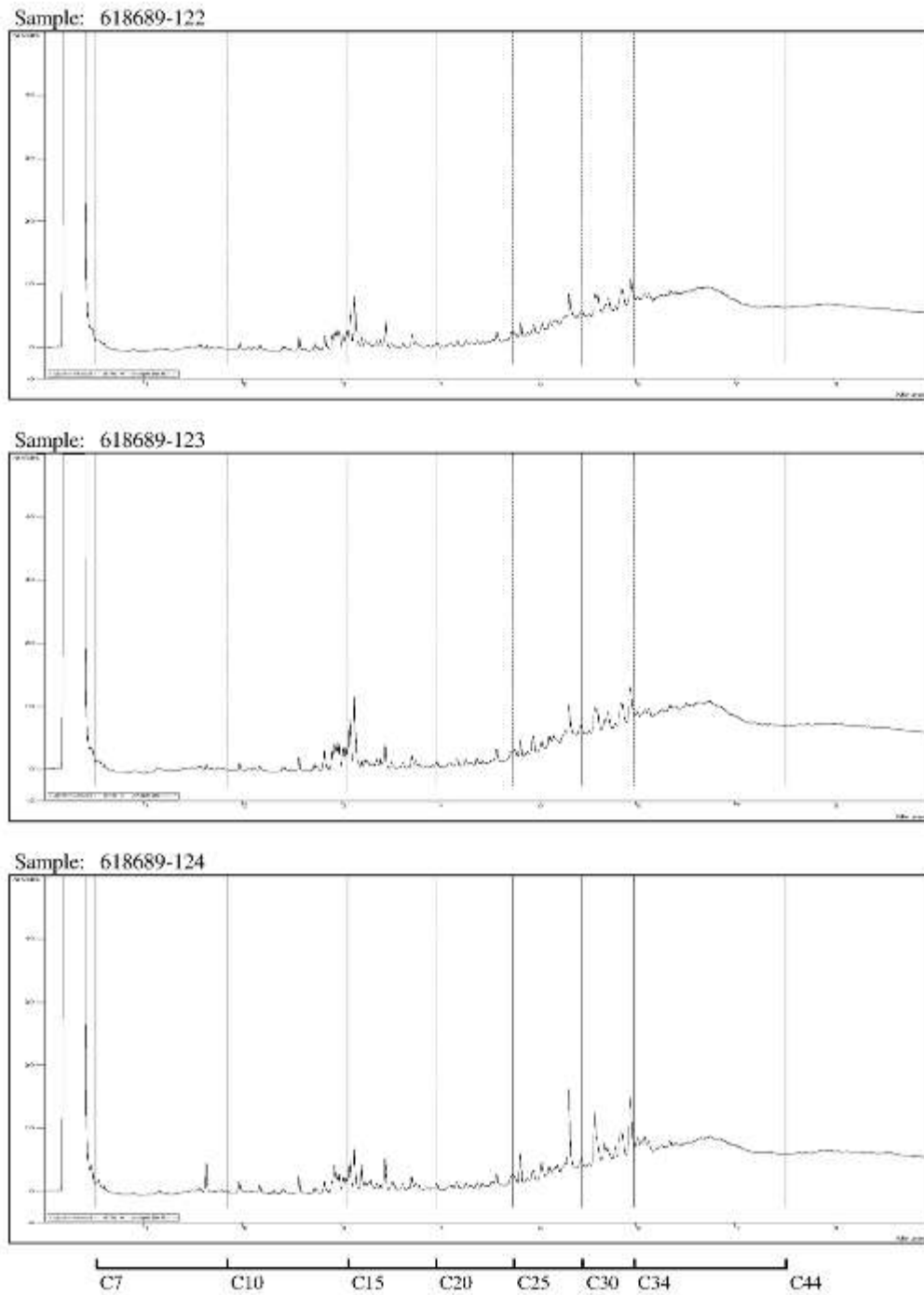


Figure 15

Samples 618689-125 to 618689-127.

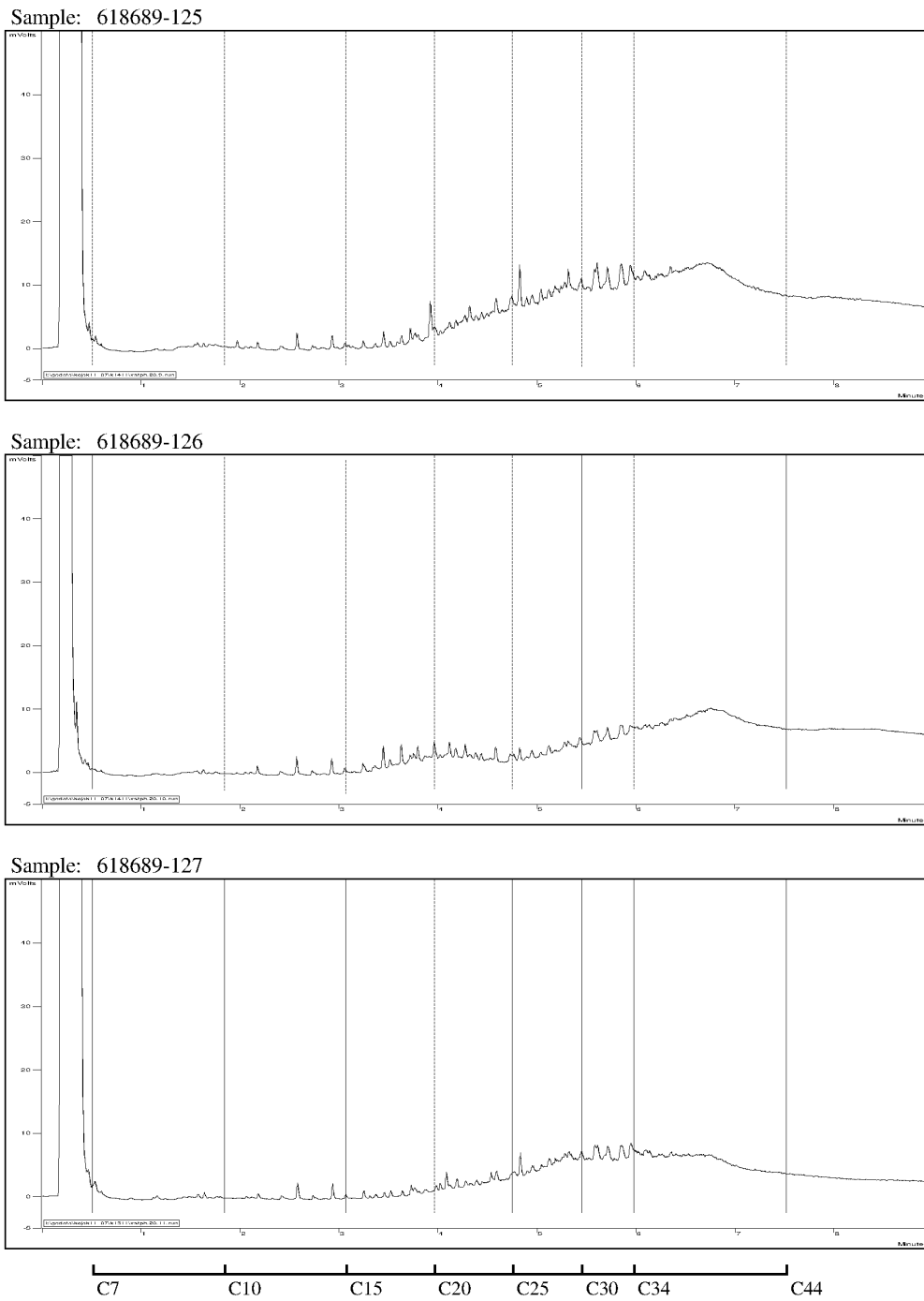
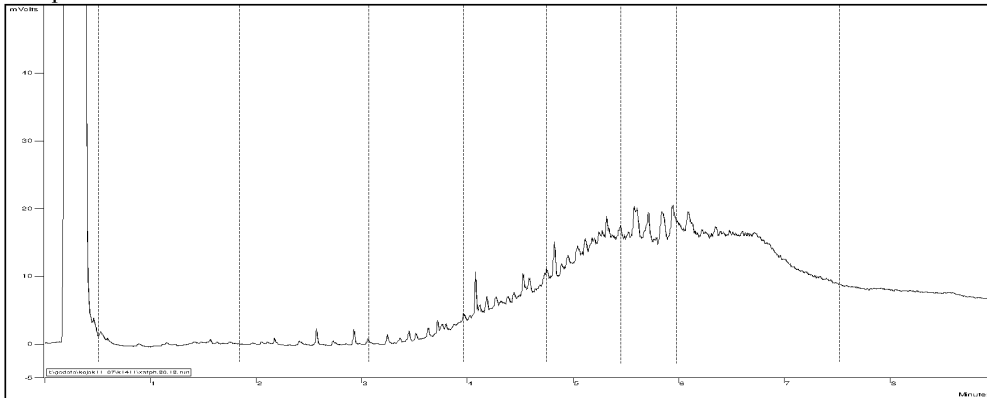


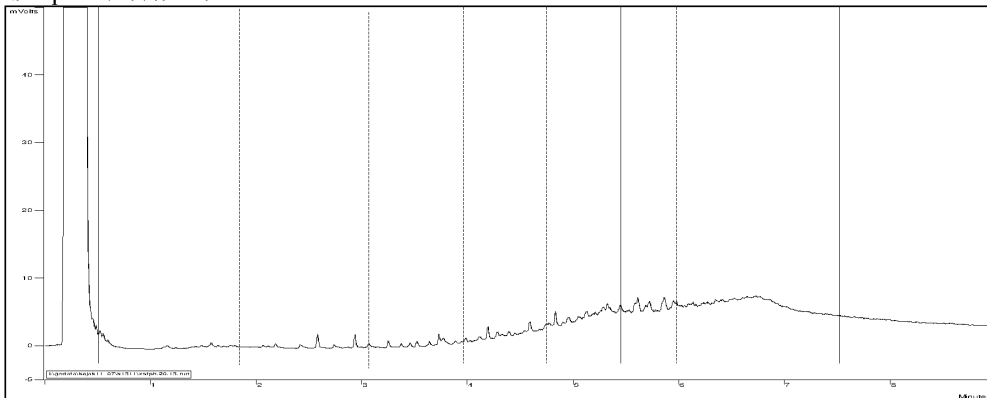
Figure 16

Samples 618689-128 to 618689-130.

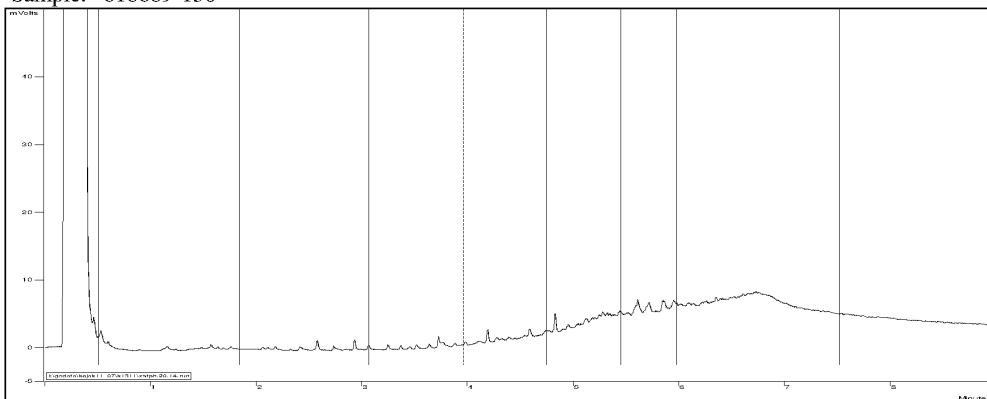
Sample: 618689-128



Sample: 618689-129



Sample: 618689-130



C7 C10 C15 C20 C25 C30 C34 C44

Figure 17

Samples 618689-131 to 618689-133.

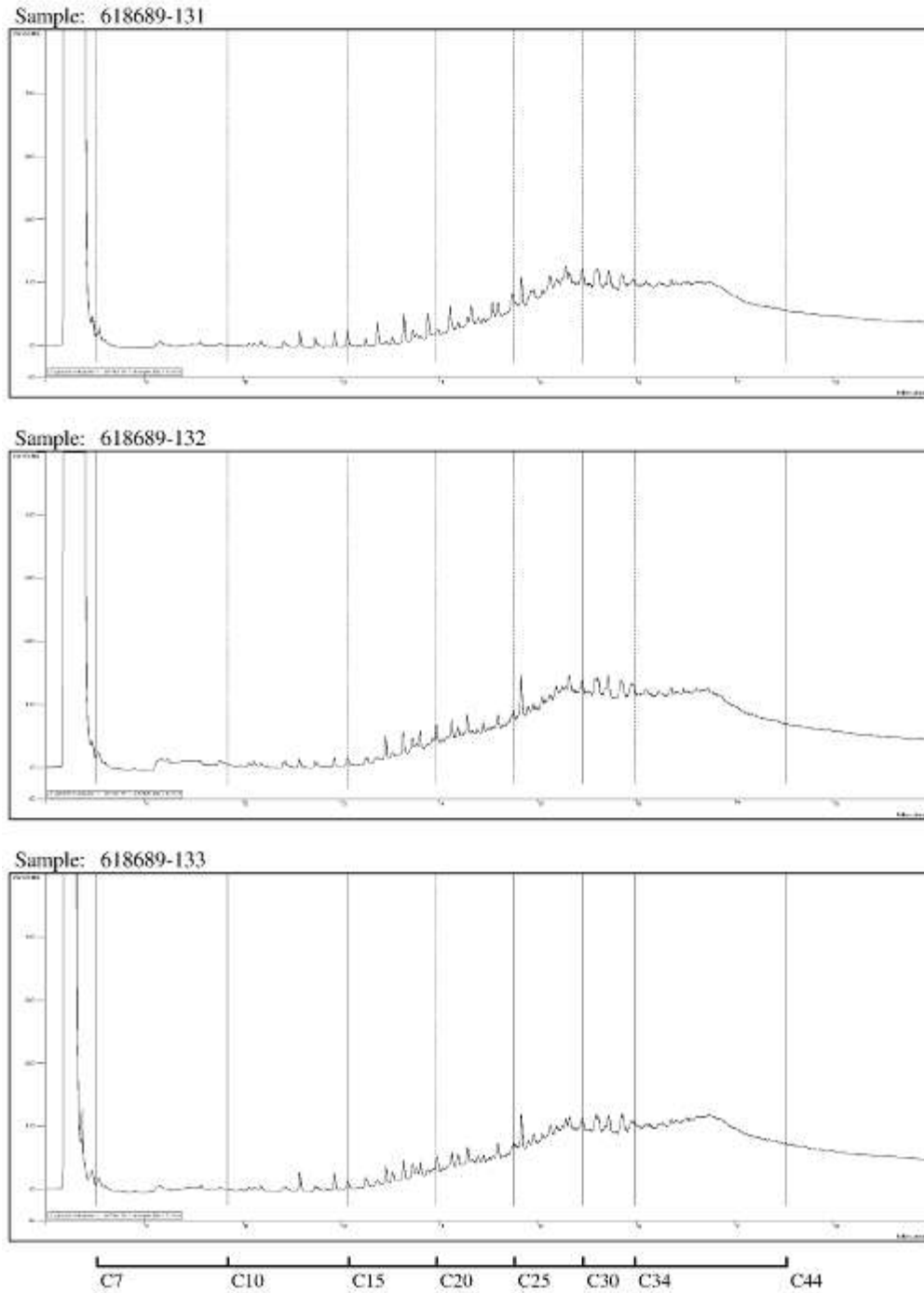


Figure 18

Samples 618689-134 to 618689-136.

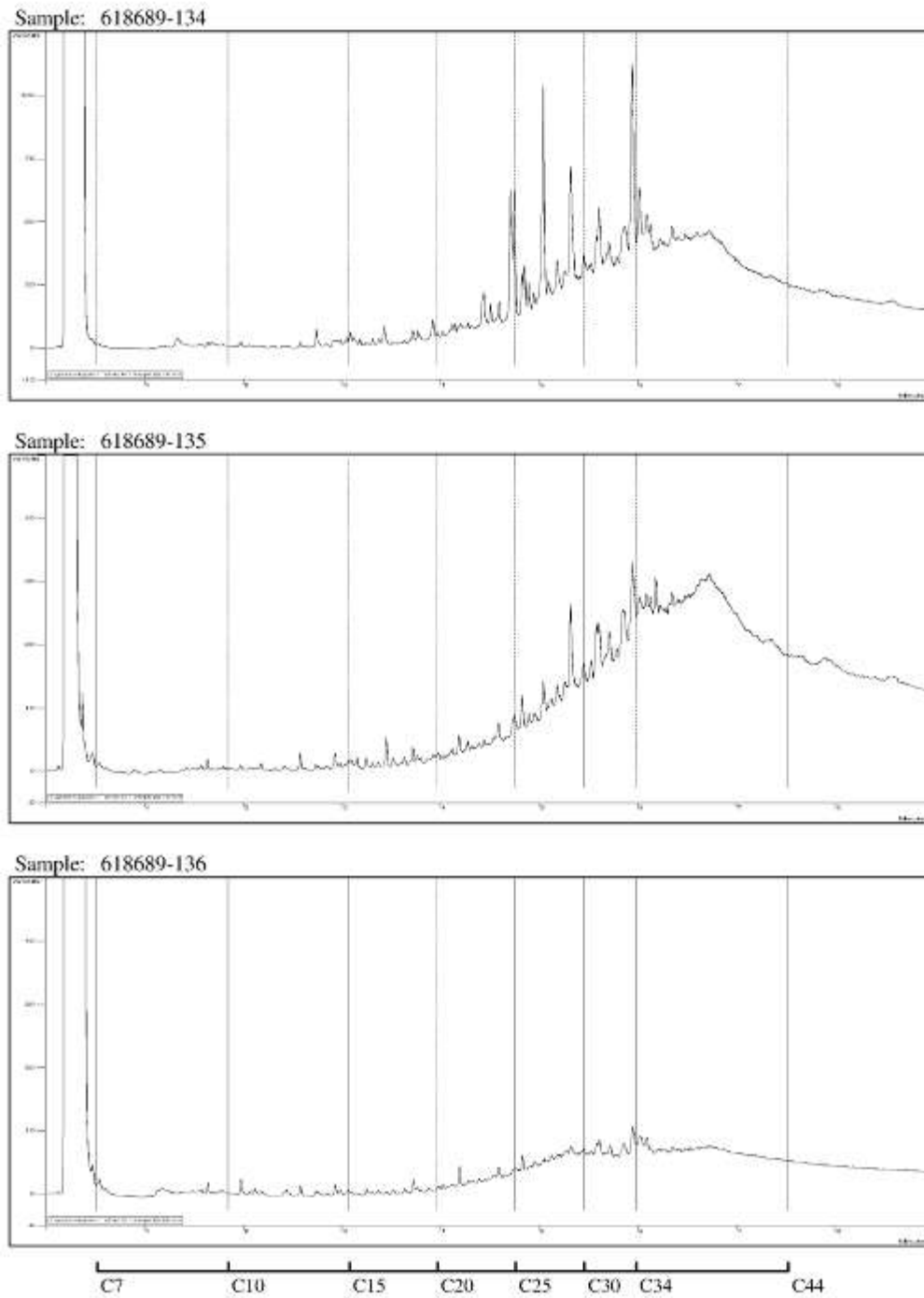


Figure 19

Samples 618689-137 to 618689-139.

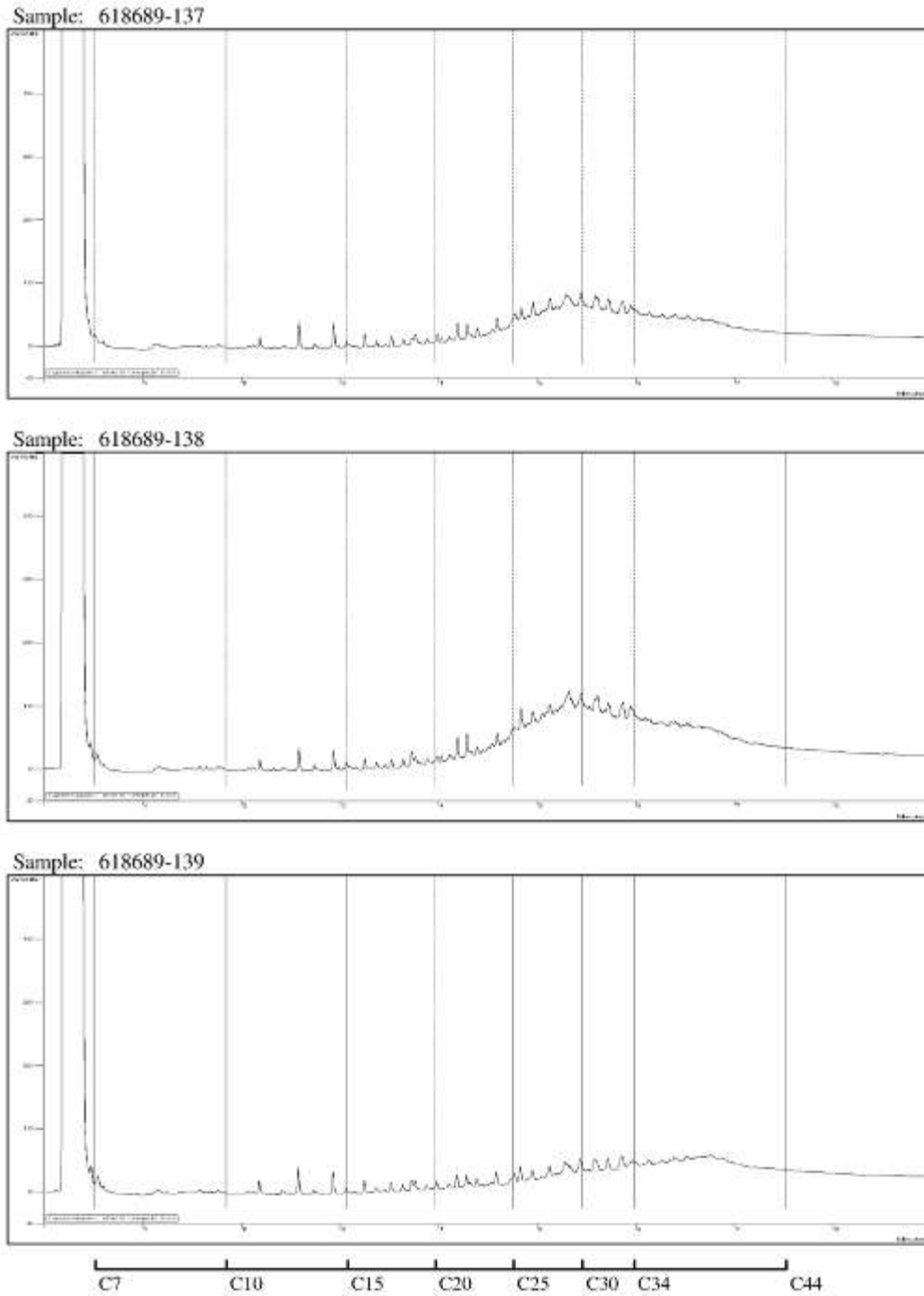
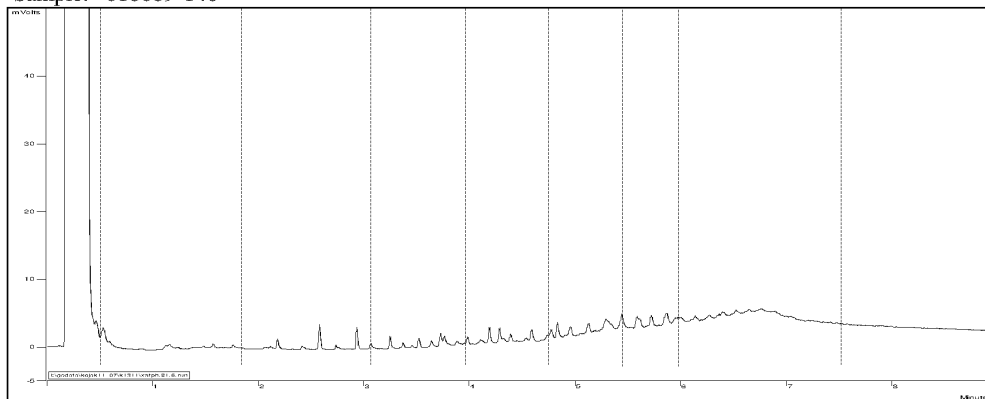


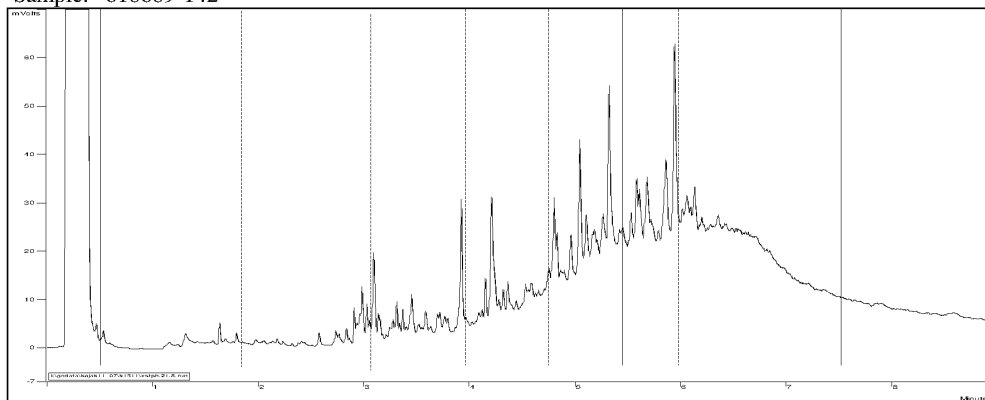
Figure 20

Samples 618689-140 to 618689-143.

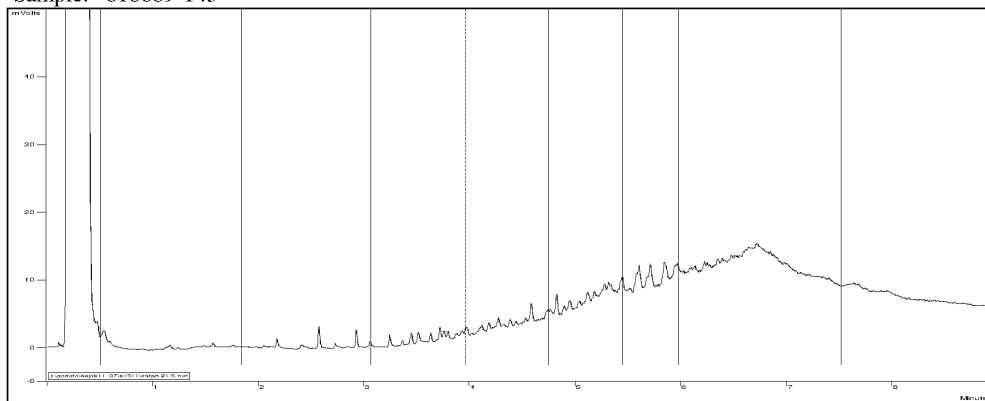
Sample: 618689-140



Sample: 618689-142



Sample: 618689-143



C7 C10 C15 C20 C25 C30 C34 C44

Figure 21

Sample 618689-144.

