

**Styx Stormwater Management Plan
Sediment Quality Monitoring
February 2014**

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1 Introduction update field

The resource consent for the Styx Stormwater Management Plan (Styx SMP; CRC131249) commenced on the 24 October 2013 and includes conditions relating to the monitoring of sediment quality. According to Section 3.1 of this report, state of the environment monitoring of sediment quality should be undertaken at twelve sites every five years. These sites generally coincide with water quality and ecology monitoring sites. The last survey was undertaken in 2009 as part of the consent application process and therefore another survey was due in 2014. This report summarises the results of this 2014 monitoring.

2 Methods

2.1 Sites and Sample Collection

There are twelve sites in the monitoring program within the Styx River catchment: seven sites in the Styx River mainstem, one site in Smacks Creek, two sites in Kaputone Creek, one site in Wilsons Drain and another site in Horners Drain (Table 1). One-off samples from these sites were collected by the Christchurch City Council laboratory staff on the 27th February 2014. The exception to this was the site in Smacks Creek, which was not sampled as there was not enough sediment available to do so. This is likely due to the habitat at this site, as no sediment dredging for maintenance has been undertaken in this location. All samples were collected according to the protocol outlined in the monitoring plan.

Table 1. Sediment quality monitoring sites of the Styx Stormwater Management Plan

Site	Easting	Northing
Styx River at Sawyers Arms Road	2476194	5747792
Smacks Creek upstream of Husseys Road	2477072	5749363
Styx River at Styx Mill Conservation Reserve	2478629	5749061
Styx River at Main North Road	2479110	5748827
Styx River at Redwood springs	2480092	5749035
Kaputone Creek at Blakes Road	2480384	5749665
Kaputone Creek at Belfast Road	2482200	5749890
Styx River at Marshland Road	2482364	5749401
Styx River at Richards bridge	2484011	5751224
Styx River at Kainga Road	2485009	5756361
Wilsons Drain at Otukaikino Memorial Reserve	2481259	5752508
Horners Drain at Prestons Road	2480777	5748019

2.2 Sediment Quality Parameters Tested

The samples were tested at the laboratory for a range of different sediment quality parameters, as outlined in Table 2, in accordance with the analysis protocol in the monitoring program. A brief discussion of each parameter is provided in the following paragraphs, with the sources of these contaminants detailed in Table 3. Interim Sediment Quality Guidelines (ISQG) are provided by the Australian and New Zealand guidelines for fresh and marine water quality to assess the effects of contaminated sediment on freshwater biota (ANZECC, 2000). These guidelines include ISQG-low and ISQG-high values. Exceedance of either of these values indicates that more investigation is required to determine the adverse effects of contaminants on aquatic biota. Guideline levels for each parameter are also discussed below.

Metals, in particular, *copper*, *lead* and *zinc*, can be toxic to aquatic organisms, negatively affecting such things as fecundity, maturation, respiration, physical structure and behaviour (Harding, 2005). The ISQG-low and ISQG-high values for copper, lead and zinc are 65 g/m³ and 270 g/m³, 50 g/m³ and 220 g/m³, and 200 g/m³ and 410 g/m³, respectively.

Sediments that contain high concentrations of organic carbon, measured as *Total Organic Content* (TOC), are more likely to accumulate greater concentrations of organic contaminants, such as polyaromatic hydrocarbons (Golder Associates, 2009). As such, it is important to also detail the concentrations of this parameter to understand the results of the other contaminants. There are no guideline levels for TOC.

Polyaromatic hydrocarbons (PAHs) can also cause toxic and carcinogenic effects on stream biota (Maltby et al., 1995; Kelly, 2010). There are sixteen constituents of PAHs that are analysed by the laboratory that often return results less than the laboratory limit of detection (LOD). Therefore, given the scale of presenting all of these results, Total PAHs are only provided in detail in this report (although laboratory results are provided for all in Appendix A). Total PAHs were calculated by summing the concentrations of all the individual constituents. The ISQG-low and ISQG-high values for Total PAHs are 4 g/m³ and 45 g/m³, respectively. Given the relationship between PAHs and TOC, the ANZECC guidelines state that if TOC content is markedly higher than 1%, the guideline value should be relaxed (i.e. made less stringent), due to additional carbon binding sites reducing the bioavailability of the contaminant (ANZECC, 2000). PAH values should therefore be normalised to 1% TOC before comparison to guidelines (ANZECC, 2000). This was undertaken by dividing PAH values for each site by their respective TOC values, given that TOC was recorded in g/100g.

Particle size distribution details the percentage by weight of particles within different size ranges. This parameter is important to understand to give an indication of the amount of fine sediment present. Sediment can adversely affect aquatic plants, invertebrates and fish (Crowe & Hay, 2004; Ryan, 1991). For example, sediment can affect photosynthesis of plants and therefore primary productivity within streams, interfere with feeding through the smothering of food supply, and can clog suitable habitat for species (Crowe & Hay, 2004; Ryan, 1991). In this study, particles less than 2000 µm in size were classified into coarse sand (500 – 2000 µm), medium sand (250 – 500 µm), fine sand (63 – 250 µm), and silt and clay (<63 µm) categories. These

classifications are consistent with the Golder 2009 study and are a modification of the Wentworth Scale (Golder Associated, 2009).

Table 2. Sediment quality parameters analysed for sites within the Styx Stormwater Management Plan area

Parameter	Units of measurement
Total copper	g/m ³ dry weight
Total lead	g/m ³ dry weight
Total zinc	g/m ³ dry weight
Polyaromatic Hydrocarbons (PAHs)	g/m ³ dry weight
Total Organic Content (TOC)	g/100g dry weight
Particle size distribution	-

Table 3. Sources of contaminants in sediment in urban areas (from Golder Associates, 2009)

Contaminant	Sources
Copper	Road runoff - commonly used in brake linings
Lead	Historical contamination – petrol additive Road runoff - used to minor extent in brake linings
Zinc	Road runoff - used in tyres Roof runoff – used in galvanised roof products
PAHs	Combustion - household fires, industrial emissions, rural burn-offs Vehicle emissions - exhaust, oil and grease leaks, tyre wear Road wear – bitumen and tar

2.3 Statistical Analyses

Sediment quality concentrations were compared to that recorded at the same sites during the 1980 Robb study (Robb, 1988) and the Golder Associates 2009 study (Golder Associates, 2009)¹. To allow analysis of concentrations, sediment quality values that were less than the laboratory Limit of Detection (LOD) were converted to half the detection limit (this is also consistent with Golder, 2009, methodology).

Chi-square Goodness-of-Fit tests were conducted to establish whether concentrations varied significantly between years (with levels expected to be the same between years). Overall tests for all years were undertaken, as well as tests between pairs of years (i.e. 1980 versus 2009, 2009 versus 2014 and 2014 versus 1980). Differences were considered to be significant if *P*-values were less than 0.05. A summary of the results of this testing are presented on the graphs within this report, with full test results presented in Appendix B. Particle size distribution between years was not statistically analysed, only visually compared.

¹ PAHs and TOC were not recorded during the 1980 Robb study, and therefore comparisons were unable to be made

3 Results

The laboratory results from all sites are presented in Appendix A and the results of each parameter summarised in the following sections.

3.1 Total Copper

Total copper concentrations in the sediment samples varied between the sites but were all below the lower and upper ISQG values (Figure 1). The exception to this was the Kaputone Creek at Belfast Road site, which recorded a substantially higher value than the other sites (170 mg/kg), which was above the ISQG-low value, but below the ISQG-high value. This is the first year this ISQG-low value has been exceeded at this site. There were no apparent upstream to downstream trends in concentrations in the Styx River mainstem. The majority of chi-square tests recorded significant differences in levels between years, with concentrations generally increasing sequentially from 1980 (Figure 1 and Appendix B). However, there were four sites where levels did not vary between the sampling periods: Styx River at Redwood Springs, Styx River at the Marshland Road and Richards bridges, and Wilsons Drain.

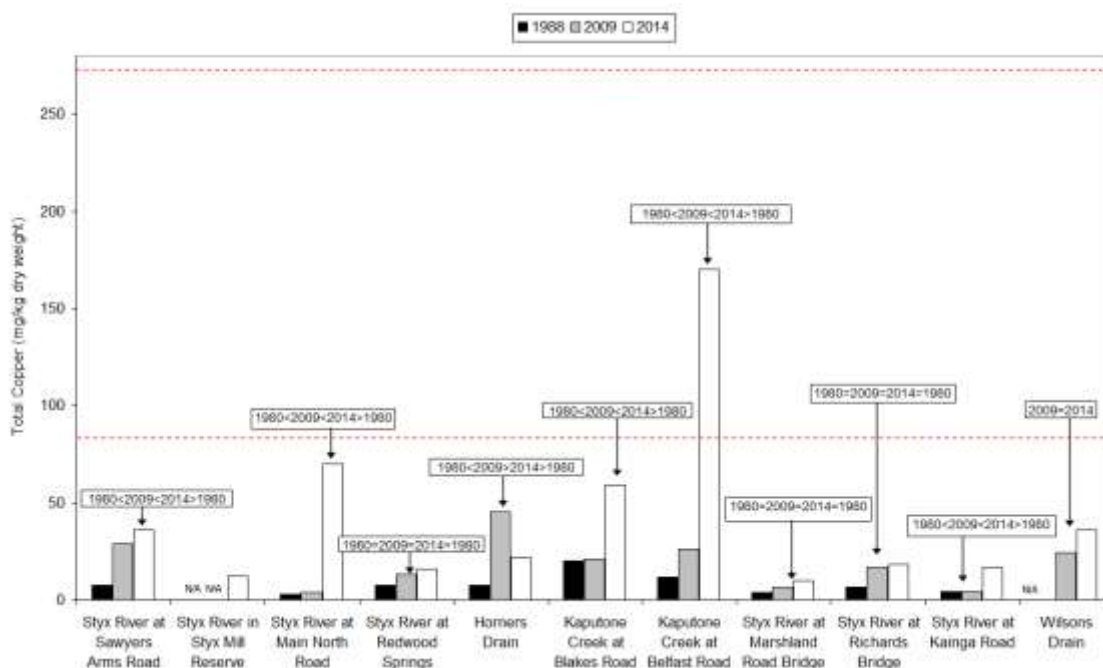


Figure 1. Total copper levels in sediment samples from the eleven sites within the Styx Stormwater Management Plan area collected during this 2014 survey, compared to levels recorded during the 1980 and 2009 surveys. Sites are ordered from upstream to downstream (left to right). The lower and upper dotted lines represent the ANZECC (2000) ISQG-low (65 g/m³) and ISQG-high (270 g/m³) values, respectively. N/A = Not Applicable, as site not sampled. Boxes indicate statistically significant (< or >) or insignificant differences (=), as determined by the chi-square tests.

3.2 Total Lead

There were variations in the levels of lead recorded in the sediment samples across sites (Figure 2). There was no apparent upstream to downstream trend in concentrations in the mainstem. Three sites recorded values above the ISQG-low value (Styx River at Sawyers arms Road and the two Kaputone Creek sites), but no sites recorded values above the ISQG-high value. These sites also exceeded the ISQG-low value in 2009, but not in 1980. Although lead levels at Horners Drain exceeded the ISQG-low guideline value in 1980 and 2009, this value was not exceeded in this survey. As was the case with copper, the highest value recorded was at the Belfast Road Kaputone Creek site (76 mg/kg). A large proportion of the chi-square tests recorded significant differences in levels between all three years (Figure 2 and Appendix B); concentrations in 1980 were substantially lower than the later two surveys, and 2009 levels were either higher or lower than 2014, depending on the site. However, as was the case with copper, lead levels did not vary between sampling periods at the Styx River at Redwood Springs, Styx River at Marshland Road bridge, Styx River at Richards bridge and Wilsons Drain sites.

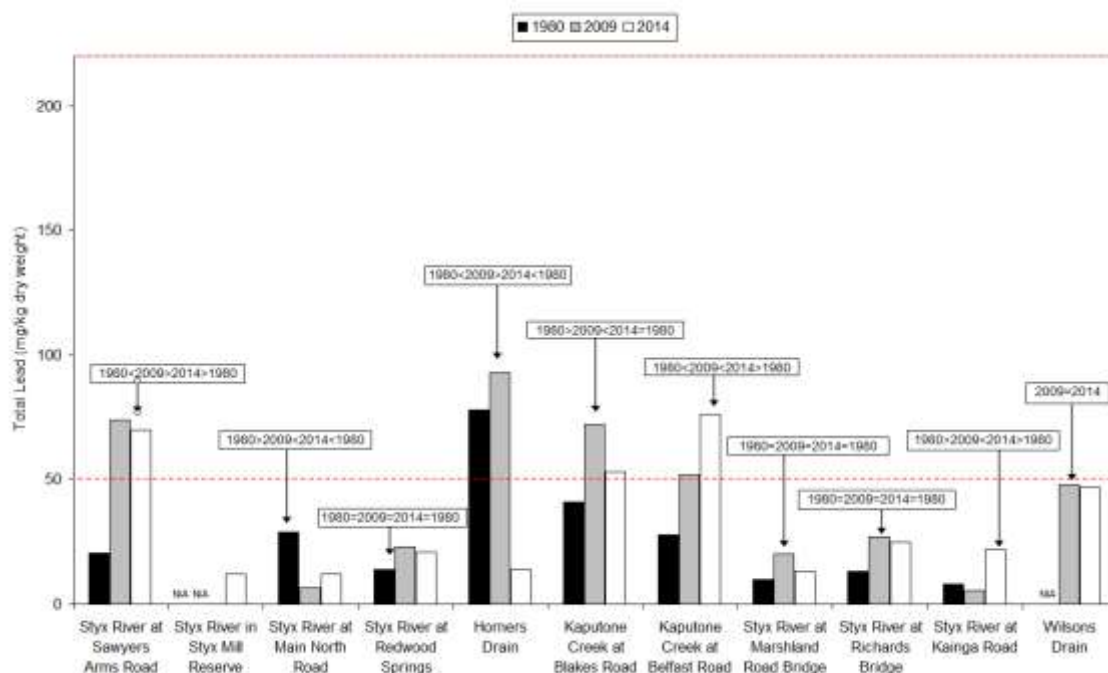


Figure 2. Total lead levels in sediment samples from the eleven sites within the Styx Stormwater Management Plan area collected during this 2014 survey, compared to levels recorded during the 1980 and 2009 surveys. Sites are ordered from upstream to downstream (left to right). The lower and upper dotted lines represent the ANZECC (2000) ISQG-low (50 g/m³) and ISQG-high (220 g/m³) values, respectively. N/A = Not Applicable, as site not sampled. Boxes indicate statistically significant (< or >) or insignificant differences (=), as determined by the chi-square tests.

3.3 Total Zinc

Total zinc concentrations in the sediment samples varied between the sites, but concentrations were generally higher in the tributaries than the mainstem (Figure 3). There were no apparent upstream to downstream trends in concentrations in the Styx River mainstem. The ISQG-high value was exceeded at the two Kaputone Creek sites, consistent with that recorded in 2009. Although the Horners Drain site also exceeded this value in 2009, in this survey this site did not even exceed the ISQG-low value. The ISQG-low value was exceeded at Wilsons Drain, but not the ISQG-high value. This site also exceeded the ISQG-low value in 2009 (and was not sampled in 1980). The Kaputone Creek at Belfast Road site again recorded the highest concentration (600 mg/kg). The Kaputone Creek Blakes Road site also recorded a high zinc level of 500 mg/kg. All but the Wilson Drain site recorded significant differences in levels between years, with concentrations between 2009 and 2014 either increasing or decreasing, depending on the site, and both these surveys recording higher levels than the 1980 survey at all sites (Figure 3 and Appendix B).

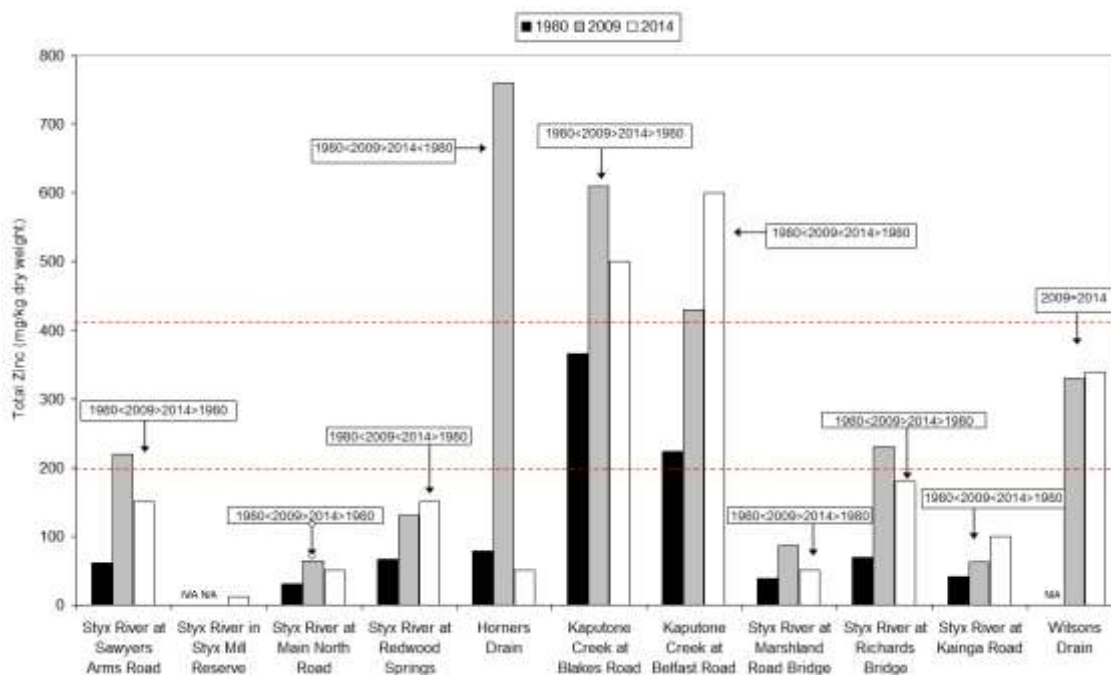


Figure 3. Total zinc levels in sediment samples from the eleven sites within the Styx Stormwater Management Plan area collected during this 2014 survey, compared to levels recorded during the 1980 and 2009 surveys. Sites are ordered from upstream to downstream (left to right). The lower and upper dotted lines represent the ANZECC (2000) ISQG-low (200 g/m^3) and ISQG-high (410 g/m^3) values, respectively. N/A = Not Applicable, as site not sampled. Boxes indicate statistically significant (< or >) or insignificant differences (=), as determined by the chi-square tests. Some values were below the laboratory limit of detection of 100 g/m^3 – these values were recorded as half this value (50 g/m^3) to allow analyses to be undertaken.

3.4 TOC

TOC levels varied across the sites, with no apparent upstream to downstream trend in the mainstem (Figure 4). Consistent with the other parameters, highest levels of organic content were recorded at the Kaputone Creek at Belfast Road site (15 g/100g), at a level similar to that recorded in 2009 (14 g/100g). No guideline levels are available for TOC. There were no significant differences in levels between years at all sites, except for the Styx River at Main North Road site, which recorded significantly higher levels compared to 2009 (Figure 4 and Appendix B).

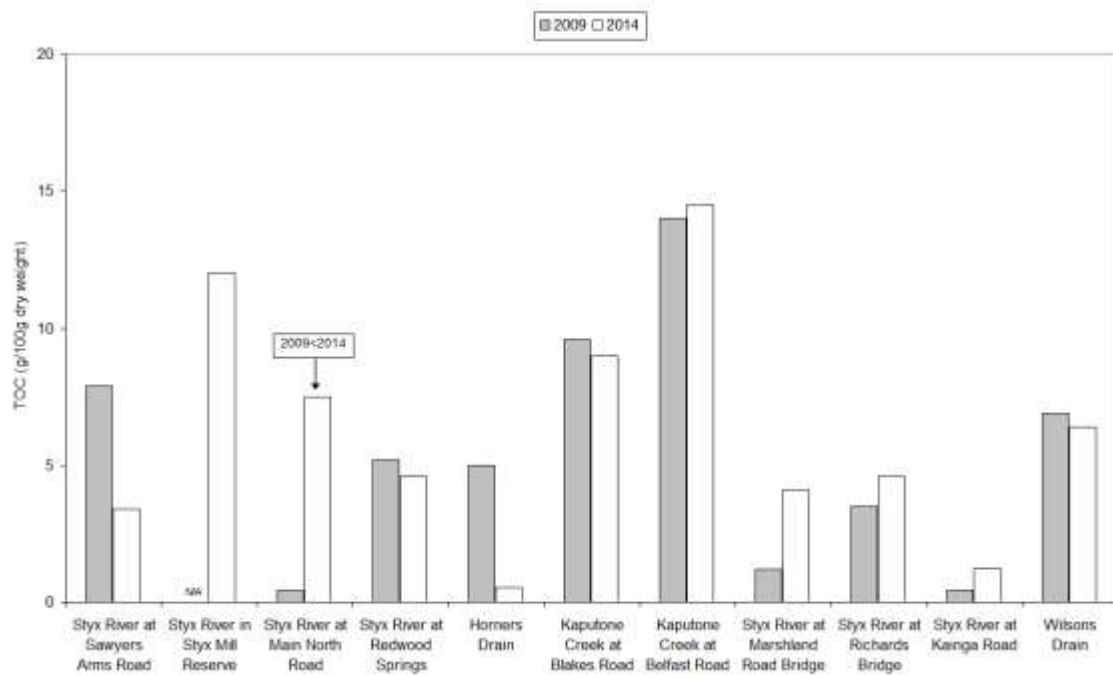


Figure 4. Total Organic Content (TOC) levels in sediment samples from the eleven sites within the Styx Stormwater Management Plan area collected during this 2014 survey, compared to levels recorded during the 2009 survey. Sites are ordered from upstream to downstream (left to right). N/A = Not Applicable, as site not sampled. Boxes indicate statistically significant (< or >) or insignificant differences (=), as determined by the chi-square tests. No guideline levels are available for this parameter.

3.5 PAHs

There were only a few sites in this survey where PAHs were detected: Styx River at Sawyers Arms Road, Horners Drain, Styx River at Kainga Road and Wilsons Drain (Figure 5). Of these sites, PAHs were not recorded at the Kainga Road site in 2009. In contrast, in 2009, PAHs were detected at the Kaputone Creek at Blakes Road, and the Styx River at Marshland Road and Richards bridges sites, but not in 2014. Neither the ISQG-low or high guideline values were exceeded at any of the sites, consistent with that recorded in 2009. There were also no significant differences in concentrations between the two surveys at any of the sites (Figure 5 and Appendix B).

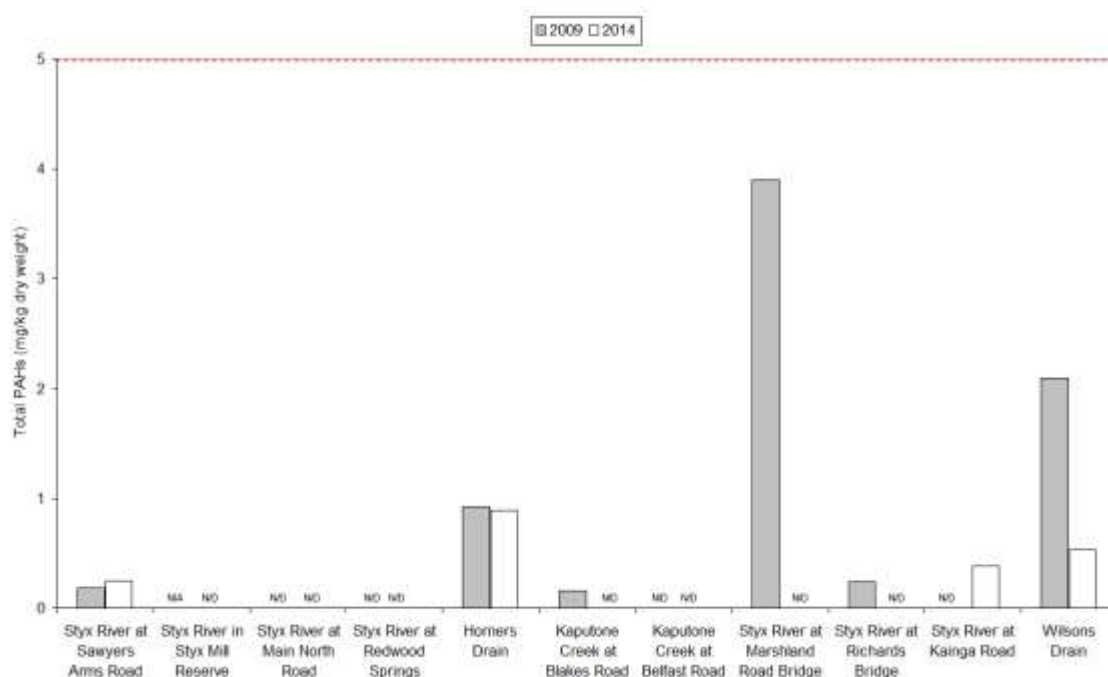


Figure 5. Total Polyaromatic Hydrocarbon (PAHs) levels in sediment samples from the eleven sites within the Styx Stormwater Management Plan area collected during this 2014 survey, compared to levels recorded during the 2009 survey. Sites are ordered from upstream to downstream (left to right). Values are normalised by 1% TOC (ANZECC, 2000). The dotted line represents the ANZECC (2000) ISQG-low value (4 g/m^3). The ISQG-high value (45 g/m^3) is not represented on the graph, as the scale does not extend this far. N/D = PAHs Not Detected. No significant differences between years were recorded.

3.6 Particle Size Distribution

Each of the eleven sites recorded sediment <2000 μm within the four particle sizes of coarse sand, medium sand, fine sand, and silt and clay (Figure 6). The exception to this was Horners Drain, where no coarse sand was recorded. The predominant sediment categories recorded were fine sand, and silt and clay. This is the same as that in the 1980 and 2009 surveys. However, overall there appears to have been a sequential decrease in the amount of fine sand, and silt and clay (and therefore an increase in the amount of coarse and medium sand) at the sites since 1980.

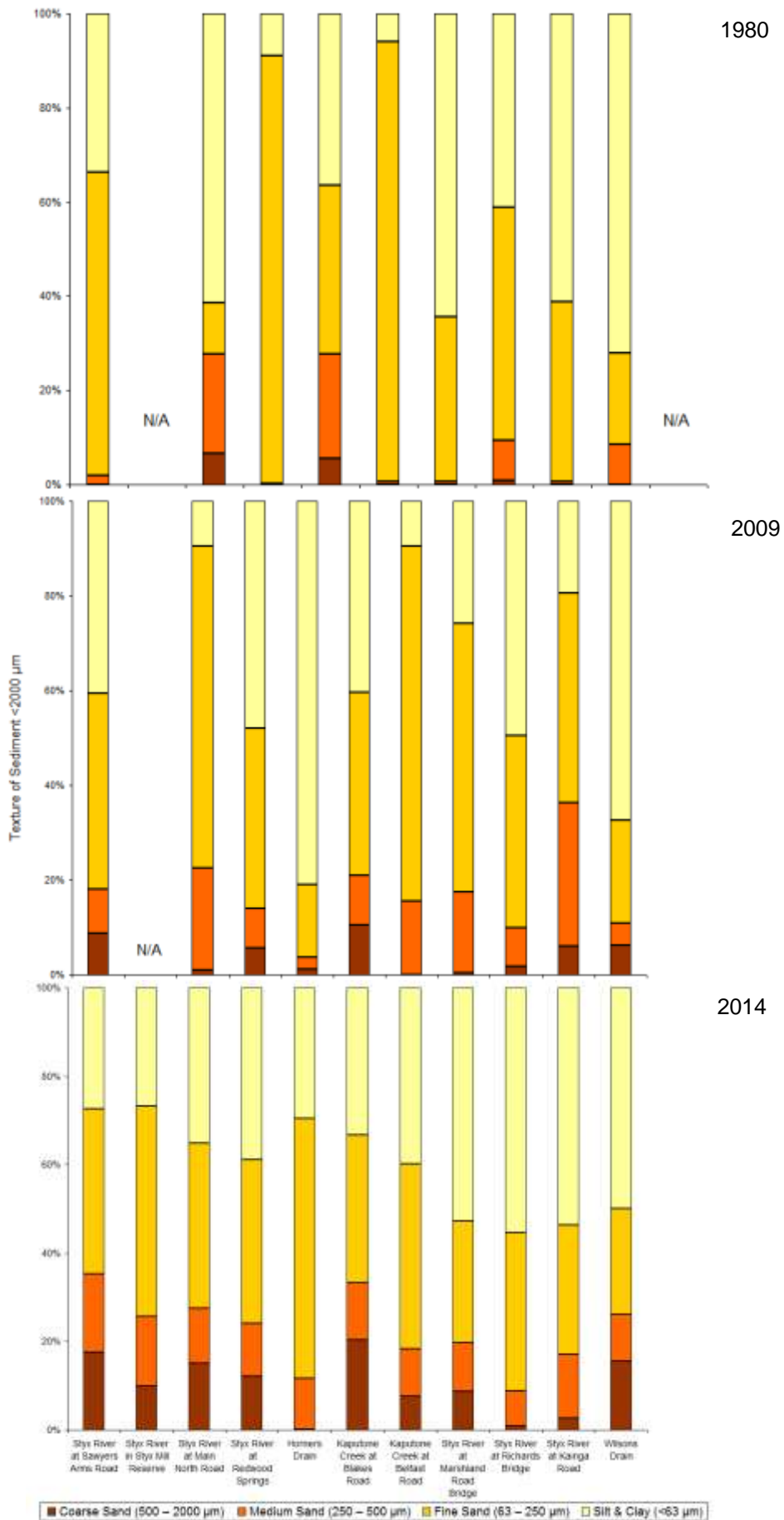


Figure 6. Particle size distribution of sediment collected from eleven sites within the Styx Stormwater Management Plan area during 1980, 2009 and 2014 (this survey). Sites are ordered from upstream to downstream (left to right). N/A = Not Applicable, as site not surveyed.

4 Discussion

Although copper concentrations have mostly increased sequentially through the three surveys in 1980, 2009 and 2014, levels in this study were generally within the guidelines. PAHs were generally not detected in the sediment and when they were concentrations were well below the guidelines. There were no significant changes in PAHs levels between 2009 and 2014. Both these parameters are therefore unlikely to be having adverse effects on biota within the catchment.

Lead concentrations exceeded the ISQG-low levels at some of the sites, but no sites exceeded the ISQG-high level. Lead levels in 2009 and 2014 were significantly higher than that recorded in 1980. Levels also significantly differed at some of the sites between 2009 and 2014, with levels either increasing or decreasing, although some sites did not vary significantly between these two surveys. Zinc concentrations were generally higher in the tributaries than the mainstem, and many sites exceeded both the low and high guideline levels. Again, concentrations in 2009 and 2014 were significantly higher than that recorded in 1980. Levels between 2009 and 2014 were also significantly different, with levels increasing or decreasing between surveys. These two parameters may therefore be having adverse effects on biota in these waterways. This also further confirms that the waterways are being subjected to contaminated input, most likely from stormwater.

With respect to organic content in the waterways, levels varied between sites, but were generally not significantly different between the 2009 and 2014 surveys. Particle size analyses also showed that fine sand, and silt and clay, dominated the stream beds. It appears that the amount of these two substrate categories has declined sequentially through the three surveys, resulting in larger amounts of coarser particles being present at the sites. It seems unlikely this change is due to stream maintenance, as only localised dredging has been undertaken in the Styx River and Kaputone Creek, and none has been carried out in Horners and Wilsons Drains. This change may instead be due to hydrology and natural processes, potentially exacerbated by bed heave due to the earthquakes, resulting in coarser old Waimakariri substrates coming to the surface, and finer substrates washing downstream. Regardless, this is a positive change ecologically, as finer sediment can cause adverse effects on biota, as discussed previously in Section 2.2.

The location that recorded the lowest levels of contaminants in sediment overall was the Styx River site within the Styx Mill Reserve. In contrast, the site that recorded the highest level of contaminants that predominantly exceeded the guideline levels (i.e. for copper, lead and zinc, but not for PAHs) was the Kaputone Creek at Belfast Road site. As discussed in the water quality report, this waterway flows through a predominantly agricultural catchment and has been subject historically to adjacent hazardous land use, including freezing work and wool scour activities. A piggery is also located upstream of the Belfast Road site. These activities may explain the presence of these contaminants in the sediment of this waterway, although they are typically associated with road and roof runoff. Over time, the SMP should address the influence of these activities, by intercepting and treating stormwater discharges, and re-developing the catchment. However, potential discharges as a result of the current piggery may also need to be investigated by Environment Canterbury.

In summary, sediment quality at these Styx SMP sites has variably increased, decreased or not changed significantly since the last survey, depending on the parameter. Lead and zinc levels are still high throughout the catchment and therefore these parameters may be causing adverse effects on biota. It is predicted that contaminant levels in these waterways will reduce over time, once the SMP has been implemented fully. It would be prudent to focus treatment on Kaputone Creek, which has been indentified in this report as the worst site in the catchment.

References

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5 Appendix A: Laboratory Reports

18/03/2014

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Greenspace
P O Box 237
Christchurch

Report Number: 140228002

Client Order No:

LABORATORY ANALYSIS REPORT

Lab. No: Sample Name:	Date Sampled: Time Sampled: Date Received: Date Received: Sampled By:	Sample Description:	Parameter Name:	Result:	Units:
1402944	27/02/14 pm 27/02/14 Paul Woods	1 Sawyers Arms Rd Styx River Sediment			
		Arsenic Total (*)		<4.0	mg/kg dw
		Copper Total		38	mg/kg dw
		Lead Total		70	mg/kg dw
		Zinc Total		150	mg/kg dw
		Total Organic Carbon (S) (*)		See Hill rpt 1242970	g,m-3
		Semi-Volatile Organic Compounds (SVC)		See Hill rpt 1242970	mg/kg
		Polycyclic Aromatic Hydrocarbons - Soil		See Hill rpt 1242970	mg/kg d wt
1402946	27/02/14 27/02/14 Paul Woods	2 Upstream Husseys Rd Smacks Creek Sediment			
		Sample Taken		Not taken	
1402947	27/02/14 27/02/14 Paul Woods	3 Conservation Reserve Styx River Sediment			
		Copper Total		12	mg/kg dw
		Lead Total		11	mg/kg dw
		Zinc Total		<100	mg/kg dw
		Total Organic Carbon (S) (*)		See Hill rpt 1242970	g,m-3

Lab. No: Sample Name:	Date Sampled: Time Sampled: Date Received: Sampled By:	Sample Description:	Parameter Name:	Result:	Units:
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt
1402948	27/02/14	4 Main North Road			
	27/02/14	Styx River			
	Paul Woods	Sediment			
			Arsenic Total (*)	10	mg/kg dw
			Copper Total	70	mg/kg dw
			Lead Total	12	mg/kg dw
			Zinc Total	<100	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Semi-Volatile Organic Compounds (SVC)	See Hill rpt 1242970	mg/kg
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt
1402949	27/02/14	5 Redwood Springs			
	27/02/14	Styx River			
	Paul Woods	Sediment			
			Copper Total	16	mg/kg dw
			Lead Total	21	mg/kg dw
			Zinc Total	150	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt
1402950	27/02/14	6 Blakes Road			
	27/02/14	Kaputone Stream			
	Paul Woods	Sediment			
			Arsenic Total (*)	16	mg/kg dw
			Copper Total	59	mg/kg dw
			Lead Total	53	mg/kg dw
			Zinc Total	500	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Semi-Volatile Organic Compounds (SVC)	See Hill rpt 1242970	mg/kg
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt

Lab. No: Sample Name:	Date Sampled: Time Sampled: Date Received: Sampled By:	Sample Description:	Parameter Name:	Result:	Units:
1402951	27/02/14 27/02/14 Paul Woods	7 Belfast Road East Kaputone Stream Sediment	Copper Total	170	mg/kg dw
			Lead Total	76	mg/kg dw
			Zinc Total	600	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt.
1402952	27/02/14 27/02/14 Paul Woods	8 Marshlands Road Styx River Sediment	Arsenic Total (*)	10	mg/kg dw
			Copper Total	9.6	mg/kg dw
			Lead Total	13	mg/kg dw
			Zinc Total	<100	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Semi-Volatile Organic Compounds (SVC)	See Hill rpt 1242970	mg/kg
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt.
1402953	27/02/14 27/02/14 Paul Woods	9 Richards Bridge Styx River Sediment	Copper Total	18	mg/kg dw
			Lead Total	25	mg/kg dw
			Zinc Total	180	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt.
1402954	27/02/14 27/02/14 Paul Woods	10 Kainga Road Styx River Sediment	Arsenic Total (*)	8.1	mg/kg dw
			Copper Total	17	mg/kg dw



This Laboratory is accredited by International Accreditation New Zealand. The reported tests have been performed in accordance with its terms of accreditation, with the exception of tests marked *, which are not accredited.

Contact: Paul Woods
DDI: 03 941 5702

Lab. No: Sample Name:	Date Sampled: Time Sampled: Date Received: Sampled By:	Sample Description:	Parameter Name:	Result:	Units:
			Lead Total	22	mg/kg dw
			Zinc Total	100	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Semi-Volatile Organic Compounds (SVC)	See Hill rpt 1242970	mg/kg
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt
1402955	27/02/14	11			
	27/02/14	Otukaikino Memorial			
	Paul Woods	Wilson's Drain			
		Sediment			
			Arsenic Total (*)	16	mg/kg dw
			Copper Total	36	mg/kg dw
			Lead Total	47	mg/kg dw
			Zinc Total	340	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Semi-Volatile Organic Compounds (SVC)	See Hill rpt 1242970	mg/kg
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt
1402956	27/02/14	12			
	27/02/14	Prestons Road			
	Paul Woods	Homers Drain			
		Sediment			
			Copper Total	22	mg/kg dw
			Lead Total	14	mg/kg dw
			Zinc Total	<100	mg/kg dw
			Total Organic Carbon (S) (*)	See Hill rpt 1242970	g.m-3
			Polycyclic Aromatic Hydrocarbons - Soil	See Hill rpt 1242970	mg/kg d wt

Methods:

Comments:

Symbols: < means less than, > means greater than.
 Units of mg/L are equivalent to g/m³ and ppm.
 APHA: American Public Health Association 22nd Edition 2012
 (S) = Subcontracted analysis
 (*) = Not IANZ accredited for this test.
 e=Estimated No. CFU/100mL

	Method
Arsenic Total (*)	USEPA 200.2
Copper Total	USEPA 200.2



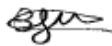
This Laboratory is accredited by International Accreditation New Zealand. The reported tests have been performed in accordance with its terms of accreditation, with the exception of tests marked *, which are not accredited.

Contact: Paul Woods
 DD: 03 941 5702

Lab. No:	Date Sampled:	Sample Description:	Parameter Name:	Result:	Units:
Sample Name:	Time Sampled:				
	Date Received:				
	Sampled By:				

	Method
Lead Total	USEPA 200.2
Polycyclic Aromatic Hydrocarb	APHA 6410B (modified)
Sample Taken	
Semi-Volatile Organic Compound	See Sub-contracted report
Total Organic Carbon (S) (*)	APHA 5310B
Zinc Total	USEPA 200.2

Comments:



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ANALYSIS REPORT Page 1 of 6

Client: Christchurch City Council	Lab No: 1242970 SPV1
Contact: Anna Munro	Date Registered: 04-Mar-2014
C/- Christchurch City Council	Date Reported: 14-Mar-2014
City Water and Waste Laboratory	Quote No:
PO Box 73041	Order No: 4500364890
CHRISTCHURCH 8140	Client Reference:
	Submitted By: Anna Munro

Sample Type: Sediment						
Sample Name:	1402944	1402947	1402948	1402949	1402950	
	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	
Lab Number:	1242970.1	1242970.2	1242970.3	1242970.4	1242970.5	
Individual Tests						
Dry Matter	g/100g as rcvd	40	55	18.6	28	22
Particle size analysis*		See attached report	See attached report	See attached report	See attached report	See attached report
Total Organic Carbon*	g/100g dry wt	3.4	1.87	7.5	4.6	9.0
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Acenaphthylene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Anthracene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Benzo[a]anthracene	mg/kg dry wt	0.07	< 0.04	< 0.12	< 0.08	< 0.10
Benzo[a]pyrene (BAP)	mg/kg dry wt	0.06	< 0.04	< 0.12	< 0.08	< 0.10
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	0.07	< 0.04	< 0.12	< 0.08	< 0.10
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Benzo[k]fluoranthene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Chrysene	mg/kg dry wt	0.06	< 0.04	< 0.12	< 0.08	< 0.10
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Fluoranthene	mg/kg dry wt	0.14	< 0.04	< 0.12	< 0.08	< 0.10
Fluorene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Indeno[1,2,3-c,d]pyrene	mg/kg dry wt	< 0.06	< 0.04	< 0.12	< 0.08	< 0.10
Naphthalene	mg/kg dry wt	< 0.3	< 0.2	< 0.6	< 0.4	< 0.5
Phenanthrene	mg/kg dry wt	0.12	< 0.04	< 0.12	< 0.08	< 0.10
Pyrene	mg/kg dry wt	0.15	< 0.04	< 0.12	< 0.08	< 0.10
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	< 6	-	< 13	-	< 11
Bis(2-chloroethyl)ether	mg/kg dry wt	< 6	-	< 13	-	< 11
Bis(2-chloroisopropyl)ether	mg/kg dry wt	< 6	-	< 13	-	< 11
4-Bromophenyl phenyl ether	mg/kg dry wt	< 6	-	< 13	-	< 11
4-Chlorophenyl phenyl ether	mg/kg dry wt	< 6	-	< 13	-	< 11
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
3,3'-Dichlorobenzidine	mg/kg dry wt	< 30	-	< 70	-	< 60
2,4-Dinitrotoluene	mg/kg dry wt	< 12	-	< 30	-	< 30
2,6-Dinitrotoluene	mg/kg dry wt	< 12	-	< 30	-	< 30
Nitrobenzene	mg/kg dry wt	< 6	-	< 13	-	< 11
N-Nitrosodi-n-propylamine	mg/kg dry wt	< 12	-	< 30	-	< 30
N-Nitrosodiphenylamine	mg/kg dry wt	< 12	-	< 30	-	< 30
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	< 6	-	< 13	-	< 11
alpha-BHC	mg/kg dry wt	< 6	-	< 13	-	< 11



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Sample Type: Sediment						
Sample Name:	1402944 27-Feb-2014	1402947 27-Feb-2014	1402948 27-Feb-2014	1402949 27-Feb-2014	1402950 27-Feb-2014	
Lab Number:	1242970.1	1242970.2	1242970.3	1242970.4	1242970.5	
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
beta-BHC	mg/kg dry wt	< 6	-	< 13	-	< 11
delta-BHC	mg/kg dry wt	< 6	-	< 13	-	< 11
gamma-BHC (Lindane)	mg/kg dry wt	< 6	-	< 13	-	< 11
4,4'-DDD	mg/kg dry wt	< 6	-	< 13	-	< 11
4,4'-DDE	mg/kg dry wt	< 6	-	< 13	-	< 11
4,4'-DDT	mg/kg dry wt	< 12	-	< 30	-	< 30
Dieldrin	mg/kg dry wt	< 6	-	< 13	-	< 11
Endosulfan I	mg/kg dry wt	< 12	-	< 30	-	< 30
Endosulfan II	mg/kg dry wt	< 12	-	< 30	-	< 30
Endosulfan sulphate	mg/kg dry wt	< 12	-	< 30	-	< 30
Endrin	mg/kg dry wt	< 12	-	< 30	-	< 30
Endrin ketone	mg/kg dry wt	< 12	-	< 30	-	< 30
Heptachlor	mg/kg dry wt	< 6	-	< 13	-	< 11
Heptachlor epoxide	mg/kg dry wt	< 6	-	< 13	-	< 11
Hexachlorobenzene	mg/kg dry wt	< 6	-	< 13	-	< 11
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS						
Acenaphthene	mg/kg dry wt	< 3	-	< 7	-	< 6
Acenaphthylene	mg/kg dry wt	< 3	-	< 7	-	< 6
Anthracene	mg/kg dry wt	< 3	-	< 7	-	< 6
Benzo[a]anthracene	mg/kg dry wt	< 3	-	< 7	-	< 6
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 6	-	< 13	-	< 11
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 6	-	< 13	-	< 11
Benzo[g,h,i]perylene	mg/kg dry wt	< 6	-	< 13	-	< 11
Benzo[k]fluoranthene	mg/kg dry wt	< 6	-	< 13	-	< 11
2-Chloronaphthalene	mg/kg dry wt	< 3	-	< 7	-	< 6
Chrysene	mg/kg dry wt	< 3	-	< 7	-	< 6
Dibenzo[a,h]anthracene	mg/kg dry wt	< 6	-	< 13	-	< 11
Fluoranthene	mg/kg dry wt	< 3	-	< 7	-	< 6
Fluorene	mg/kg dry wt	< 3	-	< 7	-	< 6
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 6	-	< 13	-	< 11
2-Methylnaphthalene	mg/kg dry wt	< 3	-	< 7	-	< 6
Naphthalene	mg/kg dry wt	< 3	-	< 7	-	< 6
Phenanthrene	mg/kg dry wt	< 3	-	< 7	-	< 6
Pyrene	mg/kg dry wt	< 3	-	< 7	-	< 6
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	< 12	-	< 30	-	< 30
2-Chlorophenol	mg/kg dry wt	< 6	-	< 13	-	< 11
2,4-Dichlorophenol	mg/kg dry wt	< 6	-	< 13	-	< 11
2,4-Dimethylphenol	mg/kg dry wt	< 6	-	< 13	-	< 11
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	< 12	-	< 30	-	< 30
2-Methylphenol (o-Cresol)	mg/kg dry wt	< 6	-	< 13	-	< 11
2-Nitrophenol	mg/kg dry wt	< 12	-	< 30	-	< 30
Pentachlorophenol (PCP)	mg/kg dry wt	< 120	-	< 300	-	< 300
Phenol	mg/kg dry wt	< 12	-	< 30	-	< 30
2,4,5-Trichlorophenol	mg/kg dry wt	< 12	-	< 30	-	< 30
2,4,6-Trichlorophenol	mg/kg dry wt	< 12	-	< 30	-	< 30
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	< 30	-	< 60	-	< 50
Butylbenzylphthalate	mg/kg dry wt	< 12	-	< 30	-	< 30
Di(2-ethylhexyl)adipate	mg/kg dry wt	< 6	-	< 13	-	< 11
Diethylphthalate	mg/kg dry wt	< 12	-	< 30	-	< 30
Dimethylphthalate	mg/kg dry wt	< 12	-	< 30	-	< 30
Di-n-butylphthalate	mg/kg dry wt	< 12	-	< 30	-	< 30

Sample Type: Sediment						
Sample Name:	1402944	1402947	1402948	1402949	1402950	
	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	
Lab Number:	1242970.1	1242970.2	1242970.3	1242970.4	1242970.5	
Plasticisers in SVOC Soil Samples by GC-MS						
Di-n-octylphthalate	mg/kg dry wt	< 12	-	< 30	-	< 30
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	< 12	-	< 30	-	< 30
1,3-Dichlorobenzene	mg/kg dry wt	< 12	-	< 30	-	< 30
1,4-Dichlorobenzene	mg/kg dry wt	< 12	-	< 30	-	< 30
Hexachlorobutadiene	mg/kg dry wt	< 12	-	< 30	-	< 30
Hexachlorocyclopentadiene	mg/kg dry wt	< 30	-	< 70	-	< 60
Hexachloroethane	mg/kg dry wt	< 12	-	< 30	-	< 30
1,2,4-Trichlorobenzene	mg/kg dry wt	< 6	-	< 13	-	< 11
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	< 60	-	< 130	-	< 110
Carbazole	mg/kg dry wt	< 6	-	< 13	-	< 11
Dibenzofuran	mg/kg dry wt	< 6	-	< 13	-	< 11
Isophorone	mg/kg dry wt	< 6	-	< 13	-	< 11
Sample Name:	1402951	1402952	1402953	1402954	1402955	
	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	
Lab Number:	1242970.6	1242970.7	1242970.8	1242970.9	1242970.10	
Individual Tests						
Dry Matter	g/100g as rcvd	14.3	34	39	64	34
Particle size analysis*		See attached report	See attached report	See attached report	See attached report	See attached report
Total Organic Carbon*	g/100g dry wt	14.5	4.1	4.6	1.22	6.4
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	< 0.07
Acenaphthylene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	< 0.07
Anthracene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.10
Benzo[a]anthracene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.24
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.25
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.25
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.15
Benzo[k]fluoranthene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.13
Chrysene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.23
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	< 0.07
Fluoranthene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	0.04	0.52
Fluorene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.07
Indeno[1,2,3-c,d]pyrene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	< 0.04	0.16
Naphthalene	mg/kg dry wt	< 0.8	< 0.4	< 0.3	< 0.18	< 0.4
Phenanthrene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	0.05	0.46
Pyrene	mg/kg dry wt	< 0.16	< 0.07	< 0.06	0.05	0.53
Haloethers in SVOC Soil Samples by GC-MS						
Bis(2-chloroethoxy) methane	mg/kg dry wt	-	< 4	-	< 1.9	< 8
Bis(2-chloroethyl)ether	mg/kg dry wt	-	< 4	-	< 1.9	< 8
Bis(2-chloroisopropyl)ether	mg/kg dry wt	-	< 4	-	< 1.9	< 8
4-Bromophenyl phenyl ether	mg/kg dry wt	-	< 4	-	< 1.9	< 8
4-Chlorophenyl phenyl ether	mg/kg dry wt	-	< 4	-	< 1.9	< 8
Nitrogen containing compounds in SVOC Soil Samples by GC-MS						
3,3'-Dichlorobenzidine	mg/kg dry wt	-	< 18	-	< 10	< 40
2,4-Dinitrotoluene	mg/kg dry wt	-	< 8	-	< 4	< 15
2,6-Dinitrotoluene	mg/kg dry wt	-	< 8	-	< 4	< 15
Nitrobenzene	mg/kg dry wt	-	< 4	-	< 1.9	< 8
N-Nitrosodi-n-propylamine	mg/kg dry wt	-	< 8	-	< 4	< 15
N-Nitrosodiphenylamine	mg/kg dry wt	-	< 8	-	< 4	< 15
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
Aldrin	mg/kg dry wt	-	< 4	-	< 1.9	< 8

Sample Type: Sediment						
Sample Name:		1402951 27-Feb-2014	1402952 27-Feb-2014	1402953 27-Feb-2014	1402954 27-Feb-2014	1402955 27-Feb-2014
Lab Number:		1242970.6	1242970.7	1242970.8	1242970.9	1242970.10
Organochlorine Pesticides in SVOC Soil Samples by GC-MS						
alpha-BHC	mg/kg dry wt	-	<4	-	<1.9	<8
beta-BHC	mg/kg dry wt	-	<4	-	<1.9	<8
delta-BHC	mg/kg dry wt	-	<4	-	<1.9	<8
gamma-BHC (Lindane)	mg/kg dry wt	-	<4	-	<1.9	<8
4,4'-DDD	mg/kg dry wt	-	<4	-	<1.9	<8
4,4'-DDE	mg/kg dry wt	-	<4	-	<1.9	<8
4,4'-DDT	mg/kg dry wt	-	<8	-	<4	<15
Dieldrin	mg/kg dry wt	-	<4	-	<1.9	<8
Endosulfan I	mg/kg dry wt	-	<8	-	<4	<15
Endosulfan II	mg/kg dry wt	-	<8	-	<4	<15
Endosulfan sulphate	mg/kg dry wt	-	<8	-	<4	<15
Endrin	mg/kg dry wt	-	<8	-	<4	<15
Endrin ketone	mg/kg dry wt	-	<8	-	<4	<15
Heptachlor	mg/kg dry wt	-	<4	-	<1.9	<8
Heptachlor epoxide	mg/kg dry wt	-	<4	-	<1.9	<8
Hexachlorobenzene	mg/kg dry wt	-	<4	-	<1.9	<8
Polycyclic Aromatic Hydrocarbons in SVOC Soil Samples by GC-MS						
Acenaphthene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Acenaphthylene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Anthracene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Benzo[a]anthracene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Benzo[a]pyrene (BAP)	mg/kg dry wt	-	<4	-	<1.9	<8
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	-	<4	-	<1.9	<8
Benzo[g,h,i]perylene	mg/kg dry wt	-	<4	-	<1.9	<8
Benzo[k]fluoranthene	mg/kg dry wt	-	<4	-	<1.9	<8
2-Chloronaphthalene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Chrysene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Dibenzo[a,h]anthracene	mg/kg dry wt	-	<4	-	<1.9	<8
Fluoranthene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Fluorene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Indeno[1,2,3-c,d]pyrene	mg/kg dry wt	-	<4	-	<1.9	<8
2-Methylnaphthalene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Naphthalene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Phenanthrene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Pyrene	mg/kg dry wt	-	<1.8	-	<1.0	<4
Phenols in SVOC Soil Samples by GC-MS						
4-Chloro-3-methylphenol	mg/kg dry wt	-	<8	-	<5	<15
2-Chlorophenol	mg/kg dry wt	-	<4	-	<1.9	<8
2,4-Dichlorophenol	mg/kg dry wt	-	<4	-	<1.9	<8
2,4-Dimethylphenol	mg/kg dry wt	-	<4	-	<3	<8
3 & 4-Methylphenol (m- + p-cresol)	mg/kg dry wt	-	<8	-	<4	<15
2-Methylphenol (o-Cresol)	mg/kg dry wt	-	<4	-	<1.9	<8
2-Nitrophenol	mg/kg dry wt	-	<8	-	<5	<15
Pentachlorophenol (PCP)	mg/kg dry wt	-	<80	-	<40	<150
Phenol	mg/kg dry wt	-	<8	-	<4	<15
2,4,5-Trichlorophenol	mg/kg dry wt	-	<8	-	<4	<15
2,4,6-Trichlorophenol	mg/kg dry wt	-	<8	-	<4	<15
Plasticisers in SVOC Soil Samples by GC-MS						
Bis(2-ethylhexyl)phthalate	mg/kg dry wt	-	<15	-	<8	<30
Butylbenzylphthalate	mg/kg dry wt	-	<8	-	<4	<15
Di(2-ethylhexyl)adipate	mg/kg dry wt	-	<4	-	<1.9	<8
Diethylphthalate	mg/kg dry wt	-	<8	-	<4	<15
Dimethylphthalate	mg/kg dry wt	-	<8	-	<4	<15

Sample Type: Sediment						
Sample Name:	1402951	1402952	1402953	1402954	1402955	
	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	27-Feb-2014	
Lab Number:	1242970.6	1242970.7	1242970.8	1242970.9	1242970.10	
Plasticisers in SVOC Soil Samples by GC-MS						
Di-n-butylphthalate	mg/kg dry wt	-	< 8	-	< 4	< 15
Di-n-octylphthalate	mg/kg dry wt	-	< 8	-	< 4	< 15
Other Halogenated compounds in SVOC Soil Samples by GC-MS						
1,2-Dichlorobenzene	mg/kg dry wt	-	< 8	-	< 4	< 15
1,3-Dichlorobenzene	mg/kg dry wt	-	< 8	-	< 4	< 15
1,4-Dichlorobenzene	mg/kg dry wt	-	< 8	-	< 4	< 15
Hexachlorobutadiene	mg/kg dry wt	-	< 8	-	< 4	< 15
Hexachlorocyclopentadiene	mg/kg dry wt	-	< 18	-	< 10	< 40
Hexachloroethane	mg/kg dry wt	-	< 8	-	< 4	< 15
1,2,4-Trichlorobenzene	mg/kg dry wt	-	< 4	-	< 1.0	< 8
Other compounds in SVOC Soil Samples by GC-MS						
Benzyl alcohol	mg/kg dry wt	-	< 40	-	< 10	< 80
Carbazole	mg/kg dry wt	-	< 4	-	< 1.0	< 8
Dibenzofuran	mg/kg dry wt	-	< 4	-	< 1.0	< 8
Isophorone	mg/kg dry wt	-	< 4	-	< 1.0	< 8
Sample Name:	1402956					
	27-Feb-2014					
Lab Number:	1242970.11					
Individual Tests						
Dry Matter	g/100g as rcvd	73	-	-	-	-
Particle size analysis*		See attached report	-	-	-	-
Total Organic Carbon*	g/100g dry wt	0.53	-	-	-	-
Polycyclic Aromatic Hydrocarbons Screening in Soil						
Acenaphthene	mg/kg dry wt	< 0.04	-	-	-	-
Acenaphthylene	mg/kg dry wt	< 0.04	-	-	-	-
Anthracene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]anthracene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[a]pyrene (BAP)	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[b]fluoranthene + Benzo[j]fluoranthene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[g,h,i]perylene	mg/kg dry wt	< 0.04	-	-	-	-
Benzo[k]fluoranthene	mg/kg dry wt	< 0.04	-	-	-	-
Chrysene	mg/kg dry wt	< 0.04	-	-	-	-
Dibenzo[a,h]anthracene	mg/kg dry wt	< 0.04	-	-	-	-
Fluoranthene	mg/kg dry wt	0.05	-	-	-	-
Fluorene	mg/kg dry wt	< 0.04	-	-	-	-
Indeno(1,2,3-c,d)pyrene	mg/kg dry wt	< 0.04	-	-	-	-
Naphthalene	mg/kg dry wt	< 0.16	-	-	-	-
Phenanthrene	mg/kg dry wt	0.04	-	-	-	-
Pyrene	mg/kg dry wt	0.06	-	-	-	-
Analyst's Comments						
Appendix No.1 - Particle Size Analysis Report						
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: Sediment						
Test	Method Description	Default Detection Limit	Sample No			
Environmental Solids Sample Preparation	Air dried at 35°C and sieved, <2mm fraction. Used for sample preparation. May contain a residual moisture content of 2-5%.	-	1-11			
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:5786,2805,2895]	0.010 - 0.05 mg/kg dry wt	1-11			

Sample Type: Sediment			
Test	Method Description	Default Detection Limit	Sample No
Semivolatile Organic Compounds Screening in Soil by GC-MS	Sonication extraction, GPC cleanup (if required), GC-MS FS analysis. Tested on as received sample	0.3 - 30 mg/kg dry wt	1, 3, 5, 7, 9-10
Dry Matter (Env)	Dried at 103°C for 4-22hr (removes 3-5% more water than air dry) , gravimetry. US EPA 3550. (Free water removed before analysis).	0.10 g/100g as rowd	1-11
Particle size analysis*	Malvern Laser Sizer particle size analysis. Subcontracted to Earth Sciences Department, Waikato University, Hamilton.	-	1-11
Total Organic Carbon*	Acid pretreatment to remove carbonates if present, neutralisation, Elemental Combustion Analyser.	0.05 g/100g dry wt	1-11

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.

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Martin Cowell - BSc
Client Services Manager - Environmental Division



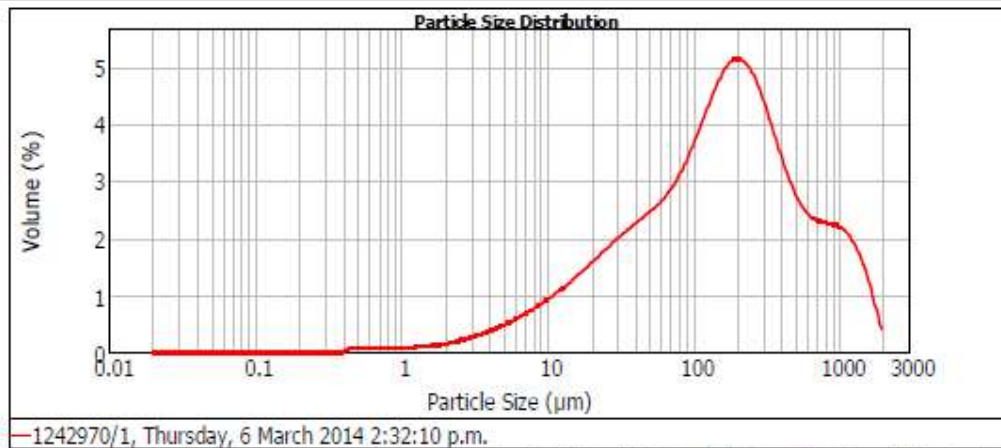
Result Analysis Report

Sample Name: 1242970/1	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 2:32:10 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 2:32:11 p.m.
Sample bulk lot ref: 2014035/1	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 14.61 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.233 %	Result Emulation: Off

Concentration: 0.0709 %Vol	Span : 4.938	Uniformity: 1.42	Result units: Volume
Specific Surface Area: 0.197 m ² /g	Surface Weighted Mean D[3,2]: 30.522 um	Vol. Weighted Mean D[4,3]: 292.391 um	Standard Deviation 362.013 um

d(0.1): 17.369 um d(0.5): 160.354 um d(0.9): 809.149 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.580	0.48	37.000	18.94	100.000	37.92	300.000	70.39	840.000	90.50
0.060	0.00	2.000	0.97	44.000	21.50	125.000	42.49	350.000	74.62	1000.000	93.11
0.120	0.00	3.900	2.03	53.000	24.43	149.000	47.68	420.000	78.91	1190.000	95.53
0.240	0.00	7.800	4.47	63.000	27.36	177.000	53.23	500.000	82.35	1410.000	97.59
0.490	0.08	15.600	9.04	74.000	30.32	210.000	58.96	590.000	85.17	1680.000	99.19
0.700	0.28	31.000	16.51	88.000	33.85	250.000	64.75	710.000	88.05	2000.000	100.00

Operator notes:



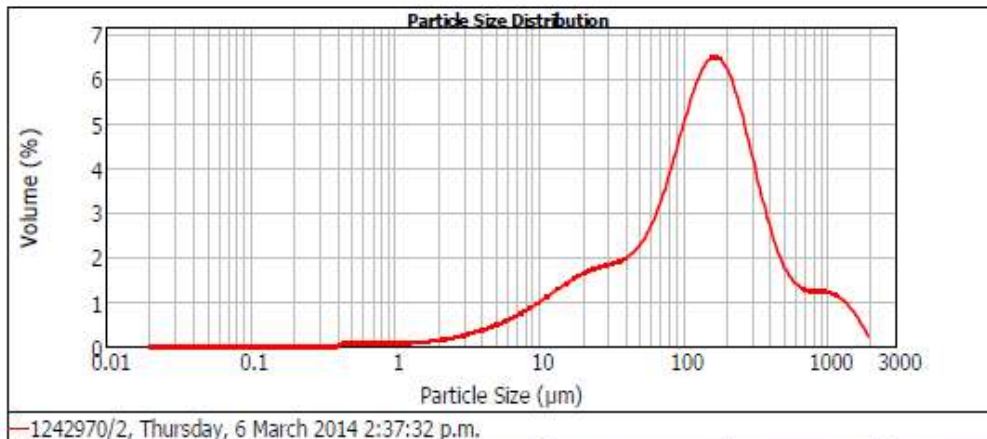
Result Analysis Report

Sample Name: 1242970/2	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 2:37:32 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 2:37:34 p.m.
Sample bulk lot ref: 2014035/2	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 19.59 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.203 %	Result Emulation: Off

Concentration: 0.0977 %Vol	Span : 3.514	Uniformity: 1.19	Result units: Volume
Specific Surface Area: 0.197 m ² /g	Surface Weighted Mean D[3,2]: 30.527 um	Vol. Weighted Mean D[4,3]: 224.266 um	Standard Deviation 289.365 um

d(0.1): 16.804 um d(0.5): 137.617 um d(0.9): 500.455 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.990	0.40	37.000	18.90	105.000	39.86	300.000	80.12	840.000	94.74
0.060	0.00	2.000	0.91	44.000	21.19	125.000	46.18	350.000	84.05	1000.000	96.14
0.120	0.00	3.900	1.92	53.000	23.86	149.000	53.28	420.000	87.56	1190.000	97.49
0.240	0.00	7.800	4.37	63.000	26.78	177.000	60.58	500.000	89.99	1410.000	98.65
0.480	0.08	15.600	9.29	74.000	30.07	210.000	67.68	590.000	91.74	1680.000	99.54
0.700	0.27	31.000	16.78	88.000	34.42	250.000	74.28	710.000	93.36	2000.000	100.00

Operator notes:



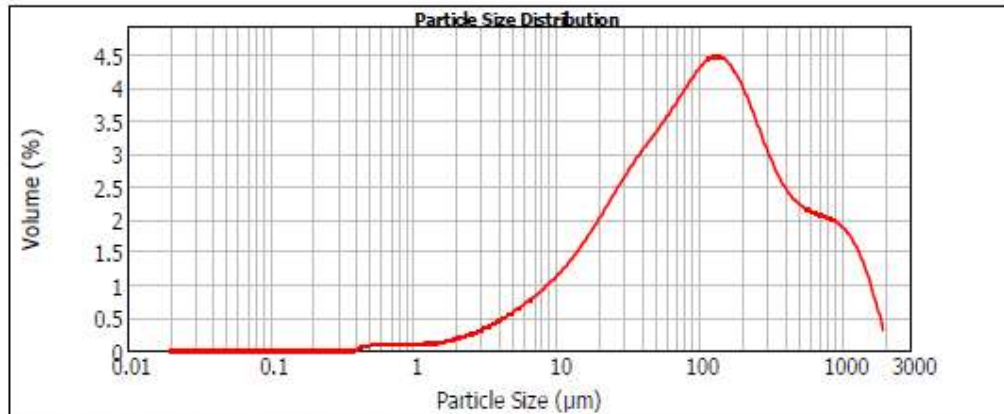
Result Analysis Report

Sample Name: 1242970/3	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 2:43:02 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 2:43:04 p.m.
Sample bulk lot ref: 2014035/3	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 μ m	Obscuration: 11.33 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.216 %	Result Emulation: Off

Concentration: 0.0464 %Vol	Span : 6.367	Uniformity: 1.83	Result units: Volume
Specific Surface Area: 0.226 m^2/g	Surface Weighted Mean D[3,2]: 26.528 μ m	Vol. Weighted Mean D[4,3]: 247.053 μ m	Standard Deviation 343.506 μ m

d(0.1): 14.303 μ m d(0.5): 110.551 μ m d(0.9): 718.152 μ m



1242970/3, Thursday, 6 March 2014 2:43:02 p.m.

Size (μ m)	Vol Under %	Size (μ m)	Vol Under %	Size (μ m)	Vol Under %	Size (μ m)	Vol Under %	Size (μ m)	Vol Under %
0.050	0.00	0.990	0.48	37.000	23.80	105.000	46.53	300.000	75.37
0.060	0.00	2.000	1.00	44.000	27.24	125.000	53.56	350.000	79.28
0.120	0.00	3.900	2.32	53.000	31.23	149.000	58.69	420.000	82.33
0.240	0.00	7.800	5.29	63.000	35.19	177.000	63.61	500.000	84.97
0.480	0.07	15.600	10.90	74.000	39.13	210.000	68.20	590.000	87.32
0.700	0.28	31.000	20.55	88.000	43.64	250.000	72.46	710.000	89.85
								1000.000	94.31
								1190.000	96.36
								1410.000	98.06
								1680.000	99.35
								2000.000	100.00

Operator notes:



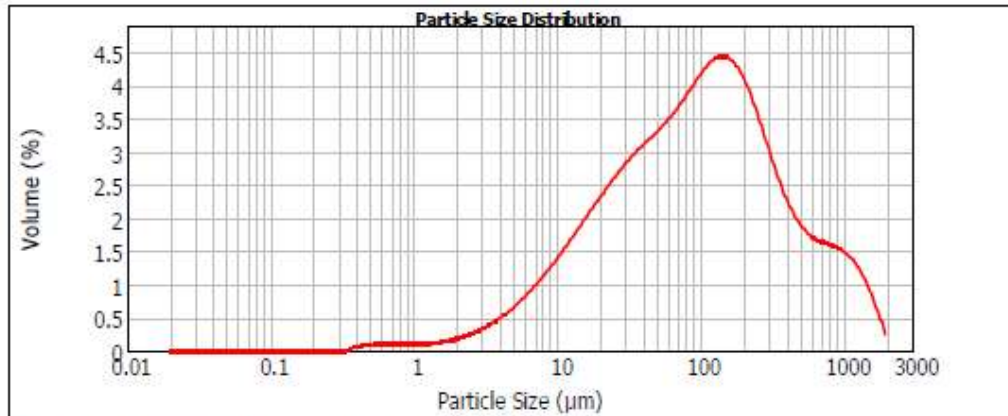
Result Analysis Report

Sample Name: 1242970/4	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 2:48:21 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 2:48:22 p.m.
Sample bulk lot ref: 2014035/4	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 16.70 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.222 %	Result Emulation: Off

Concentration: 0.0616 %Vol	Span : 5.962	Uniformity: 1.82	Result units: Volume
Specific Surface Area: 0.264 m ² /g	Surface Weighted Mean D[3,2]: 22.686 um	Vol. Weighted Mean D[4,3]: 216.835 um	Standard Deviation 315.888 um

d(0.1): 12.089 um d(0.5): 98.014 um d(0.9): 596.415 um



1242970/4, Thursday, 6 March 2014 2:48:21 p.m.

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.980	0.63	37.000	27.43	105.000	51.89	300.000	79.90	840.000	93.70
0.060	0.00	2.000	1.25	44.000	30.97	125.000	56.84	350.000	82.75	1000.000	95.47
0.120	0.00	3.900	2.61	53.000	34.97	149.000	61.90	420.000	85.60	1190.000	97.10
0.240	0.00	7.800	6.08	63.000	38.88	177.000	66.91	500.000	87.91	1410.000	98.46
0.490	0.15	15.600	13.03	74.000	42.73	210.000	71.59	600.000	89.88	1680.000	99.48
0.700	0.40	31.000	24.01	88.000	47.13	250.000	75.94	710.000	91.92	2000.000	100.00

Operator notes:



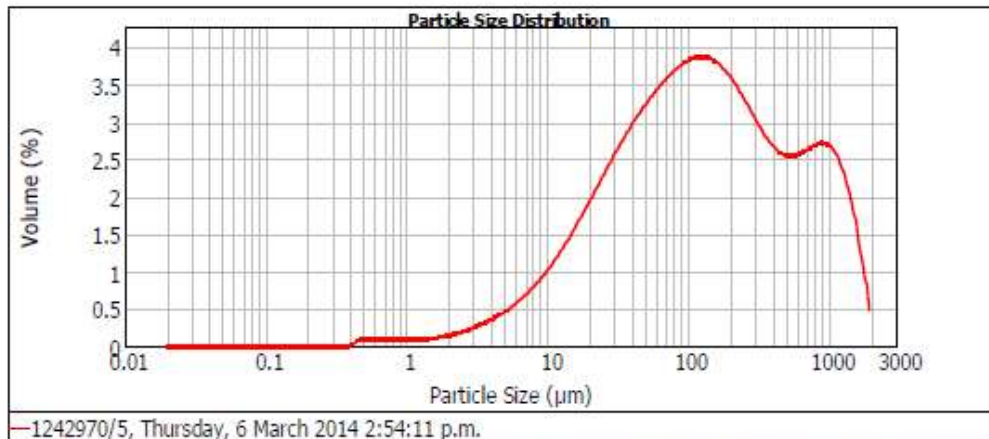
Result Analysis Report

Sample Name: 1242970/5	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 2:54:11 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 2:54:12 p.m.
Sample bulk lot ref: 2014035/5	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 17.40 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.273 %	Result Emulation: Off

Concentration: 0.0804 %Vol	Span : 7.194	Uniformity: 2	Result units: Volume
Specific Surface Area: 0.21 m ² /g	Surface Weighted Mean D[3,2]: 28.562 um	Vol. Weighted Mean D[4,3]: 300.362 um	Standard Deviation 395.5 um

d(0.1): 16.208 um d(0.5): 125.182 um d(0.9): 916.751 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.990	0.51	37.000	22.14	105.000	45.50	300.000	70.45	840.000	88.45
0.060	0.00	2.000	1.01	44.000	25.51	125.000	49.96	350.000	73.42	1000.000	91.54
0.120	0.00	3.900	2.02	53.000	29.40	149.000	54.40	420.000	76.67	1190.000	94.51
0.240	0.00	7.800	4.45	63.000	33.24	177.000	58.67	500.000	79.62	1410.000	97.05
0.490	0.08	15.600	8.60	74.000	36.98	210.000	62.74	590.000	82.37	1680.000	99.00
0.700	0.30	31.000	18.97	88.000	41.16	250.000	66.66	710.000	85.50	2000.000	100.00

Operator notes:



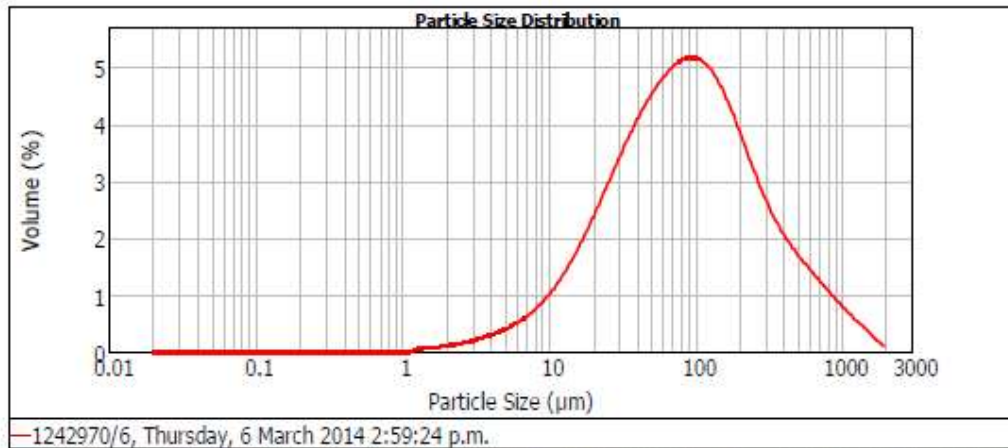
Result Analysis Report

Sample Name: 1242970/6	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 2:59:24 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 2:59:25 p.m.
Sample bulk lot ref: 2014035/6	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 12.95 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.165 %	Result Emulation: Off

Concentration: 0.0714 %Vol	Span : 4.603	Uniformity: 1.5	Result units: Volume
Specific Surface Area: 0.16 m ² /g	Surface Weighted Mean D[3,2]: 37.557 um	Vol. Weighted Mean D[4,3]: 169.260 um	Standard Deviation 238.445 um

d(0.1): 17.582 um d(0.5): 85.863 um d(0.9): 412.821 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.990	0.00	37.000	24.43	105.000	56.79	300.000	85.13	840.000	96.96
0.060	0.00	2.000	0.29	44.000	29.05	125.000	62.58	350.000	87.66	1000.000	99.01
0.120	0.00	3.900	1.06	53.000	34.45	149.000	68.15	420.000	90.23	1190.000	98.83
0.240	0.00	7.800	3.17	63.000	39.61	177.000	73.18	500.000	92.33	1410.000	99.41
0.490	0.00	15.600	8.51	74.000	45.04	210.000	77.64	590.000	94.06	1680.000	99.81
0.700	0.00	31.000	20.17	88.000	50.83	250.000	81.61	710.000	95.71	2000.000	100.00

Operator notes:



Result Analysis Report

Sample Name: 1242970/7
Sample Source & type:
Sample bulk lot ref: 2014035/7

SOP Name: Marine Sediment
Measured by: rogers
Result Source: Measurement

Measured: Thursday, 6 March 2014 3:04:25 p.m.
Analysed: Thursday, 6 March 2014 3:04:27 p.m.

Particle Name: Marine Sediment
Particle RI: 1.500
Dispersant Name: Water

Accessory Name: Hydro 2000G (A)
Absorption: 0.2
Dispersant RI: 1.330

Analysis model: General purpose
Size range: 0.020 to 2000.000 um
Weighted Residual: 0.342 %

Sensitivity: Enhanced
Obscuration: 14.67 %
Result Emulation: Off

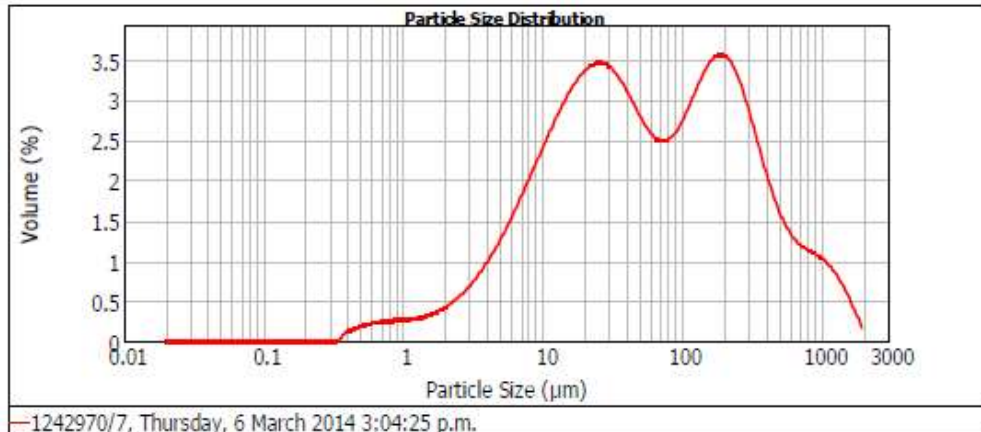
Concentration: 0.0308 %Vol
Specific Surface Area: 0.462 m²/g

Span : 8.122
Surface Weighted Mean D[3,2]: 12.977 um

Uniformity: 2.77
Vol. Weighted Mean D[4,3]: 169.055 um

Result units: Volume
Standard Deviation: 276.932 um

d(0.1): 6.528 um **d(0.5):** 53.882 um **d(0.9):** 444.135 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.990	1.34	37.000	42.70	105.000	61.25	300.000	83.94	840.000	95.74
0.060	0.00	2.000	2.82	44.000	46.23	125.000	64.63	350.000	86.65	1000.000	96.97
0.120	0.00	3.900	5.69	53.000	49.71	149.000	68.97	420.000	89.30	1190.000	98.08
0.240	0.00	7.800	12.12	63.000	52.67	177.000	72.31	500.000	91.34	1410.000	98.99
0.490	0.27	15.600	23.72	74.000	55.31	210.000	76.30	590.000	92.93	1680.000	99.66
0.700	0.78	31.000	38.89	88.000	58.16	260.000	80.22	710.000	94.47	2000.000	100.00

Operator notes:

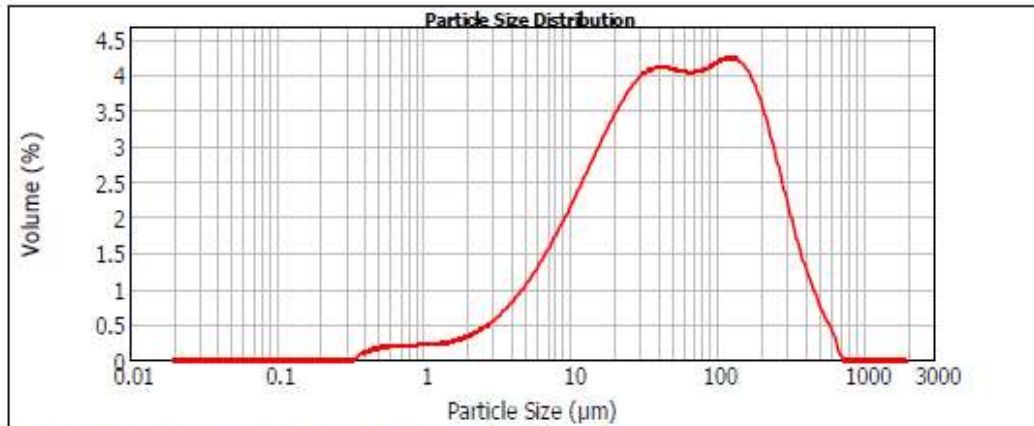


Result Analysis Report

Sample Name: 1242970/8	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 3:37:01 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 3:37:02 p.m.
Sample bulk lot ref: 2014035/8	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 15.85 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.374 %	Result Emulation: Off
Concentration: 0.0373 %Vol	Span : 4.448	Uniformity: 1.4	Result units: Volume
Specific Surface Area: 0.417 m ² /g	Surface Weighted Mean D[3,2]: 14.399 um	Vol. Weighted Mean D[4,3]: 93.183 um	Standard Deviation 107.232 um

d(0.1): 7.785 um d(0.5): 51.366 um d(0.9): 236.251 um



—1242970/8, Thursday, 6 March 2014 3:37:01 p.m.

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.980	1.16	37.000	41.21	105.000	69.06	300.000	94.19	840.000	100.00
0.060	0.00	2.000	2.32	44.000	45.96	125.000	73.88	350.000	96.18	1000.000	100.00
0.120	0.00	3.900	4.58	53.000	50.82	149.000	78.73	420.000	97.90	1190.000	100.00
0.240	0.00	7.800	10.02	63.000	55.41	177.000	83.30	500.000	99.01	1410.000	100.00
0.490	0.26	15.600	20.56	74.000	59.65	210.000	87.46	590.000	99.68	1680.000	100.00
0.700	0.70	31.000	36.52	88.000	64.26	250.000	91.11	710.000	100.00	2000.000	100.00

Operator notes:



Result Analysis Report

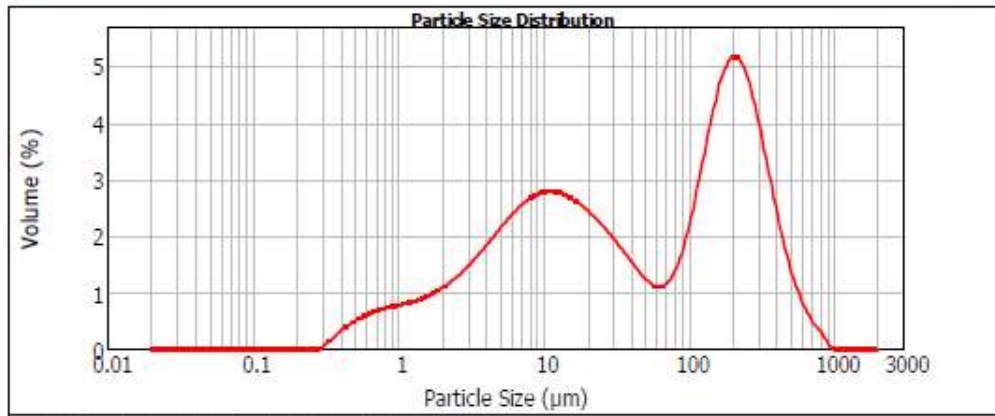
Sample Name: 1242970/9
Sample Source & type:
Sample bulk lot ref: 2014035/9

SOP Name: Marine Sediment
Measured by: rogers
Result Source: Measurement

Measured: Thursday, 6 March 2014 3:43:06 p.m.
Analysed: Thursday, 6 March 2014 3:43:08 p.m.

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 20.13 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.643 %	Result Emulation: Off
Concentration: 0.0231 %Vol	Span : 7.904	Uniformity: 2.69	Result units: Volume
Specific Surface Area: 0.922 m ² /g	Surface Weighted Mean D[3,2]: 6.506 um	Vol. Weighted Mean D[4,3]: 119.175 um	Standard Deviation 147.576 um

d(0.1): 2.603 um **d(0.5):** 40.158 um **d(0.9):** 320.014 um



1242970/9, Thursday, 6 March 2014 3:43:06 p.m.

Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.990	3.81	37.000	49.14	105.000	58.71	300.000	88.24	840.000	99.88
0.060	0.00	2.000	7.97	44.000	50.89	125.000	61.91	350.000	92.05	1000.000	100.00
0.120	0.00	3.900	14.04	53.000	52.45	149.000	66.25	420.000	95.31	1190.000	100.00
0.240	0.00	7.800	24.17	63.000	53.72	177.000	71.46	500.000	97.39	1410.000	100.00
0.490	0.96	15.600	36.58	74.000	54.90	210.000	77.16	590.000	98.64	1680.000	100.00
0.700	2.22	31.000	47.05	88.000	56.46	250.000	82.95	710.000	99.47	2000.000	100.00

Operator notes:

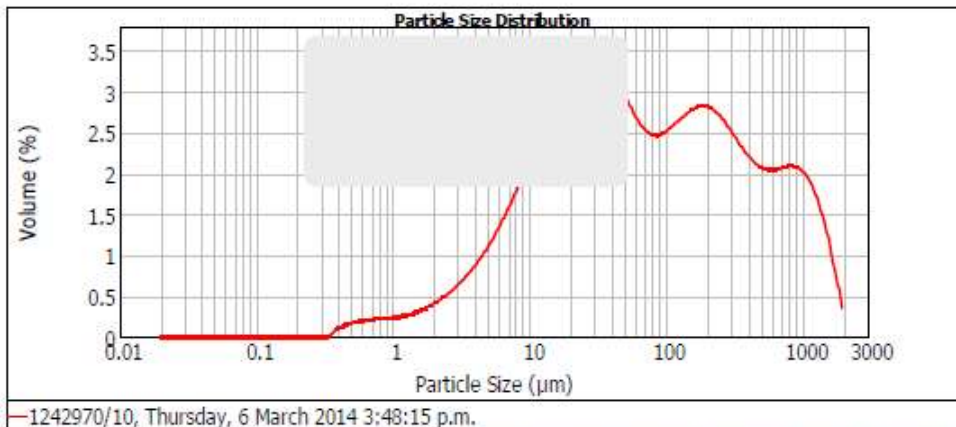


Result Analysis Report

Sample Name: 1242970/10	SOP Name: Marine Sediment	Measured: Thursday, 6 March 2014 3:48:15 p.m.
Sample Source & type:	Measured by: rodgers	Analysed: Thursday, 6 March 2014 3:48:17 p.m.
Sample bulk lot ref: 2014035/10	Result Source: Measurement	

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 14.21 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.350 %	Result Emulation: Off
Concentration: 0.0326 %Vol	Span : 11.807	Uniformity: 3.31	Result units: Volume
Specific Surface Area: 0.421 m ² /g	Surface Weighted Mean D[3,2]: 14.257 um	Vol. Weighted Mean D[4,3]: 231.658 um	Standard Deviation 360.458 um

d(0.1): 7.214 um d(0.5): 63.161 um d(0.9): 752.958 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.980	1.18	37.000	39.50	105.000	58.30	300.000	75.95	840.000	91.49
0.060	0.00	2.000	2.56	44.000	43.19	125.000	61.28	250.000	79.40	1000.000	93.85
0.120	0.00	3.900	5.19	53.000	46.85	149.000	64.39	420.000	82.09	1190.000	95.06
0.240	0.00	7.800	10.86	63.000	49.96	177.000	67.54	800.000	84.50	1410.000	97.91
0.490	0.25	15.600	21.18	74.000	52.65	210.000	70.69	590.000	86.72	1680.000	99.30
0.700	0.70	31.000	35.56	88.000	55.45	250.000	73.83	710.000	89.20	2000.000	100.00

Operator notes:

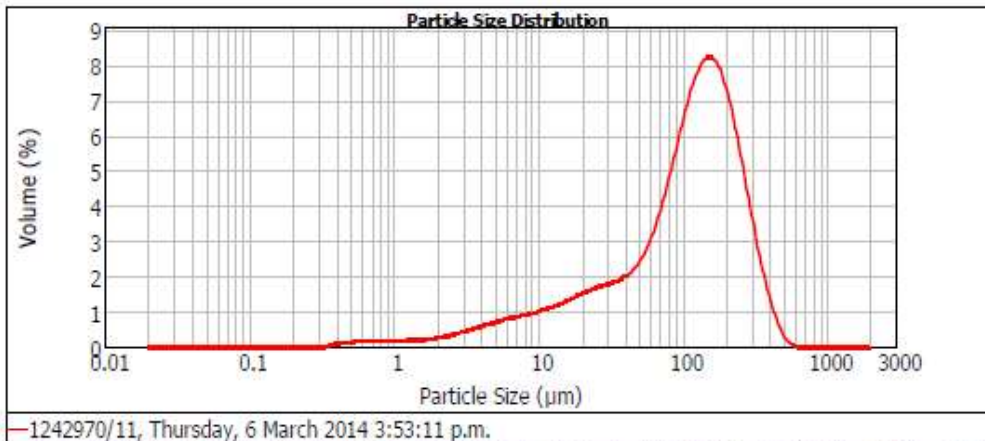


Result Analysis Report

Sample Name: 1242970/11 **SOP Name:** Marine Sediment **Measured:** Thursday, 6 March 2014 3:53:11 p.m.
Sample Source & type: **Measured by:** rogers **Analysed:** Thursday, 6 March 2014 3:53:13 p.m.
Sample bulk lot ref: 2014035/11 **Result Source:** Measurement

Particle Name: Marine Sediment	Accessory Name: Hydro 2000G (A)	Analysis model: General purpose	Sensitivity: Enhanced
Particle RI: 1.500	Absorption: 0.2	Size range: 0.020 to 2000.000 um	Obscuration: 14.79 %
Dispersant Name: Water	Dispersant RI: 1.330	Weighted Residual: 0.311 %	Result Emulation: Off
Concentration: 0.0486 %Vol	Span : 2.177	Uniformity: 0.673	Result units: Volume
Specific Surface Area: 0.302 m ² /g	Surface Weighted Mean D[3,2]: 19.874 um	Vol. Weighted Mean D[4,3]: 128.891 um	Standard Deviation 98.245 um

d(0.1): 12.219 um **d(0.5):** 115.035 um **d(0.9):** 262.646 um



Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %	Size (µm)	Vol Under %
0.050	0.00	0.980	0.98	37.000	21.15	105.000	45.82	300.000	93.88	840.000	100.00
0.060	0.00	2.000	1.93	44.000	23.42	125.000	54.09	350.000	95.99	1000.000	100.00
0.120	0.00	3.900	3.68	53.000	26.24	149.000	63.33	420.000	99.04	1190.000	100.00
0.240	0.00	7.800	7.06	63.000	29.49	177.000	72.54	500.000	99.94	1410.000	100.00
0.480	0.22	15.600	11.94	74.000	33.36	210.000	81.02	590.000	100.00	1680.000	100.00
0.700	0.59	31.000	19.00	88.000	38.81	250.000	86.27	710.000	100.00	2000.000	100.00

Operator notes:

6 Appendix B: Chi-Square Test Results

Table 4. Chi-square Goodness-of-Fit tests between years for total copper concentrations in sediment samples from the eleven sites of the Styx Stormwater Management Plan. Green *P*-values are statistically significant ($P < 0.05$) and red *P*-values are non-significant. d.f = degrees of freedom. N/A = Not Applicable, as site not surveyed.

Site	Concentrations (mg/kg dry weight)			χ^2 Value	d.f.	Overall <i>P</i> - Value	Differences
	1980	2009	2014				
Styx River at Sawyers Arms Road	8	29	36	18.3	2	0.00	1980<2009<2014>1980
Styx River in Styx Mill Reserve	N/A	N/A	12	-	2	-	-
Styx River at Main North Road	3	4	70	116.8	2	0.00	1980<2009<2014>1980
Styx River at Redwood Springs	8	13	16	3.1	2	0.22	1980=2009=2014=1980
Horners Drain	8	45	22	28.6	2	0.00	1980<2009>2014>1980
Kaputone Creek at Blakes Road	20	21	59	29.4	2	0.00	1980<2009<2014>1980
Kaputone Creek at Belfast Road	12	26	170	222.0	2	0.00	1980<2009<2014>1980
Styx River at Marshlands Road Bridge	4	6	10	2.5	2	0.29	1980=2009=2014=1980
Styx River at Richards Bridge	6	17	18	6.0	2	0.05	1980=2009=2014=1980
Styx River at Kainga Road	4	4	17	12.5	2	0.00	1980<2009<2014>1980
Wilson's Drain	N/A	24	36	2.4	1	0.12	2009=2014

Table 5. Chi-square Goodness-of-Fit tests between years for total lead concentrations in sediment samples from the eleven sites of the Styx Stormwater Management Plan. Green *P*-values are statistically significant ($P < 0.05$) and red *P*-values are non-significant. d.f = degrees of freedom.

Site	Concentrations (mg/kg dry weight)			χ^2 Value	d.f.	Overall <i>P</i> - Value	Differences
	1980	2009	2014				
Styx River at Sawyers Arms Road	21	74	70	32.2	2	0.00	1980<2009>2014>1980
Styx River in Styx Mill Reserve	N/A	N/A	12	-	2	-	-
Styx River at Main North Road	29	7	12	17.1	2	0.00	1980>2009<2014<1980
Styx River at Redwood Springs	14	23	21	2.3	2	0.32	1980=2009=2014=1980
Horners Drain	78	93	14	57.1	2	0.00	1980<2009>2014<1980
Kaputone Creek at Blakes Road	41	72	53	8.8	2	0.01	1980>2009<2014=1980
Kaputone Creek at Belfast Road	28	52	76	22.2	2	0.00	1980<2009<2014>1980
Styx River at Marshlands Road Bridge	10	20	13	3.8	2	0.15	1980=2009=2014=1980
Styx River at Richards Bridge	13	27	25	5.2	2	0.07	1980=2009=2014=1980
Styx River at Kainga Road	8	5	22	13.3	2	0.00	1980>2009<2014>1980
Wilson's Drain	N/A	48	47	0.0	1	0.92	2009=2014

Table 6. Chi-square Goodness-of-Fit tests between years for total zinc concentrations in sediment samples from the eleven sites of the Styx Stormwater Management Plan. Green *P*-values are statistically significant ($P < 0.05$) and red *P*-values are non-significant. d.f = degrees of freedom.

Site	Concentrations (mg/kg dry weight)			χ^2 Value	d.f.	Overall <i>P</i> - Value	Differences
	1980	2009	2014				
Styx River at Sawyers Arms Road	61	220	150	87.9	2	0.00	1980<2009>2014>1980
Styx River in Styx Mill Reserve	N/A	N/A	12	-	2	-	-
Styx River at Main North Road	31	64	50	11.6	2	0.00	1980<2009>2014>1980
Styx River at Redwood Springs	66	130	150	33.5	2	0.00	1980<2009<2014>1980
Horners Drain	79	760	50	1089.7	2	0.00	1980<2009>2014<1980
Kaputone Creek at Blakes Road	366	610	500	60.7	2	0.00	1980<2009>2014>1980
Kaputone Creek at Belfast Road	224	430	600	169.6	2	0.00	1980<2009<2014>1980
Styx River at Marshlands Road Bridge	38	86	50	21.4	2	0.00	1980<2009>2014>1980
Styx River at Richards Bridge	69	230	180	85.1	2	0.00	1980<2009>2014>1980
Styx River at Kainga Road	42	63	100	25.6	2	0.00	1980<2009<2014>1980
Wilsons Drain	N/A	330	340	0.1	1	0.70	2009=2014

Table 7. Chi-square Goodness-of-Fit tests between years for Total Organic Content (TOC) levels in sediment samples from the eleven sites of the Styx Stormwater Management Plan. Green *P*-values are statistically significant ($P < 0.05$) and red *P*-values are non-significant. d.f = degrees of freedom.

Site	Concentrations (mg/kg dry weight)		χ^2 Value	d.f.	Overall <i>P</i> - Value	Differences
	2009	2014				
Styx River at Sawyers Arms Road	8	3	1.8	1	0.18	2009=2014
Styx River in Styx Mill Reserve	N/A	12	N/A	1	-	-
Styx River at Main North Road	0	8	6.3	1	0.01	2009<2014
Styx River at Redwood Springs	5	5	0.0	1	0.85	2009=2014
Horners Drain	5	1	3.6	1	0.06	2009=2014
Kaputone Creek at Blakes Road	10	9	0.0	1	0.89	2009=2014
Kaputone Creek at Belfast Road	14	15	0.0	1	0.93	2009=2014
Styx River at Marshlands Road Bridge	1	4	1.6	1	0.21	2009=2014
Styx River at Richards Bridge	4	5	0.1	1	0.70	2009=2014
Styx River at Kainga Road	0	1	0.4	1	0.54	2009=2014
Wilsons Drain	7	6	0.0	1	0.89	2009=2014

Table 8. Chi-square Goodness-of-Fit tests between years for Total Polyaromatic Hydrocarbons (PAHs) concentrations in sediment samples from the eleven sites of the Styx Stormwater Management Plan. Green *P*-values are statistically significant ($P < 0.05$) and red *P*-values are non-significant. d.f = degrees of freedom.

Site	Concentrations (mg/kg dry weight)		χ^2 Value	d.f.	Overall <i>P</i> - Value	Differences
	2009	2014				
Styx River at Sawyers Arms Road	0.18	0.25	0.0	1	0.92	2009=2014
Styx River in Styx Mill Reserve	NT	ND	N/A	1	N/A	N/A
Styx River at Main North Road	ND	ND	N/A	1	N/A	N/A
Styx River at Redwood Springs	ND	ND	N/A	1	N/A	N/A
Horners Drain	0.92	0.89	0.0	1	0.98	2009=2014
Kaputone Creek at Blakes Road	0.16	ND	N/A	1	N/A	N/A
Kaputone Creek at Belfast Road	ND	ND	N/A	1	N/A	N/A
Styx River at Marshlands Road Bridge	3.90	ND	N/A	1	N/A	N/A
Styx River at Richards Bridge	0.24	ND	N/A	1	N/A	N/A
Styx River at Kainga Road	ND	0.39	N/A	1	N/A	N/A
Wilson's Drain	2.10	0.53	0.9	1	0.33	2009=2014