IS100050/DOC

Pearl Environmental

Site Investigation Report

Land Opposite 20-30 Ashbourne Street,
Norden,
Rochdale,
OL11 5XF

Prepared by Pearl Environmental (UK) Ltd for:
D. Briggs

October 2012

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1. Introduction

This report details an intrusive investigation undertaken by Pearl Environmental (UK) Ltd at the request of Mr David Briggs, as the developer of a plot of land on Ashbourne Street, Norden, Rochdale.

The objective of this investigation was to obtain information on potential ground contamination, sources of which were identified within the Preliminary Risk Assessment Report (version 1, Pearl Environmental, Sept 2011).

The proposed development comprises the construction of 4no. residential dwellings, in accordance with planning permission issued by Rochdale MBC (Planning Ref: 10/D53726 and 12/D55428).

The investigation was undertaken in two separate stages (September 2011 & October 2012); this was due to contractual issues between the site owner and developer. The investigation involved digging a number of trial pits, the locations of which are shown on the Site Plan (appendix A). All laboratory analysis derived from the investigation (both stages) is also presented in appendix D.

2. The Site

The plot is located on the southern side of Ashbourne Street, Norden. It was divided into two distinct areas; a former car sales/garage plot (split level, containing two small buildings and a concreted yard, and an area of rough open space (former allotments/small holding). To the north of the plot are numerous terraced houses located on the opposite side of Ashbourne Street. Directly to the south of the plot is a track road running southwards and beyond this track is a former gritstone quarry. The area to the west has recently been developed into a small car parking area.

At the time of the first investigation visit, the car sales plot was entirely concreted and contained two small units. The western side of the plot comprised an overgrown area of open ground formerly used for allotments and the keeping of chickens. Site elevations dropped quite steeply by ~2-3m from southern to northern boundary. Only part of the plot (ex allotments) was initially accessible for investigation involving trial pits, with a second round of investigations being undertaken 12 months later following the clearance of the car lot section of the site. By this time, the whole plot had been levelled and all made ground removed.

The original outline planning permission permitted 6 dwellings covering the entire plot. A 2nd application for full permission related to only 4 dwellings on a reduced area. The site investigations focused on this reduced area.

3. Conceptual Model

The conceptual model, as discussed in the PRA, is detailed below:

Table 1. Conceptual Model

Receptor	Potential Contaminant	Pathways	Potential Linkage?	Risk Rating
Occupiers	Heavy metals, PAH's, TPH	Dermal Contact, Dust inhalation, Vapour inhalation, Soil ingestion	Y	Ground contamination **Low/Mod Risk**
	Methane/Carbon Dioxide	Mines Gas from previous coal workings at shallow depths	Y	Mines Gas **Low/Mod Risk**
Construction Workers	Heavy Metals, PAH's, TPH	Dermal Contact, Dust inhalation, Vapour inhalation, Soil ingestion	Y	Ground Contamination **Low/Mod Risk**
	Methane/Carbon Dioxide	Mines Gas from previous coal workings at shallow depths.	Y	Mines Gas **Low/Mod Risk**
Buildings	Sulphate	Soluble Sulphate in perched waters	Y	Ground Contamination **Low Risk**
	Methane/Carbon Dioxide	Mines gas from previous coal workings at shallow depths.	Y	Mines Gas **Low/Mod Risk**
Minor Aquifer	Heavy Metals TPH	Leaching of contaminants	Y	Ground Contamination **Low/Mod Risk**

This investigation and report aims to consider all pollutant linkages listed above.

4. Ground Investigation

The ground investigation was carried out by Pearl Environmental (UK) Ltd in two phases; visit 1 in September 2011, visit 2 in October 2012. Trial pit locations are shown on the plan in the appendix A. Details of the trial pits and their locations are summarised in Table 2 below:

Table 2. Trial Pit Locations

Trial Pit	Date of investigation	Previous Use	Proposed Use
TP1	Sept 2011	Allotment/Small Holding	Rear Garden
TP2	Sept 2011	Allotment/Small Holding	Front Garden
TP3	Oct 2012	Allotment/Small Holding	Rear Garden
TP4	Oct 2012	Allotment/Small Holding	Rear Garden
TP5	Oct 2012	Car Sales Lot	Front Garden
TP6	Oct 2012	Car Sales Lot	Within Building Footprint

Visit 1 (September 2011), focused upon part of the former allotment area to the west of the plot. This phase of the investigation comprised the excavation of 2no. trial pits (using a

mini digger) across the plot (see site plan). Trial pits were dug to depths of 1.0m bgl. Made ground was encountered at both trial pits. Clay (natural ground) was encountered at both trial pits at shallow depths.

Visit 2, undertaken in October 2012, focussed on areas which were previously inaccessible. By this time, all former concrete surfaces had been broken out and removed (i.e. former car lot). Furthermore, a thin layer of sub base had been laid down as part of site preparation.

This 2nd phase of the investigation involved the excavation of 4no. trial pits (using a mini digger) across the site, in areas shown on the plan in Appendix A. Trial pits were dug to depths ranging between 0.8 – 1.1m bgl. No made ground was encountered at any trial pits.

4.1 Ground Conditions

At the time of the first investigation, minimal site works has commenced. At the time of the second site visit all made ground originally on site had been removed, comprising the sandy soil within the former allotment area, and the concrete flooring of the car lot. The soils had been removed to a permitted inert waste facility, whilst the concrete had been excavated, crushed and stockpiled on site for use within the development.

4.2 Trial Pits

In total, 6no. trial pits were dug over both site visits, as shown on the site plan. The trial pit logs are contained within the appendix. Natural ground (clay) was encountered at all trial pit locations. Made ground was encountered at trial pits 1 & 2 which comprised sandy soils containing small brick fragments. The presence and depth of natural ground was generally consistent across the site and comprised sandy clay becoming firmer with depth. No groundwater was encountered in any trial pit.

4.3 Field Sampling

In total, 6 samples were collected during both investigations. Each where placed in plastic sampling tubs, glass jars & vials, and were stored within a cool box awaiting transportation to a UKAS accredited laboratory in Manchester.

One sample was taken from each trial pit at varying depths ranging from 0.3m to 0.5m. The samples were tested for a range of contaminants as summarised in the table below. The testing suite for each soil sample is listed below:

Table 3. Sample Summary

Sample Reference	Description	Analysis suite
TP1 0.3m	Dark brown sand (made ground) containing small brick pieces.	Soil suite 1*, PAHs, Soil organic matter
TP2 0.40m	Dark brown sand (made ground) containing small brick pieces.	Soil suite 1*, PAHs, TPH Total
TP3 0.40m	Light brown clayey sand (natural ground) containing small sub angular stones	Soil suite 1*, PAHs, TPH Total.

TP4 0.50m	Light brown sandy clay (natural ground) containing small sub rounded stones	Soil suite 1*, PAHs, TPH CWG
TP5 0.50m	Light brown sandy clay (natural ground) containing small sub angular stones	Soil suite 1*, PAHs
TP6 0.30m	Light brown clayey sand (natural ground) containing small sub angular stones	Soil suite 1*, PAHs, Soil organic matter, Leachable Metals.

*Heavy Metals, pH, Phenols (mono), Soluble Sulphate, Sulphide

5.0 Generic Quantitative Risk Assessment

5.1 Introduction

Current good practice requires that the findings from the site investigation be evaluated on a site specific basis using a risk assessment process. An identification and evaluation of the hazards posed by the concentrations of contaminants measured, allows the risks posed to the development by these hazards to be evaluated. Information gained from the preliminary conceptual model is used to inform the risk assessment.

5.2 Risk Assessment

5.2.1 Human Health

The first stage of assessment includes the use of SGVs (Soil Guidance Values) and LQM (Land Quality Management) Generic Assessment Criteria (GAC) (2nd edition) as Tier 1 screening levels.

It is understood that the proposed development entails the erection of residential houses with private gardens, and it is therefore appropriate to compare the analytical results of soil sampling with SGVs and GACs assigned for the 'residential' scenario.

In terms of organic contamination, PAHs are of concern when considering human health risk assessment. A commonly used Tier 1 screening level of 40mg/kg is often considered the most conservative level relevant for protection of human health and controlled waters, however the main risk from PAHs are benzo(a)pyrene (BaP), dibenzo(a,h,)anthracene (D(ah)A) and naphthalene (BaP and D(ah)A are possible carcinogens and the most toxic of the PAHs; naphthalene is the most soluble). These are therefore the most relevant when assessing risk from PAHs.

The potential presence of petroleum hydrocarbons (previous car lot) are of concern since they could pose a risk to the end users and groundwater. Although there were no indications of hydrocarbon contamination during the investigation, a number of samples were analysed for TPH and one for TPH (CWG).

The full set of analytical results is reproduced in the appendices. Tables 1-3 below summarises these results, and compares them to the relevant Tier 1 screening values for human health.

Tier 1 Screening of Analytical Results:

Table 4. Metals & PAHs Summary

Contaminant	No. of Samples	Max results mg/kg	Assessment Criteria (mg/kg)	Source	No. exceeded.
Arsenic	6	32	32	SGV	0
Cadmium	6	<1	10	SGV	0
Chromium	6	28	3000	LQM	0
Copper	6	50	2330	LQM	0
Lead	6	180	450	SGV*	0
Mercury	6	<1	170	SGV	0
Nickel	6	33	130	SGV	0
Selenium	6	<3	350	SGV	0
Zinc	6	160	3750	SGV	0
Phenol	6	<1	420	SGV	0
BaP	**6**	**2.1**	**0.94**	**LQM**	**1**
Napthalene	6	0.17	3.7	LQM	0
D(ah)A	8	0.28	0.86	LQM	0

Table 5. BTEX Summary

Contaminant	No. of samples	Max results µg/kg	Assessment criteria µg/kg	Source	No. Exceeded
Benzene	1	<5	330	CLEA	0
Toluene	1	<5	610000	CLEA	0
EthylBenzene	1	<5	350000	CLEA	0
Xylene	1	<5	230000	CLEA	0

Table 6. TPH (CWG) Summary

Contaminant	No. of samples	Max results mg/kg	Assessment criteria mg/kg	Source	No. Exceeded
Ali EC5-6	1	<0.050	55	LQM	0
Ali EC6-8	1	<0.050	160	LQM	0
Ali EC8-10	1	<0.050	46	LQM	0
Ali EC 10-12	1	<1	230	LQM	0
Ali EC 12-16	1	<1	1700	LQM	0
Ali EC 16-35	1	<1	64000	LQM	0
Aro EC 5-7	1	<0.050	130	LQM	0
Aro EC 7-8	1	<0.050	270	LQM	0
Aro EC 8-10	1	<0.050	65	LQM	0
Aro EC 10-12	1	<1	160	LQM	0
Aro EC 12-16	1	<1	310	LQM	0
Aro EC 16-21	1	<1	480	LQM	0
Aro EC 21-35	1	<1	1100	LQM	0

SGV- CLEA Soil Guidance Value (residential scenario)
LQM – Land Quality Management screening value (residential), 2.5% SOM.
*Former SGV for lead issued under CLEA ver. 1.03.

Two samples were also analysed for *Total TPH*, the results of which where 200mg/kg (made ground) and 15mg/kg (natural ground).

It can be seen from Tables 1-3 that no samples exceeded any of the generic assessment criteria (GACs) for the residential scenario apart from *benzo(a)pyrene*. Contaminant concentrations below the GACs are considered not to warrant further risk assessment. Concentrations of potential contaminants above the GACs require further action.

Concentrations of *TPH* within the soil are considerably below the 500mg/kg threshold for 'inert' material (WAC for inert waste disposal). As such TPH concentrations are not considered to warrant further assessment.

Tables 4, 5 and 6 show that levels of contaminants within the soil do not pose an unacceptable risk to human health, as all levels of contaminants (bar one) are below the GACs. The only exceedance relates to the slightly elevated benzo(a)pyrene (2.1mg/kg) within the made ground at Trial Pit 2. However, all of this made ground material was excavated and removed when the site was reduced to formation level.

5.2.2 Controlled Waters

One soil sample was analysed for leachable heavy metals in order to assess the risk to the Minor Aquifer. The results, contained in Appendix D, are considered low, with the majority of the results being less than the instrument LOD. Only boron was shown to be above the LOD at 0.04mg/l. With the EQS for boron being 2mg/l, this result it well within compliance.

The above results are not considered sufficiently elevated so as to pose a risk to the quality of groundwater in the Minor Aquifer.

5.3 Additional Parameters

Comparing the data to BRE Digest SD1:2005 'Concrete in Aggressive Ground' suggests the samples from the site fall with Design Sulphate Class DS-1 where no special precautions are required.

The concentrations of phytotoxic metals are insufficiently elevated so as to affect plant growth in gardens/ landscaped areas.

5.4 Part 2A Legislation

Section 78A(2) of the Environmental Protection Act 1990 defines contaminated land for the purposes of 2A as:

"Any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, or under the land, that

A) Significant Harm is being caused, or there is a significant possibility of such harm being cause; or
B) Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused."

The EPA defines risk as the combination of:

a) The likelihood that harm, or pollution of water will occur as a result of contaminants in, on or under the land; and

b) The scale and seriousness of such harm or pollution if it did occur.

Under IIA, for a relevant risk to exist there needs to be one or more contaminant-pathway-receptor pollutant linkages ('contaminant linkage') by which a relevant receptor might be affected by the contaminants in question. If either the contaminant, pathway or receptor are missing, then there is no significant risk. If all three are present, then the site requires further assessment and remediation.

5.5 Discussion

The assessment of the analytical data has shown that the soils on the site are highly unlikely to pose an unacceptable risk to receptors identified within the conceptual model when assessed in accordance with current UK methodology. The only slight elevation of one contaminant was within the made ground which was sampled as part of the first investigation. This material was removed shortly after the first investigation, where land levels where reduced to the level of natural ground (sandy clay, underlain by clay) to allow for the formation of appropriate land levels for the development. The concrete surfacing which was initially present on the eastern half of the plot had been broken up and crushed for re use within the development. Apart from this recycled aggregate, no other made ground remains on the plot. As such, the risk to site workers, and site end users is classed as low.

The presence of naturally occurring clay across the site surface is sufficient to provide a physical barrier to prevent any risk from vertical gas migration (mines gas or otherwise). As such, the risk from gas migration to site workers, occupiers and buildings is considered low.

The soils analysis has shown that levels of contaminants with the soil are very low and as such will not pose a risk to controlled waters through the percolation of water through the site surface. As such, the pollution risk to controlled waters is low.

The risk to buildings and services from chemical attack is very low, and consequently no special precautions are required during construction.

Given the levels of contaminants within the soil are low, this removes the 'contaminant' from the 'contaminant linkage', thus concluding there is no significant risk under Part IIA guidance.

6.0 Revised Conceptual Model

From the findings above, the conceptual model has been amended as follows:

Table 7. Revised Conceptual Model

Receptor	Potential Contaminant	Pathways	Potential Linkage?	Risk Rating	Comment
Occupiers	Heavy metals, PAH's, TPH	Dermal Contact, Dust inhalation, Vapour inhalation, Soil ingestion	N	Ground contamination **Very Low Risk**	Made ground removed as part of level formation – only clean natural clay remains (All levels of contaminants in soil below GACs).
	Methane/Carbon Dioxide	Mines Gas from previous coal workings at shallow depths	N	Mines Gas **Low Risk**	Presence of stiff clay (Natural Ground) across the site
Construction Workers	Heavy Metals, PAH's, TPH	Dermal Contact, Dust inhalation, Vapour inhalation, Soil ingestion	N	Ground Contamination **Very low Risk**	Made ground removed as part of level formation – only clean natural clay remains. (All levels of contaminants in soil below GACs).
	Methane/Carbon Dioxide	Mines Gas from previous coal workings at shallow depths.	N	Mines Gas **Low Risk**	Presence of stiff clay (Natural ground) across the site
Buildings	Sulphate	Soluble Sulphate in perched waters	N	Ground Contamination **Low Risk**	Sulphate levels low. Site considered within Design Sulphate Class DS-1 – no special precautions are required.
	Methane/Carbon Dioxide	Mines gas from previous coal workings at shallow depths.	N	Mines Gas **Low Risk**	Presence of stiff clay (Natural ground) across the site
Minor Aquifer	Heavy Metals TPH	Leaching of contaminants	N	Ground Contamination **Very Low Risk**	All leachable contaminants low / at LOD.

7.0 Conclusions and Recommendations

7.1 Conclusions

The conclusions from the investigations are as follows:

- The soils remaining on the site are highly unlikely to pose a risk to end users of the site or site workers.
- The controlled waters (groundwater) beneath the site are unlikely to be impacted by the percolation of water through the site.
- No special precautions are required in the selection of building materials.
- The site is highly unlikely to be classed as contaminated under Part IIA guidance.
- The site is suitable for use for residential development.

7.2 Recommendations

Given the removal of previous made ground has already taken place as part of level formation, no formal recommendations regarding remediation are required. However, any material imported to site for use within garden and landscaping areas must be clean validated topsoil and certified as suitable for use.

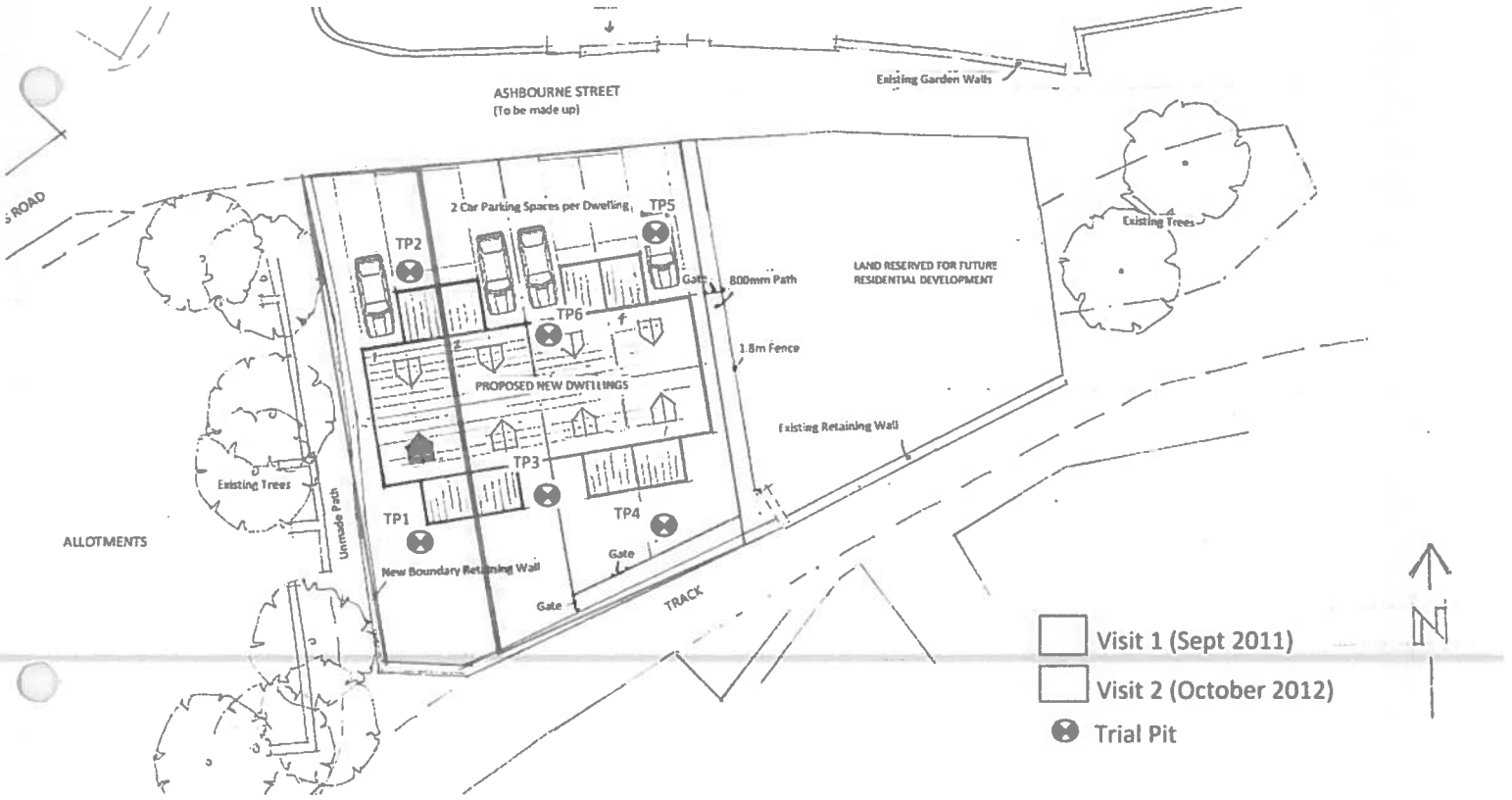
Sarah Bradshaw BSc
Senior Consultant

Keith Lewis BSc MSc
Senior Consultant

Appendices

- A - Site Plan
- B - Trial Pit photographs
- C - Trial Pit logs
- D - Chemical Analysis

Appendix A – Site Plan



Appendix B – Trial Pit Photographs



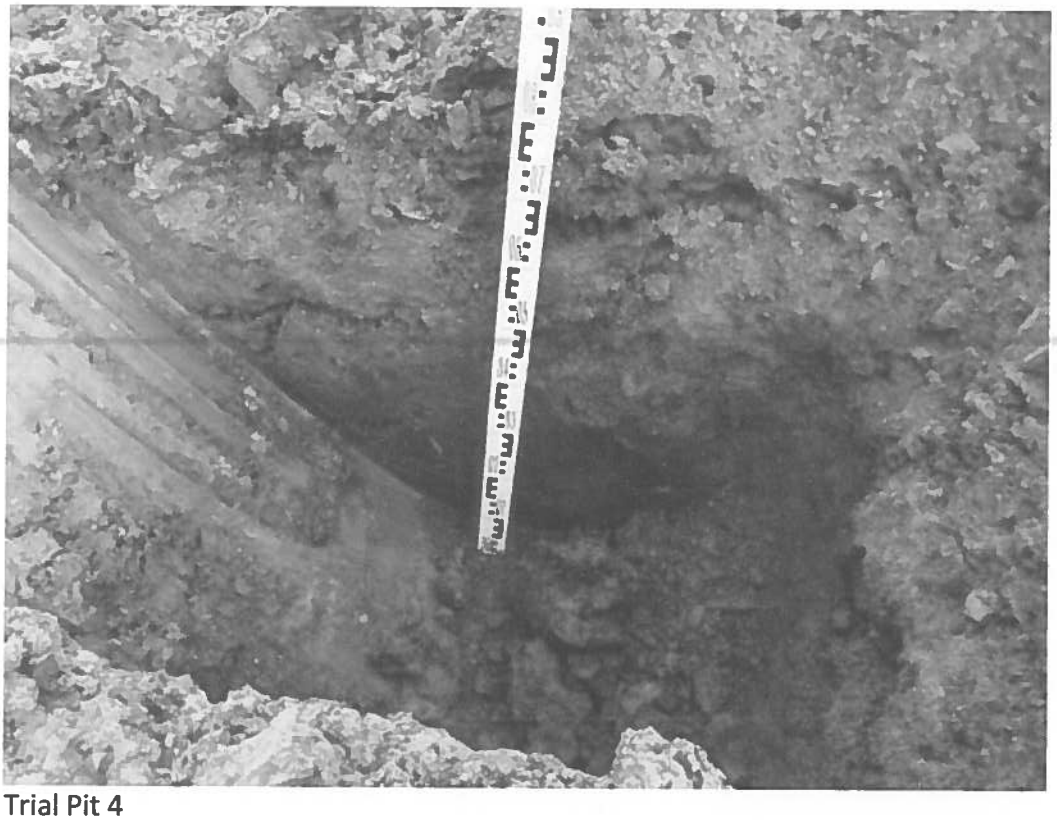
Trial Pit 1



Trial Pit 2



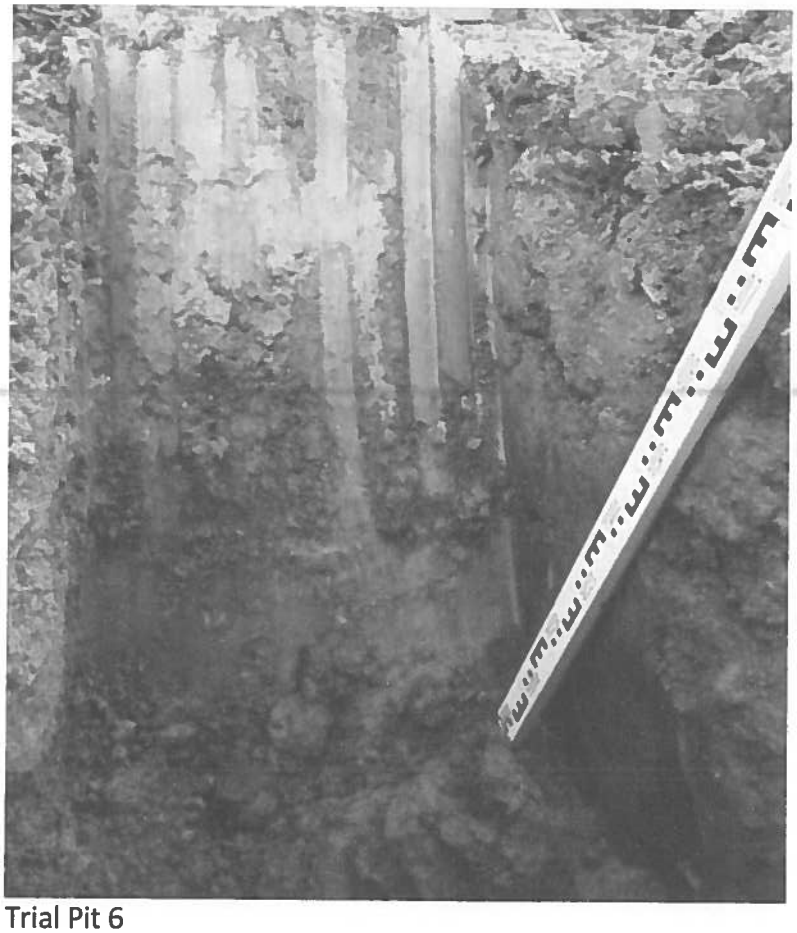
Trial Pit 3



Trial Pit 4



Trial Pit 5



Trial Pit 6

Appendix C – Trial Pit Logs

Pearl Environmental (UK) Ltd, Po Box 307, Manchester, M12 0AH, Tel: 0161 273 3078	Project Briggs, Norden.				Job Ref.	
	Section				Sheet no Trial pit 1	
	Calc. by S.B	Date	Chk'd by KL	Date	App'd By	Date 15/9/2011

TRIAL PIT LOG

Water	Legend	Depth below ground level (m)	Description
		0.0	
	X X X X X X X X X X	0.5m	MADE GROUND consisting of dark brown loamy Sand containing brick pieces.
	X X X X X X X X X X X	0.8m	CLAY- light brown sandy clay
	- 0 - 0 - 0 - 0 -	1.0m	CLAY – Light brown clay becoming firm with depth
			Trial Pit Ends

Not shown to scale

Notes:
Sample taken at 0.3m.

Pearl Environmental (UK) Ltd, Po Box 307, Manchester, M12 0AH, Tel: 0161 273 3078	Project Briggs, Norden.				Job Ref.	
	Section				Sheet no Trial pit 2	
	Calc. by S.B	Date	Chk'd by KL	Date	App'd By	Date 15/9/2011

TRIAL PIT LOG

Water	Legend	Depth below ground level (m)	Description
		0.0	
	X X X X X X X X X X X X X X	0.7m	MADE GROUND consisting of dark brown loamy Sand containing small brick pieces.
	X X X X X X X	0.9m	CLAY- light brown sandy clay
	- 0 - 0 - 0 - 0 -	1.1m	CLAY – Light brown clay becoming firm with depth
			Trial Pit Ends

Not shown to scale

Notes:
Sample taken at 0.4m.

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Pearl Environmental (UK) Ltd, Po Box 307, Manchester, M12 0AH, Tel: 0161 273 3078	Project Briggs, Norden.				Job Ref.	
	Section				Sheet no Trial pit 3	
	Calc. by S.B	Date	Chk'd by KL	Date	App'd By	Date 4/10/12

TRIAL PIT LOG

Water	Legend	Depth below ground level (m)	Description
		0.0	
	X X X X X X X X X X X X X X X X X X	0.5m	CLAY- Brown clayey Sand containing small angular stones
	- 0 - 0 - 0 - 0 - - 0 - 0 -	0.8m	CLAY – Light brown sandy Clay becoming firm with depth
			Trial Pit Ends

Not shown to scale

Notes:
Sample taken at 0.4m.

Pearl Environmental (UK) Ltd, Po Box 307, Manchester, M12 0AH, Tel: 0161 273 3078	Project Briggs, Norden.				Job Ref.	
	Section				Sheet no Trial pit 4	
	Calc. by S.B	Date	Chk'd by KL	Date	App'd By	Date 4/10/12

TRIAL PIT LOG

Water	Legend	Depth below ground level (m)	Description
		0.0	
	X X X X X X X X X X X	0.3m	CLAY- Light brown sandy Clay containing small sub rounded stones
	- 0 - 0 - 0 - 0 - - 0 - 0 - 0 - 0 - - 0 - 0 - 0 - 0 - - 0 - 0 -	1.0m	CLAY – Grey clay becoming firm with depth
			Trial Pit Ends

Not shown to scale

Notes:
Sample taken at 0.5m.

Pearl Environmental (UK) Ltd, Po Box 307, Manchester, M12 0AH, Tel: 0161 273 3078	Project Briggs, Norden.				Job Ref.	
	Section				Sheet no Trial pit 5	
	Calc. by S.B	Date	Chk'd by KL	Date	App'd By	Date 4/10/12

TRIAL PIT LOG

Water	Legend	Depth below ground level (m)	Description
		0.0	
	X X X X X X X X X X X X X X	0.35m	CLAY- Light brown sandy Clay containing small sub angular stones
	- 0 - 0 - 0 - 0 - - 0 - 0 - 0 - 0 -	0.8m	CLAY – Grey clay becoming firm with depth
			Trial Pit Ends

Not shown to scale

Notes:
Sample taken at 0.5m.

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Pearl Environmental (UK) Ltd, Po Box 307, Manchester, M12 0AH, Tel: 0161 273 3078	Project Briggs, Norden.				Job Ref.	
	Section				Sheet no Trial pit 6	
	Calc. by S.B	Date	Chk'd by KL	Date	App'd By	Date 4/10/12

TRIAL PIT LOG

Water	Legend	Depth below ground level (m)	Description
		0.0	
	X X X X X X X X X X X X X X	0.4m	CLAY- light brown clayey Sand containing small sub angular stones
	- 0 - 0 - 0 - 0 - - 0 - 0 - 0 - 0 - - 0 - 0 - 0 - 0 - - 0 - 0 -	1.1m	CLAY – Grey clay becoming firm with depth
			Trial Pit Ends

Not shown to scale

Notes:
Sample taken at 0.3m.

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Certificate of Analysis

Cornbrook
Manchester
M16 9FE
Tel : 0161 874 2400
Fax : 0161 874 2468

Report Number: 250659-1

Date of Report: 26-Sep-2011

Customer: Pearl Environmental UK Ltd
PO Box 307
Manchester.
M12 0AH.

Customer Contact: Miss Sarah Bradshaw

Customer Job Reference: NORDEN
Date Job Received at SAL: 15-Sep-2011
Date Analysis Started: 16-Sep-2011
Date Analysis Completed: 26-Sep-2011

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
This report should not be reproduced except in full without the written approval of the laboratory
Tests covered by this certificate were conducted in accordance with SAL SOPs

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1549

Report checked
and authorised by :
Miss Emma Tibbitts
Senior Project Manager

Issued by :
Miss Emma Tibbitts
Senior Project Manager

This document has been printed from a digitally signed master copy

SAL Reference: 250659
Customer Reference: NORDEN

Soil Analysed as Soil
Miscellaneous

				SAL Reference	250659 001	250659 002
				Customer Sample Reference	TP1 0.3	TP2 0.4
				Date Sampled	15-SEP-2011	15-SEP-2011
Determinand	Method	Test Sample	LOD	Units		
Soil Organic Matter	T287	AR	0.1	%	11	-
Total Petroleum Hydrocarbons	T8	AR	1	mg/kg	-	200

SAL Reference: 250659
Customer Reference: NORDEN

Soil Analysed as Soil
Pearl Environmental Suite

				SAL Reference	250659 001	250659 002
				Customer Sample Reference	TP1 0.3	TP2 0.4
				Date Sampled	15-SEP-2011	15-SEP-2011
Determinand	Method	Test Sample	LOD	Units		
Arsenic	T6	AR	1	mg/kg	14	32
Boron (water-soluble)	T6	AR	1	mg/kg	<1	<1
Cadmium	T6	AR	1	mg/kg	<1	<1
Chromium	T6	AR	1	mg/kg	17	15
Copper	T6	AR	1	mg/kg	50	50
Cyanide(free)	T4	AR	1	mg/kg	<1	<1
Lead	T6	AR	1	mg/kg	180	120
Mercury	T6	AR	1	mg/kg	<1	<1
Nickel	T6	AR	1	mg/kg	20	33
pH	T7	AR			7.8	8.0
Phenols(Mono)	T4	AR	1	mg/kg	<1	<1
Selenium	T6	AR	3	mg/kg	<3	<3
SO4(2:1)	T6	AR	0.1	g/l	<0.1	<0.1
Sulphide	T4	AR	10	mg/kg	<10	<10
Zinc	T6	AR	1	mg/kg	160	84

SAL Reference: 250659
Customer Reference: NORDEN

Soil Analysed as Soil
Total and Speciated USEPA16 PAH

				SAL Reference	250659 001	250659 002
				Customer Sample Reference	TP1 0.3	TP2 0.4
				Date Sampled	15-SEP-2011	15-SEP-2011
Determinand	Method	Test Sample	LOD	Units		
Naphthalene	T149	AR	0.01	mg/kg	0.17	0.07
Acenaphthylene	T149	AR	0.01	mg/kg	0.03	0.06
Acenaphthene	T149	AR	0.01	mg/kg	0.27	0.03
Fluorene	T149	AR	0.01	mg/kg	0.20	0.06
Phenanthrene	T149	AR	0.01	mg/kg	1.5	0.42
Anthracene	T149	AR	0.01	mg/kg	0.38	0.29
Fluoranthene	T149	AR	0.01	mg/kg	2.0	0.51
Pyrene	T149	AR	0.01	mg/kg	1.8	0.96
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	0.82	2.0
Chrysene	T149	AR	0.01	mg/kg	0.87	2.3
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	1.3	2.8
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	0.82	2.1
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	0.35	0.35
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	0.07	0.28
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	0.39	0.49
PAH(total)	T149	AR	0.01	mg/kg	11	13

Index to symbols used in 250659-1

Value	Description
AR	As Received
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T149	GC/MS (SIR)
T8	GC/FID
T4	Colorimetry
T6	ICP/OES
T7	Probe
T287	Calc TOC/0.58

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Arsenic	T6	AR	1	mg/kg	U	001-002
Boron (water-soluble)	T6	AR	1	mg/kg	N	001-002
Cadmium	T6	AR	1	mg/kg	U	001-002
Chromium	T6	AR	1	mg/kg	U	001-002
Copper	T6	AR	1	mg/kg	U	001-002
Cyanide(free)	T4	AR	1	mg/kg	U	001-002
Lead	T6	AR	1	mg/kg	U	001-002
Mercury	T6	AR	1	mg/kg	U	001-002
Nickel	T6	AR	1	mg/kg	U	001-002
pH	T7	AR			U	001-002
Phenols(Mono)	T4	AR	1	mg/kg	U	001-002
Selenium	T6	AR	3	mg/kg	U	001-002
SO4(2:1)	T6	AR	0.1	g/l	N	001-002
Sulphide	T4	AR	10	mg/kg	N	001-002
Zinc	T6	AR	1	mg/kg	U	001-002
Soil Organic Matter	T287	AR	0.1	%	N	001
Total Petroleum Hydrocarbons	T8	AR	1	mg/kg	U	002
Naphthalene	T149	AR	0.01	mg/kg	U	001-002
Acenaphthylene	T149	AR	0.01	mg/kg	U	001-002
Acenaphthene	T149	AR	0.01	mg/kg	U	001-002
Fluorene	T149	AR	0.01	mg/kg	U	001-002
Phenanthrene	T149	AR	0.01	mg/kg	U	001-002
Anthracene	T149	AR	0.01	mg/kg	U	001-002
Fluoranthene	T149	AR	0.01	mg/kg	U	001-002
Pyrene	T149	AR	0.01	mg/kg	U	001-002
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	U	001-002
Chrysene	T149	AR	0.01	mg/kg	U	001-002
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	U	001-002
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	U	001-002
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	U	001-002
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	U	001-002
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	U	001-002
PAH(total)	T149	AR	0.01	mg/kg	U	001-002

Scientific Analysis Laboratories is a limited company registered in England and Wales (No 2514788) whose address is at Hadfield House, Hadfield Street, Manchester M16 9FE

Scientific Analysis Laboratories Ltd

Certificate of Analysis

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Report Number: 298358-1

Date of Report: 15-Oct-2012

Customer: Pearl Environmental UK Ltd
PO Box 307
Manchester.
M12 0AH.

Customer Contact: Miss Sarah Bradshaw

Customer Job Reference: Norden
Date Job Received at SAL: 04-Oct-2012
Date Analysis Started: 05-Oct-2012
Date Analysis Completed: 15-Oct-2012

The results reported relate to samples received in the laboratory
Opinions and interpretations expressed herein are outside the scope of UKAS accreditation
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Tests covered by this certificate were conducted in accordance with SAL SOPs

UKAS TESTING
1549

Report checked and authorised by :
Lianne Bromiley
Project Manager

Issued by :
Lianne Bromiley
Project Manager

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SAL Reference: 298358
Customer Reference: Norden

Soil Analysed as Soil
Pearl Environmental Suite

					SAL Reference	298358 001	298358 002	298358 003	298358 004
					Customer Sample Reference	TP3 0.4	TP4 0.5	TP5 0.5	TP6 0.3
					Date Sampled	03-OCT-2012	03-OCT-2012	03-OCT-2012	03-OCT-2012
Determinand	**Method**	**Test Sample**	**LOD**	**Units**					
Arsenic	T6	AR	1	mg/kg		7	7	5	6
Boron (water-soluble)	T6	AR	1	mg/kg		<1	<1	<1	<1
Cadmium	T6	AR	1	mg/kg		<1	<1	<1	<1
Chromium	T6	AR	1	mg/kg		22	24	18	28
Copper	T6	AR	1	mg/kg		18	17	11	16
Cyanide(free)	T4	AR	1	mg/kg		<1	<1	<1	<1
Lead	T6	AR	1	mg/kg		24	16	11	18
Mercury	T6	AR	1	mg/kg		<1	<1	<1	<1
Nickel	T6	AR	1	mg/kg		21	22	17	24
pH	T7	AR				7.3	7.1	6.9	6.0
Phenols(Mono)	T4	AR	1	mg/kg		<1	<1	<1	<1
Selenium	T6	AR	3	mg/kg		<3	<3	<3	<3
SO4(2:1)	T6	AR	0.1	g/l		<0.1	<0.1	<0.1	<0.1
Sulphide	T4	AR	10	mg/kg		<10	<10	<10	<10
Zinc	T6	AR	1	mg/kg		53	50	36	61

SAL Reference: 298358
Customer Reference: Norden

Soil Analysed as Soil
TPH (CWG)

					SAL Reference	298358 002
					Customer Sample Reference	TP4 0.5
					Date Sampled	03-OCT-2012
Determinand	**Method**	**Test Sample**	**LOD**	**Units**		
Benzene	T54	AR	1	µg/kg		(2,13) <5
Toluene	T54	AR	1	µg/kg		(2) <5
EthylBenzene	T54	AR	1	µg/kg		(2) <5
M/P Xylene	T54	AR	1	µg/kg		(2) <5
O Xylene	T54	AR	1	µg/kg		(2) <5
Methyl tert-Butyl Ether	T54	AR	1	µg/kg		(2) <5
TPH (C5-C6 aliphatic)	T54	AR	0.010	mg/kg		(2) <0.050
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg		(2) <0.050
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg		(2) <0.050
TPH (C10-C12 aliphatic)	T8	AR	1	mg/kg		<1
TPH (C12-C16 aliphatic)	T8	AR	1	mg/kg		<1
TPH (C16-C21 aliphatic)	T8	AR	1	mg/kg		<1
TPH (C21-C35 aliphatic)	T8	AR	1	mg/kg		<1
TPH (C6-C7 aromatic)	T54	AR	0.010	mg/kg		(2) <0.050
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg		(2) <0.050
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg		(2) <0.050
TPH (C10-C12 aromatic)	T8	AR	1	mg/kg		<1
TPH (C12-C16 aromatic)	T8	AR	1	mg/kg		<1
TPH (C16-C21 aromatic)	T8	AR	1	mg/kg		<1
TPH (C21-C35 aromatic)	T8	AR	1	mg/kg		<1

SAL Reference: 298358
Customer Reference: Norden

Soil — Analysed as Soil
Total and Speciated USEPA16 PAH

				SAL Reference	298358 001	298358 002	298358 003	298358 004
				Customer Sample Reference	TP3 0.4	TP4 0.5	TP5 0.5	TP6 0.3
				Date Sampled	03-OCT-2012	03-OCT-2012	03-OCT-2012	03-OCT-2012
Determinand	Method	Test Sample	LOD	Units				
Naphthalene	T149	AR	0.01	mg/kg	0.06	0.03	0.07	(110) <0.10
Acenaphthylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Acenaphthene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Fluorene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Phenanthrene	T149	AR	0.01	mg/kg	0.02	<0.01	<0.01	<0.01
Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Fluoranthene	T149	AR	0.01	mg/kg	0.01	<0.01	<0.01	<0.01
Pyrene	T149	AR	0.01	mg/kg	0.01	<0.01	<0.01	<0.01
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	0.01	<0.01	<0.01	<0.01
Chrysene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	0.01	<0.01	<0.01	<0.01
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	<0.01	<0.01	<0.01	<0.01
PAH(total)	T149	AR	0.01	mg/kg	0.12	0.03	0.07	<0.01

SAL Reference: 298358
Customer Reference: Norden

Soil — Analysed as Soil
Miscellaneous

				SAL Reference	298358 001	298358 004
				Customer Sample Reference	TP3 0.4	TP6 0.3
				Date Sampled	03-OCT-2012	03-OCT-2012
Determinand	Method	Test Sample	LOD	Units		
Soil Organic Matter	T287	AR	0.1	%	-	0.8
Total Petroleum Hydrocarbons	T8	AR	1	mg/kg	15	-

SAL Reference: 298358
Customer Reference: Norden

Leachate — Analysed as Water
ICRCL (Table 3:metals)

				SAL Reference	298358 004
				Customer Sample Reference	TP6 0.3
				Date Sampled	03-OCT-2012
Determinand	Method	Test Sample	LOD	Units	
Arsenic	T6	10:1	0.02	mg/l	<0.02
Boron	T6	10:1	0.01	mg/l	0.04
Cadmium	T6	10:1	0.01	mg/l	<0.01
Chromium	T6	10:1	0.01	mg/l	<0.01
Copper	T6	10:1	0.01	mg/l	<0.01
Lead	T6	10:1	0.03	mg/l	<0.03
Mercury	T6	10:1	0.01	mg/l	<0.01
Nickel	T6	10:1	0.01	mg/l	<0.01
Selenium	T6	10:1	0.04	mg/l	<0.04
Zinc	T6	10:1	0.01	mg/l	<0.01

Index to symbols used in 298358-1

Value	Description
AR	As Received
10:1	Leachate
2	LOD Raised Due to Matrix Interference

110	LOD raised due to low internal standard recovery.
13	Results have been blank corrected.
U	Analysis is UKAS accredited
N	Analysis is not UKAS accredited

Method Index

Value	Description
T287	Calc TOC/0.58
T8	GC/FID
T7	Probe
T54	GC/MS (Headspace)
T4	Colorimetry
T149	GC/MS (SIR)
T6	ICP/OES

Accreditation Summary

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Naphthalene	T149	AR	0.01	mg/kg	U	001-004
Acenaphthylene	T149	AR	0.01	mg/kg	U	001-004
Acenaphthene	T149	AR	0.01	mg/kg	U	001-004
Fluorene	T149	AR	0.01	mg/kg	U	001-004
Phenanthrene	T149	AR	0.01	mg/kg	U	001-004
Anthracene	T149	AR	0.01	mg/kg	U	001-004
Fluoranthene	T149	AR	0.01	mg/kg	U	001-004
Pyrene	T149	AR	0.01	mg/kg	U	001-004
Benzo(a)Anthracene	T149	AR	0.01	mg/kg	U	001-004
Chrysene	T149	AR	0.01	mg/kg	U	001-004
Benzo(b/k)Fluoranthene	T149	AR	0.01	mg/kg	U	001-004
Benzo(a)Pyrene	T149	AR	0.01	mg/kg	U	001-004
Indeno(123-cd)Pyrene	T149	AR	0.01	mg/kg	U	001-004
Dibenzo(ah)Anthracene	T149	AR	0.01	mg/kg	U	001-004
Benzo(ghi)Perylene	T149	AR	0.01	mg/kg	U	001-004
PAH(total)	T149	AR	0.01	mg/kg	U	001-004
Arsenic	T6	10:1	0.02	mg/l	U	004
Boron	T6	10:1	0.01	mg/l	N	004
Cadmium	T6	10:1	0.01	mg/l	U	004
Chromium	T6	10:1	0.01	mg/l	U	004
Copper	T6	10:1	0.01	mg/l	U	004
Lead	T6	10:1	0.03	mg/l	U	004
Mercury	T6	10:1	0.01	mg/l	U	004
Nickel	T6	10:1	0.01	mg/l	U	004
Selenium	T6	10:1	0.04	mg/l	U	004
Zinc	T6	10:1	0.01	mg/l	U	004
Benzene	T54	AR	1	µg/kg	U	002
Toluene	T54	AR	1	µg/kg	U	002
EthylBenzene	T54	AR	1	µg/kg	U	002
M/P Xylene	T54	AR	1	µg/kg	U	002
O Xylene	T54	AR	1	µg/kg	U	002
Methyl tert-Butyl Ether	T54	AR	1	µg/kg	U	002
TPH (C5-C6 aliphatic)	T54	AR	0.010	mg/kg	N	002
TPH (C6-C8 aliphatic)	T54	AR	0.010	mg/kg	N	002
TPH (C8-C10 aliphatic)	T54	AR	0.010	mg/kg	N	002
TPH (C10-C12 aliphatic)	T8	AR	1	mg/kg	N	002
TPH (C12-C16 aliphatic)	T8	AR	1	mg/kg	N	002
TPH (C16-C21 aliphatic)	T8	AR	1	mg/kg	N	002
TPH (C21-C35 aliphatic)	T8	AR	1	mg/kg	N	002
TPH (C6-C7 aromatic)	T54	AR	0.010	mg/kg	N	002
TPH (C7-C8 aromatic)	T54	AR	0.010	mg/kg	N	002
TPH (C8-C10 aromatic)	T54	AR	0.010	mg/kg	N	002
TPH (C10-C12 aromatic)	T8	AR	1	mg/kg	N	002
TPH (C12-C16 aromatic)	T8	AR	1	mg/kg	N	002
TPH (C16-C21 aromatic)	T8	AR	1	mg/kg	N	002
TPH (C21-C35 aromatic)	T8	AR	1	mg/kg	N	002
Soil Organic Matter	T287	AR	0.1	%	N	004
Total Petroleum Hydrocarbons	T8	AR	1	mg/kg	U	001
Arsenic	T6	AR	1	mg/kg	U	001-004
Boron (water-soluble)	T6	AR	1	mg/kg	N	001-004

Determinand	Method	Test Sample	LOD	Units	Symbol	SAL References
Cadmium	T6	AR	1	mg/kg	U	001-004
Chromium	T6	AR	1	mg/kg	U	001-004
Copper	T6	AR	1	mg/kg	U	001-004
Cyanide(free)	T4	AR	1	mg/kg	U	001-004
Lead	T6	AR	1	mg/kg	U	001-004
Mercury	T6	AR	1	mg/kg	U	001-004
Nickel	T6	AR	1	mg/kg	U	001-004
pH	T7	AR			U	001-004
Phenols(Mono)	T4	AR	1	mg/kg	U	001-004
Selenium	T6	AR	3	mg/kg	U	001-004
SO4(2:1)	T6	AR	0.1	g/l	N	001-004
Sulphide	T4	AR	10	mg/kg	N	001-004
Zinc	T6	AR	1	mg/kg	U	001-004