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Materials Recovery and Energy Centre (MREC) Crymlyn Burrows

Site Investigation Interpretative Report

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Contents

1 Introduction

1.1 Background

Jacobs Engineering UK Limited (Jacobs) has been commissioned by Neath Port Talbot County Borough Council (NPTCBC) to carry out an investigation of groundwater contamination at the Materials Recovery and Energy Centre (MREC) at Crymlyn Burrows.

A Phase 1 Environmental Site Assessment was undertaken by Jacobs in February 2012 which found visual and olfactory evidence of hydrocarbon contamination within a damaged existing storm water attenuation pipe adjacent to the southern boundary of the site where a new access road (the Fabian Way Link Road) is being constructed close to the boundary.

The contamination is believed to be entering the attenuation pipe from the surrounding soil and groundwater and appears to be associated with the existence of old pipelines which ran east-west along the new access road and have now been removed. However, site personnel at the MREC report that hydrocarbon contamination has been observed in the petrol interceptor since work on the removal of the pipeline was undertaken.

Further to the Phase 1 Environmental Site Assessment Jacobs has been commissioned by NPTCBC to carry out an investigation of groundwater contamination at the Materials Recovery and Energy Centre (MREC) at Crymlyn Burrows. The purpose of the ground investigation was to establish the presence of and groundwater contamination and comment on the whether the contamination is entering the ground beneath MREC or is an existing 'on-site' source.

1.2 Report Structure

The works carried out to investigate the extent and nature of the hydrocarbon contamination of the soils and groundwater are described in a separate report, Site Investigation Factual Report June 2012 (Doc. Ref. No. B15974EX/12365/R4960), which presents the factual results of the investigation. This report discusses the nature and extent of contaminants detected in the soils and groundwater boreholes and should be read alongside the factual report.

Sections 2-4 of this report describe a preliminary assessment of the environmental risks identified and the regulatory context and recommendations for further work. It includes a commentary on concentrations, spatial and depth distributions of the hydrocarbon contamination. Likely source areas of contamination identified during the site investigation are discussed and appropriate actions recommended through a generic quantitative risk assessment (GQRA). The results of the GQRA are discussed with respect to existing regulatory controls relating to contaminated land and pollution of controlled waters. The final section of this report provides recommendations to mitigate identified pollutant linkages at the site.

1.3 Limitations

This report was prepared by Jacobs for the sole use of Neath Port Talbot County Borough Council. This report shall not be relied upon or transferred to any other parties. If an unauthorised third party comes into possession of this report, they rely on its contents at their own risk.

The findings and opinions conveyed via this report are based on information obtained from a variety of sources as detailed within this report and which Jacobs believes is reliable. Nevertheless, Jacobs cannot and does not guarantee the authenticity or reliability of the information. No attempt has been made to verify independently any data collected by others from other sources.

2 Contamination Risk Assessment

2.1 Conceptual Site Model

The assessment below is based on the Contaminated Land Report (CLR) 11: Model Procedures for the Management of Land Contamination (EA, 2004). CLR 11 has been developed to provide the technical framework for applying a risk management process when dealing with land affected by contamination. An important thread throughout the overall process of risk assessment is the need to formulate and develop a Conceptual Site Model (CSM) for the site, which supports the identification and assessment of pollutant linkages. The ground investigation and chemical analysis undertaken will be used to developed the preliminary CSM and quantitatively assess the risk (via a tier 1 assessment).

2.1.1 Sources of Contamination

Potential sources of contamination identified at the site are limited to the following;

- Site history as rail sidings and as a rail freight terminal for a number of years may have resulted in residual soil and groundwater contamination. (However, ground investigations undertaken for the MREC (1998) and the new recycling building (2010) did not identify significant contaminants in the soil or groundwater).
- Potential for contamination to impact the site from off site sources due to the long history of heavy industrial use in the area and current activities on adjoining sites.
- Visual and olfactory evidence of hydrocarbon contamination within the attenuation sewer adjacent the southern boundary of the site. It is thought that hydrocarbons are entering the damaged attenuation pipe from the soils and groundwater around the attenuation sewer.
- A previous investigation for the Ffordd Amazon Link Road adjacent the southern boundary (January 2010) identified five old pipelines at shallow depth running east to west. The soil and groundwater around the pipelines were observed as being contaminated with petroleum hydrocarbons. The pipelines have been recently removed as part of the construction works for the Ffordd Amazon Link Road. No details are available for what exactly was contained within the pipelines or how they were removed during construction of the access road. It is thought that the pipelines once served the BP refinery to the north and would have carried various hydrocarbon based fluids.

2.1.2 Pathways

Pathways refer to the means by which contaminants can be exposed to the susceptible receptors directly or indirectly.

The pathways by which humans can be exposed include:

- Direct dermal contact with impacted soils, free phase product and surface waters;
- Ingestion of impacted soils, free phase product and surface waters;
- Ingestion and/or inhalation of impacted fugitive dust and household dust (due to tracking back of soil from the site to residential properties);
- Inhalation of vapours (from impacted soils, free phase product and surface waters) released into ambient air;
- Inhalation of vapours (from impacted soils, free phase product and surface waters) intruding into enclosed spaces;
- Permeation of plastic water supply pipes leading to ingestion of contaminated drinking water;
- Asphyxiation due to intrusion of noxious vapours and/or gases; and
- Ignition of explosive gases and/or flammable vapours.

The pathways by which controlled waters can be exposed include:

- Soluble contaminants leaching to groundwater;
- Infiltration of hydrocarbons to groundwater;
- Migration of hydrocarbons across groundwater table;
- Migration of hydrocarbons along strata boundaries;
- Groundwater transport of soluble contaminants;
- Preferential migration of dissolved phase contaminants and/or hydrocarbons along drains, cable ducts, pipes and/or associated bedding materials.

2.1.3 Receptors

Human receptors include:

- Construction and maintenance workers;
- Existing site workers;
- Future site users; and
- Users of adjacent sites.

Controlled water receptors include:

- Tennant Canal: The site location is considered to be of low environmental sensitivity with respect to surface waters given that the Tennant Canal is located approximately 50m to the north of the site, but is a watercourse of 'poor' quality.

- Groundwater Aquifer: The environmental sensitivity of the site setting in relation to groundwater vulnerability is considered to be moderate since the site is underlain by geology classified as

a ‘Secondary A’ aquifer. The aquifer is likely to be poor quality and impacted by industrial history of the area, particularly the Gower Chemical works.

- Crymlyn Bog: The site is located approximately 200m from Cyrmlyn Bog which is designated as a Site of Special Scientific Importance (SSSI), RAMSAR site and a Special Area of Conservation. Tennant Canal is located between the site and Crymlyn Bog and is likely to prevent any significant impacts to the Bog.

- Swansea Bay could be impacted by contaminated groundwater flowing south and discharging to the bay. However, the receptor is approximately 600m from the site and has a large industrial estate between the site and the Bay.

2.2 Soils Contamination Analysis

A total of 12No. soil samples were obtained from granular Made Ground (at depths ranging from 0.8m to 4.5m) and were scheduled to be analysed for the presence of the following potential contaminants:

- Total Petroleum Hydrocarbons (TPH)
- Volatile Organic Carbons (VOC)
- Total Organic Carbon (TOC).

Full details of the ground investigation together with contamination testing results are contained in the factual report of the investigation.

The contamination assessment is based on the Contaminated Land Exposure Assessment model (CLEA) and follows the Model Procedures for the Management of Land Contamination (CLR11, Environment Agency, 2004).

A screening exercise has been undertaken by Jacobs to compare the results of contamination testing with Critical Concentrations (Cc). The Cc which have been applied are either published Soil Guideline Values (SGV) or Generic Soil Screening Values (GSSV) derived by Jacobs using CLEA v.1.06 software and its associated documentation (SR2-4).

CLEA software is consistent with current government policy on assessing land contamination and can be used to derive contaminants for which no SGV report has been published.

2.2.1 Screening Exercise – Commercial / Industrial End Use Scenario

The existing site use is considered consistent with the generic commercial land-uses specified in the Contaminated Land Exposure Assessment (CLEA) model.

Where available, Soil Guideline Values published by the Environment Agency (EA) were adopted as the Cc. Where SGVs were unavailable, published Cc were selected from authoritative reference sources (either the Chartered Institute of Environmental Health (CIEH) or the Environmental Industries Commission (EIC) where available or otherwise derived by Jacobs in accordance with the CLEA model (using CLEA Version 1.06).

There is no generic assessment criteria for a number of VOCs and a Detailed Quantitative Risk assessment would be required to derive specific criteria. In the absence of guideline values for VOCs the Limit of Detection (LOD) has been used. Were the LOD is exceeded this has been used as a guide to indicate the presence of a particular substance that may warrant further investigation.

Analysis of the soil contaminant concentrations are as follows:

a) Total Petroleum Hydrocarbon (TPH)

There were no hydrocarbon fractions detected above generic assessment criteria (Refer to Table 1 in Appendix B of the factual report).

b) Volatile Organic Compounds (VOCs)

A number of VOCs have been identified above the limit of detection in BH1, BH5, BH6, BH8 and TP3 (refer to Table 2). Concentrations of Benzo(a)pyrene (34mg/kg) and Naphthalene (239mg/kg) from TP3 also exceed the respective SGV (14mg/kg and 200mg/kg).

The presence of the VOCs in samples submitted for analysis is likely to be associated with hydrocarbon contamination. However, further assessment would be required to determine if they are likely to have any impact on identified receptors.

2.3 Groundwater Contamination Analysis

In order to assess risks to identified controlled waters receptors, a Generic Quantitative Risk Assessment (GQRA) was undertaken in accordance with the guidance presented in the Environment Agency publication “Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination” (2009) .

For the purposes of the initial risk evaluation groundwater analytical results were compared against Generic Screening Criteria herein referred to as Controlled Waters Screening Criteria (CWSC). The adopted CWSC thus, conservatively, represent the Remedial Target Concentration (RTC). The following screening assessments were undertaken in accordance with The Remedial Targets Methodology which both assume that groundwater immediately beneath the site is the receptor;

Where available, Saltwater Environmental Quality Standards (EQS) have been considered appropriate CWSC.

In the absence of EQS, UK Drinking Water Standards (DWS) have been adopted as the CWSC, however these are considered to be overly conservative for the assessment of risks to surface water and the aquifer.

Two rounds of groundwater monitoring have been undertaken with 5 No. samples taken from the boreholes on the southern boundary in each round. The samples were submitted for analysis for speciated TPH and PAH. A review of analytical results has revealed elevated concentrations of TPH in all 5 boreholes. The most significant concentrations were identified in BH5 during the first round of monitoring with Aliphatics >C12-C16 noted to be 42,400ug/l. However, it is noted that there was a significant reduction in the levels of all TPH bands in all boreholes following the second groundwater monitoring event. For example Aliphatics >C12-C16 in BH5 were found to be 2,260ug/l. This compares with a CWSC of 10ug/l (Refer Table 3, Appendix A).

The majority of individual Polyaromatic Hydrocarbons (PAHs) were identified marginally above assessment criteria in BH5 in the first round of monitoring. However, only Benzo(a)anthracene, Benzo(a)pyrene, Benzo(b)fluoranthene, Chrysene, Fluoranthene, and Pyrene were noted to be above relevant assessment criteria. In addition, levels of individual PAHs decreased significantly in the second round of monitoring. For example Benzo(a)pyrene was 18.5ug/l in the first monitoring event and 1.89 ug/l in the second monitoring event. This compares with a CSWC of 0.1ug/l.

At this stage only two rounds of groundwater monitoring and chemical analysis have been undertaken. Elevated concentrations of TPH and PAH contamination have been identified within the groundwater when compared to the relevant EQS or DQS although the values have decreased significantly in the second round of monitoring. The decreased levels of TPH and PAH could be a result of dilution associated with heavy rainfall between the two monitoring rounds. Further monitoring and assessment would be required to determine whether the levels of TPH and PAH are being influenced by the effects of dilution from rainfall, fluctuating groundwater levels and/or groundwater flow.

3 Regulatory Context

3.1 Introduction

Land contamination liabilities associated with the site will primarily be driven by regulatory requirements to undertake remedial action(s) to address contamination deemed to present unacceptable risks to human health or the wider environment. Such requirements will be dictated by the current legislative framework, as enforced by the relevant regulatory authorities: in the case of protection of human health, the Local Authority, Neath Port Talbot County Borough Council, and in the case of the aquatic environment the Environment Agency Wales (EA).

Given the above, an appreciation of the current regulatory framework and best practice guidance on land contamination assessment is fundamental to understanding the scope, objectives, and implications of the review of land contamination liabilities presented within this report.

3.2 Part 2A Environmental Protection Act 1990

Government policy for dealing with past land contamination focuses on taking action where there are "unacceptable risks to human health and the environment" based on the "suitable for use approach". This approach is carried forward into the definition of contaminated land under the regulatory regime in Sections 78A to 78YC of Part 2A of the Environmental Protection Act 1990 (as implemented by Section 57 of the Environment Act 1995).

Section 78A (2) defines Contaminated Land for the purposes of Part 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, on or under the land, that:

(a) Significant Harm is being caused or there is a significant possibility of such harm being caused; or

(b) Significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused"

"Harm" is defined in Section 78A(4) as:

> *"harm to the health of living organisms or other interference with the ecological systems of which they form part and, in the case of man, includes harm to his property."*

"Pollution of controlled waters" is defined in Section 78A(9) by reference to Part 3 (Section 104) of the Water Resources Act 1991, as:

"the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter".

In addition to the above, Part 2A creates a particular category of Contaminated Land called 'Special Sites'. For any Special Site, the Environment Agency, rather than the Local Authority becomes the enforcing authority for the purposes of the Part 2A regime.

Where entry of pollutants into controlled waters has ceased, and there is unlikely to be future entry, then the land should not be determined as 'Contaminated Land'. Under such circumstances the Environment Agency may exercise alternative powers under the Water Resources Act 1991 (as amended, December 2009) to take regulatory action.

The Local Authority and the Environment Agency have not been consulted with respect to Part 2A of the Environmental Protection Act 1990 to determine whether the site has been identified as a potential site for further investigation under this legislation. Based on the results of the current ground investigation there does not appear to be an immediate risk to human health.

3.3 Section 161 Water Resources Act 1991 (as amended)

Under this Act, the EA has powers under Sections 85 and 161 of the Water Resources Act 1991 (as amended, December 2009) (WRA) to address pollution of controlled waters. Section 85 of the Act makes it an offence to

"cause or knowingly permit
a) any poisonous, noxious or polluting matter or any solid waste matter to enter any controlled waters"

and gives the EA powers to take action to prevent or remedy pollution of controlled waters.

Under Section 161 the EA may take action:

"where it appears to the Agency that any poisonous, noxious or polluting matter or any solid waste matter is likely to enter, or to be or to have been present in, any controlled waters, the Agency shall be entitled to carry out the following works and operations"
The normal enforcement mechanism under these powers is a works notice served under Section 161A, on any person(s) who "caused or knowingly permitted" the potential pollutant to be in the place from which it is likely to enter controlled waters or to have caused or knowingly permitted a pollutant to enter controlled waters.

The powers conferred on the EA by the Act to prevent or remedy pollution of controlled waters are only exercisable where:

- the Environment Agency considers it necessary to carry out any works forthwith;
- or (after reasonable enquiry) no responsible person can be found on whom to serve a works notice.
-

The Act does not elaborate under what circumstances the Environment Agency would consider immediate action necessary (i.e. forthwith); however, a reasonable inference is that the Environment Agency would take into account the severity and predicted timescale of pollution when considering exercising their powers.

3.4 Groundwater Regulations 1998

These Regulations are intendeded to enforce the Groundwater Directive (Council Directive 80/68/EEC) and are designed to protect water resources from pollution by substances defined in two lists, List I and List II. The EA may issue a notice to anyone who is responsible for such a discharge to groundwater prohibiting it.

3.5 Environmental Permitting (England and Wales) Regulations 2010

The MREC operates under the conditions of an Environmental Permit issued under the terms of the Environmental Permitting (England and Wales) Regulations 2010. The Environmental Permitting Regime requires operators to obtain permits for some facilities, to register others as exempt and provides for ongoing supervision by the regulators. The aim of the Regime is to:

- Protect the environment so that Statutory and Government Policy environmental targets and outcomes are achieved.
- Deliver permitting and compliance with permits and certain environmental targets effectively and efficiently in a way that provides increased clarity and minimises the administrative burden on both the regulator and the operators
- Encourage regulators to promote best practice in the operation of facilities,
- Continue to fully implement European legislation.

The Phase 1 Environmental Site Assessment identified that the MREC site appears to be in compliance with its existing Environmental Permit and subsequent variations. All Environment Agency (EA) improvement notices have been implemented at the site and acknowledged by the EA.

The permitting regime requires that when the Permit is returned to the Agency the land at the permitted facility has to be returned to the quality which existed at the date on which the permit was granted.

3.6 Specific Considerations

In the context of this site, NPTCBC has three distinct and overlapping roles. These are:

- Regulator for Contaminated Land issues under Part 2A of EPA 1990,
- Permit Holder under the Environmental Permitting Regulations, and
- Landowner

There is enough evidence to assume with reasonable certainty that the hydrocarbon contamination which is present on the southern boundary of the MREC site has not come from within the MREC site and emanates from a source or sources off site. It is not clear who is responsible for this pollution and who may be considered as potentially responsible polluters in terms of Part 2A, but NPTCBC may be able to take action as a regulator to deal with this pollution. In doing so, there will be a need to consult with the Environment Agency which also has a role as regulator for controlled waters.

As a permit holder, NPTCBC may be required by the terms of the permit to notify the EA about the presence of this contamination. This may prompt the EA to take action with regard to the source of the pollution and dealing with those who are responsible.

As a landowner, NPTCBC may chose to take action under civil law to make the identified polluter remedy the situation in order to ensure that there is no additional action, and associated cost, required at the time of the surrender of the Environmental Permit, to restore land quality at the site to an acceptable condition. In this case the permit is granted and regulated by the EA.

These roles take on a further significance in the context of NPTCBC's current plan to dispose of shares in the company which operates the MREC. Discussions of the implications of the findings of this report in the context of that planned transaction fall outside the scope of this report because Jacobs is not fully aware of the status of that process.

4 Summary of Findings

The Ground investigation undertaken has confirmed the presence of hydrocarbon contamination of the ground and groundwater along the route of the former pipeline which ran in an approximate east to west direction on the southern boundary of the site. At this stage it is not possible to confirm the full lateral and vertical extent of the hydrocarbon contamination across the site and it is not known what range of chemicals may have passed through these pipelines. However, evidence from the logs appears to suggest that hydrocarbon contamination is restricted to sands where it interfaces with the groundwater along the southern boundary of the site.

Due to difficulties encountered on site with running/blown sands it was not possible to place groundwater monitoring installations in BH1, BH2 and BH3. Whilst a slight odour of contamination was noted in BH2 there were no significant concentrations recorded in the laboratory analysis for TPH or PAH at this location.

Hydrocarbon odours were noted in the boreholes (BH4 to BH9) undertaken along the access road. These odours tended to be associated with dark grey Sand identified between 1m and 2m depth below ground level. There were no excedences of TPH above assessment criteria used to assess risks to human health. Risks to human health associated with long-term exposure to TPH contamination can be discounted at this stage.

However, there were a number of VOCs noted above the limit of detection along the access road which are likely to be associated with the presence of hydrocarbon contamination.

The groundwater chemical data clearly show that groundwater on the southern boundary of the site in the vicinity of the access road is impacted by the presence of hydrocarbons. The results of the second round of monitoring show a marked decrease in recorded TPH and PAH concentrations. Further monitoring and assessment would be required to determine whether the levels of TPH and PAH are influenced by dilution effects caused by increased rainfall, fluctuating groundwater levels and/or groundwater flow.

At this stage, the analytical results indicate that there is a source of localised contamination that is impacting on controlled waters along the southern boundary of the site. The extent and location of the source has not been defined fully by this investigation. The scope of this investigation means that it has not been possible to demonstrate that identified off-site receptors (the Tennant Canal, Crymlyn Bog and the sea in Swansea Bay) are currently being impacted by hydrocarbon contamination. A Tier 3 Detailed Quantitative Risk Assessment (DQRA) would be required to consider the risk to the identified controlled water receptors and satisfy the Environment Agency that there are no significant risks to identified receptors.

5 Recommendations for Further Works

Cognisant of the regulatory context outlined in the previous section, this section recommends consideration of the following additional work and consultation.

The results have indicated the presence of shallow groundwater impacted by hydrocarbons. The results of the second round of monitoring showed a significant decrease in recorded concentrations of hydrocarbons. It is therefore recommended that groundwater monitoring is continued and further samples are collected and assessed to identify a representative level of hydrocarbons in the groundwater over an initial three month period.

The observed hydrocarbon contamination of the groundwater is known to be entering the storm water attenuation sewer which runs along the southern boundary, and is being captured by the petrol interceptor at the western end of the site. NPTCBC is proposing to undertake remedial works to the attenuation sewer and is currently looking at options.

The presence of hydrocarbon contamination in the vicinity of the sewer will need to be considered prior to any remedial works being undertaken on the sewer with particular regards to potential human health impacts during the works. This will need to be discussed with NPTCBC environmental health.

However, it is probable that the source of the hydrocarbon contamination lies outside the boundary of the MREC site and is associated with the disused pipelines which served the now closed Llandarcy Refinery. There is no apparent source of such contamination within the MREC site.

As such, the question of who is responsible for the contamination of the ground adjoining the southern boundary of the site raises itself. This may be a matter for NPTCBC to consider either in its role as regulator for contaminated land, or as owner of the MREC site where contamination appears to be migrating onto the site from an off site source.

As part of the process of considering what actions may be required, the local Environment Agency Wales groundwater / hydrogeology team should be contacted to obtain an opinion on the relative importance of the receptor groundwater bodies identified in this report (the Tennant Canal, Crymlyn Bog and the sea in Swansea Bay), their view of the hydrocarbon contamination identified within this report and the potential need to undertake further Tier 3 Detailed Quantitative Risk Assessment (DQRA) to consider the risk to the identified controlled water receptors.

References

Information has been gained from a number of sources as outlined below.

- Ordnance Survey, 1:50,000 Landranger, Sheet 170 Vale of Glamorgan and Rhondda.
- Jacobs UK Limited Ground Investigation Factual Report entitled “Materials Recovery and Energy Centre (MREC), Crymlyn Burrows, Phase 1 Environmental Site Assessment”, February 2012, Document Ref: B15974EX/12528/R4922.
- Jacobs UK Limited entitled “Materials Recovery and Energy Centre (MREC), Crymlyn Burrows, Ground Investigation Factual Report”, June 2012, Document Ref: B15974EX/12528/R4960.
- Environment Agency, Model Procedures for the Management of Land Contamination, Contaminated Land Report 11, Department for Environment Food and Rural Affairs (Defra) 2004.
- Environment Agency, “Using Science to Create a Better Place, Human Health Toxicological Assessment of Contaminants in Soil”, Science Report – Final SC050021/SR2.
- Environment Agency, “Using Science to Create a Better Place, Updated Technical Background to the CLEA Model”, Science Report: SC050021/SR3.
- Environment Agency “Remedial Targets Methodology – Hydrogeological Risk Assessment for Land Contamination”, 2009.
- The Water Resources Act 1991 as amended. HMSO

Appendix A Tables

Table 1 - Soil Analytical Results for Petroleum Hydrocarbons

Table 2 - Soil Analytical Results for VOCs

Table 3 - Groundwater Analytical Results for Petroleum Hydrocarbons

Table 4 - Groundwater Analytical Results for Polynuclear Aromatic Hydrocarbons

Table 1 Soil Analytical Results for Petroleum Hydrocarbons

			Aliphatics							Aromatics							BTEX					Phenol
			>C5-C6	>C6-C8	>C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35	>C5-C7	>C7-C8	>C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35	Benzene	Toluene	Ethylbenzene	m & p - Xylene	o - Xylene	
		No. Results	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
		No. < LOD	7	4	2	3	4	4	4	10	12	2	4	0	3	5	9	10	11	11	12	9
		HHSC	**3400**	**8300**	**2100**	**10000**	**61000**	**1600000**	**1600000**	**28000**	**59000**	**3700**	**17000**	**36000**	**28000**	**28000**	**95**	**4400**	**2800**	**3200**	**2600**	**3200**
		Ref.	CIEH*	CIEH*	CIEH*	CIEH*	CIEH*	CIEH	CIEH	CIEH*	CIEH*	CIEH*	CIEH*	CIEH*	CIEH	CIEH	SGV	SGV	SGV	SGV**	SGV	SGV
		No. > HHSC	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
		Min	0.0108	0.011	0.0192	0.0156	3.74	5.15	6.49	0.223	0	0.0156	0.018	2.63	1.33	3.8	0.369	0.00252	0.006	0.0216	0	0.205
		Max	2.4	423.0	1860.0	808.0	4240.0	2260.0	3490.0	0.4	0.0	1240.0	538.0	1180.0	1140.0	2900.0	0.4	0.0	0.0	0.0	0.0	5.8
		Mean	0.0	0.0	0.0	0.0	0.0	414.0	588.9	0.0	0.0	0.0	0.0	0.0	182.7	537.5	0.0	0.0	0.0	0.0	0.0	2.4
Sampling Location	**Stratum Sampled**	**Sample Depth (m bgl)**	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg	mg/kg
BH1		1.20-1.70	0.0108	0.0276	0.0228	0.0156	4.88	11.1	42.2	<0.01	<0.01	0.0204	<0.01	5.38	10.8	38.1	<0.01	0.006	<0.003	<0.006	<0.003	<0.2
BH2		2.00-3.00	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	3.19	<0.1	<0.1	<0.01	<0.002	<0.003	<0.006	<0.003	<0.1
BH4		2.00-3.00	<0.01	<0.01	0.0192	0.0276	18.6	51.8	112	<0.01	<0.01	0.042	0.018	22.1	34.7	141	<0.01	<0.002	0.006	0.0216	<0.003	<0.1
BH4		4.00-4.50	<0.01	<0.01	<0.01	<0.01	<0.1	<0.1	<0.1	<0.01	<0.01	<0.01	<0.01	7.48	<0.1	<0.1	<0.01	<0.002	<0.003	<0.006	<0.003	<0.1
BH5		1.80-2.00	1.19	294	911	453	4240	2260	3490	0.369	<0.2	607	302	1180	1140	2900	0.369	<0.04	<0.06	<0.12	<0.06	1.24
BH5		3.00-4.00	<0.01	0.011	0.0573	0.215	3.74	5.15	6.49	<0.01	<0.01	0.039	0.143	2.63	<0.1	<0.1	<0.01	<0.002	<0.003	<0.006	<0.003	<0.1
BH6		1.80-2.00	2.08	166	1170	704	977	787	955	0.223	<0.2	782	469	431	351	613	<0.2	<0.04	<0.06	<0.12	<0.06	0.205
BH6		3.00-4.00	<0.01	0.083	0.11	0.478	<0.1	<0.1	<0.1	<0.01	<0.01	0.0732	0.318	7.39	2.96	3.8	<0.01	<0.002	<0.003	<0.006	<0.003	<0.1
BH7		1.80-2.00	<0.01	<0.01	0.0228	0.101	<0.1	<0.1	<0.1	<0.01	<0.01	0.0156	0.0672	11.1	3.34	<0.1	<0.01	<0.002	<0.003	<0.006	<0.003	<0.1
BH8		1.70-2.00	2.42	423	1860	808	765	176	42.4	<0.2	<0.2	1240	538	407	76.5	20.2	<0.2	<0.04	<0.06	<0.12	<0.06	<0.1
BH9		1.60-2.00	<0.01	0.0135	0.0812	0.185	23.7	7.34	7.19	<0.01	<0.01	0.0541	0.123	11	1.33	<0.1	<0.01	<0.002	<0.003	<0.006	<0.003	<0.1
TP3		0.8	0.0126	0.0328	0.029	<0.01	10.6	13.6	56.1	<0.01	<0.01	0.0202	<0.01	16.2	23.7	46.4	<0.01	0.00252	<0.003	<0.006	<0.003	5.77

Legend:

10	Exceeds HHSC
<10	Less than LOD

Key:

HHSC	Screening Criteria for Human Health
LOD	Laboratory Limit of Detection
m bgl	metres below ground level
-	Not tested

Assessment Criteria References:

CIEH - 1% SOM Commercial
EIC - 1% SOM Commercial
SGV - Commercial
*above soil saturation limit
**SGV for p xylene

Table 2 Soil Analytical Results for VOCs

		Phenol	Nitrobenzene	Isophorone	Dibenzofuran	Carbazole	bis(2-Ethylhexyl) phthalate	bis(2-Chloroethoxy)methane	Azobenzene	4-Nitrophenol	4-Nitroaniline	4-Methylphenol	3-Nitroaniline	2-Nitrophenol	2,6-Dinitrotoluene	2,4-Dinitrotoluene	2,4,6-Trichlorophenol	2-Methylnaphthalene	Acenaphthylene	Acenaphthene	Anthracene	Benzo(a)anthracene	Benzo(b)fluoranthene	Benzo(k)fluoranthene	Benzo(a)pyrene	Benzo(g,h,i)perylene	Chrysene	Fluoranthene	Fluorene	Indeno(1,2,3-cd)pyrene	Phenanthrene	Pyrene	Naphthalene	Dibenz(a,h)anthracene
	No. Results	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
	No. < LOD	7	7	7	7	9	7	7	7	7	7	7	7	7	7	7	7	7	7	7	8	8	8	8	8	8	8	8	8	7	8	7	8	7	9
	n/a	**3200**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**100**	**85000000**	**530000000**	**90000**	**100000**	**140000**	**14000**	**650000**	**140000**	**23000000**	**64000000**	**60000**	**22000000**	**54000000**	**200000**	**13000**
	Ref.	SGV	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	LOD	CIEH*	CIEH	CIEH	CIEH	CIEH	CIEH	CIEH	CIEH	CIEH	CIEH*	CIEH	CIEH	CIEH	CIEH*	CIEH
	No. > HHSC	1	3	5	5	3	3	5	5	3	3	5	4	3	5	4	4	4	4	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Min	205	1690	2140	1070	707	334	2000	127	4870	196	280	639	5970	1530	2190	311	813	927	1280	507	364	181	176	241	123	500	1080	1740	131	417	829	798	384
	Max	5770.0	2440.0	3960.0	30900.0	7100.0	334.0	3020.0	177.0	4870.0	196.0	20000.0	639.0	5970.0	1940.0	2190.0	311.0	58600.0	1380.0	41100.0	15200.0	37100.0	27000.0	26300.0	34100.0	16900.0	39000.0	76900.0	22800.0	14600.0	92600.0	68200.0	239000.0	4670.0
	Mean	2405.0	2120.0	2873.3	7418.0	3903.5	334.0	2636.7	152.0	4870.0	196.0	6872.0	639.0	5970.0	1735.0	2190.0	311.0	34353.3	1098.0	9820.0	5409.3	11241.0	8087.8	7809.0	10052.8	4094.8	11770.0	24230.0	6736.0	4427.8	23939.4	20949.8	49643.6	2527.0
		µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg	µg/kg
BH1	1.20-1.70	<200	**<200**	**<200**	**1550**	**707**	**334**	**<200**	**<200**	**<200**	**<200**	**<200**	**<200**	**<200**	**<200**	**<200**	**<200**	**813**	<200	1670	3690	4150	2430	2410	3020	1530	3460	11200	2060	1510	12600	8110	798	384
BH2	2.00-3.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	211	<100	<100	<100	131	<100	<100	<100	<100
BH4	2.00-3.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
BH4	4.00-4.50	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
BH5	1.80-2.00	1240	**2440**	**3960**	**2140**	**<1000**	**<1000**	**3020**	**<1000**	**4870**	<1000	**<1000**	**<1000**	**5970**	**<1000**	**<1000**	**<1000**	**22700**	**1380**	3280	2240	3350	2740	2350	2850	1710	4120	7740	4510	1470	10900	6660	3370	<1000
BH5	3.00-4.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
BH6	1.80-2.00	205	**1690**	**2140**	**1430**	<100	<100	**2000**	**177**	<100	**196**	**336**	<100	<100	**1940**	**2190**	<100	<100	**927**	1770	507	364	181	176	241	123	500	1080	2570	<100	3180	829	2310	<100
BH6	3.00-4.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
BH7	1.80-2.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
BH8	1.70-2.00	<100	**2230**	**2520**	**1070**	<100	<100	**2890**	**127**	<100	<100	**280**	**639**	<100	**1530**	<100	**311**	**55300**	**987**	1280	<100	<100	<100	<100	<100	<100	<100	<100	1740	<100	417	<100	2740	<100
BH9	1.60-2.00	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100	<100
TP3	0.80-	**5770**	**<1000**	**<1000**	**30900**	**7100**	**<1000**	**<1000**	**<1000**	**<1000**	**<1000**	**20000**	**<1000**	**<1000**	**<1000**	**<1000**	**<1000**	**58600**	**<1000**	41100	15200	37100	27000	26300	**34100**	16900	39000	76900	22800	14600	92600	68200	**239000**	4670

Legend:

10	Exceeds HHSC
<10	Less than LOD

Key:

HHSC	Screening Criteria for Human Health
LOD	Laboratory Limit of Detection
m bgl	metres below ground level

Table 2 Soil Analytical Results for VOCs

Table 3 Groundwater Analytical Results for Petroleum Hydrocarbons

			Aliphatics							Aromatics							BTEX				
			>C5-C6	>C6-C8	>C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35	>C5-C7	>C7-C8	>C8-C10	>C10-C12	>C12-C16	>C16-C21	>C21-C35	Benzene	Toluene	Ethylbenzene	m & p - Xylene	o - Xylene
		No. Results	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12	12
		No. < LOD	8	4	3	2	0	0	0	12	12	4	3	1	0	0	12	12	12	12	12
		CWSC	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**	**10.0**
		Ref.	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS
		Min	12	23	12	39	140	152	239	0	0	29	26	204	41	153	0	0	0	0	0
		Max	30.0	175.0	583.0	1040.0	42400.0	19100.0	25900.0	0.0	0.0	388.0	690.0	12700.0	11200.0	26900.0	0.0	0.0	0.0	0.0	0.0
		Mean	0.0	0.0	0.0	0.0	0.0	5098.3	7367.8	0.0	0.0	0.0	0.0	0.0	2778.0	6970.8	0.0	0.0	0.0	0.0	0.0
Sampling Location	**Stratum Sampled**	**Sample Depth (m bgl)**	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
BH4/W1		2.70-3.48	<10	<10	**12**	**39**	**745**	**942**	**2170**	<10	<10	<10	**26**	**204**	**405**	**1310**	<7	<4	<5	<8	<3
BH5/W1		1.90-2.40	**12**	**175**	**583**	**1040**	**42400**	**19100**	**25900**	<10	<10	**388**	**690**	**12700**	**11200**	**26900**	<7	<4	<5	<8	<3
BH6/W1		1.77-2.47	**30**	**103**	**450**	**673**	**10100**	**3920**	**4860**	<10	<10	**300**	**449**	**2850**	**1600**	**2810**	<7	<4	<5	<8	<3
BH7/W1		1.40-1.96	<10	**23**	**43**	**142**	**6920**	**5740**	**10200**	<10	<10	**29**	**95**	**1440**	**3210**	**10400**	<7	<4	<5	<8	<3
BH8/W1		1.28-1.91	<10	**43**	**298**	**499**	**4370**	**736**	**838**	<10	<10	**198**	**333**	**616**	**212**	**252**	<7	<4	<5	<8	<3
BH9/W1		1.19-1.83	<10	<10	<10	<10	**140**	**152**	**239**	<10	<10	<10	<10	<10	**41**	**153**	<7	<4	<5	<8	<3
BH4/W2		2.53-3.46	<10	<10	<10	11	**174**	**241**	**594**	<10	<10	<10	<10	**113**	**161**	**544**	<7	<4	<5	<8	<3
BH5/W2		1.80-2.34	**18**	**161**	**408**	**646**	**2260**	**966**	**1220**	<10	<10	**272**	**431**	**933**	**634**	**1400**	<7	<4	<5	<8	<3
BH6/W2		1.70-2.40	**16**	**58**	**223**	**309**	**541**	**228**	**238**	<10	<10	**149**	**206**	**216**	**96**	**123**	<7	<4	<5	<8	<3
BH7/W2		1.40-1.91	<10	**22**	**49**	**124**	**686**	**432**	**648**	<10	<10	**32**	**83**	**349**	**435**	**1210**	<7	<4	<5	<8	<3
BH8/W2		1.27-1.89	<10	**37**	**270**	**348**	**3340**	**490**	**335**	<10	<10	**180**	**232**	**777**	**133**	**71**	<7	<4	<5	<8	<3
BH9/W2		1.18-1.89	<10	<10	<10	<10	**447**	**213**	**292**	<10	<10	<10	<10	**15**	**61**	**272**	<7	<4	<5	<8	<3

Legend:

10	Exceeds CWSC
<10	Less than LOD

Drinking Water Standards (DWS) based on Water Supply (Water Quality) Regulations 2000 (1989 values shown in brackets where excluded from 2000 regulations)

Freshwater Envi Screening Criteria for Human Health

Table 4 Groundwater Analytical Results for Polynuclear Aromatic Hydrocarbons

			Acenaphthene	Acenaphthylene	Anthracene	Benzo (a) anthracene	Benzo (a) pyrene	Benzo (b) fluoranthene	Benzo (ghi) perylene	Benzo (k) fluoranthene	Chrysene	Dibenzo (ah) anthracene	Fluoranthene	Fluorene	Indeno (1,2,3-cd) pyrene	Naphthalene	Phenanthrene	Pyrene
		No. Results	12	12	12	12	12	6	12	12	12	12	12	12	12	12	12	12
		No. < LOD	11	12	10	9	6	4	10	7	9	11	9	11	11	12	10	9
		CWSC	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**3.0**	**0.1**	**0.1**	**0.1**	**2.4**	**0.1**	**0.1**
		Ref.	UK DWS	UK DWS	S EQS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	UK DWS	S EQS	UK DWS	UK DWS	S EQS	UK DWS	UK DWS
		No. > CWSC	1	0	2	3	6	6	2	5	3	1	3	1	1	0	2	3
		Min	**14.3**	0	**1.23**	**2.24**	**1.39**	**1.45**	**1.07**	**13.3**	**2.89**	**3.36**	**4.91**	**23**	**8.22**	0	**4.36**	**5**
		Max	**14.3**	0.0	**12.6**	**24.3**	**18.5**	**21.1**	**9.3**	**13.3**	**28.2**	**3.4**	**51.0**	**23.0**	**8.2**	0.0	**57.4**	**44.9**
		Mean	**14.3**	0.0	**6.9**	**13.3**	**9.9**	**11.3**	**5.2**	**13.3**	**15.5**	**3.4**	**28.0**	**23.0**	**8.2**	0.0	**30.9**	**25.0**
Sampling Location	**Stratum Sampled**	**Sample Depth (m bgl)**	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l	ug/l
BH4/W1		2.70-3.48	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BH5/W1		1.90-2.40	**14.3**	<1	**12.6**	**24.3**	**18.5**	**21.1**	**9.3**	**13.3**	**28.2**	**3.36**	**51**	**23**	**8.22**	<1	**57.4**	**44.9**
BH6/W1		1.77-2.47	<1	<1	**1.23**	**2.24**	**1.39**	**1.45**	**1.07**	<1	**2.89**	<1	**4.91**	<1	<1	<1	**4.36**	**5**
BH7/W1		1.40-1.96	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BH8/W1		1.28-1.91	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BH9/W1		1.19-1.83	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BH4/W2		2.53-3.46	<1	<1	<1	<1	**1.13**	**1.21**	<1	**1.07**	<1	<1	<1	<1	<1	<1	<1	<1
BH5/W2		1.80-2.34	<1	<1	<1	**2**	**1.89**	**2.16**	<1	**1.67**	**2.08**	<1	**3.22**	<1	<1	<1	<1	**2.89**
BH6/W2		1.70-2.40	<1	<1	<1	<1	**1.12**	**1.14**	<1	**1.14**	<1	<1	<1	<1	<1	<1	<1	<1
BH7/W2		1.40-1.91	<1	<1	<1	<1	**2.42**	**2.59**	<1	**2.61**	<1	<1	<1	<1	<1	<1	<1	<1
BH8/W2		1.27-1.89	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1
BH9/W2		1.18-1.89	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1	<1

Legend:

10	Exceeds CWSC
<10	Less than LOD

Drinking Water Standards (DWS) based on Water Supply (Water Quality) Regulations 2000 (1989 values shown in brackets where excluded from 2000 regulations)

Freshwater Environmental Screening Criteria for Human Health

S EQS Saltwater EQS