Former Albright & Wilson Works, Whitehaven Cumbria

Phase II Investigations and Environmental Assessments

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EXECUTIVE SUMMARY

The principal aim of this Phase II Investigation of the Former Albright & Wilson Whitehaven facility was to develop a comprehensive understanding of the contaminated land issues associated with the site. It is proposed that the site may be destined for a recreational 'right to roam' end use. In addition, a study was undertaken to understand the issues associated with leaving the site as a "derelict" land end-use, with no public access allowed. As such, the assessments carried out by URS for this study are based upon both these proposed end uses.

Rhodia ceased operations at the site in 2001 and have since been decommissioning large areas of the site. Huntsman currently leases part of the site from Rhodia to operate its surfactants business, although operations have significantly reduced between 2005 and present. It is understood that the remaining buildings are likely to be razed to slab level as part of a decommissioning programme, although the future status of the underground utilities (including the drainage) is uncertain. Huntsman has indicated that they will continue operations in a small area of the site, around the S5 plant in the north east of the site.

The assessments carried out have drawn upon information gathered from several phases of previous site investigation carried out by URS since the mid 1990s, data provided within Huntsman's IPPC application and from correspondence and discussion with environmental regulators over the years.

The current study has comprised:

- *a desk study to characterise potential sources of contamination and identify data gaps in the conceptual site model (CSM);*
- *a targeted soil and groundwater investigation involving trial pitting, borehole drilling and shallow well installation;*
- *sampling and laboratory analysis of soils, shallow and deep groundwater and off-site surface water receptors for potential contaminants of concern;*
- *refinement of the CSM; and*
- *Tier 2/3 Quantitative Risk Assessments to evaluate potentially significant risks to human health and controlled waters receptors.*

The conclusions and recommendations from these assessments are presented below.

For the majority of the site, it is considered that sufficient soil and groundwater data exists to be able to make an initial assessment of potential environmental issues associated with the site and on the assumption that the site is be decommissioned to a recreational 'right to roam' end use. However, selected areas of the site could not be investigated in sufficient detail due to continuing Huntsman operations (e.g. the former coke works area beneath the Imidazoline Plant) and will require further investigation following cessation of Huntsman operations. Since the current investigation was mainly focussed on the collection of additional soil and shallow groundwater data, there have been no significant changes to URS' conceptual understanding of the site in terms of potential migration pathways and receptors. The principal changes to the CSM are, therefore, from the more thorough

characterisation of the potential source areas at the site. In particular, elevated concentrations of hydrocarbons in soils were detected in an area of former oil storage, immediately to the north of the Ufex Landfill, whilst high levels of surfactants in groundwater were detected across a large area of the site, in particular in the tanker washing area. Other hotspots of contamination have also been detected across the site.

Following a collation of all historic and current analytical data, Tier 3 Quantitative Risk Assessments were performed to assess potentially significant risks to Human Health and Controlled Waters receptors, based on the future end use for the site. In the case of the Human Health QRA, off-site residents and commercial users of the Tamar office facility to the north were also considered as potential receptors. The controlled waters QRA was carried out by two separate approaches: the first using a standard approach to assess potentially significant risks to the Sandwith Beck and the Irish Sea coastal waters via contaminant migration in shallow groundwater; and the second using a specially developed mass balance - dilution model to assess the deep migration pathways. The latter involved the further development of the mass balance model presented by URS to the regulators in January 2005.

Copeland Borough Council recently has recently re-identified the site, excluding the Hutbank and Ufex licensed waste disposal areas, as contaminated land and a "special site" in terms of the Environmental Protection Act1990, Part IIa (as amended) and the Contaminated Land (England) Regulations 2000 (letter of 10 May 2005 from the Council to the Company Secretary (Rhodia)). This determination has been made on the basis of potential pollutant linkages between contaminants in soil, leaching from the soil and migrating through soils, along the drainage system and through fractured strata to controlled waters. No potential significant risks to human health have been highlighted in the council's determination.

These are defined in the table below, along with the more detailed assessment of the pollutant linkages as derived from URS' quantitative risk assessment.

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
Petroleum Hydrocarbons in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*TPH contamination of soils in three locations across the site (refer to Figure 12) may result in the pollution of controlled waters and, therefore, should be remediated*
Poly Aromatic Hydrocarbons in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*Naphthalene concentrations in soils exceed the controlled water risk assessment criteria, which may require remediation. However, no observations of naphthalene in groundwater was observed suggesting that the partitioning of soil contamination to water is too conservative and that actual risks are unlikely to exist* *A number of poly-aromatic hydrocarbons in soil in the south east of the site and the tank washing area exceed human health risk assessment criteria and, therefore, may require to be remediated*

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
Surfactants in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant levels of MBAS located in soil. High levels of MBAS in groundwater considered to be associated with localised areas of leakage from drains.* *The high levels of MBAS at the Byerstead fault should decline once Huntsman cease operations. Similarly, the cessation of productions at the site will break the pollutant linkage between the site and the surface water at Bell House Gill, although in the latter the mechanisms of contaminant transport from the site to the Bell House Gill is not known*
Phosphates in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*Phosphates were measured in soils and groundwaters across the site. Levels of phosphates observed at the Byerstead fault appear to be much higher than those observed in site groundwaters, leading to the interpretation that the source of phosphate to the Byerstead spring is the site effluent drainage system. Cessation of operations should result in observable reductions of phosphate in the Byerstead spring.*
Arsenic in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from arsenic in soil impacting controlled waters identified. Similarly no risks from arsenic calculated to impact human health (on and off site workers and off site residents)*
Boron in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from boron in soil impacting controlled waters identified. Similarly no risks from boron calculated to impact human health (on and off site workers and off site residents)*
Cadmium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from cadmium in soil impacting controlled waters identified. In addition, no impacts of cadmium concentrations soil observed in shallow groundwater beneath the site. Similarly no risks from cadmium calculated to impact human health (on and off site workers and off site residents)*
Chromium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from chromium in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of chromium concentrations soil observed in shallow groundwater beneath the site Similarly no risks from chromium calculated to impact human health (on and off site workers and off site residents)*

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
Copper in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from copper in soil impacting shallow controlled waters identified over the next 200 years. Theoretical impacts through Byerstead fault to the coast simulated in the risk assessment, but not measured in practice.* *No risks from calculated to impact human health (on and off site workers and off site residents)*
Lead in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from lead in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of lead concentrations soil observed in shallow groundwater beneath the site. Similarly no risks from lead calculated to impact human health (on and off site workers and off site residents)*
Mercury in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from mercury in soil impacting controlled waters identified. .* *Mercury in soils in the north east of the site exceeds human health risk assessment criteria and, therefore, may require to be remediated*
Nickel in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from nickel in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of nickel concentrations soil observed in shallow groundwater beneath the site. Similarly no significant risks from nickel calculated to impact human health (on and off site workers and off site residents).*
Selenium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from selenium in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of selenium concentrations soil observed in shallow groundwater beneath the site. Similarly no significant risks from selenium calculated to impact human health (on and off site workers and off site residents).*
Zinc in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from zinc in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of zinc concentrations soil observed in shallow groundwater beneath the site. Similarly no significant risks from zinc calculated to impact human health (on and off site workers and off site residents).*

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
VOC's/SVOCs in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No VOC's or SVOCs in soil found to be impacting controlled waters receptors or human health.*

In summary the results of the risk assessments indicate remediation to mitigate against human health and/or controlled waters risks for the following contaminants:

- ***Mercury** in soils in the north east of the site and a number of **poly-aromatic hydrocarbons** in soil in the south east of the site and the tank washing area (theoretical human health risks);*
- ***TPH** contamination of soils in three locations across the site (refer to Figure 12, controlled waters);*
- ***Naphthalene** concentrations in soils also exceed the controlled water risk assessment criteria, and may require remediation. No observations of naphthalene in groundwater were recorded suggesting that the modelled partitioning of soil contamination to water is too conservative and that actual risks are unlikely to exist;*
- *The concentrations of **surfactants** (measured by methyl blue active substances MBAS) at the Byerstead fault should decline once Huntsman reduce operations. Similarly, the significant reduction in processes at the site will reduce the significance of the potential pollutant linkage between the site and the surface water at Bell House Gill, although in the latter the precise mechanisms of contaminant transport from the site to the Bell House Gill are not known.*

Appropriate remedial action may comprise one or more of: excavation of shallow hotspots of soil contamination and disposal of these in a suitable licensed landfill; bioremediation; soil washing and thermal desorption. Based on our analysis of the data the average volume of contaminated soil that may need to be removed is likely to be approximately 10,000 – 15,000 m^3, although this could rise considerably when new areas of the site are decommissioned and investigated (possibly as high as 50,000m^3).

Further assessment of the areas around the TPH in soils is required to establish whether the TPH has resulted in contamination of the underlying shallow groundwater. Should this prove to be the case, either a monitored natural attenuation strategy or a short term pump and treat strategy may be required.

For other contaminants observed in shallow groundwater, the contamination is considered related to above ground operations and the existing drainage system. Given that site operations are due to substantially reduce between 2005 and 2007, on-going monitoring of shallow groundwater quality is considered the most appropriate remedial action for shallow groundwater.

Similarly, it is considered that the best practical and economic approach for the management of contamination within the deep groundwater, is monitoring of the deep groundwater monitoring wells

and surface water receptors over at least the next 2-3 years. The results of the risk assessment suggest that water quality is likely to improve following cessation of on-site operations.

1. INTRODUCTION

1.1. General Introduction

URS Corporation Ltd (URS) was commissioned by Rhodia UK Ltd (Rhodia) in March 2005 to undertake a Phase II Investigation in and around the former Albright & Wilson site in Whitehaven, Cumbria. The request for these works was made following two meetings held in January and February 2005 with Dave Hodgson, Tony McGrath and Helen Stephenson of Rhodia and Alistair Wyness of URS to discuss the findings of previous work carried out at the site. A site-walkover was made by Alistair in the presence of Fred Proud and Derek Wood of Rhodia on 15 February 2005.

This report presents the findings of the current Phase II Investigation and the risk assessments undertaken using new and relevant historic data. Figure 1 shows the site location and off-site features whilst Figure 2 presents the site layout.

The investigation and reporting were completed during 2005, and in this issue of the report account has been taken of Environment Agency comments on the report issued in June 2005. This report is presented as an Appendix to the Remediation Statement for the site, which describes the remediation works that will be undertaken.

1.2. Background

The intrusive investigation and risk assessments undertaken for this study and reported herein, builds upon many years of environmental investigations carried out at the Rhodia (former Albright & Wilson) site. URS has undertaken a number of these investigations since the mid 1990s. A brief summary of the findings of these studies is presented in Section 3.2.

During this period, Rhodia's operations on the site have diminished and the phosphate business operated by Rhodia has been closed down. In recent months the majority of the buildings in which phosphate operations took place have been demolished to ground level.

The northern and central part of the site has historically comprised a deep coal mine, coke works and alabaster works (developed between the late 1800's/early 1900's (Figure 2). It was developed for the manufacture of chemicals (including firelighters, detergents and other inorganic and organic chemicals) in the 1940's. As such, there is the possibility of a large number of potential contaminants to be present beneath the site. A review of the history of the site and characterisation of potential source areas is presented in Section 2.4 of this report.

Recent on-site processes have related solely to the surfactants business. Site processes are to significantly reduce between 2005 and 2007 as the site is being decontaminated and demolished.

There are two closed landfills within the main site boundary, the Ufex and Hutbank landfills. Both of these landfills are regulated under separate Waste Management Licenses, not under the "contaminated land" regime (Part IIA of the Environmental Protection Act (EPA) 1990). The landfills are therefore not considered as part of this report.

In 2003, Tamar took over a portion of the former manufacturing area in the northern part of the site (see figure 2). This land was mainly used as offices and it is understood that Tamar have continued this usage. Tamar's land is not included within this study.

1.3. Aims and Objectives

The overall aim of both the Phase II Investigation is to develop a comprehensive understanding of the contaminated land issues relating to the site.

It should be recognised that, due to the presence of existing buildings and ongoing manufacturing operations by Huntsman, areas of the site could not be accessed and, therefore, not all of the contaminated land issues can be addressed in this report. Assessment actions within the Remediation Statement have been defined to address these data gaps. This report, however, does outline the future investigations that need to be conducted in order to close out these issues.

The detailed objectives of the Phase II Investigation are as follows:

- To define the contaminated land issues related to historical contamination of soil, groundwater and surface water, based on an assessment of the risks to human health, controlled waters and the environment;

- To define potential remediation actions, which may include further site investigations in areas that cannot be accessed until decommissioned.

1.4. Applicable Framework for Assessment

The two most relevant pieces of environmental legislation that relate to potential contamination on this site are the Water Resources Act (WRA) 1991 and Part IIA of the Environmental Protection Act (EPA) 1990. The former gives the Environment Agency the power to enforce clean-up of polluted controlled waters and the latter gives the Agency and Local Authorities the power to enforce the remediation of contaminated land. In the first instance, local authorities have a duty to act under Part IIA to assess whether land is defined as "**Contaminated Land**". Contaminated Land is defined under Section 78A (2) of the EPA 1990 as:

"any land which appears to the local authority…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) pollution of controlled waters is being, or is likely to be caused."

Part IIA prescribes a risk-based approach in determining what actions should be taken for identified contamination. Thus, any identifiable contamination should be considered within the overall context of a site's environmental setting with appropriate consideration given to the identified source(s), pathway(s) and receptors for such contamination. The end use of the site (and therefore its sensitivity), will determine the level of remediation that may be required at the site.

If the land is designated *contaminated land* as a result of pollution of controlled waters, the Local Authority will recommend that the land be considered a "**special site**", after which the site is regulated by the Environment Agency.

Whilst it is understood that there is no legal obligation under these regulations at the time of site closure or exit, it is the duty of enforcing authorities to identify "appropriate person(s)" responsible for any contamination subsequently identified and to apportion appropriate works accordingly. Without accurate information about the condition of the site at the time of site departure, the existing site occupant may become liable for contamination identified, which could potentially be unrelated to site activities undertaken during site occupation.

As part of the assessment of whether the Whitehaven site should be designated as contaminated land, the Environment Agency commissioned consultants Entec to review the potential pollutant linkages at the site in 2004[1]. The consequence of this review has been the issue of a letter from Copeland Borough Council to Rhodia (dated 10 May 2005) re-identifying the site, excluding the Hutbank and Ufex licensed waste disposal areas, as "a special site contaminated land" in terms of the Environmental Protection Act 1990, Part IIa (as amended) and the Contaminated Land (England) Regulations 2000. This determination has been made on the basis of potential pollutant linkages between contaminants in soil, leaching from the soil and migrating through soils, along the drainage system and through fractured strata to controlled waters. No potential significant risks to human health have been highlighted in the council's determination.

1.5. Scope of Works

The agreed scope of works comprised initial desk studies, site investigations, and risk assessment, as detailed below.

1.5.1. Site Investigations

Prior to site work commencing, a Health & Safety Plan was prepared. The historic data was collated into a database and a review of the history of the site was made in order to characterise source areas and identify key data gaps which required further investigation.

The site investigation was subsequently conducted which comprised:

- excavation of 26 trial pits using a JCB excavator;
- drilling of 21 shallow boreholes into the Made Ground/drift deposits using a window sampling technique. 9 of these boreholes were installed as groundwater monitoring wells to facilitate groundwater sampling. New monitoring wells were levelled to a site datum common with existing wells;
- field screening of soil samples at regular intervals by headspace analysis using a Photo Ionisation Detector (PID), recording of visual observations of contamination and geological logging;
- selection and submission of soil samples for laboratory analysis;
- purging and sampling of groundwater from 3 existing and 6 new shallow monitoring wells installed at the site, together with sampling of the five deep monitoring wells. Field measurements of pH, EC and temperature were made during purging and sampling;
- sampling of key surface water receptors in the vicinity of the site as part of an ongoing sampling programme. These included Sandwith Beck (two locations), the Byerstead Fault and Bellhouse Gill;
- submission of groundwater and surface water samples for laboratory analysis.

1.5.2. Assessment of Risks to Human Health, Controlled Waters and the Environment

The risk assessment methodology adopted herein is considered to represent current best practice in the UK, which is based on a tiered approach in order to evaluate whether or not the concentrations of the compounds of potential concern pose a significant risk to identified receptors from which the site could be classified as Contaminated Land under Part IIa of the EPA 1990 and to determine the level of clean-up required to render the site suitable for its proposed end use.

A refined conceptual model has been produced using the additional desk study, geological and hydrogeological information obtained. This includes any relevant information gathered during the drainage assessments and an assessment of plausible human health pathways and receptors based on the future proposed land use. All significant pollutant linkages (source, pathway, receptor relationships) have been identified and risk assessments carried out (see below).

The risks to human health have been assessed using UK best practice and a methodology which is compliant with current legislation and guidance documents, in

[1] Appended to a letter to Tony McGrath of Rhodia from Environment Agency (Ref: PB/EMNC37/E176.4.99/HO) dated 21 May 2004.

particular the three stage process defined in CLR11 "Model Procedures for the Management of Land Contamination" (Environment Agency, September 2004).

The results of the Human Health Risk Assessment have been used as part of the assessment of remediation options and the assessment of the contaminated land issues.

Controlled Waters

Due to the complex geology and hydrogeology beneath the site, the Agency has previously agreed with URS' earlier views that a 'standard' controlled waters risk assessment approach would not adequately characterise the complexities of the site. The evaluation of potentially significant risks to controlled water bodies was commenced by URS in late 2004 with the development of an initial approach based on a mass balance model. This was presented to Rhodia[2] and subsequently to the Environment Agency in January/February 2005.

The scope of works for this current assessment comprises full testing of this model, including sensitivity analysis to ensure that the model will withstand the scrutiny of the Environment Agency. This has included an assessment of different levels of contaminant storage in the deeper aquifers, anhydrite and coal mines to establish more accurately the source of the contamination at the Byerstead Fault. The model has also been extended to include an assessment of risk from any residual hotspots of soil contamination, observed from the shallow intrusive works and sampling.

Prior to this study, the model had been set up to assess the risks from shallow and deep groundwater contamination at the Byerstead fault. The model has now been further developed to include the potential pollutant linkages to the other surface water receptors: the coast, the Sandwith Beck and the Bell House Gill.

Following development, testing and incorporation of any changes to the conceptual understanding of the contaminant-groundwater flow mechanisms and pollutant linkages, the model has been used to assess the risks to controlled waters from the residual contamination of the soils and shallow groundwater.

As the January 2005 report indicates, the risks at the Byerstead fault are generally related to residual groundwater contamination, and in general, exceed appropriate water target values. It is anticipated that this assessment, using the most up-to-date data, will continue to show that water quality criteria continue to be exceeded. With a cessation of the majority of site processes, there is anticipated to be a decline in the concentrations at the fault. The model will be used to demonstrate this. However, the proof will be through the continued monitoring of the deep aquifer and the receptors, although the remedial options appraisal/ will be used to demonstrate that this is the most appropriate remedial approach.

[2] "*Further Monitoring Works and Risk Assessment Approach for the Environment Agency",* 21 January 2005, Draft Issue No 2, reference 44557-045-787 / R1771-B02

1.5.3. Assessment of Remedial Requirements and Contaminated Land Issues

An assessment of various remedial options has been made following the findings of the risk assessments. Prior to undertaking this assessment it was considered that the remedial options are likely to be limited for the deeper aquifer system, where the most likely remedial approach will be monitoring of the deep aquifer and the receptors. The same applies to shallow groundwater contamination, where the main risk driver is the contamination of controlled waters at the Byerstead fault. However, where human health risks have been identified from shallow soils and groundwater, additional remediation strategies have been reviewed.

The remedial assessment has also included the following:

- remedial options for the shallow soils and groundwater across the site, including an assessment of the further sampling and potential remediation that may be required for areas that could not be assessed during these studies (e.g. the coke works);

- remedial options for the deeper aquifer system, which as noted earlier, will centre round negotiation with the Environment Agency and continued monitoring

1.5.4. Structure of the Report

This report has been split into a number of sections and appendices as follows:

- **Section 2 Regional Environmental Setting and Source Characterisation**, where the hydrology, geology and hydrogeology of the Whitehaven area is described along with a review of historical land use and above ground processes at the site in order to assess the potential contaminant sources.

- **Section 3 Site Investigations**, where details of previous investigations and the result of the investigations commissioned for this Phase II assessment are presented. This section is supported by Appendix A (Borehole and Trial Pit Logs) and Appendix B (Analytical Results and comparison with Tier 1 Screening Criteria).

- **Section 4 Conceptual Site Model and Potential Pollutant Linkages,** where the key pollutant linkages are defined on the basis of our understanding of the fate and transport of chemicals in soil and groundwater at the site.

- **Section 5 Risk Assessment**, where the assessment of potential risks to human health and controlled waters receptors is summarised. This is supported by two detailed appendices: Appendix C on Human Health and Appendix D on Controlled Waters.

- **Section 6 Mine shaft inspection**

- **Section 7 Conclusions and Recommendations**

2. REGIONAL ENVIRONMENTAL SETTING AND SOURCE CHARACTERISATION

2.1. Location

The site is located in the northwest of England on the Cumbrian coast approximately two kilometres south of the town of Whitehaven, grid reference 296640, 515850 and covers an area of approximately 54 hectares (Figure 1). To the south and southwest the site is bordered by agricultural land mainly used for sheep and cattle grazing. To the west and northwest of the site, where the site is at its shortest distance from the coast, the land is either agricultural land or is open to the public. Immediately to the north of the site is a former area of the Rhodia site which has been recently sold to Tamar, who will use the land as offices. The residential area of Woodhouse borders the site to the northeast.

2.2. Hydrology

There is one surface water feature on the main site. This is a pond located in the southern part of the site, adjacent to the Ufex Landfill (Figure 2), which is currently being extended for use as a storm water storage pond to alleviate flooding. This pond was previously used to store leachate from the Ufex landfill, and removal of contaminated bottom sediments have formed part of the construction process. Rhodia are planning to construct a second pond to increase water storage capacity, which will be connected by an underground pipe to the first pond. Both ponds will discharge to the Sandwith Beck to the south of the site under a discharge consent.

A number of small watercourses are present in the surrounding area. Immediately outside but adjoining the site boundary lies Sandwith Beck, which issues at NGR NX967154 and flows in a generally south to south-south-east direction (Figure 1). The watercourse passes through the village of Sandwith and Rottingham, where it meets with Thorney Beck, and from there it flows towards the sea at St. Bees as Rottingham Beck. In addition to Sandwith Beck, 500m to the south-east of the site a tributary of Pow Beck drains eastwards towards a reservoir, which lies to the south of Mirehouse West. 500m further on lies Bell House Gill, where a second tributary issues to flow in a north-easterly direction, meeting up with Pow Beck to flow into Stanley Pond and from there southwestwards along the Whitehaven-St. Bees valley towards St. Bees and the Irish Sea.

Historical maps indicate that a stream ran across the centre of the site in a north south orientation prior to development of the site, following the line of lowest topography. This extended towards the current source of Sandwith Beck suggesting historically that the Beck had its source on the site itself.

At the location it issues on the southern boundary of the site Sandwith Beck has a catchment area of approximately 0.65km^2. The catchment has an annual average rainfall of approximately 1070mm and baseflow, the proportion of river flow provided by groundwater, is estimated as 82% indicating that groundwater contributes a considerable proportion of the average flow in this watercourse. The catchment does not receive

runoff from the entire site as part of the northern area is understood to direct runoff towards the north. The existing site drainage system also removes water towards the north, discharging through a pipe into the Irish Sea under a discharge consent.

The effect of the surface topography is that there is a drainage divide running approximately east-west. The northern portion of the site drains towards the central line and then north towards the Irish Sea. The southern portion drains toward the central line, then south towards Sandwith Beck.

2.3. Geology and Hydrogeology

The geology and hydrogeology of the Rhodia site is complex. This is largely due to the faulting of a sequence of geological units with distinctly different characteristics that has been further complicated by anthropogenic influences including site processes (particularly relating to the use of acid) and former anhydrite and coal mining (shafts, adits, abandoned workings).

Figure 3 presents the geology of the site and surrounding area, including principal faults. Figures 4 to 9 present cross sections through the site, developed by URS during previous investigations. Figure 10 presents the shallow groundwater contours from measurements taken during the current investigation and supplemented by our understanding of the shallow groundwater regime from previous investigations. Groundwater elevations from the deep monitoring wells are also presented on this figure.

Figure 10 shows that shallow groundwater is affected by a similar flow divide to the surface water. Shallow groundwater flows from both east and west towards the central line of the site. In the northern part, flow turns north towards the Irish Sea, and in the southern part flow turns south towards Sandwith Beck.

Deep groundwater flow is very complicated and not well understood, however in general terms it appears to move westwards towards the Irish Sea. Some rapid pathways appear to be present through faults, dissolution features, shafts and adits, and these result in rapid movement of groundwater from the site to the coast.

The stratigraphic sequence for the geology beneath the site (including man-made ground) and the geological and hydrogeological characteristics derived from published sources of information, previous and current intrusive investigations are presented in the table overleaf (youngest strata first):

Table 2.1: Geological and Hydrogeological Characteristics						
Period	**Group**	**Formation**	**General Description**	**Approximate Thickness/Dip/ Outcrop of Beds**	**Aquifer Status**	**Hydrogeological Characteristics**
N/a	N/a	N/a	Made Ground - Heterogeneous matrix consisting of silts, sands, gravels coal fill, reworked clay, brick fragments, clinker, slag, soft amorphous powders and sulphurous salts and black fused ash	Generally present over majority of main site. Average thickness of 1.1m, though depths vary between 0.2m and 4.2m bgl	Not applicable	Generally granular fill considered to promote preferential groundwater flow both vertically and horizontally.
						Shallow perched groundwater interpreted to flow in a general westerly direction but influenced by underground features such as foundations. No continuous water table appears to exist.
Quaternary	West Cumbria Drift Group		Glacial tills (Boulder Clay), Observed as a soft to firm clay (occasionally peaty) with varying amounts of sand and silt	Typically 0.2m bgl to over 5 m bgl, Clay thickest along central area of western boundary and northern site perimeter but thinner towards the east. Encountered over at least 80% of site, absent in western and some eastern parts of the site.	Not classified. Normally regarded as a low permeability drift deposit	Low permeability, likely to retard vertical migration though sand and silt horizons may encourage horizontal migration.
						Groundwater flow directions are strongly influenced by underground services and structures (foundations). Typically flows towards topographic low in centre of site, then either north or south dependant on groundwater divide. No continuous water table appears to exist.

Table 2.1: Geological and Hydrogeological Characteristics						
Period	**Group**	**Formation**	**General Description**	**Approximate Thickness/Dip/ Outcrop of Beds**	**Aquifer Status**	**Hydrogeological Characteristics**
Triassic	Sherwood Sandstone	St Bees Sandstone	Fine-grained, medium to thickly bedded sandstone with interbedded shales.	Dips 5-10° to the south west. Not present beneath site, except for extreme western edge of site (Hutbank Landfill). Outcrops on land immediately west of main site. (See sections A-A' and E-E').	Major aquifer though may have a low intergranular permeability that is influenced by fracturing and presence of mudstone bands	Overlies the lower permeability St. Bees shale and, therefore, vertically infiltrating rainwater is likely to preferentially migrate horizontally within this unit towards the south west rather than vertically into underlying strata.
Permian	Cumbrian Coast Group	St Bees Shales	Massive and laminated siltstone and very fine grained sandstone with subordinate claystones and anhydrite according to the BGS 1:10,000 sheet. Anhydrite not observed in BH201, in which grey, brown and red-purple shales were observed.	Dips 5-10° to the south west. Outcrops on western and south western parts of main site, providing a base for the Hutbank landfill (Section E-E') and the southern half of the Ufex landfill. Also outcrops on coastline to west of main site. Variable in thickness due to faulting, but typically 40-100m thick (Section A-A' and B-B').	Non-aquifer	Vertical infiltration of rainwater through St. Bees Sandstone considered to be discouraged upon reaching St. Bees Shales. Impervious nature of shales likely to encourage preferential horizontal flow down dip (south-westwards) towards the Byerstead Fault.
			Found to contain approximately 12% calcium carbonate in a sample from a nearby quarry (Ground Engineering Ltd, 1965)			Vertical migration of groundwater via fractures considered to be a minor flow component only.
						Horizontal flow potentially encouraged by dissolution of horizons enriched in calcium carbonate.

Table 2.1: Geological and Hydrogeological Characteristics						
Period	**Group**	**Formation**	**General Description**	**Approximate Thickness/Dip/ Outcrop of Beds**	**Aquifer Status**	**Hydrogeological Characteristics**
		St Bees Evaporites	Anhydrite and/or gypsum, with subordinate dolomite and siltstone, interbedded in cyclical sequences. Based on logs from Anhydrite mine, limestone may form basal lithology.	Dips 5-10° to the south west. Outcrops over majority of site, except for northern tip and west/south west where St Bees Shales outcrop. In east of site limestone/dolomite and siltstones present. Anhydrite mined to west of site (accessed via shaft from southwest corner of site) where limestone appears to form basal unit. Thus outcrop in eastern part of site likely to represent basal section of evaporite sequence. Typically 15-20m thick, but less at outcrop. Natural dissolution features likely to have been enhanced by acid leakage historically from site.	Classified as a non-aquifer	Considered as having negligible intergranular permeability but a large bulk hydraulic conductivity due to presence of dissolution features and possible karstic conditions. Fracturing may produce pathways of much higher permeability and may control vertical flow between units, further complicated by mining adits, which pass through the less permeable St Bees Shale. Groundwater is likely to be sourced from vertically infiltrating rainwater, together with a less significant input from the glacial tills and St Bees Shale. Packer test conducted on BH201 (2002) indicated a hydraulic conductivity of 2.5m/day (less than the 6-30km/day flow from site to Byerstead spring previously inferred from tracer tests). Flow is considered to be largely channelised and is likely to present the key pathway for site-derived contamination at the Byerstead Fault.

Table 2.1: Geological and Hydrogeological Characteristics						
Period	**Group**	**Formation**	**General Description**	**Approximate Thickness/Dip/ Outcrop of Beds**	**Aquifer Status**	**Hydrogeological Characteristics**
	Appleby Group	Brockram	Coarse, poorly bedded, poorly to moderately sorted, generally massive, matrix or clast support breccias that are considered to be moderately well cemented.	Dips 5-10° to the south west as with overlying beds. Rests unconformably on Upper Carboniferous. Typically only 1-2m thick. Outcrops in a very narrow east west band in northern part of site (approximately from WS108 to BH204), and close to boundary with Tamar. Also anticipated to outcrop beneath car parks (eastern boundary) and lorry park. Present at depth over majority of site beneath St Bees Evaporites	Considered as an aquitard in previous Entec study, although classified as a major aquifer according to Agency Groundwater Vulnerability Map.	Considered to act as a barrier to vertical flow, except in areas of fracturing: may therefore prevent vertical flow into the underlying Whitehaven Sandstone where not faulted.
Upper Carboniferous	Coal Measures	Whitehaven Sandstone Formation	Generally massively bedded red sandstones and siltstones, with some minor interbeds of limestone	Dips 5-15° to the northwest. Outcrops to the north of the Brockram, close to the site boundary with Tamar, and to north west and east of site. Present at depth over majority of site (encountered in BH202 deep, 203 & 204). Thickness variable due to	Classified as a Minor Aquifer according to Agency Groundwater Vulnerability Map.	Water levels in BH202D, 203 & 204 indicate flow towards west and is unconfined. Apparent steep hydraulic gradient measured in previous studies may be due to a fault separating BH202 from other wells. Sandstone may act as both a receptor for site derived contamination as well as a source for Byerstead (see CSM).

Table 2.1: Geological and Hydrogeological Characteristics						
Period	**Group**	**Formation**	**General Description**	**Approximate Thickness/Dip/ Outcrop of Beds**	**Aquifer Status**	**Hydrogeological Characteristics**
				faulting and unconformities above and below, but estimated at 10-50m. Mine adits and shafts penetrate this unit.		The EA & Entec consider that the unsaturated nature of the sandstone may indicate limited connection (or recharge from) overlying St Bees Evaporites; unit may be recharged from the east and the Brockram could be acting as an effective aquitard. The Agency also consider that drainage by adits (e.g. McCourts adit) installed to lower heads to protect coal mining in the MCM may have caused a lowering of water levels in sandstone.
		Middle Coal Measures (MCM)	Multi-cyclic sequence of sandstones, siltstones, mudstones, seatearth and coal seams.	Dips 5-15° to the northwest. Only outcrops in eastern part of lorry park. Present at depth beneath site and encountered in BH101. Truncated by a series of north west trending normal faults. Coal seams worked at 150-200m below site. MCM strata several hundred metres in thickness.	Classified as a minor aquifer according to the Agency groundwater vulnerability map.	Likely to form a multi-layered aquifer with zones of high and low horizontal hydraulic conductivity formed by fractured sandstones and shales. Numerous north west trending faults likely to significantly influence horizontal and vertical flow. Groundwater level reportedly at –178m AOD in 1977 prior to infilling of the shaft. Vertical and horizontal pathways likely to exist via boring of shafts and working of coal seams.

Faulting

Numerous faults transect the site and surrounding area (illustrated in Figure 3 and the cross sections in Figures 4 to 9). The two key faults considered to have an influence on contaminant migration are the Byerstead Fault and the 'North-South' Fault. Both of these faults dissect the entire geological sequence described above and their key attributes are as follows:

Byerstead Fault:

- Trends in an approximate south east to north westerly direction with the downthrown side to the southwest. A displacement of approximately 100m has reportedly been recorded in the Carboniferous Coal Seams, however displacement in the overlying Permo-Triassic is thought to be less and is understood to be a few tens of metres at the coast;
- Branches into two from a single strand at two locations; the distance between the splays is narrower at the coast than towards Sandwith;
- Located less than 100m from the south-western site boundary at its closest point;
- Associated with this large normal fault may be a zone of extensive fracturing and smaller subsidiary faults;
- Considered a pathway for the historic presence of site process waters on beach at the Byerstead Spring, approximately 800m south west of site;
- Likely to channel flow horizontally and also vertically between units of significant pressure difference;
- Intersected by two anhydrite mine drifts;
- Intersected at approximately 109m below Ordnance Datum by service road tunnelled from Ladysmith shaft (centre of site) to workings beneath Sandwith;
- Considered to act as a zone of enhanced permeability when considering reported inflows into anhydrite mine at its intersection with the fault and the presence of rust coloured waters close to the beach following coal mine closure and consequent flooding in 1933; and
- The cross section parallel to fault presented as Figure 9.

North-South Fault:

- Dissects the south-western margin of the site and trends in a south-south-easterly to north-northwesterly direction;

- Eastern side estimated to be downthrown between 10m and 20m, bringing the St. Bees Shales into contact with St. Bees Evaporites and potentially the Whitehaven Sandstone into contact with the St. Bees Evaporites;

- Not considered to act as a vertical barrier to horizontal flow from east to west; fault would otherwise disrupt horizontal flow hence fast travel times of site effluent to Byerstead Spring might not be recorded;

- Connects to the Byerstead Fault less than 200m south of the southern site boundary according to BGS 1:10,000 map;

- May encourage vertical flow from shallower (and hence potentially more contaminated) more permeable horizons (particularly the karst-fracture system in the St Bees Evaporites) to short circuit underlying less permeable horizons (namely the Brockram). Surfactants have been detected in the St Bees Evaporites and the Whitehaven Sandstone on the downthrown (eastern) side in May 2004 (BH202 shallow and deep), August 2004 (BH202 deep) and November 2004 (BH202 shallow) (results presented in Appendix B); and

- The Agency/Entec consider that the unconfined nature of the Whitehaven Sandstone aquifer may relate either to the aquifer's low permeability or to the low permeability of the north-south fault plane or low permeability strata abutting the sandstone across the fault.

2.4. Source Characterisation

2.4.1. Site history

Information pertaining to the history of the site was obtained from Historical Ordnance Survey (OS) maps provided as part of the Envirocheck report from Landmark Information Group Ltd (Ref: 9786741-1-2, dated 21 March 2005). This included 1:10,000 scale maps (1979, 1988, 1993, 2000)' 1:10,560 scale maps (1867, 1900, 1926, 1938, 1957, 1968, 1967) and 1:2,500 scale maps (1863, 1865, 1877, 1879, 1899, 1925, 1938, 1962, 1961, 1968,1964, 1974, 1976). Evidence was also obtained from an Entec report (REF: Review of Documentary Information at the Former Albright & Wilson Works, Whitehaven, Cumbria, dated 14th April 2004). Information on the site history has also been supplied by Rhodia.

Site development

The history of the development of the site and the surrounding area has been established from a review of historical maps and is presented below. It should be noted that the publication date of maps may sometimes be several years later than the date surveyed and in some cases, dates may therefore be approximate. Figure 2 presents the location of many of the historic land uses described.

Mid 1800's Quarrying of the St. Bees Sandstone and St. Bees Shale.

1863-77 The earliest map available shows most of the land was used for agriculture. There is evidence of coal mining in the form of the Croft Pit (296480, 515850) and the Wilson Pit (296890, 515250). The Croft Pit is located centrally in the northern half of what would be the present day site and has an associated mineral railway running northward. The Croft Shaft was sunk in 1775. The Wilson Pit is located in the southwest of the site very close to the site boundary. Sandwith Beck is marked on the map with its source just inside the southern site boundary.

1900 By 1900 the Croft Pit has developed and there is now a second mineral railway servicing the pit that runs eastwards to join the main railway line. Barrowmouth Alabaster Works (296450, 516020) has also been established in the north westerly part of the site, approximately 150m from the western site boundary.

1900 The Ladysmith Shaft was sunk in 1900. It is likely, but not known, that Croft Pit had closed before Ladysmith Pit opened.

1912 Coke production at Ladysmith commenced

1925/26 Ladysmith Pit has now expanded substantially with more buildings present on site. Extra branches from the second mineral railway have been constructed to service the pit. No industrial development has taken place on the southern part of the site, which remains agricultural.

1932 Small tar distillation plant operating onsite (only operated for a short period of time).

1938 Within the site boundary there has been no discernible change to industry or land use. Coke production ceased in the Ladysmith Pit.

1939 Site purchased by Marchon Products.

1943 Firelighter production began on site.

1944 Detergent production onsite began.

1951 Production of phosphoric acid and sodium tripolyphosphate (STPP) began.

1954 Fatty alcohol production began, plant used for the production of lauryl sulphate.

1955 Anhydrite mine opened. Site acquired by Albright and Wilson.

1957/62 The site has undergone major development sometime between 1938 and 1962 with the disappearance of the Ladysmith Pit during this period and the establishment of what appears to be a more chemically based industry. The mineral railway is still present and numerous buildings and liquid/gas storage containers (circular features on the map) have been erected in the northern half of the site. The southern half of the site, previously used for agriculture, is now heavily populated with works buildings and liquid/gas storage containers. Electricity pylons are marked with the electricity line terminating at a substation in the west of the site.

1968-76 The maps from this time show more buildings on the southern half of the site. An anhydrite quarry is marked close to the western site boundary. The buildings are now marked Chemical Works. There are several cooling towers in the southwest of the site and a nearby chimney and electrical substation. Anhydrite mine closed in 1975.

1977 Ladysmith Shaft and Croft Shaft filled with variable proportions of cement clinker, building rubble, and colliery refuse.

1979 The majority of the site has not changed. A large building and a few smaller buildings are present adjacent to the southeast corner of the site.

1987 Anhydrite mine sealed.

1994 Sodium lauryl sulphate plant closed.

1995 Phosphoric acid production ceased.

1997 Sulphuric acid plant closed.

2000 Several tank farms are present especially in the northern half of the site and a larger number of smaller buildings have appeared in the northern half of the site. Buildings that were present in the southwest corner have now been removed. A landfill occupies the most southerly part of the site and a playing field is located directly north of this (occupying the northern part of the Ufex landfill).

2001 Phosphate production ceased on 21st December 2001, Rhodia ceased all production on site.

2002 Rhodia commenced clean up operations on the site.

2003 Tamar acquires northern portion of the site

Historical development of Surrounding Area

1863-77 To the west of the site footprint there is a Tile Works (297500, 515430) and the Moss pit (297370, 515250). The Moss Pit is marked Old Coalpit. There is an old quarry approximately 175m southwest of the Moss Pit. The Sandwith Beck is marked, running southwards from the site. Kells pit is marked as an Old Coalpit approximately 200m north of the most northern point of the site boundary.

1900 Reservoirs (297020, 515800) and a spring (297230, 515430) are marked on the map at this time to the east of the site. The Tile Works is no longer shown and the area is marked as an Old Clay Pit. Barrowmouth Gypsum mine is operating near the coast (295820, 515620). Several quarries exist to the west of the site near the coastline. A feature that was unidentified in the 1863 map, approximately 150m to the west of the site (297020, 515800) is identified as reservoirs. A large rectangular feature marked Kells (200mx150m) is present about 100m north of the Kells pit.

1925/26 The spring and the Old Clay Pit to the east of the site are no longer marked on the map. The rectangular feature at Kells is marked as an institution. Barrowmouth Alabaster Works, Ashbank Quarry and the gypsum mine are now marked as disused. The Wilson Pit has Old Shaft marked next to it.

1938 The residential areas of Woodhouse and Greenbank have greatly expanded to the east of the site footprint. On the coast to the northwest of the site the land is being used as a rifle range.

1957/62 Electricity pylons are running in a northwest-southeast direction just north of Sandwith Ward. The rifle range is no longer marked on the map. A school is present approximately 150m north of the site and also a recreation ground approximately 200m to the east of the school.

1968/76 The village of Mirehouse West has been developed approximately 700m to the east of the site boundary. Fairview Poultry Farm is present 500m south of the site. The reservoir to the east of the site is now shaded which may indicate that it has been infilled or drained.

1979 A large building and a few smaller buildings are present immediately to the southeast of the site in the area that is now the truckwash.

2000 The Wilson Pit road has been straightened just off the southeast corner of the site. No other discernible off site changes have taken place.

2.4.2. Source Characterisation

Industrial use of the site has been varied and includes coal and gypsum mining, firelighter manufacture, detergent production, sulphuric acid production, phosphate production, surfactant and emulsifier production and fatty alcohol production. Marchon products owned the site from 1939 and were acquired by Albright and Wilson in 1955.

Following a review of historical maps, the 2004 Entec Report, and other information obtained by URS from Rhodia and public record searches, an attempt has been made to characterise potential source areas on the site based on historical and current land use.

This has then been used to identify data gaps and guide the sampling strategy for the Phase II Investigation.

The site has been subdivided into ten 'zones', which represent different activities and processes. Some zones have been used over the years for several different land uses and there is some overlap between the uses (Figure 2).

BS10175: 2001 (Investigation of Potentially Contaminated Sites- Code of Practice) was followed when designing the scope of this investigation. Section 4.1 (paragraph 4) of this document states the following:

" The objectives of a site investigation vary, depending upon the stage in the process that has been reached, and the underlying intentions for the land involved. Objectives may for example be to:

- *define or clarify a conceptual model;*
- *support a risk assessment;*
- *provide data for the design of remedial works;*
- *benchmark the contamination status of a site."*

The driver for this investigation was to gain an understanding of the contaminated land issues relating to the site, whilst addressing components of Part IIa of the Environmental Protection Act 1990. The objectives include improvement of the CSM, supporting risk assessment to evaluate pollutant linkages, and providing data to inform preliminary assessment of remedial requirements. Further investigations will be required to address the exact scope of any potential remedial works for the site. In BS10175 terms, the objectives fall primarily into the first two categories. It is expected that additional data will be required in order to design remedial works.

The number and positioning of the boreholes and trial pits within the March 2005 works was based on a number of factors, as described below.

1. Previous Works

A substantial volume of data on was available from previous projects for the site. This included four intrusive investigations and two environmental audits, and therefore a reasonable amount of soil and groundwater quality data was already available. A good level of detail on the historic activities and their locations was also available.

From this URS could obtain a well-informed understanding as to which areas of site were most likely to be impacted by contamination. Because of this relatively large amount of background information, a targeted sampling strategy was selected in preference to a grid pattern. This allowed us to focus on areas where contamination was expected, and

on areas where contamination had previously been detected, and to fill in gaps in sampling coverage. This was judged a more reliable means than a grid to detect areas of contamination.

2. Access to proposed areas of investigation

Given that most of the site had yet to be demolished, it was not possible to perform intrusive works in some areas (under storage tanks and in production areas). These areas have the potential to contain impacted soil and groundwater. Further investigation will be required in these areas once the site has been demolished.

3. Proposed use of site

The proposed site use (public open space) covers the entire area. There are no areas particularly identified as likely to attract more intensive use than any others. The requirement to understand contaminant distribution in specific areas is therefore much less than it would be in a use such as residential development with gardens.

The Whitehaven site is also very large, covering over 50 hectares. As described in Section 7.6.2.5 of BS10175: 2001 *"Lower density sample locations may be acceptable on large sites, subject to the chosen spacing providing adequate data and being consistent with the objectives of the investigation".*

The sampling density required for a project is subject to the objectives of that investigation. The higher sampling densities (i.e. 10m centres) are used when a high level of confidence is required (for example, when the site is destined for a residential end use), or when a very detailed spatial understanding is required in order to design remediation.

The sampling densities for 10, 25, 50 and 100m centres are presented below:

Sampling Grid	Number of samples required (per hectare)
10m centres	100
25m centres	16
50m centres	4
100m centres	1

Based on the rationale described above, it is considered appropriate at this stage of the assessment to aim for an average sampling density of approximately 4 samples per hectare (i.e. equivalent to a 50m grid) across the majority of the site. Higher densities are proposed in some areas where contamination is more likely, and/or where the contaminant distribution is likely to be complicated. The sampling strategy is targeted within zones to focus on locations that are most likely to be contaminated, and the exact density is therefore variable. It is neither necessary nor appropriate to adhere precisely to the target in every area – it is a guide, not a specification.

A sampling density for each zone was calculated, and is presented in Table 2.2.

On a number of occasions, the sampling density achieved was less than that proposed. This was due to problems encountered during the site investigation (generally associated with drilling refusals and ongoing site operations). The sample densities range from zero samples/hectare (where access was not possible) to 283 samples/hectare (where a targeted investigation had been conducted in Zone 1).

When target sampling densities were not achievable, 'future actions' were proposed. These stipulate the requirement for future intrusive works to be conducted within individual zone, allowing any uncertainties to be reduced to an acceptable level. Zones requiring future investigation are identified in Table 2.2.

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
-	Former Ladysmith Pit	Former pit, railway lines/sidings, coking works, rock store, dry and wet salts storage (south only). Currently occupied in part by Imidazoline plant, CAPB plant and surfactant smoothing chambers	Historic coke works contaminants (e.g. PAHs, cyanide, sulphate, pH), Former chemical processing – inorganics, Current – surfactants, inorganics, (caustic) imidazoline, acetic acid	7- SB4, WS114, WS115, WS165, WS119, WS134, WS133 (no sample taken from WS118)	11- WS405, WS406, WS419, WS420, TP504, TP505, TP506, TP507, TP508, TP524, TP525	8 - WS406, WS420, TP505, TP506, TP507, TP508, TP524, TP525	15	5.08	3.0	3.5	Coke works extended beneath Imidazoline plant (access denied – currently operational). Additional sampling to be conducted after decommisioning, also to include area around cathedral.
				17- TP 1 to TP17 South end of coke works subject to focused trial pit investigation in 2003 (sampling density calculated separately)	0- not required, sampling considered adequate	0- not required, sampling considered adequate	17	0.06	283	283	Focused Investigation already completed. No further investigation planned.
?	Former Alabaster Works	Former alabaster works, some rail lines. Not used significantly for manufacturing East part of zone occupied by surfactant smoothing	Historic - limited from alabaster works. Potential from rail lines (e.g. TPH, PCBs, PAHs). Potential release of general site effluent from drains prior to repairs.	4- SB9, WS120, WS121, WS122	2- WS402, WS401	1- WS402 (no sample taken from WS401)	5	1.57	3.2	3.8	Extra sampling required around naphthalene contaminated area

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
		chambers, underground pipes and off-site discharge point (to sea)	Current/recent – surfactants if problems with drainage or overflow at off-site discharge point.								
3	Surfactants processing area	Historic and current use for surfactant manufacture. Perfume building. General stores. Majority of zone currently occupied by Huntsman	Surfactants, ammonia	11- SB1, SB6, WS110, SB2, WS109, WS111, SB5, WS112, WS116, SB7, WS136 (no sample taken from SB3)	0- area known to inaccessible prior to site works	0- area known to inaccessible prior to site works	11	3.27	3.4	3.4	No new sampling locations due to current operations. Sampling to be conducted after Huntsman operations cease- No current plan to decommission.
4	Dry and Wet Salts	Historically used for dry and wet salt manufacturing. South west corner comprised Methyl Ester (ME plant), methanol tower and petrol additives area. Area no longer used (demolished), except for ME	Inorganics, alcohols (e.g. methanol), esters, other organic compounds.	7- WS117, WS137, WS135, SB12, WS139, WS141, WS142. (No samples taken at WS138, WS140)	5- TP501, TP502, TP503, WS403, WS404.	3- TP502, TP503, WS403	10	4.42	2.3	2.7	Requirement for a limited number of additional locations to increase general coverage of boreholes in area formerly containing offices and open ground.

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
		plant (currently used by Huntsman).									
5	Fatty Alcohol & Ethoxylation plants	Historically and currently (by Huntsman) used as Fatty Alcohol Plant, Ethoxylation Plant and ethylene oxide (ETO) storage. Current above ground oil storage tanks	Compounds such as alcohols, esters, amides and amines. Ethoxylates, ethylene oxide, acetic acid. Hydrocarbons. Copper, nitric acid, chromium, ammonia, barium, nitrate, caustic, hydrochloric acid.	7- SB13, WS124, SB14, SB16, WS130, SB15, WS129	0- area known to be inaccessible prior to site works	0- area known to be inaccessible prior to site works	7	1.5	4.7	4.7	Extra sampling required around naphthalene contaminated area
5	Former MMO, MOS, MO and Ufex Plants	Historically used for chemical manufacturing/processing. Now disused and demolished	Phosphoric acid and related chemicals	5- WS123, WS126, WS127, WS128, WS152 (no sample taken at WS125)	10- WS416, WS417, WS415, WS414, TP517, TP518, TP519, TP520, TP521, TP526	7- WS415, WS416, TP517, TP518, TP519, TP520, TP521	12	2.37	5.1	6.3	Extra sampling required around naphthalene contaminated area

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
	Amine Plants and Sulphate/ Sulphonation Area	Historically and currently (by Huntsman) used for sulphate and sulphonation processes (north), amine plant and drum filling (south east), South west part formerly Solway Acid area (sulphuric acid manufacture), now demolished. Former railway sidings/lines on western boundary of zone. Ladysmith Pit may have extended onto northern part of zone.	Sulphate and it's compounds, amines and derivatives, alcohols, ethoxylates, alkyl benzene, inorganics (caustic) Associated with railway sidings (extreme west) and pit (north), e.g. TPH, PCBs, PAHs.	13- WS143, WS145, SB10, WS144, WS147, SB17, SB11, SB18, SB21, SB22, WS148, WS156, WS150 (no sample taken from WS149)	0- not required, sampling considered adequate	0- not required, sampling considered adequate	13	3.97	3.3	3.3	Extra sampling required around amine plants and sulphonation plants to improve site coverage.

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
3	Former cement works & raffinate processing area	Formerly used for cement manufacture and storage of clinker and other products. Also formerly occupied by raffinate treatment plant (south) and drum storage area (east). Eastern part of zone currently used by Huntsman as a distribution centre. Remainder disused and demolished. Historic rail lines across zone. Also includes former anhydrite mine yard (west)	Associated with cement works and raffinate treatment (sulphate, heavy metals. Associated with rail activities (e.g. TPH, PAHs, PCBs). Currently associated with Huntsman surfactant processing (but likelihood low due to storage only)	7- SB23, WS154, WS155, WS155a, WS158, WS164, WS160	13- WS408, WS409, WS407, WS412, WS421, WS410, TP509, TP510, TP512, TP514, TP511, TP522, TP513	9- WS409, WS407, WS412, TP510, TP512, TP514, TP511, TP522, TP513	16	6.67	2.4	3.0	Targeted sampling planned to define hotspots (TPH and naphthalene).
9a	Acid storage area	Former area of four bunded acid tanks. Now disused.	Uncertain which acids were stored. Possibly Sulphuric Acid	1- WS157	0- Inaccessible due to presence of acid tanks	0- Inaccessible due to presence of acid tanks	1	0.16	6.3	6.3	No further investigation required.

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
9b	Acid storage area	Former area of acid tanks and drum store. Majority of area currently leased to Huntsman	Uncertain which acids were stored	0	0- Inaccessible due to presence of acid tanks	0- Inaccessible due to presence of acid tanks	0	0.4	0	0	Limited number of boreholes required to investigate TPH contamination
9c	Former oil storage area	Area formerly used for heavy fuel storage in eastern part of site.	Heavy fuel oils, PAHs from fill materials. Area was investigated and impacted soil removed to landfill in 2003. Limited residual soil contamination remains.	3- WS108, BH302, BH303 plus numerous sampling locations within remediated area.	9- Stage 3W, Stage 3X, Stage 3Y, Stage 3AA, S16, S17, BH302, BH303, and WS108 - Within remediation area, sufficient samples exist	0- Within remediation area, sufficient samples exist	9	0.1	90.00	90.00	Limited number of boreholes required to investigate mercury contamination
9d	Former oil storage area	Historic maps indicate area of former fuel storage (type of fuel unknown)	Hydrocarbons and associated compounds (e.g. VOCs, PAHs)	0	2- WS411, TP523	2- WS411, TP523	2	0.21	10	10	Targeted sampling planned to define hotspots (TPH and naphthalene).
10a	Ancillary Services	Area occupied by cooling towers with large areas of previously unused land	Considered limited. General fill materials.	4- WS132, WS131, WS151a, WS151	2- WS418, TP516	2- WS418, TP516	6	1.93	3	3	Sampling to be conducted to delineate TPH/naphthalene contamination

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
.0b	Ancillary Services	CHP Plant, jointly shared by Rhodia and Huntsman. Main plant recently built (since 2000). Boiler house in east of older construction and use	Considered limited. General fill materials.	0	0- Inaccessible due to presence of buildings	0- Inaccessible due to presence of buildings	0	0.47	0	0	Sampling to be conducted after decommisioning
.0c	Ancillary Services	Offices, Engineering Workshop (DEW), research building, compounds, garage and gatehouse. Of these, gatehouse, access roads, offices and area to north west occupied by Huntsman	Considered limited. General fill materials.	3- SB19, WS153, SB20 (no sample taken from WS146)	0- Inaccessible due to presence of buildings	0- Inaccessible due to presence of buildings	3	3.4	1	1	Extra sampling required to define area of PAH contamination, and to improve sampling coverage.
.0d	Ancillary services (Tanker Washing and Lorry Park)	Tanker washing area and lorry park	Limited but potentially surfactants and hydrocarbons/grease from washing down	2- WS162, WS161	2- WS413, TP515	2- WS413, TP515	4	1.25	3	3	Extra sampling required to define area of PAH contamination, and to improve sampling coverage.

Table 2.2: Source Characterisation Across the Whitehaven Site

Zone/ Area Number	Area Title	Historical/ Current land use	Potential Contaminants	Sampling Locations (e.g. trial pits, boreholes, shallow wells)			Total Number of sample locations	Area of Zone (Ha)	Sampling Density (Samples/Ha)	Target Sampling Density (Samples/Ha)	Comments
				Existing Locations (prior to 2005 Investigation)	Proposed Locations for 2005 Investigation	Achieved Locations in 2005 Location					
.0e	Ancillary Services	Always used for car parking since development from greenfield	Considered limited. General fill materials.	0	2- TP 702 , TP701	2- TP 702 , TP701	2	3.1	1	1	None

3. SITE INVESTIGATIONS

3.1. Introduction

This section provides a brief summary of the principal site investigations previously carried out by URS and the recent work carried out for Huntsman Surface Sciences by Environmental Resources Management (ERM). Details regarding the current investigation are also provided including site geology, observations of contamination, constraints to drilling/sampling and a summary of the findings of the Tier 1 Assessment of the observed contaminant levels measured during these and from relevant historic investigations.

3.2. Previous Studies

The conceptual site model presented in this report has been developed through URS' work on the Whitehaven site over a number of years. We have also been provided with information from Huntsman's Integrated Pollution Prevention and Control (IPPC) permit application. The scope of works and main conclusions from the previous reports is summarised in Table 3.1 overleaf.

Table 3.1 Summary of Previous Investigations at the Whitehaven Site			
Report	**Aims and Objectives**	**Scope of Works**	**Conclusions**
Source Audit at the Former Albright and Wilson Facility (URS 2002)	To narrow the potential lists of sources and pathways of contaminant discharge at the Byerstead fault To limit the potential for further works to as manageable and cost effective as possible	Detailed audit of the sites drainage system Desk study of old records for potential contributing factors Sampling of effluent discharge at the beach	Waste streams emanating from the drainage system are a likely source of contamination at the Byerstead Fault It is unlikely that mine water has a significant impact on discharge at the Byerstead Fault.
Refining the Conceptual Site Model at the former Albright and Wilson Facility, Whitehaven (URS 2003)	To better understand the impact of leakage from the site drainage system To identify pathways from the site to the Byerstead Fault	Tracer testing using fluorescein dye in order to better understand the link between activities on site and discharge at the Byerstead Fault Sampling of drainage water and discharge at the Byerstead Fault to determine whether a link exists Sampling of the BH101 which is screened across the St Bees Evaporites Sampling of water from the coal and anhydrite mine	Discharge at the fault comprises many different sources and pathways. Sources include leakage from the site drainage, on-site spillages, infiltrating precipitation, groundwater, leachate. Pathways include through the stratigraphic layers, through enhanced solution features and through the coal and anhydrite mines which may act as sinks. The repair to the drainage system by Rhodia has reduced leakage It is unlikely that the anhydrite mine acts as a sole source of contamination
Additional Investigations at the Former Albright and Wilson Works , Whitehaven (URS 2003)	To compile a history of site activity Quantify the contamination of groundwater receptors Investigate potential for soil and shallow groundwater contamination from a former coke works Establish a method for long term monitoring of the Byerstead fault and deep groundwater	Install deep boreholes - BH201 (65.5m),BH202 (51m),BH203 (25m),BH204 (35.5m) 16 trial pits up to a depth of 3.65m in vicinity of coke works Sampling the local surface water	No significant sources of contamination were found at the former coke works No significant risk from radiological contamination. Conceptual model refined and long term monitoring strategy established

Table 3.1 Summary of Previous Investigations at the Whitehaven Site			
Report	**Aims and Objectives**	**Scope of Works**	**Conclusions**
Further Monitoring Works and Risk Assessment Approach for the Environment Agency (URS 2005)	Long term monitoring of surface water and groundwater Define methodology to assess the risks to controlled waters Update human health risk assessment and assess tidal influence in anhydrite mine	Quarterly sampling of groundwater in 6 deep boreholes and the Byerstead Fault during 2004 Sampling of shallow network of monitoring wells Sampling surface waters in the vicinity and at distance (background levels) from the site Tidal influence testing on the anhydrite mine air shaft Update human health risk assessment Develop initial phase of mass balance model for the controlled waters risk assessment (deep pathway)	Presence and magnitude of MBAS, phosphorus, major cations and anions and PAHs in deep wells and surface water bodies is variable No risk to human health Largest potential source is leakage from drainage Rapid pathways from site to beach Limited contamination of deep groundwater due to rapid shallow pathway
PPC Phase Ia Site Condition Report on Huntsman operated land only (ERM 2003)	To review the previous historical uses of the site to identify potentially contaminated areas Review information of the environmental setting of the site To obtain sufficient information to develop a conceptual model of the site	Desk study	Data gaps identified Scope of works proposed in order to obtain a baseline statement of site condition Scope of works for PPC Phase 1b/2 assessment to include intrusive investigation, well installation, soil and water sampling
PPC Phase 1B/2 Site Condition Report on Huntsman operated land only (ERM 2003)	To undertake site investigation works to obtain soil data to be able to make a statement of site condition for PPC purposes	Advancement of 22 soil boreholes (SB series, marked on Figures 2, 12, 13) Field screening of soil arisings Acquisition and analysis of selected soil and groundwater samples	Sufficient data obtained to enable the baseline conditions of the site to be defined for Huntsman operated land

3.3. 2005 Site Investigations

3.3.1. Intrusive Investigations

Following completion of the source characterisation task, the Phase II investigation strategy was developed. This comprised the excavation of 26 trial pits (TP501 to 526) and the drilling of 21 boreholes (WS401 to 421), at the locations shown on Figure 2. The site investigation was undertaken between 23 March 2005 and 1 April 2005.

Sampling Strategy/Rationale

The rationale for each trial pit/borehole location, depth reached and associated comments are presented in the table below:

Table 3.2: Trial Pits and Window Sample Boreholes

Borehole/ Trial Pit	Rationale for location	Depth reached (m)	Comments
TP501	Located to fill in sampling gaps in the Wet Salts area	0.6	Refusal - concrete
TP502	Located to fill in sampling gaps in the Dry Salts area	5.0	
TP503	See TP502	3.5	
TP504	Located in a now demolished tank area	0.5	Refusal – concrete
TP505	Located in a now demolished tank area. Grassed area chosen to avoid getting a refusal	3.6	
TP506	Located potentially down-gradient of tank areas and in an area with limited previous sampling	4.8	
TP507	See TP506	4.2	
TP508	Located potentially up-gradient from tank areas	1.3	Refusal -concrete
TP509	Trial pits chosen to characterise contamination around Raffinate treatment plant	0.5	Refusal - concrete
TP510	See TP509	1.8	Refusal – metal sheets and bars
TP511	See TP509	4.0	
TP512	See TP509	2.3	Refusal - concrete
TP513	See TP509	2.8	Refusal - concrete
TP514	Filling in Gaps south of drum storage and distribution centre	3.5	
TP515	Trial pit near Tank Wash	3.4	
TP516	Trial Pit near ETO area and cooling towers	3.9	
TP517	Located in MOS Plant areas. Not previously sampled	2.65	
TP518	Located near MO Mixer settlers, though not on settler area due to standing water.	3.0	

Table 3.2: Trial Pits and Window Sample Boreholes			
Borehole/ Trial Pit	**Rationale for location**	**Depth reached (m)**	**Comments**
TP519	Distributed to cover MMO area	3.0	
TP520	See TP519	2.8	
TP521	See TP519	3.0	
TP522	Located to assess possible extent of hydrocarbons found in TP 511.	3.3	
TP523	See TP522	2.5	
TP524	Located to better determine strata after refusal by borehole WS419	3.3	
TP525	Located upstream of tanks after refusal of TP508	3.0	
TP526	Located to expand on contamination found by TP518	0.6	Refusal - concrete
WS401	Located adjacent to flume, to assess any localised pollution	4.0	Well Installed
WS402	Located further away from flume in gap in sampling locations. Also up-gradient with respect to shallow groundwater flow	3.8	
WS403	Located in tank area in Wet Salts area.	1.0	Refusal
WS404	Located in Fuel additives area, now demolished	1.6	Refusal – Possible voids beneath this area.
WS405	Located within tank area	0.5	Refusal
WS406	Located within tank area	0.6	Refusal-concrete
WS407	Centre of old floor space near Raffinate treatment.	1.7	Refusal
WS408	Located next to distribution centre, for site coverage	0.7	Refusal
WS409	For site coverage in vicinity of Raffinate treatment area and to assess shallow groundwater	2.8	Refusal. Well Installed
WS410	See WS409	0.5	Refusal
WS411	See WS409	3.75	Well Installed
WS412	See WS409	4.0	Well Installed
WS413	Additional well in Tank area	4.0	Well Installed
WS414	Located at the top of the MMO area, now demolished	0.2	Refusal – concrete
WS415	Located adjacent to a storage area in the MMO plant	4.0	Well Installed. Suspect groundwater found and sampled was perched on made ground.
WS416	Located near MOS and MMO areas for site coverage	4.0	Well Installed
WS417	Located in centre of tank area between MOS storage tanks and MO mixer.	0.5	Refusal
WS418	Located to get groundwater levels near ETO area	4.0	Well Installed
WS419	Located near to Imidazoline Plant to	0.5	Refusal

Table 3.2: Trial Pits and Window Sample Boreholes			
Borehole/ Trial Pit	**Rationale for location**	**Depth reached (m)**	**Comments**
	replace WS115, which was lost		
WS420	Located near WS419 and adjacent to Lagoon.	1.6	Refusal. Well Installed.
WS421	Located near TP511 to try and identify whether contamination is migrating southwards	1.2	Refusal

Contractors used on the site included Hewden Hire (Back hoe excavator equipped with breaker for trial pits), Global Probing and Sampling (Terrier rig for window sampling and well installation) and Eric Edmondson Surveys (levelling of boreholes). Two experienced URS site engineers were present on site to supervise the investigations.

Constraints to Drilling/Excavation

The trial pits were excavated to depths up to 3.65m. The boreholes were progressed to depths up to 4m, although most were terminated at less than 3.5m depth. As shown in the above table, refusals were encountered at a few of the trial pit locations and a number of the window sampling locations. The majority of the refusals relate to the presence of underground structures (e.g. former bunds, subsurfaces of reinforced concrete), including the occurrence of concrete floors up to 2.8m below present ground level (TP513). The area in the southwest of the site where several trial pits (TP509-13) were located was found to be underlain by a concrete floor at 4 out of the 5 trial pit locations. Depth to the top of the concrete typically ranged from 1.9-2.4m. Furthermore, in several areas the Made Ground contained slag, which was problematic in some cases (TP516, TP517) as the slag had fused together forming a solid layer, which was difficult to excavate. Consistent with previous investigations, a number of locations were terminated on the top of the bedrock, which is present near surface over much of the site. Despite the numerous refusals, shallow soil samples were able to be taken for laboratory analysis to assess potential human health and controlled waters risks.

3.3.2. Sampling and Analysis

Soil Sampling

Trial pitting using the back-hoe excavator produces disturbed and usually mixed samples, due to caving in from the side walls. Care had to be taken to select a sample from the bucket that was representative of the depth the pit had progressed to, therefore, samples were preferably taken from the back of the bucket.

Window sampling gives a continuous core of the geology down to 4.0m, ground conditions permitting. Photo-ionisation Detectors (PID) were used to screen soil samples for volatile contaminants and hence aid the selection of samples for laboratory analysis.

Groundwater Sampling

Shallow groundwater sampling was carried out between Wednesday 6th April 2005 and 8th April 2005. Sampling of all nine of the shallow groundwater wells installed during task 4 (window sampling and trial pitting) was attempted, however, three of these wells were dry. Four additional samples were taken from three shallow groundwater wells previously installed by URS (WS108, WS109 and WS157) with one of these four samples being a duplicate (from WS157).

Sampling was carried out using a peristaltic pump to raise the water out of the wells. Wells that had been installed and sampled previously were purged of three well volumes prior to sampling and new wells were purged of 5 well volumes prior to sampling. Filtering of the water on site was carried out for metals and cyanide samples.

Attempts were made to sample the shallow groundwater sampling wells installed by ERM, which lie in primarily Huntsman occupied areas of the site (SB series). Of the seven wells located, one was located within an active building and therefore an attempt was not made to sample from it. Of the remaining six, five were rusted to the point that the hexagonal key bolts used to secure the borehole tops could not be removed, without permanently damaging the covers. The final sampling well, located south of the drum filling building, was opened, however, the contents, a thick, heavy, dark grey and slightly foamy liquid at the base of the well, proved impossible to sample in sufficient quantities.

An analytical schedule for the soil and groundwater samples is presented in Appendix B. The site investigation protocols utilised in this investigation are presented in Appendix E.

3.3.3. Site Observations

Observations of Contamination

The principal observations of contamination in soil/seepage into trial pits comprised:

- a diesel odour and sheen visible on seepage water in TP511 (3-3.5m) and TP515 (0.6m), and diesel odours in TP523 at 0.9m and WS418 (1.2m). Hydrocarbon staining was also noted at 2m in WS418. Seepages of oily water were noted in TP503 (3m) and from a buried metal container at 0.7m in TP522,

- sulphurous odours in TP514 (0.3m depth), TP516 (1.2m), TP517 (0.8m), TP523 (0.4m), WS407 from 0.5 to 1.5m; and

- a solvent odour at 0.3m beneath concrete in TP518 and a 'sewage-like' odour further down the profile at 0.7m. Solvent odours were also noted in TP519 and TP520 at 0.5m depth.

Observations of contamination in groundwater comprised:

- a slight sewage-like odour was noted in WS108, and a small amount of thick grey foam-like sludge was extracted from ERM well SB20, which also smelled sewage-like, though no groundwater was present; and

- a multi-coloured sheen was visible in WS411 and a strong diesel odour.

The PID measurements and further details regarding observations of contamination are presented on the borehole logs in Appendix A.

Site Geology

The geology encountered during the intrusive investigations is presented in the borehole and trial pit logs in Appendix A and is summarised below. The shallow geology was consistent with previous investigations and from public sources (as summarised in Section 2.3).

Table 3.4: Shallow Geology Encountered During Site Investigations

Depth (m bgl)	Soil Description
0-3.4 (All trial pits and boreholes)	MADE GROUND: Comprising reinforced concrete, coarse gravel of limestone (hardcore), sand with gravel and boulders, reworked silty/sandy clay slag and clinker.
0.7-5.0 (All boreholes and trial pits progressed below the Made Ground).	DRIFT DEPOSIT: Orange brown sandy/silty CLAY. Varies from soft to stiff and gravel content commonly increases with depth.
1.5-2.45 (TP517)	DRIFT DEPOSIT: Gravel with silty medium SAND.
3.2-4.0 (WS401, WS413, TP505)	DRIFT DEPOSIT: BOULDER CLAY with fine-medium, angular-rounded gravel.
2.45-unknown (TP517, WS401, WS413)	BEDROCK: SANDSTONE.

Hydrogeology

Shallow groundwater was encountered in the limited number of monitoring wells available for sampling at depths ranging from 0.04 mbgl (metres below ground level) in WS415 to 3.21 mbgl in WS411. Across the site shallow groundwater elevations range from approximately 94m AOD in the extreme east and western parts of the site to 80m mAOD in the central and southern parts of the site. Consistent with previous investigations, shallow groundwater flow is considered to follow topography, flowing from the western and eastern areas of higher elevation towards the central north south axis of the site. Flow from this point is either northward towards the coast or southwards towards Sandwith Beck (a shallow groundwater divide appears to be present across the site). The shallow groundwater elevations and inferred contours are shown on Figure 10. Where data points are limited, this has been inferred from URS previous investigations at

the site. This defines a flow divide between the north and the south of the site and also shows convergent flow of groundwater towards the location of the former stream that used to exist across the site.

Deeper groundwater levels were measured in the deep monitoring wells at the site, and the elevations are presented on Figure 10. Due to insufficient number of data points for each geological stratum beneath the site, it is not possible to calculate flow direction from the data. However, it is apparent that there is a vertical head gradient downwards at the site.

3.4. Deep Aquifer and Receptor Monitoring 2004-5

The data collected from the last 5 rounds of deep groundwater sampling have been reviewed with the aim of identifying any significant trends in water quality. The data collected is presented as Table 20-24 in Appendix B and a number of observations are discussed briefly below.

MBAS (surfactant) concentrations within BH201 (St. Bees Shale), BH202S (St Bees Evaporites), BH202D and BH204 (Whitehaven Sandstone), Byerstead Fault and Sandwith Beck Upstream have fluctuated over time and have shown no clear trend, however concentrations in Byerstead Fault were the highest recorded during the studies carried out by URS to date. MBAS was recorded for the first time in BH101 (St Bees Evaporites) and in Bellhouse Gill, suggesting a pathway exists to this receiving water that has not before been identified. MBAS in BH203 (Whitehaven Sandstone) and in Sandwith Beck Downstream was either not present or did not exceed the minimum detection level.

The concentrations of copper recorded in most boreholes remained fairly constant, however, concentrations in Sandwith Beck Upstream and Downstream dropped significantly. The concentrations of major cations, such as calcium, magnesium, sodium and potassium fluctuate and peak at a variety of times, with no discernable pattern in either location or over time. Likewise, major anions vary in a similar manner, though there is a noticeable peak in chloride and phosphate in the August 04 monitoring round at Byerstead Fault.

PAHs, particularly the Total PAH figure, have been generally reducing in all borehole locations with the exception of BH201, where recent sampling indicates an increase in total PAH, and BH202S, where the levels continued to fluctuate.

Lastly, the level of total TPH recorded in deep ground and surface waters appears to vary with no obvious trend and it is not consistently recorded in any location.

3.5. Summary of Soil and Groundwater Contamination

3.5.1. Data Set and Tier 1 Assessment Approach

All soil, leachability and groundwater data obtained from the current 2005 investigation have been input into a database, together with all soil and leachate data collected from

the historic URS investigations and the ERM investigation. Shallow groundwater data from 2004 have also been incorporated if it was not possible to sample these wells as part of the 2005 investigation (see section 3.3.2). The analytical data is presented in Appendix B.

A Tier 1 Assessment has been performed on this dataset, involving a comparison of the data with generic criteria for both human health and controlled waters assessment. The selection of Tier 1 criteria and the methodology of the Tier 1 assessment are also presented in Appendix B. The results tables in Appendix B show the Tier 1 criteria.

In terms of human health, the Tier 1 tables only show the Tier 1 criteria for the most sensitive human health receptor, this being off-site residents. These criteria are considered conservative with respect to on-site future recreational site users and off-site commercial users on Tamar property to the north of the site.

In terms of controlled waters, the Tier 1 tables only show the Tier 1 controlled waters criteria for the shallow migration pathway towards the Sandwith Beck (a freshwater body). However, before proceeding with the Tier 2 quantitative risk assessment, the numbers were also screened against the marine and estuarine EQS values, which are protective of the other receptor (the coast) considered in the Tier 2 assessment. This was undertaken to ensure that all compounds exceeding the Tier 1 controlled waters criteria have been taken forward to a higher level of assessment.

It should be noted that the Tier 1 criteria are very conservative and are not pathway specific, although they do take into consideration the type of receptor in setting appropriate water and soil target values.

Where a measured concentration on site exceeds the Tier 1 value for a particular determinand, or where no generic criterion exists, the data have been passed to a higher level of assessment (a Tier 2/3 quantitative risk assessment (QRA)). The QRA for human health and controlled waters is presented in Section 5 with supporting information in Appendices C and D respectively.

The following presents a summary of the soil and groundwater quality at the Whitehaven site, highlighting areas of potential hotspots that have been identified on the basis of the Tier 1 assessment.

3.5.2. Soil

Of the analysed metals only phosphorous, arsenic, iron, nickel, mercury and chromium exceeded human health criteria. Phosphorous exceeds criteria across much of the site, as does iron, which is found in concentrations of more than double the Tier 1 human health value. Mercury and chromium only exceed their respective Tier 1 criteria in limited areas at WS108 (Area 9c) and WS131 (Area 10a) respectively.

Metals leachability was generally found to be within the EQS values for Sandwith Beck. Copper, chromium, selenium and mercury showed single instances (1 of 22 samples each) where the leach test result exceeded the EQS.

Of the analysed PAHs, 13 exceeded Tier 1 human health or controlled waters criteria. Of these 13 naphthalene appears the most widespread, exceeding controlled waters criteria in 47 sampling locations (based on all available soil data) but only exceeding human health criteria in three locations, all of which are in Area 1 (TP4, TP17 and WS420). The remainder, show specific hotspots at WS163 (Area 10c), TP1-17 and TP506-7, TP524, WS115 and WS133 in Area 1, and WS161 in Area 10d.

The exceeding SVOCs, of which there are 11, also fall within the list of exceeding PAHs and as such they show the same distribution.

Of the 12 VOCs exceeding Tier 1 criteria, only naphthalene exceeds both the human health and controlled waters criteria. The remaining 11 compounds include 1,2,4- and 1,3,5-trimethylbenzene, benzene, toluene and xylene. Again the distribution of those VOCs is similar to that of the PAHs and SVOCs, being concentrated around the former coke works (Area 1), however they are also found in the area of the ETO plant and MMO plant areas (Areas 5 and 6).

TPH in soil exceeding the Tier 1 criteria for human health was found in only 4 locations . These locations were in the vicinity of the former oil storage area in Area 9c and in the location of the former raffinate treatment works (Area 9d).

MBAS was found in low concentrations across the much of the site, with the exception of those locations within surfactant processing areas. High levels of surfactants in soil were identified by ERM in area 7 (SB5-6, SB10 and SB20).

3.5.3. Groundwater

As with metals in soils, metals in groundwater exceed the Tier 1 criteria across much of the site, with almost all areas having at least one compound failing the criteria. All metals, with the exception of boron, copper and lead exceed both controlled water and human health criteria in at least one location. Key hotspots appear to be WS416 and WS126 (Area 6), WS412 (Area 8), and WS141 (Area 4), where there are a number of metals exceeding both controlled water and human health criteria.

There were a number of Tier 1 exceedences of PAHs in groundwater, specifically located in areas of WS115 (Area 1), WS130 (Area 5), WS152 and WS416 (Area 6) and WS161 (Area 10d). This distribution mirrors that of PAHs in soil and includes the same compounds. Unlike in soil, no SVOCs or VOCs exceeded human health or controlled waters criteria in groundwater.

TPH exceeds the controlled waters criteria in a number of locations. Specifically, exceedences in the vicinity of the previous heavy fuel oil storage area in the north-west of the site (Area 9c), also in the vicinity of SB10 and SB21 (Area 7) and near the ETO plant in Area 5 (SB15, WS130). In addition to these areas, there were also exceedences recorded near the Wet Salts area (WS141 in Area 4), and the MMO plant (WS126 in Area 6).

Chloride exceeded both Tier 1 human health and controlled waters criteria, however it was only found in WS161 (Area 10d), which is in the Tank Wash area. Of the remaining

compounds that exceeded either human health or controlled waters criteria, MBAS was found centrally across the site and in the Tanker Wash area (Area 10d), whilst sulphate was predominantly found in the south, around the former raffinate treatment building in Area 8.

4. CONCEPTUAL SITE MODEL AND POTENTIAL POLLUTANT LINKAGES

4.1. Introduction

The conceptual site model (CSM) is the qualitative description of the geology and hydrogeology along with the plausible mechanisms by which receptors may be exposed to site-derived contamination. For exposure to be considered possible, some mechanism ('pathway') must exist by which contamination from a given source can reach a given receptor. A complete source-pathway-receptor connection is termed a 'pollutant linkage'.

The conceptual model for the Whitehaven site has been revised and updated numerous times over the last seven years as more information on geology, hydrogeology and contaminant sources has been gathered from the additional investigations and assessments carried out. The qualitative description of the geology and hydrogeology was presented in Table 2.1, with further detail relating to the current investigation provided in Section 3.

The URS January 2005 report presented the most recent conceptual understanding of the site and outlined several potential pollutant linkages which could exist at the Whitehaven site. In addition, there were a few possible linkages for which Entec/Agency considered insufficient data exists, mainly related to source characterisation. The potential sources, pathways and receptors for the Whitehaven site are described in the subsections below, together with an evaluation of the potential pollutant linkages that exist.

4.2. Potential Sources

The potential sources of contamination that are considered to exist either as residual historical or current sources are detailed below. There are likely to be sources related to soil and groundwater contamination, sources associated with the drainage system and sources within the mine system.

Soil

Residual soil contamination is considered to exist from historic operations such as the coke works, present within the Made Ground/fill materials and from the former Rhodia/Albright & Wilson/Marchon manufacturing processes. There is also the potential for current soil contamination associated with Huntsman operations to exist. In their 2004 study, Entec indicated that insufficient shallow data existed to assess potential sources of contamination such as process areas, storage tanks, areas of potential spillage, material

storage areas, areas of visible contamination and areas adjacent to the site drainage system. This has been addressed with the current site investigation, although it was not possible to access areas beneath the Imidazoline plant and a few other areas where Huntsman are currently operating. A discussion of the soil contamination with respect to the Tier 1 values has been presented in Section 3.5.

Drainage

The site drainage system is over 40 years old and it is estimated that several miles of pipework is present beneath the site. Poor drainage integrity at various locations across the site has historically been considered responsible for the presence of a proportion of contaminated water at the Byerstead Spring, although there has been considerable investment in upgrading and repairing the site drainage system over the last few years. Nevertheless, it is considered that contaminants associated with the site's drainage system (e.g. encrusted in pipes, associated with sumps) could potentially exist.

Groundwater

Potential sources of contamination are present within both the shallow aquifer system (Made Ground and boulder clay) and the deep aquifer system as storage within the St. Bees Shales, Evaporites and Whitehaven Sandstone.

A discussion of the shallow groundwater contamination with respect to the Tier 1 values and its distribution across the site has been presented in Section 3.5. To date, MBAS (surfactants), TPH, PAHs, heavy metals and major anions and cations have been detected within shallow groundwater. The analytical results for the last 5 deep monitoring rounds was presented in Section 3.4. The results indicate that selected deep wells have been impacted by site derived contaminants.

Mine Storage

Contaminated groundwater stored in the anhydrite mine and the coal mines is considered to be a potential source of contamination. MBAS was detected in the anhydrite mine during pumping of the shaft in 2000, although it was not present above the reporting limit in 2003 when a static 'grab' sample was obtained. Groundwater from the Middle Coal Measures has not been sampled directly at the site.

4.3. Potential Pathways

The following potential pathways for contaminant migration are likely to exist at the Whitehaven site:

Potential Controlled Waters Pathways

- Infiltration of rainwater through contaminated soils and subsequent leaching and vertical movement to groundwater.

- Migration of rainwater through the drainage system, possibly resulting in the dissolution of contaminants and/or the mobilisation of contaminants within the drainage bed;
- Porous media flow within the shallow aquifer;
- Porous media flow within the deep aquifers;
- Flow within solution features/fractures within the St. Bees Shale and St. Bees Evaporites enhanced by the disposal /leakage of sulphuric and phosphoric acid;
- Flow within abandoned workings and roadways of the anhydrite mine;
- Flow within the workings, roadways and shaft of the abandoned coal mines beneath the site;
- Upward flow from Middle Coal Measures (not proven);
- Enhanced migration along faults, notably the Byerstead Fault, which may connect the shallow and deeper groundwater systems at the coast;
- Flows associated with the consented discharge pipe; potentially flows to ground/groundwater along the route.

Potential Human Health Pathways

- Dermal contact/ direct ingestion of soil;
- Vapour inhalation from soil and shallow groundwater contamination;
- Inhalation of dust from contaminated soil.

4.4. Potential Receptors

The following are considered as potential receptors for site derived contamination:

Potential Controlled Waters Receptors

- Groundwater in drift.
- Groundwater in St. Bees Shales.
- Groundwater in Whitehaven Sandstone.

- Groundwater in Middle Coal Measures.
- Byerstead Spring.
- Irish Sea coastal waters.
- Sandwith Beck.
- Bellhouse Gill and other eastward trending streams.

Potential Human Health Receptors

The following are based on the future proposed land use as 'right to roam' and current land use surrounding the site.

- Human Health – on-site recreational users.
- Human Health – off-site residents.
- Human Health – off-site commercial property to the north (Tamar).

Other Potential Receptors

- Property.
- Ecology.

4.5. Potential Pollutant Linkages

The potential pollutant linkages relating to the potential sources, pathways and receptors outlined above are presented on Figure 11. Of these, the key potential pollutant linkages are considered to be:

Controlled Waters

- Soil and shallow groundwater contamination migrating through the shallow aquifer system to the Sandwith Beck and the Irish Sea Coast, depending on its location with respect to the shallow groundwater divide;

- Soil (leaching) and shallow groundwater contamination migrating vertically into the deeper aquifer system, followed by transport within this system and any anthropogenic features (e.g. solution features) towards the Byerstead Fault, ultimately discharging into the Irish Sea at the Byerstead Spring;

- Soil (leaching) and shallow groundwater contamination migrating towards and discharging into the Bellhouse Gill. The transport mechanism for this potential pollutant linkage is inconclusive.

Human Health

- Inhalation of vapours and dust, ingestion of soil and dermal contact of soil and shallow groundwater contamination by future recreational land users at the site;

- Inhalation of vapours (outdoor) and dust (indoor and outdoor) on adjacent commercial (Tamar) and residential property (to north east) arising from soil and shallow groundwater contamination present at the site. Shallow groundwater is considered to flow away from these areas and is therefore unlikely to migrate beneath these off-site properties; the principal pathway is via airborne migration across the site boundary.

5. QUANTITATIVE RISK ASSESSMENT

5.1. Introduction

In order to assess whether the observed contaminant levels in the soil and groundwater pose a theoretical risk to human health and/or controlled waters, a detailed risk assessment has been completed. These risk assessments, in general, follow appropriate government procedures and guidance, including:

- Contaminated Land: Implementation of Part IIA of the Environmental Protection Act 1990, DETR Circular 02/2000
- CLR11 Model Procedures for the Management of Land Contamination, Environment Agency, 2004
- Assessment of Risks to Human Health from Land Contamination: An Overview of the Development of Guideline Values and Related Research, Report CLR7, Defra and Environment Agency (2002)
- Priority Contaminants for the Assessment of Land, Report CLR8, Defra and Environment Agency (2002)
- Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans, Report CLR9, Defra and Environment Agency (2002)
- Contaminated Land Exposure Assessment Model (CLEA): Technical Basis and Algorithms, Report CLR10, Defra and Environment Agency (2002)
- Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources, Environment Agency R&D Publication 20, 1999

The assessment of potential risks to controlled waters from soil and shallow groundwater contamination observed at the site applied the standard preferred approach by the Environment Agency (R & D 20, 1999). The methodology is based on a risk assessment approach that incorporates the pre-determined Conceptual Site Model (CSM). This site-specific assessment criteria derived from the risk assessment are based on an assessment of the potential impact at the identified receptor.

The full technical basis for the human health risk assessment and controlled waters risk assessment is provided in Appendices C and D respectively. The sections below summarise the results of this risk assessment.

5.2. Human Health Risk Assessment

The human health risk assessment follows four stages as follows:

- **Stage 1 - Hazard identification** – establishing contaminant sources, pathways and receptors, based on the conceptual model, and the assumption that the site will be open to public access;
- **Stage 2 Hazard assessment** – analysing the potential for unacceptable risks (what linkages could be present, what the effects could be);
- **Stage 3 Risk estimation** –establishing the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it);
- **Stage 4 Risk evaluation** – establishing whether the risk is unacceptable.

Based on the Tier 1 assessment of the soil and shallow groundwater contamination, the following potential human health pollutant linkages were identified (Table 5.1). The contaminants considered to comprise the "source" are those that exceeded the Tier 1 criteria for human health. The activities of source identification equates to the hazard identification stage, and determination of potential pollutant linkages equates to the hazard assessment stage.

Table 5.1 Summary of Potential Human Health Pollutant Linkages

Contaminant Type	Exposure Pathways	Relevant Receptor
Organic Contaminants	Incidental ingestion of surficial soil	Visitor to open-space land
	Dermal contact with surficial soil outdoors	Visitor to open-space land
	Dermal contact with indoor dust	Commercial worker and resident

Table 5.1 Summary of Potential Human Health Pollutant Linkages		
Contaminant Type	**Exposure Pathways**	**Relevant Receptor**
	Inhalation of fugitive dust outdoors	Visitor to open-space land, commercial worker and resident
	Inhalation of fugitive dust indoors	Commercial worker and resident
	Inhalation of vapours from subsurface soil indoors	Commercial worker and resident
	Inhalation of vapours from subsurface soil outdoors	Visitor to open-space land, commercial worker and resident
	Inhalation of vapours from groundwater indoors	Commercial worker and resident
	Inhalation of vapours from groundwater outdoors	Visitor to open-space land, commercial worker and resident
Inorganic Contaminants	Incidental ingestion of surficial soil	Visitor to open-space land
	Dermal contact with surficial soil outdoors	Visitor to open-space land
	Dermal contact with indoor dust	Commercial worker and resident
	Inhalation of fugitive dust outdoors	Visitor to open-space land, commercial worker and resident
	Inhalation of fugitive dust indoors	Commercial worker and resident

The risk estimation stage comprises using a standard numerical model (the URS in-house model Human7, which uses the algorithms set out in CLR10) into which the above conceptual site model parameters are entered. The land-use is the primary factor in setting the parameters, and three scenarios (public open space, off-site residential and off-site commercial) were modelled. This leads to a site specific assessment criterion (SSAC) for each contaminant of concern from Tier 1. The SSACs are then compared to the measured concentrations and areas where the SSACs are exceeded reviewed. The results are summarised in Table 5.2 and the spatial distribution is illustrated in Figure 12.

The model includes consideration of risks to human health from contaminants in groundwater. No exceedances of SSACs for groundwater were present.

Table 5.2 – Shallow Soil Theoretical Human Health Exceedances

Substance	***Max. Value***	***Open Space***		***Off-Site Residential***		***Off-Site Commercial***	
		SSAC	*Nr of Exceedances*	*SSAC*	*Nr of Exceedances*	*SSAC*	*Nr of Exceedances*
Nickel	96	**75**	**2**	3610	0	59900	0
Mercury	30	**15**	**1**	9E+5	0	n/a	-
Benzo(a)anthracene	116	**11.5**	**5**	**54.3**	**1**	983	0
Benzo(a)pyrene	114	**1.15**	**12**	**5.29**	**6**	**94.7**	**1**
Benzo(b)fluoranthene	104	**11.5**	**1**	**54.3**	**1**	983	0
Benzo(k)fluoranthene	94.8	**11.5**	**4**	**54.3**	**1**	983	0
Chrysene	122	**115**	**1**	543	0	9830	0
Dibenzo(a,h) anthracene	4.3	**1.15**	**4**	5.43	0	98.3	0
Fluoranthene	247	**115**	**1**	543	0	9830	0

Note: Maximum value and SSAC presented in mg/kg
Exceedances are shaded and **bold**.

CLR7 guidance details a process for evaluating contamination distribution statistically by looking at the average contamination levels in zones defined either by the proposed use, or by the contamination distribution (or the expected contamination distribution with reference to the site history). The "mean value test" is used to compare to the SSAC as a tool for risk evaluation. The area over which results should be averaged is determined by using a combination of statistical testing (the "maximum value test" to detect statistical outliers), observation of contaminant distribution (identification of "hot spots"), expectation of contamination on the basis of site history, and potential or actual land use. The results are summarised below.

- **Nickel in shallow soil**: Two exceedances were identified (at WS134 and WS412). However these were marginally over the threshold for open space (both 96 mg/kg compared with 75 mg/kg). The values are not statistical outliers, and the upper 95% confidence level on the mean (US95) (CLR7 "mean value test") is below the SSAC using the whole site as the averaging area. This would also be the case if the site were separated into zones based on previous use. Therefore the risk is considered acceptable, and no significant pollutant linkage is identified.

- **Mercury in shallow soil:** A mercury exceedance (WS108 0.2-0.5m, 30mg/kg, against a calculated SSAC of 15 mg/kg) in the north-east corner of the site was delineated. This is considered a potential hotspot, but only one result is available. A significant pollutant linkage is considered unlikely, however further investigation is recommended.

- **Polyaromatic hydrocarbons: Benzo(a)anthracene Benzo(a)pyrene, Benzo(b)fluoranthene, Benzo(k)fluoranthene, Chrysene, Fluoranthene, Indeno[1,2,3-cd]pyrene in shallow soil** . These were found in a few locations,

primarily: WS163 near the gatehouse; WS161 at the tanker washer area and from trial pits from a previous study[3] at "Ladysmith Pit", close to the coke works. At this stage, however, these contaminants are not seen as significant, except for benzo(a)pyrene which is exceeded in 7 locations and which exceeds the SSAC for all three exposure scenarios. As a consequence there is likely to be requirement to remediate these shallow soils, within the tank washing area and in hotspots in the south west of the site. Remediation close to the coke works should be deferred until the Imidazoline Plant operated by Huntsman has been decommissioned and further intrusive investigations and risk assessments completed.

- **Groundwater**: because there were no exceedances of groundwater SSACs for human health it is considered that there are not likely to be unacceptable risks to human health from groundwater contamination.

5.3. Controlled Waters Risk Assessment

The controlled water risks assessment comprises two inter-related components:

- An assessment of the potential risks to controlled waters from soil and shallow groundwater contamination observed at the site using the standard approach preferred by the Environment Agency. The potential risks are assessed from two primary transport pathways: from soil and shallow groundwater through the shallow aquifer system to discharge at the coast (seepage along the steep coastline) and the Sandwith Beck to the south.

- An assessment of the risks from residual contamination within the shallow and deep aquifers through the complex sub-surface transport pathways to discharge to the Byerstead fault and the Bell House Gill using a mass balance technique developed by URS.

Full details of the risk assessment is included in Appendix D, including details of all input parameters, sensitivity analysis and uncertainties. The results are summarised in the sections below.

5.3.1. Shallow Soil and Groundwater Contamination Impacting the Coast and Sandwith Beck

Three main contaminant transport pathways have been simulated in this risk assessment:

- The partitioning of soil contamination between soil and water resulting in pore water concentrations to develop Tier 1 criteria, which have been evaluated and defined in Appendix B. In the case of metals, the sorption of metals to the soils is not

[3] Additional Investigation at the Former Albright & Wilson Works, Whitehaven (report dated 8 August 2003, reference R1550-C01/44557-033-787/ARC/JMC/pp)

accurately simulated using simple partitioning and, therefore, precedence has been given to laboratory leachate data.

- The migration of pore water vertically from the soil profile to the water table and dilution within the groundwater beneath the soil source. Given that the depth to groundwater is less than 1m in places, no attenuation as the pore water migrates vertically has been simulated. The diluted contaminant concentration within the groundwater beneath the site is known as the Tier 2 criterion.

- The dispersion and biodegradation within the made ground and Drift deposits towards the surface water receptors (the coast for contamination at the north of the site and the Sandwith Beck at the south of the site) – the Tier 3 Criteria. The results of this assessment are the primary driver in assessing whether the current levels of contamination are a theoretical risk to controlled waters.

The results of the soil analysis for the north of the site and the south of the site are shown in Tables 5.3 and 5.4. This also summarises the locations of any exceedances which are shown on Figure 12.

Table 5.3: Soil Tier 3 Criteria – North of Site

Substance	Maximum Observed (mg/kg)	Hazard Index	Tier 3 Soil Criteria (mg/kg)	Comments
TPH	63,368.00	<1	IR	Peak concentration associated with former tank leakage at north east boundary which has subsequently been removed
Volatile Organic Compounds				
Chloromethane	0.14	126.07	0.001	Exceedance close to the "Cathedral"

Table 5.3: Soil Tier 3 Criteria – North of Site

Substance	Maximum Observed (mg/kg)	Hazard Index	Tier 3 Soil Criteria (mg/kg)	Comments
Chloroform	0.17	<1	IR	
Tetrachloroethene	0.15	<1	IR	
Benzene	0.14	<1	IR	
Toluene	3.66	<1	IR	
Xylenes	1.15	<1	IR	
Naphthalene	132.76	284.17	0.47	Exceedances at Cathedral, Discharge flume other hotspots
Chlorobenzene	0.09	<1	IR	
1,2,4-Trimethylbenzene	0.24	<1	IR	
1,3,5-Trimethylbenzene	0.69	<1	IR	
Semi-Volatile Organic Compounds				
Phenol	0.38	<1	IR	
Acenaphthylene	6.31	<1	IR	
Benzo[a]anthracene	53.19	<1	IR	
Benzo[a]pyrene	31.47	<1	IR	
Benzo[b]fluoranthene*	42.25	<1	IR	
Benzo[k]fluoranthene*	14.04	<1	IR	
Dibenzo[a,h]anthracene	4.34	<1	IR	
Phenanthrene	136.58	<1	IR	
1-Methylnaphthalene	7.90	<1	IR	
2-Methylnaphthalene	13.80	<1	IR	
Dibenzofuran	6.29	<1	IR	
Others				
MBAS	2,930.00	71,458.22	0.04	Theoretical - partitioning soil to water estimated based on conservative assumptions
Carbazole	1.82	37.37	0.05	
Azobenzene	0.10	<1	IR	

Table 5.4 Soil Tier 3 Criteria – South of Site (Sandwith Beck Model)

Substance	Maximum Observed (mg/kg)	Hazard Index	Tier 3 Soil Criteria (mg/kg)	Comments
TPH – South of Site TPH Central area of site	3,370.00 2520.00	6.5 <1	509 IR	Residual contamination close to the locations of former oil storage tanks, near location of new treatment plant
Volatile Organic Compounds				
Trichloroethene	0.15	<1	IR	
Tetrachloroethene	0.12	<1	IR	
Naphthalene	6.40	8.45	0.76	Exceedances in hotspot round former laboratory
Semi-Volatile Organic Compounds				
Acenaphthylene	0.27	<1	IR	
Benzo[a]anthracene	116.00	<1	IR	
Benzo[a]pyrene	114.00	<1	IR	
Benzo[b]fluoranthene	104.00	<1	IR	
Benzo[k]fluoranthene	94.80	<1	IR	
Chrysene	122.00	<1	IR	
Dibenzo[a,h]anthracene	1.43	<1	IR	
Indeno[1,2,3-cd]pyrene	65.60	<1	IR	
Phenanthrene	116.00	<1	IR	
1-Methylnaphthalene	9.20	<1	IR	
2-Methylnaphthalene	14.50	<1	IR	
Dibenzofuran	3.40	<1	IR	
Others				
MBAS	535.00	580.01	0.92	Theoretical - partitioning soil to water estimated based on conservative assumptions. Exceeds throughout the site
Carbazole	189.00	2,562.33	0.07	
Azobenzene	1.07	9.94	0.11	

A number of exceedances have also been calculated for metals in the soil from the leachate analysis, as shown in Table 5.5. Exceedances are, however, spread over the large areas of the site and are primarily related to the characteristics of the made ground rather than historical above ground processes. Metal concentrations in terms of both total and leachable concentrations are typical of made ground containing coal ash and demolition rubble. It is also worth noting that the concentrations of metals simulated to occur at the Sandwith Beck has not been observed in practice.

Table 5.5 Leachate Analysis

Metal	Observed Maximum Leachate concentration (µg/l)	Hazard Index	Back-calculated Tier 3 Soil Criteria (mg/kg)
North of the Site (Coast Model)			
Chromium	15.00	1.44	25.41
Copper	60.00	6.23	22.30
Lead	6.00	<1	IR
Selenium	3.00	<1	IR
Zinc	110.00	7.34	33.10
South of the Site (Sandwith Beck Model)			
Chromium	598.00	211.71	3.53
Copper	23.00	34.19	10.01
Lead	8.00	1.33	270.14
Selenium	38.00	2.80	10.34
Zinc	109.00	10.06	165.08

NB: Hazard index is the expression of the predicted receptor point concentration derived for the maximum observed leachate concentration divided by the target concentration: a risk is predicted to exist where HI>unity. The back calculated soil concentration is the maximum observed soil concentration divided by the hazard index and assumes that the maximum soil concentration provides the maximum leachate concentration for a given contaminant.

In terms of the shallow groundwater, exceedances were simulated for a number of substances in the north and south of the site, as shown in Tables 5.6 and 5.7. In the north of the site, these are limited to a few metals in a number of isolated locations and are, therefore, not considered to result in a significant risk because the travel times for these metals in the made ground/drift exceed 200 years. In addition, there are no signs of any “plume” emanating from these isolated locations.

The concentrations of the surfactant, MBAS are also exceeded in various hotspots including one close to the treatment system (the “cathedral”) and where the MBAS is currently used in the north east of the site (refer to Figure 13). It is very likely that this will attenuate once Huntsman cease operations.

No exceedances of petroleum hydrocarbons were noted. However, it was not possible to collect groundwater samples in the area where soil exceedances have been delineated. Therefore, there still remains a possibility that there may be petroleum hydrocarbons in groundwater in these locations.

Table 5.6: Groundwater Tier 3 Criteria – North of Site (Coast Model)				
Substance	**Maximum Observed (µg/l)**	**Hazard Index**	**Tier 3 GW Criteria (µg/l)**	**Comments**
TPH	2030.0	<1	IR	
Metals				
Cadmium	140.0	20.1	7.0	Exceedance WS125
Copper	10.0	1.2	8.3	Exceedance WS125
Lead	5.0	<1	IR	
Nickel	206.0	8.5	24.1	Exceedance WS125
Selenium	63.0	1.8	35.9	Exceedance WS125
Phosphorous	238.0	<1	IR	
Zinc	1820.0	161.0	11.3	Exceedance WS108 & 405
Magnesium	63840.0	271.4	235.2	Exceedance WS416
Iron	15550.0	3.9	4000.3	Exceedance WS136
Semi-Volatile Organic Compounds				
Acenaphthylene	0.9	<1	IR	
Benzo[a]anthracene	0.1	<1	IR	
Benzo[a]pyrene	0.0	<1	IR	
Phenanthrene	0.1	<1	IR	
Others				
MBAS	14400.0	51.2	281.2	Assume no retardation, exceedances at "Cathedral" and in vicinity of current processes

Table 5.7: Groundwater Tier 3 Criteria – South of Site (Sandwith Beck Model)				
Substance	**Maximum Observed (µg/l)**	**Hazard Index**	**Tier 3 GW Criteria (µg/l)**	**Comments**
TPH	61500	<1	IR	
Metals				
Arsenic	90	1.2	73.5	Exceedance WS141
Cadmium	10	2.0	5.1	Exceedance WS150
Chromium	83	41.4	2.0	Exceedance WS157, WS164, WS411 & WS412
Copper	60	120.0	0.5	Exceedances in a number of locations
Nickel	90	4.5	19.8	Exceedance WS150, WS152
Selenium	43	4.3	10.0	Exceedance WS150
Phosphorous	13820	6.3	2209.2	Exceedance WS135 & WS156
Zinc	8478	1059.7	8.0	Exceedances in a number of locations. Very high concentration at WS411 in area where there may be considerable hydrocarbon contamination
Iron	2741	2.1	1289.4	High contamination at WS162 (the tank washing area) and WS412

Table 5.7: Groundwater Tier 3 Criteria – South of Site (Sandwith Beck Model)				
Substance	**Maximum Observed (µg/l)**	**Hazard Index**	**Tier 3 GW Criteria (µg/l)**	**Comments**
Semi-Volatile Organic Compounds				
Acenaphthylene	0.16	<1	IR	
Benzo[a]anthracene	0.52	<1	IR	
Benzo[a]pyrene	0.68	<1	IR	
Benzo[b]fluoranthene	0.56	<1	IR	
Benzo[g,h,i]perylene	0.42	<1	IR	
Benzo[k]fluoranthene	2	<1	IR	
Dibenzo[a,h]anthracene	0.15	<1	IR	
Indeno[1,2,3-cd]pyrene	0.39	<1	IR	
Phenanthrene	0.57	<1	IR	
Others				
MBAS	116000	539.6	215.0	Assuming no retardation, exceedances at three isolated "hotspots".

5.3.2. Shallow and Deep Contaminated Groundwater through the Deep Aquifer System

The primary pollutant linkages have been described previously and are related to the historical spillage of chemicals on site or leakages from the drainage system, migrating within the complex subsurface environment, with this migration being influenced by:

- natural solution features in the subsurface geology (e.g. the St Bees Evaporites);
- enhanced solution features created by acid spills in all formations, particularly the made ground, Boulder Clay and St Bees Shales;
- the location of infilled and abandoned mine adits and roadways (coal mines and anhydrite mine). These may be acting as sinks to the contamination originating at ground surface, with a slow release of contamination from storage along the Byerstead fault; and
- the apparently highly conductive Byerstead Fault.

The main receptor from deep groundwater migration is the coast at the Byerstead fault and the Bell House Gill. In addition, the groundwater of the major aquifers in the vicinity of the site is considered a controlled waters receptor: St Bees Sandstone and St Bees Evaporites.

Approach

The pollutant linkages between the site and the Byerstead Fault discharge and the Bell House Gill are, therefore considered hydrogeologically complex and greatly influenced by anthropogenic influences. The use of analytical models defining the pathway as adopted for the shallow migration models were not considered appropriate and, therefore, the development of a unique risk assessment model was considered preferable.

A mass balance approach was developed to simulate the potential mechanisms along the complex pathways. Each contaminant and water mass flux term is characterised and the overall mass/water balance used to establish the likely range of contaminant concentrations of water discharged via the Byerstead fault.

A mass balance approach has been adopted for a number of reasons, including:

- the contaminant migration velocities between the site and the fault are known to be extremely fast, as a result of tracer experiments conducted by URS and, therefore, the majority of contaminant migration from the site drainage system will be through "conduits" within the sub-surface, where the primary attenuation mechanisms will be dilution with other waters within the conduits;

- a key question that the Environment Agency and URS have with regards to mass balance is that the sum of the known sources does not add up to the observed water discharging via the Byerstead Fault to the beach. Accounting for these uncertainties will form an integral part of this risk assessment; and

- the development of a mass balance approach is relatively simple and easily understood. The adoption of more complex 3-dimensional modelling may be something that is considered in the future. However, complex modelling will require a more accurate understanding of the contaminant migration mechanisms and the parameters that influence the migrations, which are not available at present.

There are, however, a number of limitations with this model, particularly in relation to confidence in the contributing areas from each source of water that may be discharging to the Byerstead fault. These limitations are fully described and tested in Appendix D.

Results

The simulated concentrations have been compared with monitoring results at the Byerstead Fault and Bell House Gill. Relatively accurate results were achieved for the Byerstead fault. However at the Bell House Gill the accuracy of the results are not known because of the very high level of uncertainty in understanding the transport mechanism between the site and the river.

Based on the comparison of simulated concentrations with the relevant standards (UK drinking water standards and environmental quality standards[4]), there are five key contaminants of concern

- Sulphate, though this is related to the anhydrite mine and not related to the site;
- Iron
- Copper
- MBAS/surfactants
- TPH (including PAHs)

In order to assess the residual contamination of groundwater at the site, the model was re-run without the additional MBAS input from the surface processes. In effect, this is a more realistic assessment of the future risks of surfactants at the Byerstead fault and the Bell House Gill. With the removal of the surface processes, the impacts of the surfactants at the two main receptors is likely to reduce substantially – from 28.4mg/l to 1.5 mg/l and 337.9 mg/l to 2.5 mg/l at the Byerstead fault and Bell House Gill respectively. With continued infiltration of rainfall recharge through the site soils and shallow groundwater the residual surfactants will be quickly washed out of the subsurface.

Conclusions

Based on the deep groundwater transport model developed for this study, the following key conclusions can be made:

- The concentrations of contaminants, primarily surfactants, discharging at the Byerstead fault is sourced from surface process and residual shallow groundwater contamination directly beneath the site. In particular the key contributor to the Fault is the continuing surface process which leaks through voids and other rapid pathways to the Byerstead fault.
- The low levels of MBAS observed in the Bell House Gill in April 2005 indicate that a pollutant linkage between the site and this surface water body exists. The mechanism of migration is uncertain, although the mass balance model has been set up to indicate the likely level of groundwater concentrations entering the surface water from the site.
- The St Bees Evaporites solution-fracture system and St Bees Sandstone formations are rapid pathways, with little residual contamination held in storage that will be a long-term risk to receptors.

[4] It is worth noting that not many EQS are currently available.

- It is unlikely that the minewater discharge is as significant a contributor to the Byerstead fault as the site in terms of flow and mass flux. However, there could be considerable mass in storage which is currently camouflaged by the near surface process losses.

- The model and sensitivity analysis indicates that with the cessation of surface processes over the next 12 to 18 months, there will be a considerable reduction on surfactant concentrations at the Fault and the Bell House Gill. Monitoring will need to be continued, however, to both prove this and establish more accurately the contributions from storage within the mine system that may exist.

Overall, although MBAS is shown to exceed relevant standards, the most appropriate remedial approach is to continue monitoring the receptors and the deep aquifer system as Huntsman reduces and ultimately ceases operations on site.

5.4. Summary of findings with respect to Part IIA significant pollutant linkages

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
Petroleum Hydrocarbons in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*TPH contamination of soils in three locations across the site (refer to Figure 12) may result in the pollution of controlled waters and, therefore, should be remediated*
Poly Aromatic Hydrocarbons in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*Naphthalene concentrations in soils exceed the controlled water risk assessment criteria, which may require remediation. However, no observations of naphthalene in groundwater was observed suggesting that the partitioning of soil contamination to water is too conservative and that actual risks are unlikely to exist* *A number of poly-aromatic hydrocarbons in soil in the south east of the site and the tank washing area exceed human health risk assessment criteria and, therefore, may require to be remediated*
Surfactants in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant levels of MBAS located in soil. High levels of MBAS in groundwater considered to be associated with localised areas of leakage from drains.* *The high levels of MBAS at the Byerstead fault should decline once Huntsman cease operations. Similarly, the cessation of productions at the site will break the pollutant linkage between the site and the surface water at Bell House Gill, although in the latter the mechanisms of*

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
	contaminant transport from the site to the Bell House Gill is not known
Phosphates in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*Phosphates were measured in soils and groundwaters across the site. Levels of phosphates observed at the Byerstead fault appear to be much higher than those observed in site groundwaters, leading to the interpretation that the source of phosphate to the Byerstead spring is the site effluent drainage system. Cessation of operations should result in observable reductions of phosphate in the Byerstead spring.*
Arsenic in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from arsenic in soil impacting controlled waters identified. Similarly no risks from arsenic calculated to impact human health (on and off site workers and off site residents)*
Boron in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from boron in soil impacting controlled waters identified. Similarly no risks from boron calculated to impact human health (on and off site workers and off site residents)*
Cadmium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from cadmium in soil impacting controlled waters identified. In addition, no impacts of cadmium concentrations soil observed in shallow groundwater beneath the site. Similarly no risks from cadmium calculated to impact human health (on and off site workers and off site residents)*
Chromium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from chromium in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of chromium concentrations soil observed in shallow groundwater beneath the site Similarly no risks from chromium calculated to impact human health (on and off site workers and off site residents)*
Copper in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from copper in soil impacting shallow controlled waters identified over the next 200 years. Theoretical impacts through Byerstead fault to the coast simulated in the risk assessment, but not measured in practice.* *No risks from calculated to impact human health (on and off site workers and off site residents)*

Copeland Borough Council Pollutant Linkage	***Findings from Phase II investigations and Quantitative Risk Assessment***
Lead in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from lead in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of lead concentrations soil observed in shallow groundwater beneath the site. Similarly no risks from lead calculated to impact human health (on and off site workers and off site residents)*
Mercury in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No risks from mercury in soil impacting controlled waters identified. .* *Mercury in soils in the north east of the site exceeds human health risk assessment criteria and, therefore, may require to be remediated*
Nickel in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from nickel in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of nickel concentrations soil observed in shallow groundwater beneath the site. Similarly no significant risks from nickel calculated to impact human health (on and off site workers and off site residents).*
Selenium in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from selenium in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of selenium concentrations soil observed in shallow groundwater beneath the site. Similarly no significant risks from selenium calculated to impact human health (on and off site workers and off site residents).*
Zinc in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No significant risks from zinc in soil impacting controlled waters identified over the next 200 years. In addition, no impacts of zinc concentrations soil observed in shallow groundwater beneath the site. Similarly no significant risks from zinc calculated to impact human health (on and off site workers and off site residents).*
VOC's/SVOCs in soil, migrating from soil to groundwater and through drains impacting undefined controlled waters receptor.	*No VOC's or SVOCs in soil found to be impacting controlled waters receptors or human health.*

6. MINE SHAFT INSPECTION

URS was asked to carry out a walkover survey of the mineshafts that lie on land currently occupied and owned by Rhodia. Of the six mineshafts identified from available plans and reports, one, known as Wilson, falls on land no longer owned by Rhodia, as does the Anhydrite mine airshaft located at approximately 900m south-west of the site. The remaining four were surveyed on Tuesday 5th April 2005, the results of which are presented in the table below.

Mine Shaft	Location (BNG)	Description and Comments
Anhydrite Mine Airshaft	NX 9586 1464	Land not owned by Rhodia therefore not inspected
Croft	NX 9660 1588	No visible mineshaft or cap and no visible area of subsidence to indicate weakness in the existing cap. This area is currently covered in compacted brick and concrete rubble from demolition works. It is understood from Fred Proud of Rhodia that this shaft was well capped because it was proposed to develop and build upon the area above. It was not possible to see the state of the cap beneath the rubble.
Fox	NX 9688 1560	The walkover survey indicated that there is no immediately distinguishable mineshaft or cap in this location. The area lies within the currently fallow field on the eastern side of High Kells Road, opposite the DEW and Research Building. A mound of overgrown rubble adjacent to the footpath with two thick yellow plastic pipes of approximately 200mm diameter protruding from the mound, was the only indication that a shaft may be present. No visible opening or area of subsidence is apparent. Two additional thick plastic yellow pipes, potentially for sampling, were also identified in the north-west corner of the same field at NX 9684 1582, though it was not clear whether these were related to the mineshafts in this area.
Gamerigs	NX 9702 1574	This shaft is located within the same field as the Fox shaft, though it lies approximately 140m to the east in a rectangular area currently overgrown with brambles. A brick and steel structure remains, which, in plan view, has a rectangular shape in a generally east-west direction with wing walls on the western side of the rectangle. Where these wing walls join the main rectangular structure, a thick steel structure, possibly the remains of a doorframe or support, crosses between them forming a steel shelf at seat height. The brick structure itself is approximately 0.7m high from grass to top, with the wing walls at approximately 1.0m high. The centre of the brick structure appears to be filled in to around 0.45m below the top level with soil and it is grassed.

Mine Shaft	Location (BNG)	Description and Comments
		There is no visible entrance to a shaft and no sign of subsidence around any of the structure. The remains of the structure appear robust, though it is obviously used by local inhabitants in some way as indicated by discarded cans which have been used as airgun targets and evidence of fire.
Ladysmith	NX 9654 1588	Like the Croft shaft, it is understood that this shaft was well capped as it was built upon with newer areas of plant. No visible shaft cap or entrance was apparent during the walkover survey, though a number of concrete plinths, with the remains of thick metal T and H bars were noted which may have once supported the above ground machinery above the shaft. The area is on the edge of the road, which once bordered the Phosphoric Acid storage tanks and the surrounding area has been levelled and consists of compacted brick and concrete rubble.
Wilson	NX 9702 1530	Land no longer owned by Rhodia therefore not inspected.

The walkover survey of these mineshafts indicates that none of the mineshafts on Rhodia land are in a state where there is an obvious path into the previous mine workings. Of the four shafts on Rhodia's land Gamerigs is the only shaft with any remaining structure that could indicate the presence of a mineshaft in the area, if you discount the presence of the yellow sampling pipes associated with Fox shaft.

The Fox and Gamerigs shafts are also located where access by the public currently occurs, as dog walkers were seen walking their pets in these fields from the nearby Woodhouse estate.

7. CONCLUSIONS AND RECOMMENDATIONS

The principal aim of this Phase II Investigation of the Former Albright & Wilson Whitehaven facility was to develop a comprehensive understanding of the contaminated land issues at the site. The site is potentially destined for a recreational 'right to roam' end use, and the assessments carried out by URS for this study are based upon this proposed end use.

Rhodia ceased operations at the site in the late 2001 and have since been decommissioning large areas of the site. Huntsman currently lease part of the site from Rhodia to operate their surfactants business, although operations have significantly reduced over 2005. It is understood that all the remaining buildings are likely to be demolished to slab level as part of a decommissioning programme.

The assessments carried out have drawn upon information gathered from several phases of previous site investigation carried out by URS since the mid 1990s, data provided within Huntsman's IPPC application and from correspondence and discussion with environmental regulators over the years.

The current study has comprised:

- a desk study to characterise potential sources of contamination and identify data gaps in the conceptual site model (CSM);
- a targeted soil and groundwater investigation involving trial pitting, borehole drilling and shallow well installation;
- sampling and laboratory analysis of soils, shallow and deep groundwater and off-site surface water receptors for potential contaminants of concern;
- refinement of the CSM; and
- Tier 2/3 Quantitative Risk Assessments to evaluate potentially significant risks to human health and controlled waters receptors.

The conclusions and recommendation from these studies are presented in the sections below.

7.1. Conclusions

Based on the update of the conceptual site model and pollutant linkages a detailed human health and controlled waters risk assessment was conducted. Based on this risk assessment, the following conclusions have been drawn:

- Mercury in soils in the north east of the site and a number of poly-aromatic hydrocarbons in soil in the south east of the site and the tank washing area exceed human health risk assessment criteria and, therefore, may require to be remediated;

- TPH contamination of soils in three locations across the site (refer to Figure 12) may result in the pollution of controlled waters and, therefore, should be remediated;

- Naphthalene concentrations in soils also exceed the controlled water risk assessment criteria, which may require remediation. However, no observations of naphthalene in groundwater were recorded, suggesting that the modelled partitioning of soil contamination to water is too conservative and that actual risks are lower than estimated by the model.

- The high levels of MBAS at the Byerstead fault should decline once Huntsman reduce on-site operations. Similarly, the cessation of most of the processes at the site will break the pollutant linkage between the site and the surface water at Bell House Gill, although in the latter the mechanisms of contaminant transport from the site to the Bell House Gill are not known.

Although across the majority of the site, sufficient soil and groundwater data exists to be able to make an initial assessment of potential environmental issues associated with the site, selected areas of the site could not be investigated in sufficient detail due to continuing Huntsman operations (e.g. the former coke works area beneath the Imidazoline Plant) and will require further investigation following cessation of operations.

7.2. Recommendations

Appropriate remedial action may comprise one or more of: excavation of shallow hotspots of soil contamination and disposal of these in a suitable licensed landfill; bioremediation; soil washing and thermal desorption. Based on our analysis of the data the average volume of contaminated soil that may need to be removed is likely to be approximately 10,000 – 15,000 m^3, although this could rise considerably when new areas of the site are decommissioned and investigated (possibly as high as 50,000m^3).

For shallow groundwater, particularly in the south of the site, there is a slight risk that some limited shallow groundwater remediation (for TPH) could be necessary, such as a short term pump and treat system. Further boreholes are required to delineate the areas of shallow groundwater contamination in three locations before the need for any such system can be fully assessed.. Overall, however, most of the observed shallow groundwater contamination is related to above ground operations and the existing drainage system. Given that site operations are due to substantially reduce between 2005 and 2007, on-going monitoring of shallow groundwater quality is considered the most appropriate cost-effective remedial action for shallow groundwater, in terms of effectiveness and durability.

Similarly, it is considered that the best practical and economic approach for the management of contamination within the deep groundwater, is a monitoring strategy over at least the next 2-3 years of the deep groundwater monitoring wells and surface water receptors. The results of the risk assessment suggest that water quality is likely to improve following cessation of on-site operations. However, it is possible that the Environment Agency may require additional deep monitoring points to be installed and for the monitoring to be extended for a number of years.

As the sites are decommissioned it is important that further soil and groundwater samples are taken and compared with the risk based criteria developed in these studies and appropriate actions. Therefore, as more and more of the site is decommissioned, soil contamination will be dealt with at the same time, potentially reducing the cost of remediation as it is an integral part of the decommissioning work. Should concentration of contaminants in groundwater greatly exceed the thresholds defined in this report, the monitoring strategy will need to be revisited.

ooOOoo

Figure 1 Site Location

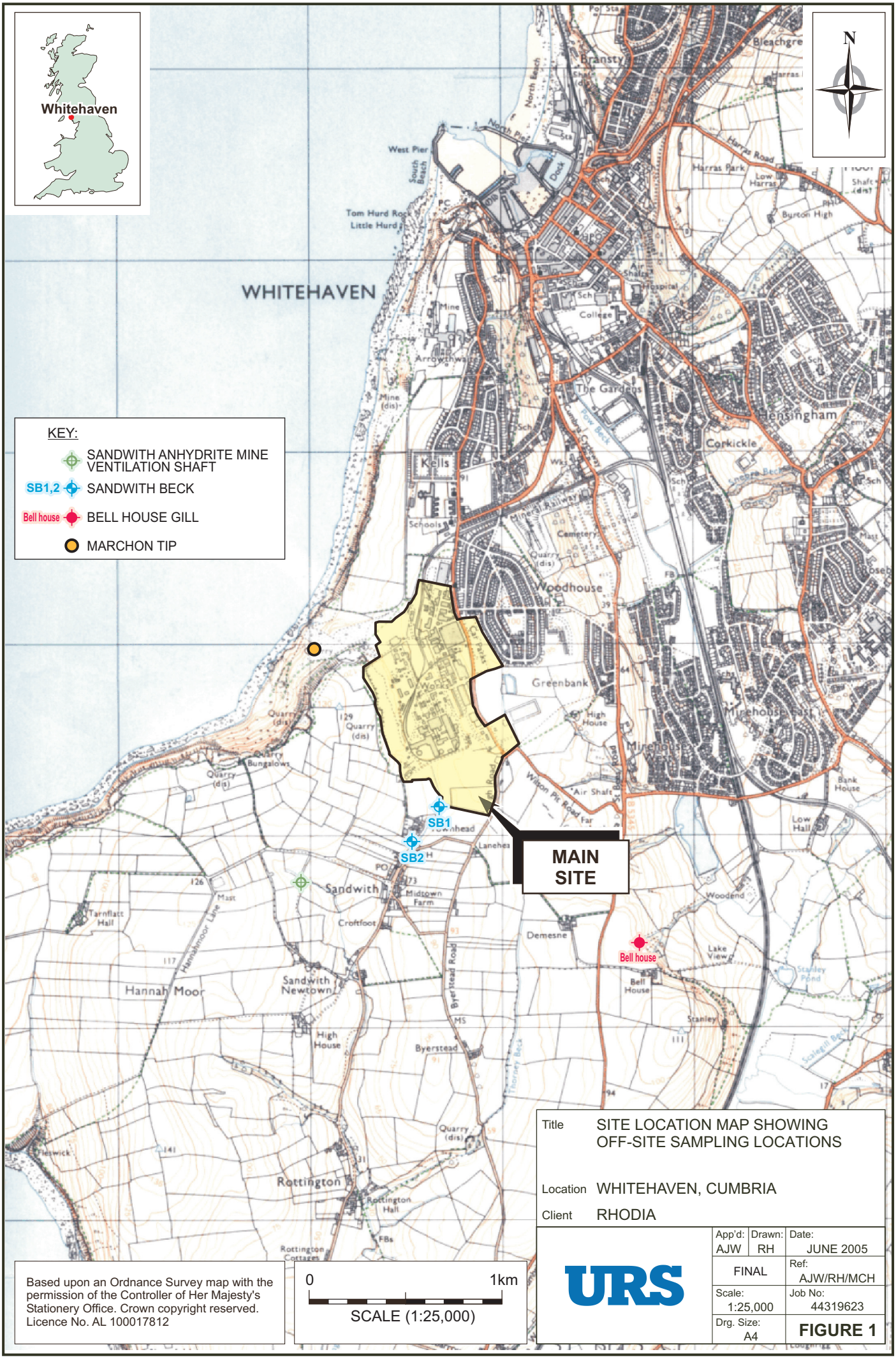
Whitehaven
N
WHITEHAVEN
KEY:
SANDWITH ANHYDRITE MINE VENTILATION SHAFT
SB1,2 SANDWITH BECK
Bell house BELL HOUSE GILL
MARCHON TIP
MAIN SITE
SB1
SB2
Bell house
Based upon an Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office. Crown copyright reserved. Licence No. AL 100017812
0
1km
SCALE (1:25,000)
Title SITE LOCATION MAP SHOWING OFF-SITE SAMPLING LOCATIONS
Location WHITEHAVEN, CUMBRIA
Client RHODIA
URS
App'd: AJW
Drawn: RH
Date: JUNE 2005
FINAL
Ref: AJW/RH/MCH
Scale: 1:25,000
Job No: 44319623
Drg. Size: A4
FIGURE 1

Figure 2 Site Characterisation and Current/Historic Sampling Locations

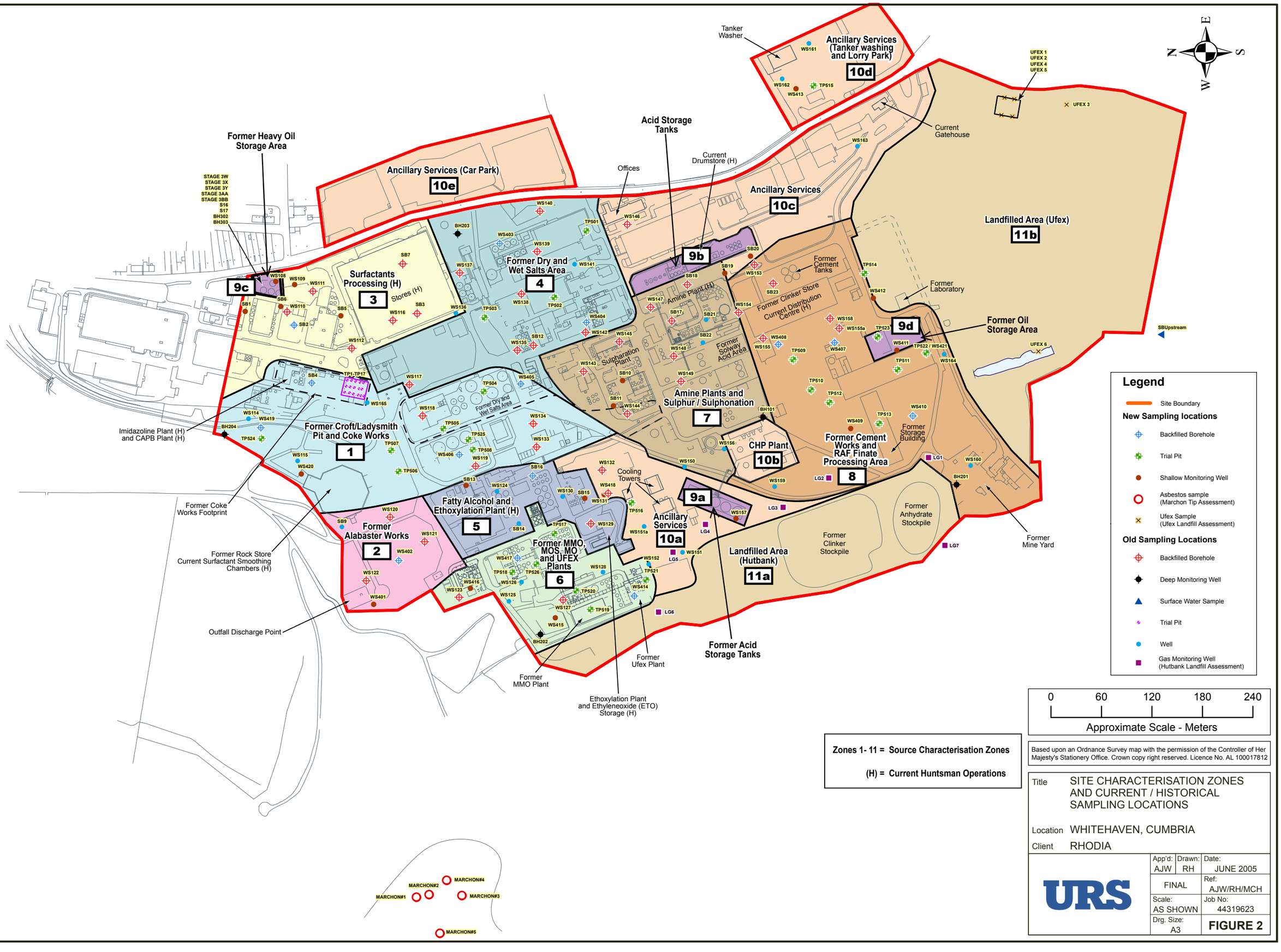
Former Heavy Oil Storage Area
Ancillary Services (Car Park) 10e
Acid Storage Tanks
Tanker Washer
Ancillary Services (Tanker washing and Lorry Park) 10d
Current Gatehouse
Offices
Current Drumstore (H)
Ancillary Services 10c
Landfilled Area (Ufex) 11b
Former Cement Tanks
Former Laboratory
Former Oil Storage Area
Former Clinker Store
Current Distribution Centre (H)
Former Dry and Wet Salts Area 4
Surfactants Processing (H) 3
Stores (H)
9c
9b
9d
Amine Plant (H)
Former Soiway Acid Area
Sulphuration Plant
Amine Plants and Sulphur / Sulphonation 7
CHP Plant 10b
Former Cement Works and RAF Finate Processing Area 8
Former Storage Building
Former Croft/Ladysmith Pit and Coke Works 1
Imidazoline Plant (H) and CAPB Plant (H)
Former Coke Works Footprint
Former Rock Store Current Surfactant Smoothing Chambers (H)
Fatty Alcohol and Ethoxylation Plant (H) 5
Cooling Towers
9a
Ancillary Services 10a
Former Alabaster Works 2
Former MMO, MOS, MO and UFEX Plants 6
Landfilled Area (Hutbank) 11a
Former Clinker Stockpile
Former Anhydrate Stockpile
Former Mine Yard
Former Acid Storage Tanks
Former Ufex Plant
Former MMO Plant
Ethoxylation Plant and Ethyleneoxide (ETO) Storage (H)
Outfall Discharge Point
UFEX 1
UFEX 2
UFEX 4
UFEX 5
UFEX 3
UFEX 6
SBUpstream
MARCHON#1
MARCHON#2
MARCHON#3
MARCHON#4
MARCHON#5
N
E
S
W
Legend
Site Boundary
New Sampling locations
Backfilled Borehole
Trial Pit
Shallow Monitoring Well
Asbestos sample (Marchon Tip Assessment)
Ufex Sample (Ufex Landfill Assessment)
Old Sampling Locations
Backfilled Borehole
Deep Monitoring Well
Surface Water Sample
Trial Pit
Well
Gas Monitoring Well (Hutbank Landfill Assessment)
0 60 120 180 240
Approximate Scale - Meters
Zones 1- 11 = Source Characterisation Zones
(H) = Current Huntsman Operations
Based upon an Ordnance Survey map with the permission of the Controller of Her Majesty's Stationery Office. Crown copy right reserved. Licence No. AL 100017812
Title SITE CHARACTERISATION ZONES AND CURRENT / HISTORICAL SAMPLING LOCATIONS
Location WHITEHAVEN, CUMBRIA
Client RHODIA
URS
App'd: AJW
Drawn: RH
Date: JUNE 2005
FINAL
Ref: AJW/RH/MCH
Scale: AS SHOWN
Job No: 44319623
Drg. Size: A3
FIGURE 2

Figure 3 Annotated Geological Map

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Saltom Bay

MARCHON TIP

A
A'
B
B'
C
C'
D
D'
E
E'
F
F'

KEY:

- Marchon Tip
- Site boundary
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporites
- Brockram
- Whitehaven Sandstone
- Middle Coal Measures
- Line of geological cross section
- Fault line
- Absence of Drift
- Geological Boundary
- Suspected Fault (not on 1:10,000 map)

0 100 200 300 400 500m

APPROXIMATE SCALE

Title ANNOTATED GEOLOGICAL MAP

Location WHITEHAVEN, CUMBRIA

Client RHODIA

URS

App'd: AJW	Drawn: RH	Date: JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: AS SHOWN		Job No: 44557-045-787
Drg. Size: A3		FIGURE 3

Figures 4 – 9 Geological Cross Sections A to F

A South West

A' North East

SITE

Ladysmith shaft (offset) 400m NW of section line (shaft capped and filled 1977)

Much of the site overlain by boulder clay. Anecdotal evidence for extensive voids in this and underlying St Bees Evaporites. This represents a potential pathway for contamination of minewater by surfactants.

Sandwith mine main adits (stopped in 1987). Anhydrite mine adits thoroughly stopped.

Sandwith mine entrance

BYERSTEAD FAULT

26m

18m

BYERSTEAD FAULT

NWEB Borehole

BH201

BHZ4

BH101 230m NORTH EAST

LADYSMITH SHAFT

ROAD

+11m on (26:7:2000)

Water level prior to pump test of anhydrite mine is potential water resource for site

-7m on (8:8:2001)

Water level after 2 week pump test

During operation of Sandwith anhydrite mine, only major source of water ingress (270-675 1/min) was intersection of adits with Byerstead Fault.

Mine in continuity with fault.

Main band goaf (roof collapse) 1920

POSSIBLE FAULT

Main Band in Ladysmith shaft at -110m

Main and Bannock fully worked from Croft and Ladysmith pits on north east side of Byerstead Fault. Ladysmith pit closed and flooded 1933.

-178m on (28:6:1977)

Water level measured prior to filling and capping of Ladysmith shaft

mAOD: 100, 80, 60, 40, 20, 0, -20, -40, -60, -80, -100, -120, -140, -160, -180, -200, -220

GEOLOGY KEY:

- Boulder Clay
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporites
- Brockram
- Whitehaven Sandstone
- Coal Measures

Unconformity

Fault with throw

0 100 200m

APPROXIMATE HORIZONTAL SCALE

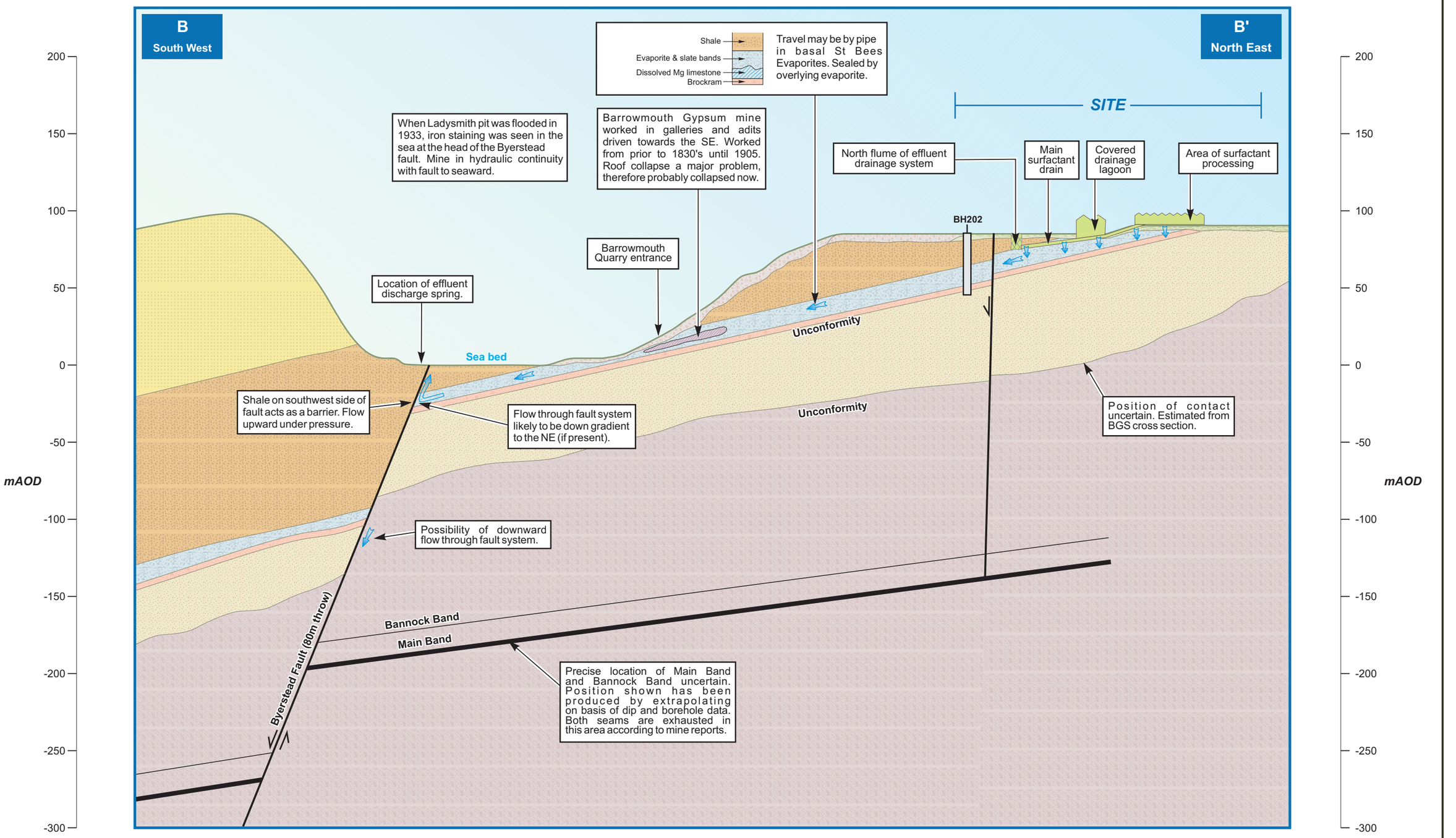
Title: GEOLOGICAL CROSS SECTION A-A'

Location: WHITEHAVEN, CUMBRIA

Client: RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	MARCH 2007
FINAL		Ref: AJW/DB/MCH
Scale: As Shown		Job No: 44319623
Drg. Size: A3		FIGURE 4



GEOLOGY KEY:

- Quarry spoil / landslip
- Boulder Clay (Typically 3-8m thick on site)
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporites
- Brockram
- Whitehaven Sandstone
- Coal Measures

- Areas of surfactant drainage
- Possible entry of surfactant into Limestone

Horizontal Scale 1:5,000

Vertical Scale 1:2,000

0 50 100 150 200 250m

HORIZONTAL SCALE

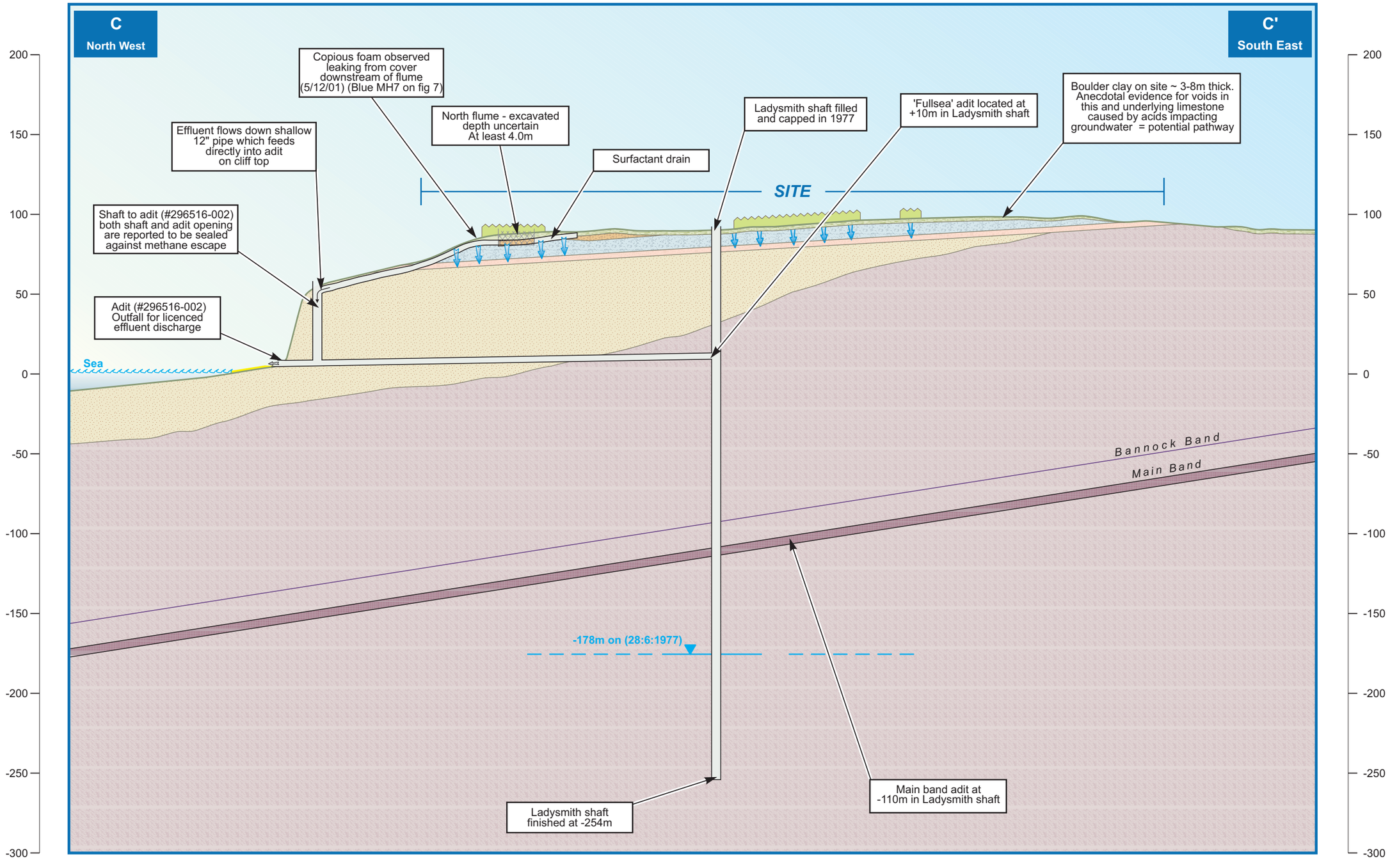
Title GEOLOGICAL CROSS SECTION B-B'

Location WHITEHAVEN, CUMBRIA

Client RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: As Shown		Job No: 44319623
Drg. Size: A3		**FIGURE 5**



GEOLOGY KEY:

- Boulder Clay (Typically 3-8m thick on site)
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporites
- Brockram
- Whitehaven Sandstone
- Coal Measures
- Marl band

- Areas of surfactant drainage
- Possible entry of surfactant into Limestone

Horizontal Scale 1:5,000

Vertical Scale 1:2,000

0 50 100 150 200 250m

HORIZONTAL SCALE

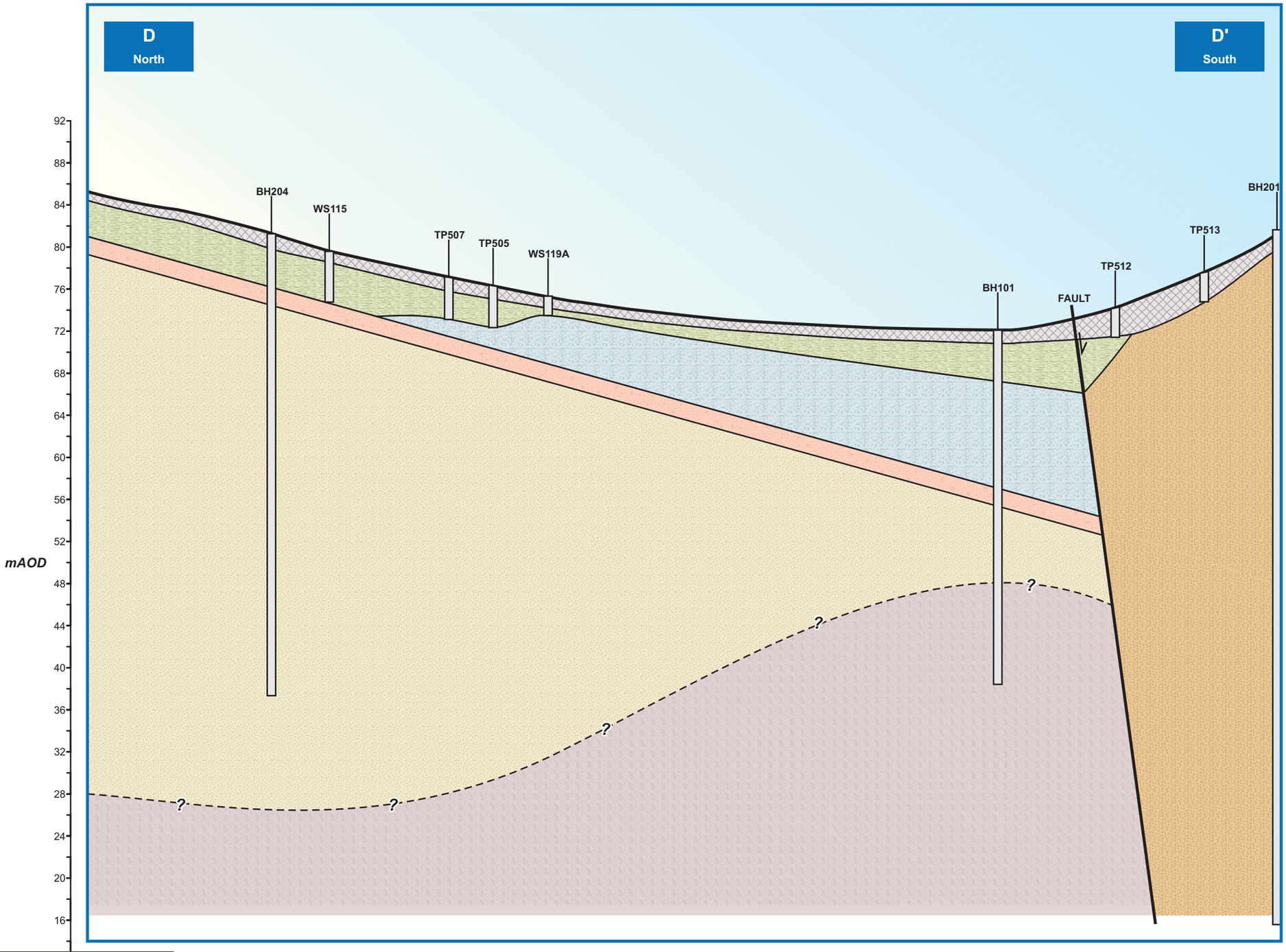
Title GEOLOGICAL CROSS SECTION C-C'

Location WHITEHAVEN, CUMBRIA

Client RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: As Shown		Job No: 44319623
Drg. Size: A3		**FIGURE 6**



GEOLOGY KEY:

- Made Ground
- Boulder Clay
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporites
- Brockram
- Whitehaven Sandstone
- Coal Measures

0 150m

APPROXIMATE HORIZONTAL SCALE

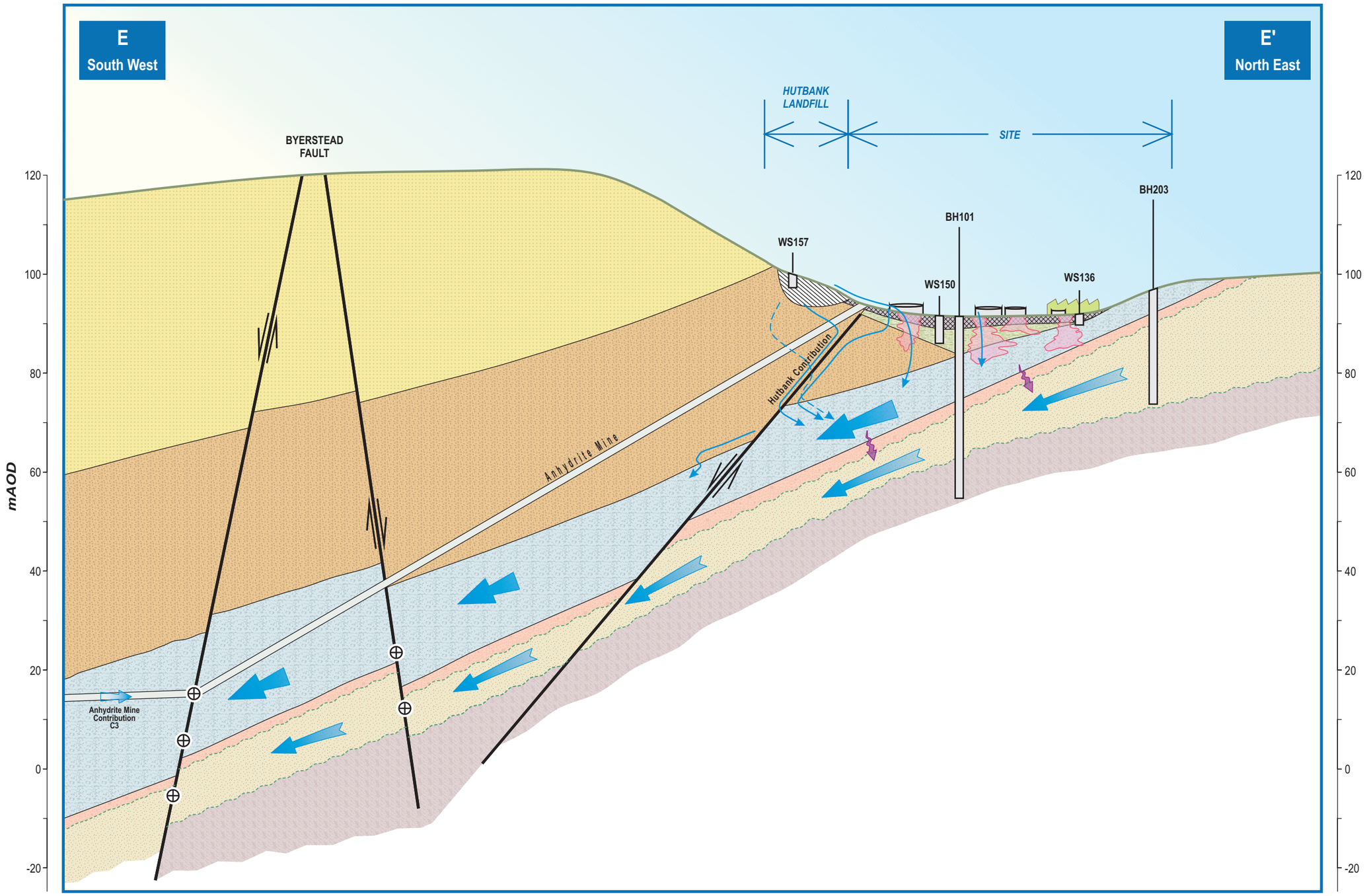
Title GEOLOGICAL CROSS SECTION D-D'

Location WHITEHAVEN, CUMBRIA

Client RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	MARCH 2007
FINAL		Ref: AJW/DB/MCH
Scale: As Shown		Job No: 44319623
Drg. Size: A3		**FIGURE 7**



GEOLOGY KEY:

- ⊕ Contaminant input into fault
- Boulder Clay
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporites
- Brockram
- Whitehaven Sandstone
- Coal Measures

- Unconformity
- Fault with throw

0 100 200 300 400m

APPROXIMATE HORIZONTAL SCALE

Title	SCHEMATIC GEOLOGICAL CROSS SECTION E-E'
Location	WHITEHAVEN, CUMBRIA
Client	RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	MARCH 2007
FINAL		Ref: AJW/DB/MCH
Scale: As Shown		Job No: 44319623
Drg. Size: A3		**FIGURE 8**

F
West North West

F'
East South East

SECTION B-B'

SECTION E-E'

80
70
60
50
40
30
20
10
0
-10
-10
-20
-30
-40
-50
-60

Saltom Bay

Unconformity

Unconformity

DENSE SEAWATER

INTERFACE

FRESH GROUNDWATER

Anhydrite Mine Adits

Rapid migration within fractures of St Bees Evaporities)

Zone of Diffusion

Dense saline waters reducing the amount of water able to pass into coal measures

GEOLOGY KEY:

- Boulder Clay (Typically 3-8m thick on site)
- St Bees Sandstone
- St Bees Shale
- St Bees Evaporities
- Brockram
- Whitehaven Sandstone
- Coal Measures
- Marl band

Arrows represent flow into fault zone

Unconformity

0 100m

APPROXIMATE HORIZONTAL SCALE

Title SCHEMATIC GEOLOGICAL CROSS SECTION F-F' ALONG BYERSTEAD FAULT

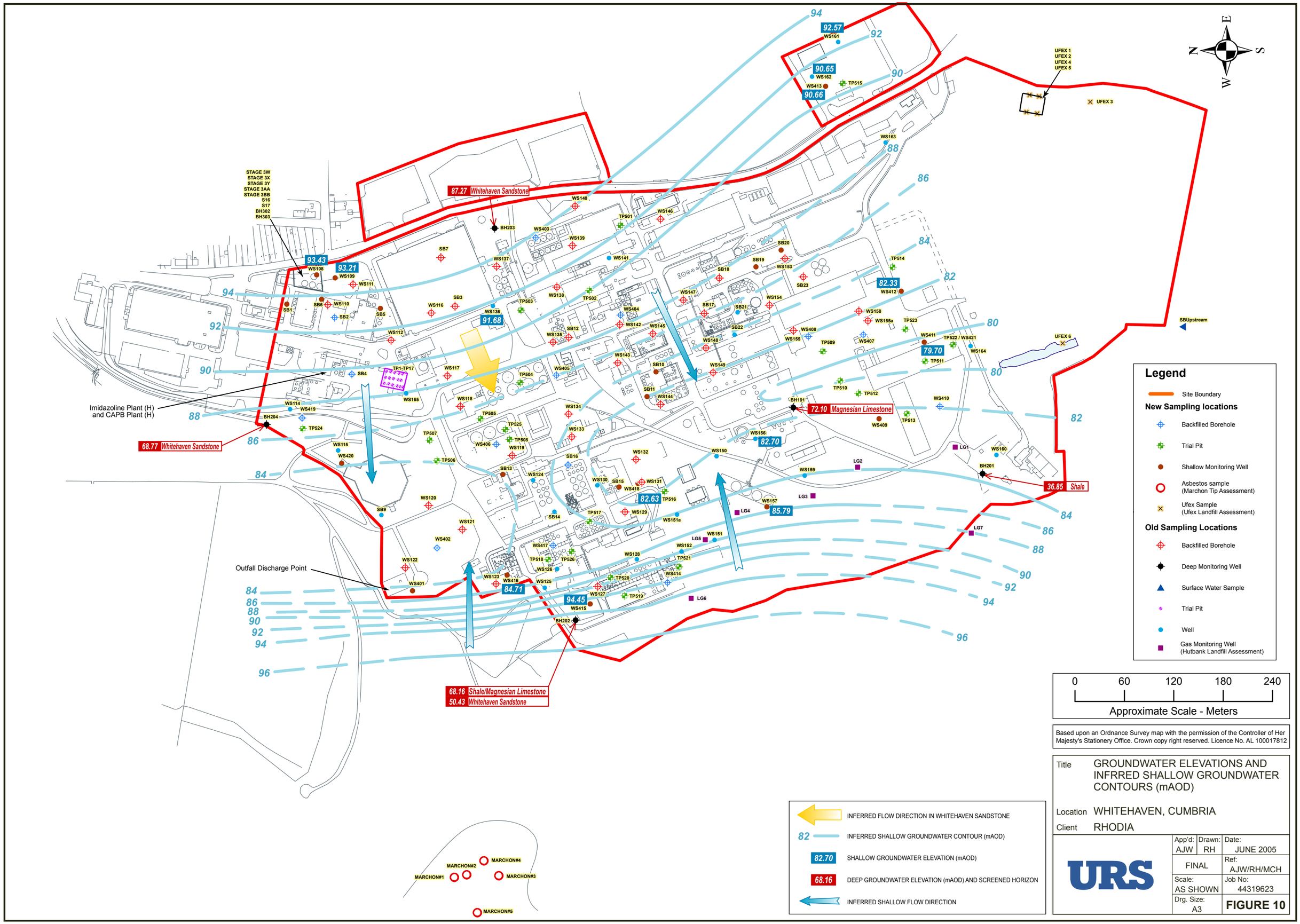
Location WHITEHAVEN, CUMBRIA

Client RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: As Shown		Job No: 44319623
Drg. Size: A3		**FIGURE 9**

Figure 10 Groundwater Elevations and Contour Map



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Title: GROUNDWATER ELEVATIONS AND INFRRED SHALLOW GROUNDWATER CONTOURS (mAOD)

Location: WHITEHAVEN, CUMBRIA

Client: RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: AS SHOWN		Job No: 44319623
Drg. Size: A3		**FIGURE 10**

Figure 11 Potential Pollutant Linkages

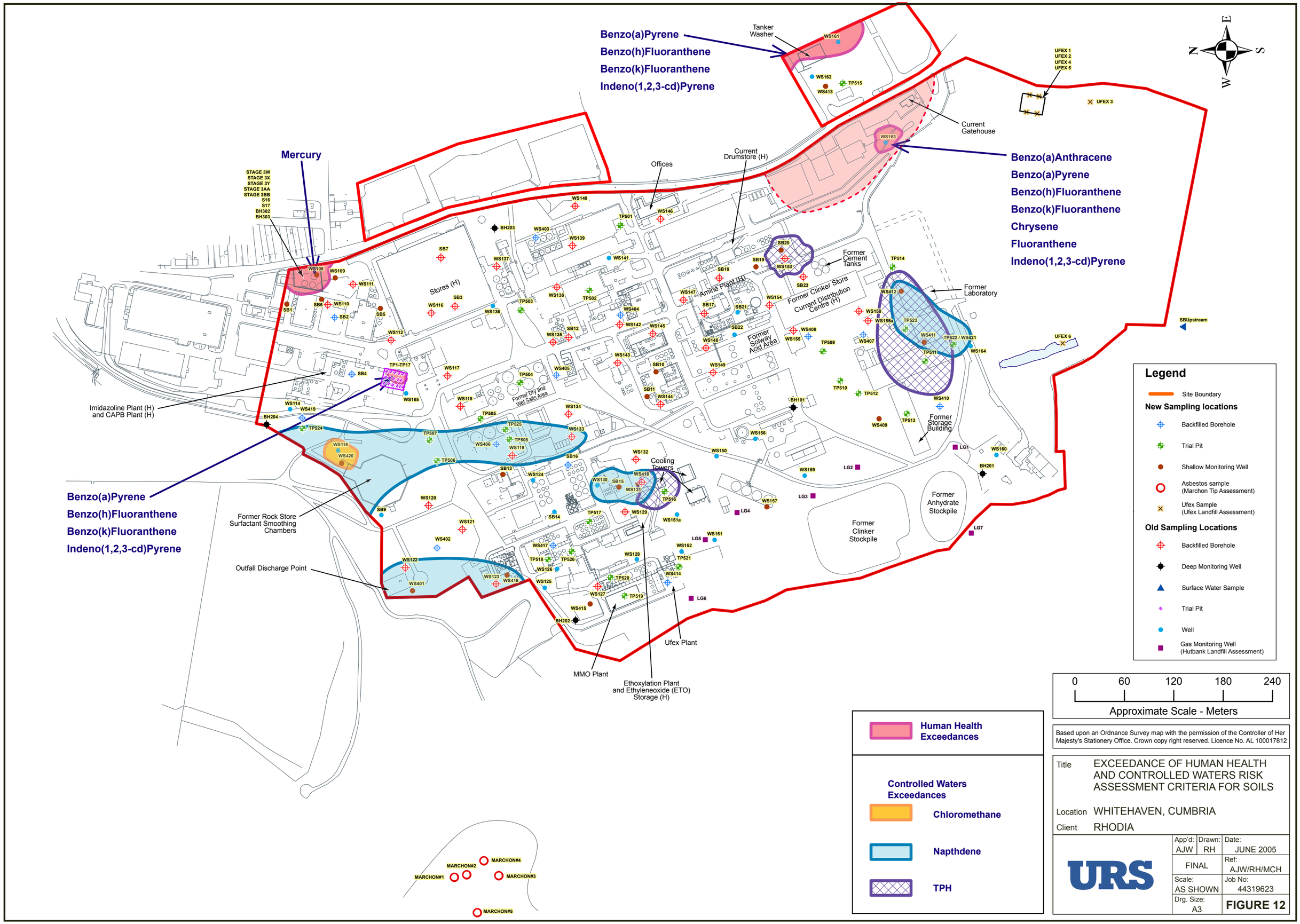
POTENTIAL SOURCES		POTENTIAL PATHWAYS	POTENTIAL RECEPTORS
SOIL	Residual soil contamination from the coke works (e.g. cyanide, sulphur, PAHs, hydrocarbons)	Infiltration of rainwater through contaminated soils and subsequent leaching and vertical movement to groundwater	Groundwater in drift.
	Made Ground	Infiltration of rainwater into on-site landfills generating leachate and subsequent vertical movement to groundwater	Groundwater in St. Bees Shales.
	Residual soil contamination associated with the former Rhodia/Albright & Wilson/ Marchon manufacturing process	Migration of rainwater through the drainage system, possibly resulting in the dissolution of contaminants and/or the mobilisation of contaminants within the drainage bed	Groundwater in St. Bees Evaporites.
	Current soil contamination associated with Huntsman operations	Porous media flow within the shallow aquifer	Groundwater in Whitehaven Sandstone.
GROUNDWATER	Shallow aquifer system	Porous media flow within the deep aquifers	Groundwater in Middle Coal Measures.
	Storage within the St. Bees Shales	Flow within solution features/fractures within the St. Bees Shale and St. Bees Evaporites enhanced by the disposal /leakage of sulphuric and phosphoric acid	Byerstead Spring.
	Storage within the St. Bees Evaporites	Flow within abandoned workings and roadways of the anhydrite mine	Irish Sea coastal waters.
	Storage within the Whitehaven Sandstone	Flow within the workings, roadways and shaft of the abandoned coal mines beneath the site	Sandwith Beck.
MINE STORAGE	Contaminated groundwater stored in the anhydrite mine	Upward flow from Middle Coal Measures	Bellhouse Gill and other eastward streams.
	Contaminated groundwater stored in the coal mines.	Enhanced migration along faults, notably the Byerstead Fault, which may connect the shallow and deeper groundwater systems at the coast	Human Health on-site recreational users;
SITE DRAINAGE	Contaminants associated with the site's drainage system (e.g. encrusted in pipes, associated with sumps)	Flows associated with the consented discharge pipe; potentially flows to ground / groundwater along the route	Human Health off-site residents;
		Landfill gas migration upward to the surface or along preferential routes within the ground	Human Health off-site commercial property to the north (Tamar);
LANDFILLS	UFEX landfill waste/leachate	Dermal contact/ingestion of soil	
	Hutbank landfill waste/leachate/gas	Vapour inhalation from soil and shallow groundwater contamination	
	Marchon Tips waste/leachate	Inhalation of dust from soil contamination	

Title	POTENTIAL POLLUTANT LINKAGES
Location	WHITEHAVEN, CUMBRIA
Client	RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: nts		Job No: 44319623
Drg. Size: A3		FIGURE 11

Figure 12 Tier 3 Exceedences in Soil



Legend

- Site Boundary

New Sampling locations

- Backfilled Borehole
- Trial Pit
- Shallow Monitoring Well
- Asbestos sample (Marchon Tip Assessment)
- Ufex Sample (Ufex Landfill Assessment)

Old Sampling Locations

- Backfilled Borehole
- Deep Monitoring Well
- Surface Water Sample
- Trial Pit
- Well
- Gas Monitoring Well (Hutbank Landfill Assessment)

Human Health Exceedances

Controlled Waters Exceedances

- Chloromethane
- Napthdene
- TPH

0 60 120 180 240

Approximate Scale - Meters

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Title: EXCEEDANCE OF HUMAN HEALTH AND CONTROLLED WATERS RISK ASSESSMENT CRITERIA FOR SOILS

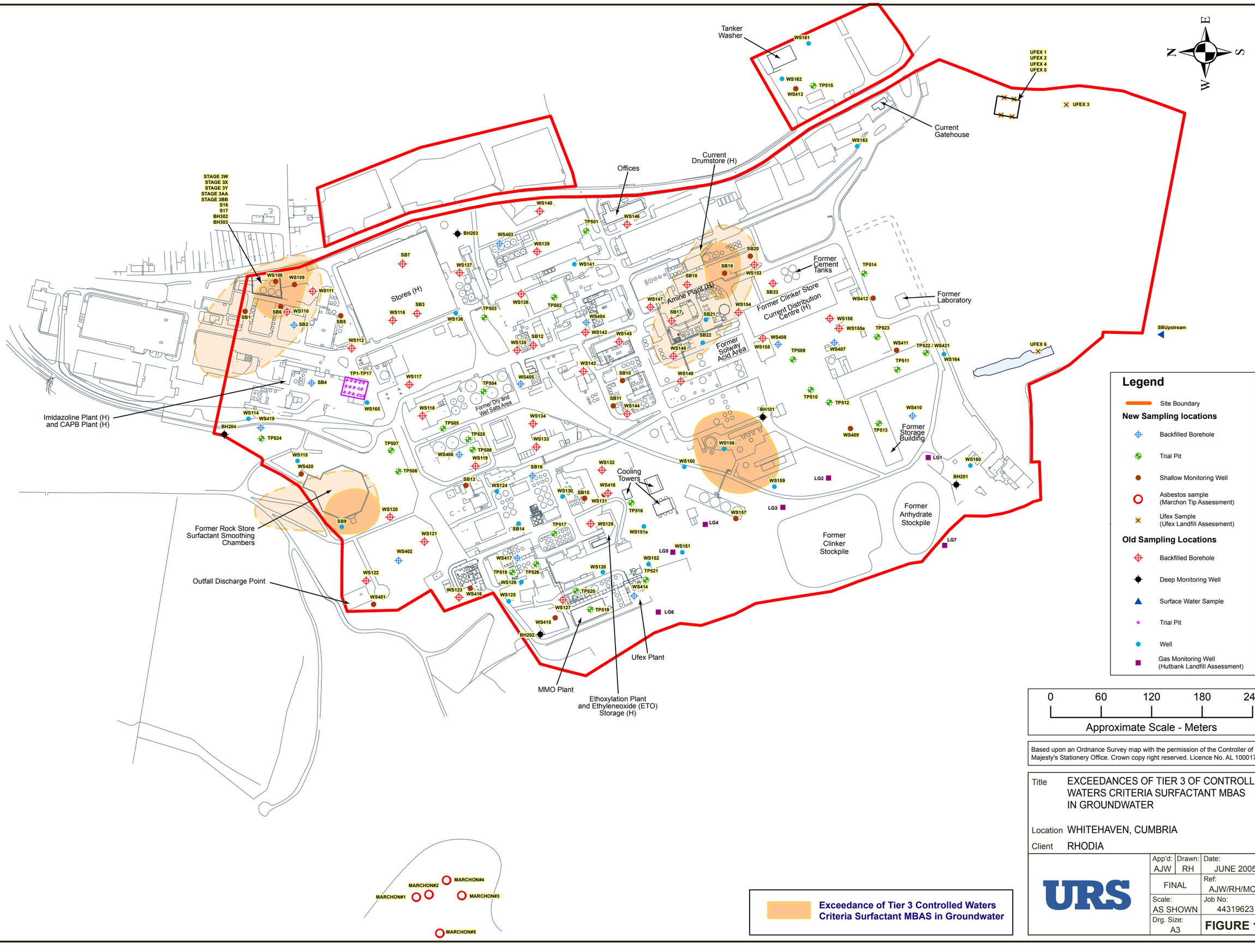
Location: WHITEHAVEN, CUMBRIA

Client: RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: AS SHOWN		Job No: 44319623
Drg. Size: A3		**FIGURE 12**

Figure 13 Tier 3 Exceedences in Shallow Groundwater



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Title: EXCEEDANCES OF TIER 3 OF CONTROLLED WATERS CRITERIA SURFACTANT MBAS IN GROUNDWATER

Location: WHITEHAVEN, CUMBRIA

Client: RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	JUNE 2005
FINAL		Ref: AJW/RH/MCH
Scale: AS SHOWN		Job No: 44319623
Drg. Size: A3		**FIGURE 13**

Appendix A - Borehole and Trial Pit Logs

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: TP501	PAGE 1 of 1
							DRILLING DATES: 23/3/05	DRILLING METHODS : Back hoe excavator
							DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
							LOGGED BY : PM	SCREEN TYPE & DIAM: NA
							CHECKED BY : LCH	SCREEN SLOT SIZE: NA

DESCRIPTION	COMMENTS
Concrete	
End of Borehole	Trial pit abandoned at 0.6m

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP502

PAGE 1 of 1

DRILLING DATES: 23/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Reinforced concrete	
	0.3m		* 0				MADE GROUND: Coarse, angular gravel with common cobbles.	
			* 0		0.5			Damp, NVO
			* 0				MADE GROUND: Black, slightly silty sand with occasional medium gravel.	
					1.0		Brown, soft-firm, sandy CLAY with black streaking.	
			* 0		1.5			
							Becoming reddish brown at 2.1m.	
			* 0		2.0			
					2.5		Medium gravel is common. Gravel is subrounded -subangular. Clay becoming stiff.	
					3.0			Moist, NVO
					3.5		Orange brown, soft, silty CLAY with black mottling.	Moist, NVO
					4.0		Dark grey/black, firm, silty/sandy CLAY with common fine-medium gravel and occasional coarse gravel. Rootlets common.	
			* 0		4.5			Moist, NVO
					5.0		End of Borehole	

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP503

PAGE 1 of 1

DRILLING DATES: 24/03/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Reinforced concrete.	
	0.3m		* 0		0.5		MADE GROUND: Reddish brown, angular cobbles of limestone with minor medium sand.	Dry, NVO
	0.7m		* 0				MADE GROUND: Dark grey/black angular gravel of shale.	
			* 0		1.0		MADE GROUND: Pale brown clayey/silty sand with building rubble and slag	
					1.5		Red brown, loose, sandy CLAY.	
			* 0		2.0		Orange brown, soft, moist sandy CLAY with some black staining. Frequent angular cobbles and occasional boulders.	
			* 0		2.5			Water seeping in at 3.0m with oily sheen visible. Black staining on clay also visible at 3.0m.
			* 0		3.0		Dark grey with orange mottling, very soft, silty CLAY with frequent angular cobbles.	
			* 0		3.5		Refusal at 3.5m	
							End of Borehole	
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: TP504	PAGE 1 of 1
							DRILLING DATES: 24/3/05	DRILLING METHODS : Back hoe excavator
							DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
							LOGGED BY : PM	SCREEN TYPE & DIAM: NA
							CHECKED BY : LCH	SCREEN SLOT SIZE: NA

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete.	
Trial pit abandoned	
End of Borehole	

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP505

PAGE 1 of 1

DRILLING DATES: 24/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.3m		* 0		0.0		MADE GROUND: Grass surface cover. Brown silty sand with angular gravel of limestone, rubble and occasional red brick cobbles.	
			* 0		0.5			Dry, NVO
					1.0		MADE GROUND: Brown, firm, sandy clay (reworked) with occasional pink mottling and black fleks of shale, common angular-rounded gravel , sometimes loose. Occasional boulders and cobbles of sandstone.	Dry, NVO
					1.5			Dry, NVO
					2.0			Dry, NVO
			* 0		2.5		Brown, loose, very sandy CLAY with gravel. Sand is fine-medium and gravel is mostly fine-medium with some coarse gravel. Gravel is subrounded-rounded.	
			* 0		3.0			
					3.5		Stiff, brown, Very sandy, slightly gravelly CLAY (BOULDER CLAY). Gravel is mostly fine-medium and anguar to rounded. Occasional boulders of sandstone and granite. Bedrock or large boulders at 3.6m	
					4.0		End of Borehole	
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP506

PAGE 1 of 1

DRILLING DATES: 24/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Grass surface cover. Sandy clay topsoil.	
	0.3m		* 0		0.5		MADE GROUND: Loose, black, silty, gravelly sand with occasional boulders of black mudstone. Metal pipes and pieces of metal common. Sand is medium-fine. Gravel is medium-coarse and angular-rounded.	Dry, NVO
					1.0			Dry, NVO
			* 0		1.5		Soft, brown sandy CLAY with occassional coal fragments.	
			* 0		2.0		Gravel common. Gravel is angular-rounded and varies from fine-coarse Cobbles (up to 13cm) at 2.3m	
			* 0		2.5		Very gravelly and loose at 2.9m	
			* 0		3.0			
					3.5			
			* 0		4.0			
					4.5			Moist, NVO
					5.0		End of Borehole	

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP507

PAGE 1 of 1

DRILLING DATES: 24/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Grass surface cover. Clayey sand with common coarse gravel.	
	0.3m		* 0				MADE GROUND: Brown, silty sand and gravel with frequent cobbles and boulders of red brick and concrete. Sand is medium. Gravel is medium-coarse and angular.	
					0.5			Dry, NVO
			* 0				MADE GROUND: Stiff, orange brown, slightly sandy clay (reworked).	
							MADE GROUND: loose black sand (probably coal).	
					1.0		MADE GROUND: Loose, dark grey sand with orange mottling and cobbles of rubble.	
					1.5			
			* 0				Soft-firm, occasionally loose, orange brown with pink mottling, sandy CLAY with gravel. Gravel is fine-coarse.	
					2.0			
					2.5		Gravel and cobbles of sandstone very frequent at 2.8m.	
					3.0			
			* 0					
			* 0		3.5		Black staining at 4.0-4.2m	
					4.0			Moist, NVO
			* 0				End of Borehole	
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP508

PAGE 1 of 1

DRILLING DATES: 24/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.4m		* 0		0.0		MADE GROUND: Reinforced concrete.	
							MADE GROUND: Hardcore-angular gravel of limestone up to 10cm.	
			* 0		0.5		MADE GROUND: loose, grey, fine-medium sand with common medium-coarse gravel.	Dry, NVO
			* 0				MADE GROUND: Dark brown/black silty sand with common angular gravel. Gravel varies from fine coarse. Occassional pieces of pipe.	
					1.0		MADE GROUND: Firm, orange brown, slightly sandy clay with common gravel. Gravel is mostly fine-medium with occassional coarse gravel.	Refusal on concrete at 1.25m
					1.5			
					2.0			
					2.5			
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: TP509	PAGE 1 of 1
							DRILLING DATES: 29/3/05	DRILLING METHODS : Back hoe excavator
							DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
							LOGGED BY : PM	SCREEN TYPE & DIAM: NA
							CHECKED BY : LCH	SCREEN SLOT SIZE: NA

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete.	Trial pit abandoned at 0.5m

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP510

PAGE 1 of 1

DRILLING DATES: 29/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.25m		* 0		0.0		MADE GROUND: Brown, firm-stiff, sandy clay with common medium-coarse gravel.	
			* 0		0.5		MADE GROUND: Grey silty sand with gravel of concrete. Gravel is fine-coarse. Frequent cobbles, boulders and metal bars. Soft crumbly white material (probably phosphate rock).	Dry, NVO
			* 0		1.0			
			* 0		1.5			Refusal on metal bars and metal sheets.
					2.0		End of Borehole	
					2.5			
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP511

PAGE 1 of 1

DRILLING DATES: 29/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Brown, loose, clayey fine sand with common medium-coarse gravel and occassional cobbles and boulders. Frequent building rubble (red brick, wood, pieces of metal and concrete boulders).	
	0.3m		* 0		0.5			Dry, NVO
			* 0					
			* 0	1.25m perched on concrete	1.0			
					1.5		MADE GROUND: Reinfirced concrete	
							MADE GROUND: Hardcore-limestone cobbles (10-20-cm diameter).	
					2.0			
					2.5		MADE GROUND: concrete	
			* 64.5				MADE GROUND: Pink grey coarse gravel and cobbles of limestone	
			* 116				Black sandy material in gravel.	Wet, strong diesel odour. Sheen visible on water.
	3.0m		* 99.5		3.0			
					3.5		Blue grey, soft-firm sandy CLAY.	Wet, moderate diesel odour.
			* 26.3					
					4.0		End of Borehole	
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP512

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.4m	⊠	* 0 * 0		0.0		MADE GROUND: Brown, firm sandy clay with common gravel and occassional cobbles (up to 0.2m) and boulders (up to 0.4m). Sand is fine-medium. Gravel is medium to coarse. Gravel and boulders mostly sandstone. Clay is commonly crumbly.	Dry, NVO
			* 0		1.0			Black staining at 1.3m
			* 0 * 0		1.5		MADE GROUND: Grey siltstone rubble with a clayey silt matrix. Gravel and cobbles of siltstone. Gravel is fine to coarse. Wood pieces. White powder (probably phosphate rock).	
					2.0		MADE GROUND: Reinforced concrete. Refusal at 2.3m.	
					2.5		End of Borehole	
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP513

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Firm-stiff, reddish brown, sandy clay with common medium-coarse gravel of sandstone. Gravel varies from angular to rounded. Occassional cobbles up to 0.2m.	
	0.3m		* 0					Dry, NVO
			* 0		0.5			Black staining and rubber like odour at 0.6m
			* 0					
			* 2.4		1.0		MADE GROUND: Clay as above except black with layer of grass and plant material.	Dry, NVO
			* 0				MADE GROUND: Grey brown loose silty sand with frequent fine-medium gravel. Gravel is angular to rounded. Occassional boulders of sandstone and concrete with attached reinforcing wire. Metal rope, pipes and bars.	
	1.4m		* 0		1.5			Dry, NVO
			* 0		2.0			
			* 0					
			* 0		2.5		MADE GROUND: Reinforced concrete - refusal	
					3.0		End of Borehole	
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP514

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Reinforced concrete.	
	0.35m		* 0				MADE GROUND: Dark grey/brown silty sand with white mottling. Common fine-coarse angular gravel of concrete and coarse gravel of a bluish white material (slag). Rare large boulders of slag up to 0.4m.	Dry, sulphurous odour.
			* 0		0.5			
			* 0				MADE GROUND: Black, loose, medium-coarse, angular gravel of black shale with frequent cobbles of black shale.	Dry, NVO
			* 0				Soft, Dark grey, very sandy CLAY. Black shale fragments common. Easily excavated and has loose appearance. Becoming brown at 1.0m Frequent medium-coarse gravel, less sandy and becoming firm at 1.2m.	
			* 0		1.0			
					1.5		Occassional boulders at 1.5m.	Dry, NVO
					2.0		Sandstone boulders at 2.3m (up to 0.3m diameter).	
			* 0		2.5			
					3.0			Moist, brown staining at 3.10m
			* 0		3.5		End of Borehole	
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP515

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.3-0.6m		* 0	Perched water	0.0		MADE GROUND: Tarmac hardstanding.	
			* 0				MADE GROUND: Orange brown medium-coarse angular gravel with minor silty sand.	Dry, NVO
			* 0		0.5		MADE GROUND: Medium-coarse gravel of slag with occassional cobbles of slag. Water present at base of layer of slag.	Wet, diesel odour, sheen on water.
							MADE GROUND: Brown/Black silty sand with shale and limestone fragments. Occassional boulders (up to 40cm) and cobbles (up to 10cm).	
			* 0		1.0			Moist, NVO
							Shale cobbles frequent at 1.5m.	
			* 0		1.5			
							Shale, red brick fragments and pale yellow mottling frequent at 2.2m.	
			* 0		2.0			
					2.5			
			* 0				MADE GROUND: Brown, soft, sandy clay with occassional medium gravel of shale and sandstone. Occasional shells. Piece of glass.	Moist, NVO
			* 0		3.0		Orange Brown, firm, sandy CLAY with pink mottling and frequent medium-coarse gravel. 5cm layer with aboundant shells. Gravel is red mudstone and angular.	Dry, NVO
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP516

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Brown, loose, silty sand with medium-coarse gravel and frequent cobbles of limestone.	Dry, NVO
	0.45m		* 0		0.5		MADE GROUND: Loose, brown, silty sand with medium-coarse gravel of tarmac, red brick and concrete and occassional thin clay layers.	Dry, NVO
	0.8m		* 0				MADE GROUND: Gravel and cobbles of slag . Well compacted, difficult to excavate.	Dry, sulphurous smell.
			* 0		1.0			
			* 0					
			* 0		1.5		Soft-firm very sandy CLAY. Dark brown for top of 0.2m and then orange brown.	
					2.0			Dry, NVO
			* 0		2.5		Becoming gravelly from 2.7m with occassional cobbles. Gravel is medium-coarse.	
			* 0		3.0		Firm-stiff, grey brown, slightly sandy CLAY (possibly boulder clay) with gravel. Gravel mostly medium and subangular to subrounded.	Dry, NVO
					3.5			
							Red brown, well compacted silty sand with angular medium-coarse angular gravel	
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP517

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Brown, loose, medium-coarse, angular gravel with silty coarse sand and common boulders of concrete (up to 0.3m diameter).	Dry, NVO
	0.4-0.6m		* 0		0.5		MADE GROUND: Orange clayey silt (possibly crushed red shale) with common soft white powder (possibly phosphate rock) and slag. Well compacted, hard to excavate. Drainage pipe struck at 0.6m.	Dry, slight sulphurous smell.
			* 0.7					
			* 0		1.0		Firm-stiff, orange brown, slightly sandy CLAY. Occasional medium gravel, coal fragments common.	Dry, NVO
			* 0					
			* 0		1.5		Red brown, fine-medium, angular-rounded GRAVEL with silty medium sand. Occasional clay bands.	
			* 0		2.0			Dry, NVO
					2.5		Sandstone, probably bedrock.	
							End of Borehole	
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP518

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.25m				0.0		MADE GROUND: Reinforced concrete.	Wet, sweet solvent odour under concrete.
	0.4m		* 1149				MADE GROUND: Loose, pale pink, angular coarse gravel with minor silt.	
			* 272		0.5		MADE GROUND: Gravel as above except pale green.	
			* 10.9				MADE GROUND: Gravel as above except dark grey/black	Wet, Sewage like odour.
			* 14.1				Orange brown slightly sandy CLAY.	
			* 404		1.0		Black band at 1.0-1.2m	
			* 45.2				More sandy at 1.5m	
					1.5			Damp, NVO
			* 2.7		2.0			
					2.5			
					3.0		End of Borehole	
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP519

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Reinforced concrete.	
	0.4m		* 16.4	perched water	0.5		MADE GROUND: Grey, loose, coarse gravel with minor fine gravel and sand.	Wet, sweet solvent odour
			* 3.4				Orange brown, loose, very sandy SILT. Easily excavated.	
			* 1.5		1.0			
			0.4					
			* 0.2		1.5			Dry, NVO
			* 13.8					
			* 0		2.0			
			* 0		2.5			
			* 0		3.0		End of Borehole	
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP520

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Light grey/brown medium coarse gravel with medium-coarse sand	Dry, NVO
	0.3m		* 25.7	perched water				
			* 113		0.5		Orange brown sandy CLAY with occasional gravel. Gravel is fine-medium and angular-rounded.	Wet, sweet solvent odour
	0.6m		* 580				Clay is brown with orange mottling from 0.8m.	
			* 331					
			* 115		1.0		Organic layer at 1.4m	
			* 9.1		1.5			Damp, NVO
			* 0.5		2.0			
			* 0.1					
			* 0		2.5			
							End of Borehole	
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP521

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
			* 0		0.0		MADE GROUND: Light brown, loose, sand and gravel. Sand is medium-coarse. Gravel is fine-medium.	Dry, NVO
					0.5		Reddish brown, stiff, sandy CLAY with common fine-medium, angular-rounded, gravel. Black flecks of coal/shale are common.	
	0.7m		* 0.1				Grey/black band at 0.7m.	
			* 0		1.0		At 2.0m clay is very loose when excavated and coarse angular gravel is very frequent .	Dry, NVO
			* 0		1.5			
			* 0		2.0			
					2.5			
					3.0		End of Borehole	
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP522

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.2-0.4m		* 0		0.0		MADE GROUND: Brown, loose, clayey fine sand with frequent medium-coarse gravel and common cobbles (up to 0.2m). Gravel is angular-rounded. Occasional pieces of slag.	Dry, NVO
					0.5		MADE GROUND: Clayey fine sand as above with building rubble, wood pieces and metal wire. Frequent concrete boulders up to 0.8m. Metal and electrical wire and copper pipes.	Metal container leaking black oily water at 1.0m
			* 0		1.0			Dry, NVO
					1.5		MADE GROUND: Reinforced concrete.	
							MADE GROUND: Limestone hardcore (up to 0.1m diameter)	Dry, NVO
			* 0		2.0		MADE GROUND: Red brown silty clay with frequent medium-coarse gravel. Gravel is angular to rounded. White boulders and powder (possibly phosphate rock).	
					2.5			Moist, NVO
			* 0		3.0		Stiff brown sandy CLAY with fine-medium angular gravel.	
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP523

PAGE 1 of 1

DRILLING DATES: 1/4/08	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
			* 0		0.0		MADE GROUND: Tarmac hardstanding	
	0.25-0.4m		* 0				MADE GROUND: Brown, loose, medium-coarse gravel of limestone.	Dry, NVO
							MADE GROUND: Blue material with white mottling (slag).	Dry, sulphurous odour
					0.5		MADE GROUND: Predominantly concrete rubble, boulders up to 0.5mwith medium-coarse gravel and fine-medium silty sand. Gravel black at 0.9m.	
	0.9m		* 42					Damp, diesel odour
			* 140		1.0			
			* 78					
			* 34				MADE GROUND: Firm sandy clay with frequent gravel of red shale. Gravel is medium-coarse and angular. Occasional boulders of shale.	
			* 21		1.5			
							clay becomes stiff at 2.0m.	
					2.0			Damp, NVO
			* 0					
					2.5			
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP524

PAGE 1 of 1

DRILLING DATES: 1/4/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Brown, soft, sandy clay topsoil.	
							MADE GROUND: Hardcore - pale reddish limestone boulders (10-15cm).	
	0.5-0.6m		* 0		0.5		MADE GROUND: Black, silty fine sand. Frequent pieces of shale.	Dry, NVO
			* 0				MADE GROUND: Firm to soft, brown, sandy clay.	
					1.0		MADE GROUND: Very soft, black, silty clay. Organic rich.	Moist, NVO
			* 0				MADE GROUND: Tabular boulders (up to 1m diameter) of limestone.	
					1.5			
							Very soft, yellow brown silty CLAY.	
			* 0		2.0			Wet, NVO
					2.5			
			* 0		3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: TP525

PAGE 1 of 1

DRILLING DATES: 1/4/05	DRILLING METHODS : Back hoe excavator
DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
LOGGED BY : PM	SCREEN TYPE & DIAM: NA
CHECKED BY : LCH	SCREEN SLOT SIZE: NA

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.3-0.5m		* 0		0.0		MADE GROUND: Reinforced concrete	
					0.5		MADE GROUND: Loose, coarse gravel with silty fine sand.	Dry, NVO
			* 0		1.0		MADE GROUND: Firm, brown, sandy clay with gravel and occasional black mottling. Gravel ranges from fine to coarse. Occasional cobbles and rare pieces of concrete.	Dry, NVO
			* 0		1.5			
			* 0		2.0			
			* 0		2.5		Stiff, brown sandy SILT with common gravel. Gravel is fine to coarse and angular to rounded. Common flecks of coal.	Dry, NVO
					3.0		End of Borehole	
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: TP526	PAGE 1 of 1
							DRILLING DATES: 1/4/05	DRILLING METHODS : Back hoe excavator
							DRILLER : Hewden Hire	BOREHOLE DIAMETER : NA
							LOGGED BY : PM	SCREEN TYPE & DIAM: NA
							CHECKED BY : LCH	SCREEN SLOT SIZE: NA

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete.	Trial pit abandoned at 0.5m

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

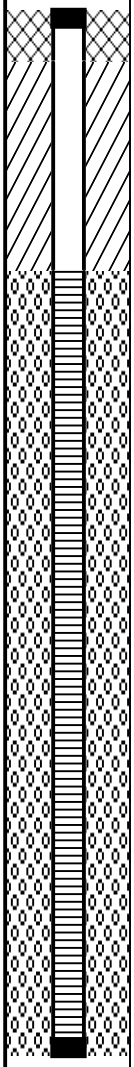
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS401

PAGE 1 of 1

DRILLING DATES: 23/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				0.0		MADE GROUND: Brown, loose, silty sand (topsoil) with roots and occasional pebbles.	Dry, NVO
		* 0		0.5		MADE GROUND: Coarse sand with large angular boulders of shale. Black and red mottling.	Dry, NVO
						MADE GROUND: Loose, red/black crushed brick with occasional pebbles of shale	Dry, NVO
				1.0		MADE GROUND: Loose, black gravel of shale with some red mottling.	
		* 0		1.5			Moist, NVO
				2.0		MADE GROUND: Compacted pebbles and boulders of hard rock with brick and shale and occasional coal fragments.	
		* 0		2.5			
				3.0		MADE GROUND: Brown clay with layers of black shale and occasional coal pieces.	Dry, NVO
		* 0		3.5		Dark brown CLAY (BOULDER CLAY) with occasional sandstone pebbles.	Dry, NVO
		* 0		4.0		End of Borehole	
				4.5			
				5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS402

PAGE 1 of 1

DRILLING DATES: 23/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Brown, sandy clay topsoi with occasional grey mottling. Occasional red brick pieces.	
	0.3-0.5						MADE GROUND: Grey/blue slag with thin layer of clay and black ash.	Dry, NVO
					0.5		MADE GROUND: Red brick rubble.	
			* 0		1.0		MADE GROUND: Clay with sandstone pebbles.	Dry, NVO
			* 0		1.5		MADE GROUND: Coarse angular gravel with occasional shale pieces.	
			* 0					
			* 0		2.0		MADE GROUND: Compacted coarse ash with larger sandy constituents. Occasional slag.	Dry, NVO
					2.5			
			* 0		3.0		Soft, brown sandy CLAY with fine subrounded-subangular gravel.	
					3.5			Dry, NVO
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS403	PAGE 1 of 1
							DRILLING DATES: 23/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Concrete.	
	Dry, NVO
MADE GROUND: Sand and slag with boulders (up to 50-60mm diameter.	
	Moist, NVO
MADE GROUND: Clayey silt with dark organic matter and occasional subangular-subrounded pebbles.	
Refusal at 1.0m	

0.5-0.8m

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS404	PAGE 1 of 1
							DRILLING DATES: 24/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete.	
MADE GROUND: Concrete rubble with gravel of sandstone and slag in a matrix of fine-coarse gravel. Poor drilling returns.	Dry, NVO
MADE GROUND: Coarse brick and shale/ash gravel with clayey matrix. Poor drilling returns.	Moist, NVO
Grey sandstone	
Refusal at 1.6m	

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

Suspected void beneath the site-large space visible below concrete and poor drilling returns. No groundwater encountered.

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS405	PAGE 1 of 1
							DRILLING DATES: 24/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete. Abandoned at 0.5m.	

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS406	PAGE 1 of 1
							DRILLING DATES: 24/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete.	
MADE GROUND: Dark brown silt with occasional subrounded gravel. Organic rich.	Dry, NVO
Shale and coal with occasional brick and sandstone.	
Refusal at 0.6m on concrete.	

0.3-0.5m

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS407	PAGE 1 of 1
							DRILLING DATES: 29/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	DEPTH (m)
MADE GROUND: Reinforced concrete.					0.0
MADE GROUND: Slightly clayey silt with grey slag.	Moist, NVO	0.2-0.4		* 0	0.5
MADE GROUND: Brown clayey silt with coarse gravel of slag.	Dry, Sulphurous smell.	0.7		* 0	
Less clayey silt.	Moist, Sulphurous smell.			* 0	1.0
					1.5
					2.0
					2.5
					3.0
					3.5
					4.0
					4.5
					5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS408	PAGE 1 of 1
							DRILLING DATES: 29/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Tarmac hardstanding.	
MADE GROUND: Reinforced concrete.	Dry, NVO
MADE GROUND: Dark grey/black silty sand with fine-coarse angular gravel of grey mudstone with occasional coal pieces. Refusal at 0.7m.	

* 0

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

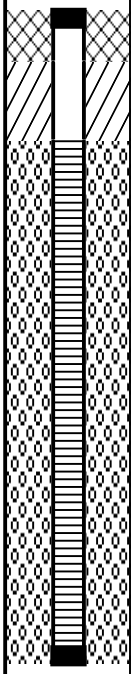
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS409

PAGE 1 of 1

DRILLING DATES: 29/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	DEPTH (m)	DESCRIPTION	COMMENTS
			0.0	MADE GROUND: Grasssurface cover topped with brown topsoil.	
				MADE GROUND: Red brown silty clay with occasional yellow and orange mottling.	
		* 0	0.5	MADE GROUND: Red brown clay with gravel of sandstone and occasional sandy layers and coal pieces.	Dry, NVO
		* 0		Sandstone boulders at 0.7m and 0.9m.	
			1.0	MADE GROUND: White/grey, soft, sility sand with occasional angular limestone gravel. Friable, gravel-sized fragments (possibly phosphate rock)	Moist, NVO
			1.5	Large angular gravel of Limestone at 1.55m (up to 50mm dimaeter).	
		* 0	2.0	MADE GROUND: Dark brown silty sand with soft white gravel (possibly phosphate rock).	Moist, NVO
				Red brick at 2.25m.	
			2.5	MADE GROUND: Soft, white/grey phosphate rock with small angular gravel of brick.	
		* 0		Refusal at 2.8m.	Moist, NVO
			3.0		
			3.5		
			4.0		
			4.5		
			5.0		

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS410	PAGE 1 of 1
							DRILLING DATES: 29/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Grass surface cover. Stiff red brown clay with ocasional coarse gravel of sandstone. Gravel is subrounded. Refusal at 0.6m.	Dry, NVO

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

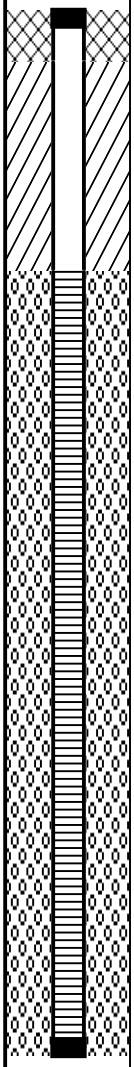
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS411

PAGE 1 of 1

DRILLING DATES: 29/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	DEPTH (m)	DESCRIPTION	COMMENTS
			0.0	MADE GROUND: Grass surface cover. Loose topsoil with subrounded-subangular gravel.	
0.5		* 0	0.5	MADE GROUND: Dense red silt with occasional with occasional weathered subrounded gravel of light grey siltstone/mudstone and occasional coarse gravel of sandstone.	Dry, NVO
				Becoming more gravelly. Coarse gravel (up to 50mm diameter).	
			1.0	White and black mottling. Phospate rock present.	Moist, NVO
		* 0	1.5		
			2.0	MADE GROUND: Dark layer of silty sand with fine gravel .	
				MADE GROUND: Friable silty sand with coarse gravel of limestone and brick and ash.	
2.3					
2.5		* 0	2.5		
				MADE GROUND: Layer of coal.	
				MADE GROUND: Dark brown silty sand with gravel of yellow sandstone. Gravel is subrounded.	Moist, NVO
			3.0	MADE GROUND: Soft, brown clay with occasional red and yellow mottling.	
				MADE GROUND: Silty sand with coarse gravel of limestone.	Moist, NVO
			3.5	MADE GROUND: Dark sandy silt with occasional phosphate rock and pale yellow clay.	Moist, NVO
			4.0		
			4.5		
			5.0		

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

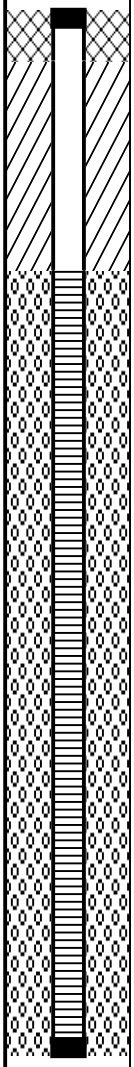
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS412

PAGE 1 of 1

DRILLING DATES: 29/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				0.0		MADE GROUND: Reinforced concrete.	
						MADE GROUND: Reddish silty sand with a coarse gravel of concrete.	
0.5m		* 0		0.5		MADE GROUND: Coarse, black sand and gravel of ash with occasional fine-medium gravel.	Dry, NVO
		* 0				MADE GROUND: Stiff red brown clay with occasional grey/orange/red mottling. Ash and coal pieces.	
				1.0		Clay becoming less stiff.	
				1.5			Dry, NVO
				2.0		Becoming less stiff	
				2.5			Dry, NVO
						Becoming stiff.	
				3.0		Rounded pebble of limestone at 3.7m.	
						Darker layer of softer silty clay at 3.8m	
				3.5			
				4.0			
				4.5			
				5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

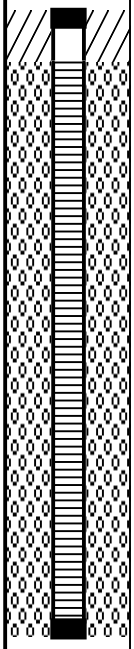
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS413

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				0.0		MADE GROUND: Reinforced concrete.	
		* 0				MADE GROUND: Pale grey gravel of slag. Gravel varies from fine to coarse.	Moist, NVO
				0.5		Humic black silt at 0.5m	
						MADE GROUND: Dark brown silt with gravel of mudstone. Occasional thin layers of coal and ash.	
		* 0		1.0			Moist, NVO
		* 105				MADE GROUND: Red/orange sand with fine to coarse gravel of sandstone. Sandstone boulders common.	
				1.5		More silty at 1.5m.	Moist, NVO
		* 37.1		2.0		Occasional ash and coal fragment and slightly darker with a slightly higher organic content.	
				2.5		Stiff CLAY with abundant pockets of ash and areas of yellow and grey mottling and fine-medium, rounded-subrounded gravel of sandstone. (BOULDER CLAY)	Dry, NVO
				3.0			
				3.5			
				4.0			
				4.5			
				5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS414	PAGE 1 of 1
							DRILLING DATES: 30/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Reinforced concrete. Borehole abandoned.	

0.0
0.5
1.0
1.5
2.0
2.5
3.0
3.5
4.0
4.5
5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS415

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
	0.2m		* 0		0.0		MADE GROUND: Loose dark brown sandy, fine-medium, organic rich gravel.	
							MADE GROUND: Reddish sandy silt with occasional light grey coarse gravel.	Moist, NVO
	0.7m		* 200		0.5		MADE GROUND: Dark reddish black clayey silt with gravel of red sandstone, occasional black mottling from ash and coal pieces.	
							Becoming more red and more stiff with increasing clay content.	Moist, NVO
			* 60		1.0		Becoming softer.	
							Becoming slightly more orange.	
					1.5			
							Becomes red again and becomes more stiff.	
					2.0			
								Dry, NVO
					2.5		Very stiff.	
					3.0			
					3.5			Dry, NVO
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

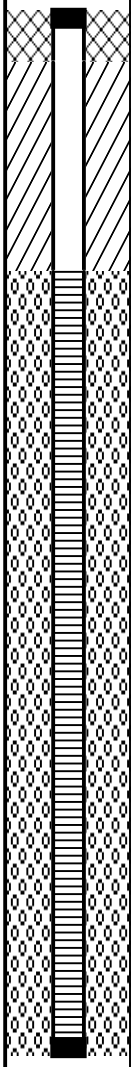
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS416

PAGE 1 of 1

DRILLING DATES: 30/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
				0.0		MADE GROUND: Pink/grey medium-coarse gravel with fine silt matrix.	Dry, NVO
		* 600		0.5		MADE GROUND: Black silt with occasional gravel of siltstone/mudstone and fine angular gravel of ash.	
						Becoming more light grey and more sandstone gravel.	Dry, NVO
		* 55		1.0		Becoming darker with more ash and coal gravel.	
							Dry, NVO
				1.5		Coal layer (20mm)	Wet, NVO
				2.0		MADE GROUND: Stiff, red, silty clay with occasional fine to mediun, rounded-subrounded gravel of sandstone.	Wet, NVO
						Becoming orange and slightly less stiff and less gravel.	
				2.5		Becoming more red and more stiff.	Wet, NVO
				3.0		MADE GROUND: Soft, dark brown clay with occasional ash	Wet, NVO
							Wet, NVO
				3.5		MADE GROUND: Stiff, red silty clay with fine-medium, subangular sandstone gravel.	
							Wet, NVO
				4.0			
				4.5			
				5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS417	PAGE 1 of 1
							DRILLING DATES: 30/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Brown, fine-coarse sand with fine-medium gravel of concrete. Roots and pieces of plastic.	
MADE GROUND: Concrete cobble across core	
MADE GROUND: Dark grey coarse sand with thin layer of concrete gravel Refusal at 0.5m	

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

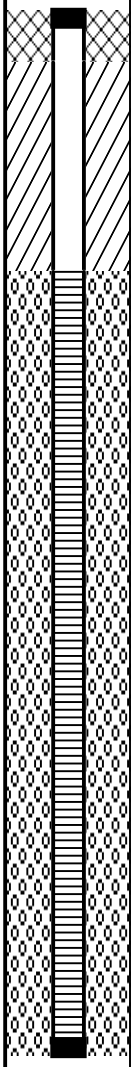
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS418

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	DEPTH (m)	DESCRIPTION	COMMENTS
			0.0	MADE GROUND: Loose, brown sandy silt with medium-coarse angular gravel. Roots common.	Dry, NVO
				MADE GROUND: Cobbles of limestone mostly >70mm.	
0.5m	*	0	0.5	MADE GROUND: Angular, fine-coarse gravel of ash, slag and phosphate rock.	Dry, NVO
				MADE GROUND:Light yellow/orange medium sand.	
0.75m			1.0	MADE GROUND: Stiff, red brown clayey silt with occasional coarse gravel of pink/white rock (possibly phosphate rock). Occasional coarse gravel of sandstone and thin silt horizons.	Dry, diesel odour
1.15m				MADE GROUND: Sandstone boulder.	
1.25m				MADE GROUND: Silty sand. Metal fragment. Diesel or heavy fuel odour.	Diesel or heavy fuel odour
			1.5	MADE GROUND: Soft, dark brown/black clay.	
				Becoming slightly more stiff and more silt rich. Occasional medium gravel of ash and sandstone.	Dry, NVO
			2.0	Becoming more black. Resembles oil staining. No odour.	Becoming blackwith oil staining, no odour
			2.5	Stiff, orange clayey SILT with occasional fine gravel of sandstone and orange mottling and occasional ash.	
				Becomes more red and soft.	
			3.0		Moist, NVO
			3.5		
			4.0		
			4.5		
			5.0		

GROUNDWATER

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS419

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Dark brown sandy silt with occasional fine-medium gravel of sandstone, slag and brick.	
							MADE GROUND: Dark brown organic sandy silt with coarse gravel of clinker and brick.	Dry, NVO
					0.5		MADE GROUND: Brown/black clayey silt with ash and occasional gravel of sandstone.	
							Refusal at 0.5m.	
					1.0			
					1.5			
					2.0			
					2.5			
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

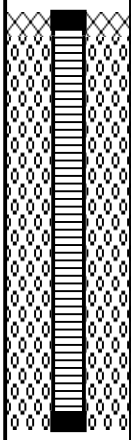
URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE NUMBER: WS420

PAGE 1 of 1

DRILLING DATES: 31/3/05	DRILLING METHODS : Window sampler
DRILLER : GPS	BOREHOLE DIAMETER : 100mm
LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm



BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	DESCRIPTION	COMMENTS
					0.0		MADE GROUND: Light grey, medium-coarse angular gravel with a pale orange silty clay matrix.	
							MADE GROUND: Dark grey sand with medium subangular-subrounded gravel.	Dry, NVO
					0.5		MADE GROUND:Light grey pink medium-coarse angular gravel of limestone with a sity sand matrix.	
							Becoming darker grey and more oganic rich.	Dry, NVO
					1.0		MADE GROUND: Stiff, red brown silty clay with occasional fine gravel of ash and grey/orange sandstone. Gravel is rounded to subrounded.	
							Sandstone gravel more frequent.	
	1.5m				1.5		MADE GROUND: Soft, dark brown silty clay with occasional fine gravel of ash and orange mottling.	Dry, NVO
							MADE GROUND: Very soft black organic rich clay.	
					2.0			
					2.5			
					3.0			
					3.5			
					4.0			
					4.5			
					5.0			

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

BOREHOLE CONSTRUCTION	SAMPLE NUMBER	SAMPLE TYPE	SOIL VAPOUR (ppm)	GROUNDWATER	DEPTH (m)	GEOLOGY	BOREHOLE NUMBER: WS421	PAGE 1 of 1
							DRILLING DATES: 31/3/05	DRILLING METHODS : Window sampler
							DRILLER : GPS	BOREHOLE DIAMETER : 100mm
							LOGGED BY : PR	SCREEN TYPE & DIAM: HDPE 50mm
							CHECKED BY : LCH	SCREEN SLOT SIZE: 2mm

DESCRIPTION	COMMENTS
MADE GROUND: Red brown silty clay with occasional gravel of sandstone. Occasional pieces of glass.	
	Dry, NVO
MADE GROUND: Coarse gravel (hardcore).	
MADE GROUND: Red brown silty clay with occasional gravel of sandstone. Occasional pieces of glass, wood and brick.	
Refusal at 1.2m.	
	Dry, NVO

* 0

0.0 0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0

LOCATION / NOTES:

NVO = No visual or olfactory evidence of contamination

No groundwater encountered

LEGEND

- Disturbed Sample
- Undisturbed Sample
- Headspace Analysis
- Down Borehole Analysis
- Groundwater Table
- Perched Water Table

BOREHOLE LOG

Job Title: Phase II Investigations and Environmental assessments.

Location: The Former Albright and Wilson Works, Whitehaven, Cumbria

Client: Rhodia

URS

App'd: NA	Date: 07/04/05
Drawn : NA	Ref: NA
Scale: NA	Job No: 44319623
Drg. Size: NA	BOREHOLE LOG

Appendix B - Tier 1 Data Assessment and Results Tables

TABLE 1
ANALYTICAL SCHEDULE FOR SOIL (CURRENT AND PREVIOUS INVESTIGATIONS)

Sample Location	*Soil Laboratory Analysis*												
	MBAS	Metals	Major Cations	Major Anions	VOC	SVOC	PAH	TPH carbon banding	TPH aliphatic/ aromatic speciation	Total TPH	PCB	TOC	PSD
BH 302					✓	✓			✓				
BH 303					✓	✓		✓					
S16								✓					
S17								✓					
SB1	✓	✓						✓					
SB10	✓	✓						✓					
SB11	✓	✓						✓					
SB12	✓	✓						✓					
SB13	✓	✓						✓					
SB14	✓	✓						✓					
SB15	✓	✓						✓					
SB16	✓	✓						✓					
SB19	✓	✓						✓					
SB2	✓	✓						✓					
SB20	✓	✓						✓					
SB21	✓	✓						✓					
SB22	✓	✓						✓					
SB23	✓	✓						✓					
SB4	✓	✓						✓					
SB5	✓	✓						✓					
SB6	✓	✓						✓					
SB7	✓	✓						✓					
SB8	✓	✓						✓					
SB9	✓	✓						✓					
STAGE3AA									✓				
STAGE3W					✓	✓			✓				
STAGE3X					✓	✓		✓					
STAGE3Y					✓	✓		✓					
STAGE3Z					✓	✓							
TP10							✓						
TP11							✓						
TP12							✓						
TP13							✓						
TP14					✓	✓	✓						
TP16					✓	✓	✓						
TP17					✓	✓	✓						
TP2							✓						
TP3					✓	✓	✓						
TP4					✓	✓	✓						
TP5							✓						
TP502	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP503	✓	✓	✓	✓	✓	✓	✓	✓	✓		✓		✓
TP505	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP506	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP507	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP508	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP510	✓	✓	✓	✓		✓	✓		✓	✓	✓		
TP511	✓	✓	✓	✓	✓	✓	✓		✓		✓		
TP512	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP513	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
TP514	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
TP515	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP516	✓	✓	✓	✓	✓	✓	✓		✓		✓	✓	✓
TP517	✓	✓	✓	✓	✓	✓	✓				✓		
TP518	✓	✓	✓	✓	✓	✓							
TP519	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP520	✓	✓	✓	✓						✓		✓	✓
TP521	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP522	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓	✓	✓
TP523	✓	✓	✓	✓	✓	✓	✓		✓			✓	✓
TP524	✓	✓	✓	✓	✓	✓	✓			✓	✓		
TP525	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
TP6							✓						
TP7							✓						
TP8					✓	✓	✓						
TP9							✓						
WS108	✓	✓			✓			✓					
WS108A					✓	✓			✓				
WS109						✓							
WS109A					✓	✓		✓					
WS110		✓			✓						✓		
WS111	✓					✓							
WS112		✓			✓	✓					✓		
WS114	✓	✓			✓	✓							
WS115	✓							✓					
WS116	✓	✓			✓	✓							

TABLE 1
ANALYTICAL SCHEDULE FOR SOIL (CURRENT AND PREVIOUS INVESTIGATIONS)

Sample Location	*Soil Laboratory Analysis*												
	MBAS	Metals	Major Cations	Major Anions	VOC	SVOC	PAH	TPH carbon banding	TPH aliphatic/ aromatic speciation	Total TPH	PCB	TOC	PSD
WS117						✓							
WS118													
WS119						✓							
WS120	✓	✓			✓								
WS121						✓							
WS122		✓			✓								
WS123						✓							
WS124	✓	✓			✓			✓					
WS126		✓				✓							
WS127						✓							
WS128		✓			✓								
WS130	✓	✓			✓	✓							
WS131		✓				✓		✓					
WS133						✓		✓					
WS134		✓			✓						✓		
WS135	✓					✓							
WS136	✓	✓			✓			✓					
WS137		✓			✓								
WS139		✓				✓							
WS141						✓		✓			✓		
WS142		✓			✓	✓							
WS143	✓	✓			✓	✓							
WS144	✓	✓				✓		✓					
WS145	✓	✓			✓	✓							
WS146													
WS147	✓	✓			✓	✓							
WS148	✓	✓				✓							
WS150	✓	✓									✓		
WS151		✓			✓	✓					✓		
WS152		✓											
WS153	✓				✓	✓		✓					
WS154		✓											
WS155		✓			✓	✓							
WS156	✓	✓						✓			✓		
WS157					✓	✓							
WS158	✓	✓											
WS159	✓				✓	✓		✓			✓		
WS160		✓											
WS161					✓	✓							
WS162		✓									✓		
WS163						✓							
WS164		✓			✓								
WS165		✓			✓						✓		
WS402	✓	✓	✓	✓	✓	✓	✓			✓	✓		
WS403	✓	✓	✓	✓	✓	✓	✓			✓	✓		
WS406	✓	✓	✓	✓									
WS407	✓	✓	✓	✓	✓	✓	✓			✓	✓		
WS409	✓	✓	✓	✓	✓	✓	✓			✓	✓		
WS411	✓	✓	✓	✓	✓	✓	✓			✓	✓	✓	✓
WS412	✓	✓	✓	✓	✓	✓	✓			✓	✓		
WS413	✓	✓	✓	✓	✓	✓	✓		✓		✓		
WS415	✓	✓	✓	✓	✓	✓	✓		✓		✓		
WS416	✓	✓	✓	✓	✓	✓	✓			✓	✓		
WS418	✓	✓	✓	✓	✓	✓	✓		✓	✓	✓		
WS420	✓	✓	✓	✓	✓	✓	✓			✓	✓		

Note:

MBAS	Methyl Blue Active Substances, i.e. Surfactants
TPH	Total Petroleum Hydrocarbons
VOCs	Volatile Organic Compounds
SVOCs	Semi Volatile Organic Compounds
PCB	Polychlorinated Biphenyls
TOC	Total organic carbon
PSD	Particle size distribution

TABLE 2
ANALYTICAL SCHEDULE FOR SHALLOW GROUNDWATER (CURRENT AND PREVIOUS INVESTIGATIONS)

Sample Location	*Shallow Groundwater Laboratory Analysis*										
	MBAS	**Metals**	**Major Cations**	**Major Anions**	**VOC**	**SVOC**	**PAH**	**TPH carbon banding**	**TPH aliphatic/ aromatic speciation**	**Total TPH**	**PCB**
SB1	✓	✓	✓	✓			✓	✓			
SB10	✓	✓						✓			
SB11	✓	✓									
SB13	✓	✓									
SB14	✓	✓						✓			
SB15	✓	✓						✓			
SB19	✓	✓						✓			
SB2	✓	✓	✓	✓			✓				
SB20	✓	✓									
SB21	✓	✓						✓			
SB22	✓	✓						✓			
SB5	✓	✓									
SB6	✓	✓						✓			
SB8	✓	✓						✓			
SB9	✓	✓									
WS108A	✓	✓	✓	✓	✓		✓		✓		✓
WS109A	✓	✓	✓	✓	✓		✓		✓		✓
WS114	✓	✓			✓		✓	✓			
WS115	✓	✓					✓				
WS120	✓	✓						✓			
WS124	✓	✓					✓	✓			
WS125	✓	✓			✓		✓	✓			
WS126	✓	✓			✓		✓	✓			
WS128					✓						
WS130	✓	✓					✓	✓			
WS136	✓	✓	✓				✓	✓			
WS141	✓	✓			✓		✓	✓			
WS147	✓	✓						✓			
WS148	✓	✓						✓			
WS150	✓	✓			✓		✓	✓			
WS151	✓	✓			✓		✓	✓			
WS152	✓	✓			✓		✓	✓			
WS153	✓	✓									
WS156	✓	✓	✓				✓	✓			
WS157	✓	✓	✓	✓	✓	✓	✓		✓		✓
WS159	✓	✓					✓				
WS160	✓	✓					✓				
WS161	✓	✓	✓				✓	✓			
WS162	✓	✓	✓				✓	✓			
WS164	✓	✓					✓				
WS165					✓						
WS411	✓	✓	✓	✓	✓	✓	✓			✓	✓
WS412	✓	✓	✓	✓	✓	✓	✓		✓		✓
WS413	✓	✓	✓	✓	✓	✓	✓		✓		✓
WS415	✓	✓	✓	✓	✓	✓	✓		✓		✓
WS416	✓	✓	✓	✓	✓	✓	✓		✓		✓
WS418	✓	✓	✓	✓	✓	✓	✓		✓		✓

Note:

MBAS	Methyl Blue Active Substances, i.e. Surfactants
TPH	Total Petroleum Hydrocarbons
VOCs	Volatile Organic Compounds
SVOCs	Semi Volatile Organic Compounds
PCB	Polychlorinated Biphenyls

TABLE 3
APRIL 2005 GROUNDWATER MEASUREMENTS

Location	Top of Casing (mAOD)	Water Level (mTOC)	Depth to base (mTOC)	Water Level (mAOD)	Purge Volume prior to Sampling (litres)	Observations
WS108	94.79	1.359	2.242	93.431	6	Silty, brown liquid becoming clear. NVO
WS109	94.71	1.497	2.627	93.213	6.6	Slightly silty liquid with occassional large, clay-like particle. No visual sheen, though a slight smell of sewage
WS136	92.01	0.326	1.302	91.684	-	Clear liquid. NVO. Purged dry at 1.5L. Too slow to recharge to sample.
WS156	83.07	0.37	1.7	82.700	-	Clear liquid. NVO. Purged dry at 1L. Too slow to recharge to sample.
WS157	86.43	0.632	1.6	85.798	4.8	Silty, red/brown liquid clearing quickly. NVO.
WS161	92.68	0.103	0.878	92.577	-	Clear liquid. NVO. Purged dry at 1.4L. Insufficient water to sample
WS162	92.53	1.874	1.981	90.656	-	Clear liquid. NVO. Purged dry at 0.1L. Insufficient water to sample
WS401	84.161	Dry	-	-	-	Dry
WS409	83.771	Dry	2.372	-	-	Dry
WS411	82.917	3.21	3.829	79.707	5	Dark brown, very silty liquid with a visible multicoloured sheen and a noticeable diesel odour
WS412	83.055	0.721	3.826	82.334	30	Light brown, slightly silty liquid. NVO. Purged dry at 8L, 11L, and 21L.
WS413	92.661	1.995	2.731	90.666	7.5	Light brown, slightly silty liquid. NVO.
WS415	94.486	0.036	3.838	94.450	48	Brown, slightly silty liquid clearing quickly. NVO
WS416	85.925	1.212	3.44	84.713	22.5	Red/brown silty liquid clearing after purging of 2-3L. Purgerd dry at 22L.
WS418	84.897	2.268	3.723	82.629	15	NVO. Purged dry at 9L, 13L and 15L.
WS420	85.731	Dry	-	-	-	Dry

mAOD - metres Above Ordnance Datum
mTOC - metres below Top Of Casing
mBGL - metres Below Ground Level

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**SB1**	**SB10**	**SB10**	**SB11**	**SB12**	**SB13**	**SB14**	**SB14**	**SB15**	**SB16**	**SB19**	**SB2**	**SB20**
Depth (m)						**2.6-2.7**	**0.5-0.6**	**3.1-3.2**	**0.5-0.6**	**0.6-0.7**	**1.95-2.05**	**0.4-0.6**	**2.4-2.5**	**0.4-0.5**	**1.1-1.2**	**2.5-2.6**	**0.5-0.6**	**2.1-2.2**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***													
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Ph	1		No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	nd	91	535	1.8	0.3	0.3	0.4	nd	0.4	nd	nd	nd	90.7
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**SB21**	**SB22**	**SB23**	**SB4**	**SB5**	**SB6**	**SB6**	**SB7**	**SB8**	**SB8**	**SB9**	**TP502**	**TP503**	**TP503**
Depth (m)						**1.2-1.3**	**0.9-1**	**0.8-0.9**	**0.7-0.8**	**0.5-0.6**	**1.7-1.8**	**2.6-2.7**	**1-1.1**	**1.3-1.4**	**4.5-4.6**	**1.6-1.7**	**0.3**	**0.3**	**0.7**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***														
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	56	26	-
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	nd	nd	**-**
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	nd	nd	-
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	6	9	-
Ph	1		No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	11.41	12.34	-
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	nd	nd	-
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**-**	**-**	**-**
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	1	nd	0.3	45.8	2930	83.1	0.2	nd	1.1	-	5	5	-
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	nd	nd	-
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	16800	400	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**TP505**	**TP506**	**TP507**	**TP508**	**TP510**	**TP511**	**TP512**	**TP513**	**TP514**	**TP514**	**TP515**	**TP516**	**TP517**	**TP518**
Depth (m)						**0.3**	**0.3**	**0.3**	**0.4**	**0.25**	**0.3**	**0.4**	**0.3**	**0.35**	**2**	**0.3**	**0.45**	**0.4**	**0.4**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***														
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	46	1552	134	84	20	27	19	25	730	-	752	86	24	124
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	45	33	21	3	nd	4	nd	nd	5	**-**	11	5	nd	nd
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	5	nd	2	1	4	3	1	1	3	-	2	3	nd	nd
Ph	1		No Criterion	No criterion	No criterion	7.96	8.06	8.1	11.58	7.69	8.03	8.13	7.87	10.48	-	11.74	8.31	10.28	10.8
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	4	nd	nd	nd	nd	nd	nd	nd	nd	-	nd	nd	258	nd
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	5	5	5	5	5	5	5	5	5	-	5	5	5	5
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	nd	1	nd	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	0.64	-	0.64	-	0.42	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	58200	12100	32500	19300	175500	19100	101800	37100	51800	-	32000	63900	163300	12700

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**TP519**	**TP520**	**TP521**	**TP522**	**TP523**	**TP524**	**TP525**	**WS108**	**WS111**	**WS114**	**WS115**	**WS115**	**WS116**
Depth (m)						**0.4**	**0.3**	**0.7**	**0.2**	**0.25**	**0.5**	**0.3**	**0.2-0.5**	**0.1-0.4**	**0.8-1**	**0.3-0.6**	**4-4.4**	**0.5-0.75**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***													
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	54	24	604	66	992	32	44	-	-	-	-	-	-
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	nd	6	nd	30	5	nd	nd	-	-	-	-	-	-
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	nd	1	nd	3	nd	1	3	-	-	-	-	-	-
Ph	1		No Criterion	No criterion	No criterion	11.24	7.98	7.54	7.92	10.76	7.35	12.58	-	-	-	-	-	-
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	nd	4	nd	nd	nd	nd	nd	-	-	-	-	-	-
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**-**	**-**	**-**	**-**	**-**	**-**	**-**	nd	nd	**458**	**700**	**700**	nd
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	5	5	5	5	38	5	5	nd	nd	nd	-	nd	nd
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	0.26	-	1.2	1.52	-	0.6	-	-	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	24300	180000	186700	14700	28300	10700	400	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**WS117**	**WS119**	**WS120**	**WS121**	**WS122**	**WS123**	**WS124**	**WS126**	**WS127**	**WS128**	**WS130**	**WS131**	**WS133**
Depth (m)						**0.2-0.5**	**0.4-0.5**	**0.3-0.6**	**0.7-1.0**	**0.25-0.5**	**0.2-0.5**	**0.1-0.2**	**0.3-0.5**	**0.3-0.4**	**0.5-0.7**	**0.5-0.8**	**1.9-2.0**	**0.2-0.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***													
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Ph	1		No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**482**	**352**	**221**	nd	**371**	**209**	nd	**3900**	**804**	**510**	**2520**	**41800**	**1770**
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	nd	-	-	-	nd	-	-	-	nd	-	-
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						WS134	WS135	WS136	WS137	WS139	WS141	WS142	WS143	WS143	WS144	WS144	WS145	WS147
Depth (m)						0.4-0.5	0.25-0.5	0.3-0.5	1.1-1.4	0.3-0.5	0.2-0.5	0.5-1.0	0.2-0.4	2.1-2.4	0.1-0.4	0.5-1	1.5-1.8	0.5-1
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*													
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Ph	1		No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**25800**	**5170**	**6130**	**1680**	**597**	**6690**	**588**	nd	nd	**853**	nd	nd	nd
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	nd	nd	-	-	-	-	-	nd	nd	nd	nd	nd
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**WS148**	**WS150**	**WS151**	**WS152**	**WS153**	**WS153**	**WS155**	**WS156**	**WS157**	**WS158**	**WS159**	**WS160**	**WS161**
Depth (m)						**0.75-0.95**	**0.5-1**	**0.5-0.7**	**0.3-0.5**	**0.1-0.4**	**0.3-0.5**	**0.5-0.7**	**0.5-1.6**	**0.5-0.8**	**0.3-0.9**	**0.5-0.7**	**0.5-1.0**	**0.3-0.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***													
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Ph	1		No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**470**	**427**	nd	**2230**	**842**	nd	**842**	**403**	**1280**	**1510**	**982**	**436**	**218**
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	nd	nd	-	-	nd	nd	-	nd	-	nd	nd	-	-
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**WS163**	**WS164**	**WS165**	**WS402**	**WS403**	**WS406**	**WS407**	**WS409**	**WS411**	**WS411**	**WS412**	**WS413**	**WS415**
Depth (m)						**0.05-0.5**	**1.9-2.4**	**0.3-0.6**	**0.3**	**0.5**	**0.3**	**0.2**	**0.4**	**0.5**	**2.5**	**0.5**	**0.8**	**0.2**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***													
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	-	-	-	116	294	46	20	23	-	64	60	162	278
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	-	17	nd	4	nd	nd	-	nd	nd	nd	8
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	-	-	-	nd	nd	nd	nd	nd	-	nd	nd	nd	nd
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	1	35	6	2	73	-	9	24	22	2
Ph	1		No Criterion	No criterion	No criterion	-	-	-	8.46	9.57	8.06	9.75	8.05	-	7.7	7.62	6.52	7.95
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	nd	10592	4	nd	nd	-	nd	nd	nd	nd
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**1430**	**383**	**578**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**	**-**
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	5	-	5	5	5	-	5	5	5	5
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	-	-	-	2	nd	nd	nd	nd	-	nd	nd	nd	nd
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-	-	-	-	-	-	0.07	-	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	-	-	-	21100	201300	168500	77000	208300	-	154500	69700	166100	28300

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 4
METHYL BLUE ACTIVE SUBSTANCES (MBAS) AND OTHER MISCELLANEOUS COMPOUNDS IN SOIL (mg/Kg)

Sample Location						**WS416**	**WS418**	**WS420**
Depth (m)						**0.45**	**0.5**	**1.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***			
Chloride Soluble	5	No Criterion	No Criterion	No criterion	Freshwater EQS (AA)	72	562	66
Fluoride Soluble	3	3666	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	8	4	nd
Free Cyanide	1	20	Adjusted DIV	0.02	ENGLAND DWS (2000)	nd	nd	nd
Nitrate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	1	6	9
Ph	1		No Criterion	No criterion	No criterion	7.53	10.4	9.48
Phosphate Soluble	1	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	nd	nd	nd
Phosphorous		1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**-**	**-**	**-**
MBAS		No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	5	5	5
Total Cyanide	1	No Criterion	No Criterion	0.02	ENGLAND DWS (2000)	nd	nd	2
Total Organic Carbon	0.01	No Criterion	No Criterion	No criterion	No criterion	-	-	-
Water Soluble Sulphate	300	No Criterion	No Criterion	No criterion	ENGLAND DWS (2000)	100800	37800	41800

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 5
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						BH 302	BH 303	STAGE3W	STAGE3X	STAGE3Y	STAGE3Z	TP14	TP16	TP17	TP3	TP4	TP502	TP503	TP505	TP506
Depth						0.5 - 0.8	0.5 - 0.65	0.5-0.55	0.4-0.5	0.5-0.65	0.25-0.33	0.3	0.5	2.4	0.5	1	0.3	0.3	0.3	0.3
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,1,1,2-Tetrachloroethane	0.001	1.50	URS GAC	0.00234	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2,2-Tetrachloroethane	0.001	27.0	URS GAC	0.000158	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	0.001	9.83	Adjusted DIV	0.501	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2-Trichloroethane	0.001	6.55	Adjusted DIV	0.865	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	0.001	0.0450	URS GAC	1.27	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	0.001	0.790	URS GAC	0.175	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	0.001	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	0.001	0.00502	USEPA R9 (Residential)	0.0000209	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	0.085	nd	0.238	0.009	0.096	0.004	nd	nd	nd
1,2-Dibromo-3-Chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	-	-	-	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	0.001	0.00689	USEPA R9 (Residential)	0.00000130	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.001	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	0.001	0.812		0.0127	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	0.001	0.342	USEPA R9 (Residential)	0.0732	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	0.001	21.3	USEPA R9 (Residential)	0.310	USEPA Region 9 (pathway specific)	0.007	nd	nd	nd	nd	nd	0.221	nd	0.685	0.022	0.257	nd	nd	nd	nd
1,3-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.001	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.001	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	0.001	42.9	USEPA R9 (Residential)	0.116	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,2-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.001	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	0.007	nd	nd	nd	nd	nd	-	-	-	-	-	0.004	-	-	-
1,2-Dibromo-3-chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-	-	-
2-Chlorotoluene	0.001	158	USEPA R9 (Residential)	3.50	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	0.027	nd	nd	nd	nd	nd	nd	-	-	-	-
Benzene	0.001	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	nd	nd	nd	0.009	nd	nd	nd	0.002	nd	nd	nd	nd	nd	nd
Bromobenzene	0.001	27.8	USEPA R9 (Residential)	0.111	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	0.001	0.824	USEPA R9 (Residential)	0.000425	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	0.001	61.6	USEPA R9 (Residential)	0.0410	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	0.001	3.90	USEPA R9 (Residential)	0.0545	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulphide	0.001	355	USEPA R9 (Residential)	1.93	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	0.001	0.655	Adjusted DIV	0.0522	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	0.001	3.03	USEPA R9 (Residential)	0.00459	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	0.001	6.55	Adjusted DIV	0.0205	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloromethane	0.001	1.23	USEPA R9 (Residential)	0.000360	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	0.001	1.11	USEPA R9 (Residential)	0.000389	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	0.001	66.9	USEPA R9 (Residential)	0.0929	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	0.001	93.9	USEPA R9 (Residential)	6.87	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	0.001	4.10	URS GAC	0.0335	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.001	80.0	UK SGV	4.16	WHO DWG	nd	nd	nd	nd	nd	nd	0.026	0.001	0.188	0.002	0.019	0.006	0.004	0.004	nd
Hexachlorobutadiene	0.001	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	0.001	572	USEPA R9 (Residential)	12.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.013	nd	0.025	nd	0.007	nd	nd	nd	nd
Methyl T-Butyl Ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	-	-	-	-	-	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.638	0.19	**89.97**	**33.817**	**43.828**	nd	nd	nd	nd
N-Butylbenzene	0.001	240	USEPA R9 (Residential)	22.7	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.039	nd	0.028	0.003	0.011	nd	nd	nd	nd
P-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	nd	nd	nd	nd
Propylbenzene	0.001	240	USEPA R9 (Residential)	6.72	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.011	nd	0.005	nd	0.003	nd	nd	nd	nd
Sec-Butylbenzene	0.001	3130	USEPA R3 (Residential)	8.41	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.019	nd	nd	nd	0.002	nd	nd	nd	nd
Styrene	0.001	250	Dutch SRC	0.977	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	0.003	nd	nd	nd	nd	nd	nd
tert-butyl methyl ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	nd	nd	nd	nd	nd	-	-	-	-
Tert-Butylbenzene	0.001	390	USEPA R9 (Residential)	6.22	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.031	nd	0.015	nd	0.006	nd	nd	nd	nd
Tetrachloroethene	0.001	4.50	URS GAC	0.0601	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	0.001	15.0	UK SGV	0.269	Freshwater EQS (AA)	0.015	0.005	nd	nd	0.018	nd	0.005	0.002	0.059	0.001	0.009	0.008	0.005	0.006	nd
Trans-1,2-Dichloroethene	0.001	69.5	USEPA R9 (Residential)	0.185	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethane	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	0.001	0.620	URS GAC	0.0362	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichlorofluoromethane	0.001	386	USEPA R9 (Residential)	8.55	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	0.001	35.0	URS GAC	0.225	Freshwater EQS (AA)	0.024	0.01	nd	nd	0.02	nd	0.076	0.003	0.431	0.007	0.102	0.02	0.014	0.017	0.114
O-Xylene	0.001	156000	USEPA R3 (Residential)	0.225	Freshwater EQS (AA)	0.009	nd	nd	nd	0.012	nd	0.05	nd	0.21	0.003	0.057	0.006	0.004	nd	nd
Vinyl Chloride	0.001	0.00400	URS GAC	0.000430	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Environmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Risk Assessment
Dutch SRC	Dutch Serious Risk Concentration
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 5
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						TP507	TP508	TP510	TP511	TP511	TP512	TP513	TP513	TP514	TP515	TP516	TP517	TP518	TP519
Depth						0.3	0.4	0.25	0.3	3	0.4	0.3	1.4	0.35	0.3	0.45	0.4	0.25	0.4
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*														
1,1,1,2-Tetrachloroethane	0.001	1.50	URS GAC	0.00234	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2,2-Tetrachloroethane	0.001	27.0	URS GAC	0.000158	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	0.001	9.83	Adjusted DIV	0.501	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2-Trichloroethane	0.001	6.55	Adjusted DIV	0.865	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	0.001	0.0450	URS GAC	1.27	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	0.001	0.790	URS GAC	0.175	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	0.001	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	0.001	0.00502	USEPA R9 (Residential)	0.0000209	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.011	nd	nd	0.002	nd	nd	nd	0.04	nd
1,2-Dibromo-3-Chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	0.001	0.00689	USEPA R9 (Residential)	0.00000130	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.001	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	0.001	0.812		0.0127	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	0.001	0.342	USEPA R9 (Residential)	0.0732	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	0.001	21.3	USEPA R9 (Residential)	0.310	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	0.001	nd	nd	nd	0.05	nd
1,3-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.001	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.001	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	0.001	42.9	USEPA R9 (Residential)	0.116	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,2-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.001	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1.2.4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	-	-	-	-	0.011	-	-	0.002	-	-	-	-	-	-
1.2-Dibromo-3-chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Chlorotoluene	0.001	158	USEPA R9 (Residential)	3.50	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	0.001	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	0.009	nd	nd	nd	nd	nd	nd	0.003	0.017	0.002	nd	nd	nd
Bromobenzene	0.001	27.8	USEPA R9 (Residential)	0.111	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	0.001	0.824	USEPA R9 (Residential)	0.000425	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	0.001	61.6	USEPA R9 (Residential)	0.0410	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	0.001	3.90	USEPA R9 (Residential)	0.0545	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulphide	0.001	355	USEPA R9 (Residential)	1.93	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	0.001	0.655	Adjusted DIV	0.0522	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	0.001	3.03	USEPA R9 (Residential)	0.00459	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	0.001	6.55	Adjusted DIV	0.0205	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloromethane	0.001	1.23	USEPA R9 (Residential)	0.000360	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	0.001	1.11	USEPA R9 (Residential)	0.000389	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	0.001	66.9	USEPA R9 (Residential)	0.0929	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	0.001	93.9	USEPA R9 (Residential)	6.87	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	0.001	4.10	URS GAC	0.0335	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.001	80.0	UK SGV	4.16	WHO DWG	0.015	0.059	nd	nd	nd	0.019	0.009	0.002	0.006	nd	nd	0.013	nd	nd
Hexachlorobutadiene	0.001	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	0.001	572	USEPA R9 (Residential)	12.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Methyl T-Butyl Ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Butylbenzene	0.001	240	USEPA R9 (Residential)	22.7	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
P-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Propylbenzene	0.001	240	USEPA R9 (Residential)	6.72	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sec-Butylbenzene	0.001	3130	USEPA R3 (Residential)	8.41	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Styrene	0.001	250	Dutch SRC	0.977	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
tert-butyl methyl ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tert-Butylbenzene	0.001	390	USEPA R9 (Residential)	6.22	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	0.001	4.50	URS GAC	0.0601	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	0.021	nd	0.089	0.121	0.053	0.074	nd	0.002
Toluene	0.001	15.0	UK SGV	0.269	Freshwater EQS (AA)	0.016	0.067	0.004	0.003	nd	0.016	0.027	0.002	0.017	0.038	0.005	nd	0.021	nd
Trans-1,2-Dichloroethene	0.001	69.5	USEPA R9 (Residential)	0.185	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethane	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	0.001	0.620	URS GAC	0.0362	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichlorofluoromethane	0.001	386	USEPA R9 (Residential)	8.55	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	0.001	35.0	URS GAC	0.225	Freshwater EQS (AA)	0.047	0.193	0.006	nd	nd	0.05	0.021	0.007	0.016	0.072	0.006	0.024	0.039	nd
O-Xylene	0.001	156000	USEPA R3 (Residential)	0.225	Freshwater EQS (AA)	0.015	0.068	nd	nd	nd	0.016	0.006	nd	0.005	nd	nd	0.005	0.017	nd
Vinyl Chloride	0.001	0.00400	URS GAC	0.000430	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Environmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Risk Assessment
Dutch SRC	Dutch Serious Risk Concentration
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 5
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						TP521	TP522	TP523	TP524	TP525	TP8	WS108	WS108A	WS109A	WS110	WS112	WS114	WS116	WS120	WS122
Depth						0.7	0.2	0.25	0.5	0.3	0.9	0.2-0.5	0.65 - 0.85	1.2 - 1.4	0.1-0.5	0.75	0.8-1	0.5-0.75	0.3-0.6	0.25-0.5
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,1,1,2-Tetrachloroethane	0.001	1.50	URS GAC	0.00234	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2,2-Tetrachloroethane	0.001	27.0	URS GAC	0.000158	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	0.001	9.83	Adjusted DIV	0.501	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.011	nd	nd	nd	nd
1,1,2-Trichloroethane	0.001	6.55	Adjusted DIV	0.865	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	0.001	0.0450	URS GAC	1.27	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	0.001	0.790	URS GAC	0.175	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	0.001	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	0.001	0.00502	USEPA R9 (Residential)	0.0000209	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.157	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromo-3-Chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	0.001	0.00689	USEPA R9 (Residential)	0.00000130	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.001	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	0.001	0.812		0.0127	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	0.001	0.342	USEPA R9 (Residential)	0.0732	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	0.001	21.3	USEPA R9 (Residential)	0.310	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.405	nd	0.018	nd	nd	nd	nd	nd	nd	nd
1,3-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.001	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.001	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	0.001	42.9	USEPA R9 (Residential)	0.116	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,2-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.001	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	0.028	nd	-	-	-	-	-	-
1,2-Dibromo-3-chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	-	-	-	-	-	-	-	nd	nd	-	-	-	-	-	-
2-Chlorotoluene	0.001	158	USEPA R9 (Residential)	3.50	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	nd	-	nd	nd	-	-	-	-	-	-
Benzene	0.001	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	nd	nd	0.002	0.002	0.143	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromobenzene	0.001	27.8	USEPA R9 (Residential)	0.111	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	0.001	0.824	USEPA R9 (Residential)	0.000425	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	0.001	61.6	USEPA R9 (Residential)	0.0410	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	0.001	3.90	USEPA R9 (Residential)	0.0545	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulphide	0.001	355	USEPA R9 (Residential)	1.93	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	0.001	0.655	Adjusted DIV	0.0522	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	0.001	3.03	USEPA R9 (Residential)	0.00459	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	0.001	6.55	Adjusted DIV	0.0205	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.172	nd	nd	nd	nd
Chloromethane	0.001	1.23	USEPA R9 (Residential)	0.000360	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	0.001	1.11	USEPA R9 (Residential)	0.000389	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	0.001	66.9	USEPA R9 (Residential)	0.0929	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	0.001	93.9	USEPA R9 (Residential)	6.87	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	0.001	4.10	URS GAC	0.0335	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.001	80.0	UK SGV	4.16	WHO DWG	nd	nd	nd	0.006	0.004	0.085	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.001	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	0.001	572	USEPA R9 (Residential)	12.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Methyl T-Butyl Ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	**132.764**	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Butylbenzene	0.001	240	USEPA R9 (Residential)	22.7	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd
P-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd	nd	nd
Propylbenzene	0.001	240	USEPA R9 (Residential)	6.72	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sec-Butylbenzene	0.001	3130	USEPA R3 (Residential)	8.41	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Styrene	0.001	250	Dutch SRC	0.977	Freshwater EQS (AA)	nd	nd	nd	nd	nd	0.361	nd	nd	nd	nd	nd	nd	nd	nd	nd
tert-butyl methyl ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	nd	-	-	-	-	-	-	-	-	-
Tert-Butylbenzene	0.001	390	USEPA R9 (Residential)	6.22	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	0.001	4.50	URS GAC	0.0601	Freshwater EQS (AA)	0.001	0.017	nd	0.068	0.054	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	0.001	15.0	UK SGV	0.269	Freshwater EQS (AA)	nd	nd	nd	0.013	0.013	0.479	nd	0.01	0.003	0.05	nd	nd	nd	nd	nd
Trans-1,2-Dichloroethene	0.001	69.5	USEPA R9 (Residential)	0.185	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethane	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	nd	-	-	nd	0.01	nd	nd	nd	-
Trichloroethene	0.001	0.620	URS GAC	0.0362	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.01	nd	nd	nd	nd
Trichlorofluoromethane	0.001	386	USEPA R9 (Residential)	8.55	USEPA Region 9 (pathway specific)	nd	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	0.001	35.0	URS GAC	0.225	Freshwater EQS (AA)	nd	nd	nd	0.012	0.013	0.86	nd	0.023	nd	nd	nd	nd	nd	nd	nd
O-Xylene	0.001	156000	USEPA R3 (Residential)	0.225	Freshwater EQS (AA)	nd	nd	nd	0.004	0.004	0.288	nd	0.01	nd	nd	nd	nd	nd	nd	nd
Vinyl Chloride	0.001	0.00400	URS GAC	0.000430	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Environmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Risk Assessment
Dutch SRC	Dutch Serious Risk Concentration
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 5
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						WS124	WS128	WS130	WS134	WS136	WS137	WS142	WS143	WS145	WS147	WS151	WS153	WS155	WS157	WS159
Depth						0.1-0.2	0.5-0.7	0.5-0.8	0.4-0.6	0.3-0.5	1.1-1.4	0.5-1.0	0.2-0.4	1.5-1.8	0.5-1	0.5-0.7	0.1-0.4	0.5-0.7	0.5-0.8	0.5-0.8
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,1,1,2-Tetrachloroethane	0.001	1.50	URS GAC	0.00234	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2,2-Tetrachloroethane	0.001	27.0	URS GAC	0.000158	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	0.001	9.83	Adjusted DIV	0.501	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2-Trichloroethane	0.001	6.55	Adjusted DIV	0.865	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	0.001	0.0450	URS GAC	1.27	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	0.001	0.790	URS GAC	0.175	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	0.001	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	0.001	0.00502	USEPA R9 (Residential)	0.0000209	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromo-3-Chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	0.001	0.00689	USEPA R9 (Residential)	0.00000130	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.001	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	0.001	0.812		0.0127	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	0.001	0.342	USEPA R9 (Residential)	0.0732	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	0.001	21.3	USEPA R9 (Residential)	0.310	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.001	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.001	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	0.001	42.9	USEPA R9 (Residential)	0.116	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,2-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.001	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
1,2-Dibromo-3-chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Chlorotoluene	0.001	158	USEPA R9 (Residential)	3.50	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	0.001	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromobenzene	0.001	27.8	USEPA R9 (Residential)	0.111	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	0.001	0.824	USEPA R9 (Residential)	0.000425	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	0.001	61.6	USEPA R9 (Residential)	0.0410	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	0.001	3.90	USEPA R9 (Residential)	0.0545	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulphide	0.001	355	USEPA R9 (Residential)	1.93	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	0.001	0.655	Adjusted DIV	0.0522	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	0.001	3.03	USEPA R9 (Residential)	0.00459	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	0.001	6.55	Adjusted DIV	0.0205	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloromethane	0.001	1.23	USEPA R9 (Residential)	0.000360	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	0.001	1.11	USEPA R9 (Residential)	0.000389	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	0.001	66.9	USEPA R9 (Residential)	0.0929	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	0.001	93.9	USEPA R9 (Residential)	6.87	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	0.001	4.10	URS GAC	0.0335	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.001	80.0	UK SGV	4.16	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.001	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	0.001	572	USEPA R9 (Residential)	12.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Methyl T-Butyl Ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Butylbenzene	0.001	240	USEPA R9 (Residential)	22.7	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
P-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Propylbenzene	0.001	240	USEPA R9 (Residential)	6.72	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sec-Butylbenzene	0.001	3130	USEPA R3 (Residential)	8.41	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Styrene	0.001	250	Dutch SRC	0.977	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
tert-butyl methyl ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tert-Butylbenzene	0.001	390	USEPA R9 (Residential)	6.22	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	0.001	4.50	URS GAC	0.0601	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	0.001	15.0	UK SGV	0.269	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,2-Dichloroethene	0.001	69.5	USEPA R9 (Residential)	0.185	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethane	0.001	No Criteria	None Found	No Criteria	None Found	nd	-	nd	-	nd	-	-	nd	nd	nd	-	nd	nd	-	nd
Trichloroethene	0.001	0.620	URS GAC	0.0362	Freshwater EQS (AA)	nd	nd	nd	nd	0.147	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichlorofluoromethane	0.001	386	USEPA R9 (Residential)	8.55	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	0.001	35.0	URS GAC	0.225	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
O-Xylene	0.001	156000	USEPA R3 (Residential)	0.225	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Vinyl Chloride	0.001	0.00400	URS GAC	0.000430	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Environmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Risk Assessment
Dutch SRC	Dutch Serious Risk Concentration
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 5
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						WS161	WS164	WS165	WS402	WS403	WS407	WS409	WS411	WS412	WS413	WS415	WS416	WS418	WS420
Depth						0.3-0.5	1.9-2.4	0.3-0.6	0.6	0.5	0.7	1.5	2.3	0.5	1.2	0.7	0.45	1.25	1.5
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*														
1,1,1,2-Tetrachloroethane	0.001	1.50	URS GAC	0.00234	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2,2-Tetrachloroethane	0.001	27.0	URS GAC	0.000158	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	0.001	9.83	Adjusted DIV	0.501	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,2-Trichloroethane	0.001	6.55	Adjusted DIV	0.865	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	0.001	0.0450	URS GAC	1.27	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	0.001	0.790	URS GAC	0.175	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	0.001	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	0.001	0.00502	USEPA R9 (Residential)	0.0000209	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.021	0.009	nd
1,2-Dibromo-3-Chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	0.001	0.00689	USEPA R9 (Residential)	0.00000130	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.001	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	0.001	0.812		0.0127	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	0.001	0.342	USEPA R9 (Residential)	0.0732	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	0.001	21.3	USEPA R9 (Residential)	0.310	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.001	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	0.001	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	0.001	42.9	USEPA R9 (Residential)	0.116	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.143
2,2-Dichloropropane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.001	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	0.001	51.6	USEPA R9 (Residential)	0.222	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	0.021	0.009	-
1,2-Dibromo-3-chloropropane	0.001	0.455	USEPA R9 (Residential)	0.00493	WHO DWG	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2-Chlorotoluene	0.001	158	USEPA R9 (Residential)	3.50	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Benzene	0.001	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	nd	nd	0.026	0.034	nd	nd	nd	nd	0.007	nd	0.015	nd	0.02
Bromobenzene	0.001	27.8	USEPA R9 (Residential)	0.111	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	0.001	0.824	USEPA R9 (Residential)	0.000425	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	0.001	61.6	USEPA R9 (Residential)	0.0410	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	0.001	3.90	USEPA R9 (Residential)	0.0545	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulphide	0.001	355	USEPA R9 (Residential)	1.93	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	0.001	0.655	Adjusted DIV	0.0522	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	0.001	3.03	USEPA R9 (Residential)	0.00459	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	0.001	6.55	Adjusted DIV	0.0205	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.092
Chloromethane	0.001	1.23	USEPA R9 (Residential)	0.000360	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	0.001	1.11	USEPA R9 (Residential)	0.000389	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	0.001	66.9	USEPA R9 (Residential)	0.0929	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	0.001	93.9	USEPA R9 (Residential)	6.87	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	0.001	4.10	URS GAC	0.0335	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	0.001	80.0	UK SGV	4.16	WHO DWG	nd	nd	nd	0.125	0.01	0.002	nd	0.008	0.044	0.034	nd	0.029	0.008	nd
Hexachlorobutadiene	0.001	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	0.001	572	USEPA R9 (Residential)	12.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Methyl T-Butyl Ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	0.101	nd	0.075	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Butylbenzene	0.001	240	USEPA R9 (Residential)	22.7	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
P-Isopropyltoluene	0.001	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Propylbenzene	0.001	240	USEPA R9 (Residential)	6.72	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sec-Butylbenzene	0.001	3130	USEPA R3 (Residential)	8.41	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Styrene	0.001	250	Dutch SRC	0.977	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
tert-butyl methyl ether	0.001	65.5	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Tert-Butylbenzene	0.001	390	USEPA R9 (Residential)	6.22	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	0.001	4.50	URS GAC	0.0601	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.018	0.154	0.079	0.428
Toluene	0.001	15.0	UK SGV	0.269	Freshwater EQS (AA)	nd	nd	nd	0.058	0.026	0.002	0.004	0.011	0.032	0.059	nd	0.056	0.014	0.016
Trans-1,2-Dichloroethene	0.001	69.5	USEPA R9 (Residential)	0.185	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	0.001	0.777	USEPA R9 (Residential)	0.0228	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethane	0.001	No Criteria	None Found	No Criteria	None Found	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Trichloroethene	0.001	0.620	URS GAC	0.0362	Freshwater EQS (AA)	nd	nd	0.005	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	**3.664**
Trichlorofluoromethane	0.001	386	USEPA R9 (Residential)	8.55	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	0.001	35.0	URS GAC	0.225	Freshwater EQS (AA)	nd	nd	nd	0.409	0.047	0.006	0.004	0.028	0.083	0.115	0.005	0.127	0.018	nd
O-Xylene	0.001	156000	USEPA R3 (Residential)	0.225	Freshwater EQS (AA)	nd	nd	nd	0.15	0.022	nd	nd	nd	0.025	0.04	nd	0.049	0.011	nd
Vinyl Chloride	0.001	0.00400	URS GAC	0.000430	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Environmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Risk Assessment
Dutch SRC	Dutch Serious Risk Concentration
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 6
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						BH 302	BH303	STAGE3W	STAGE3X	STAGE3Y	STAGE3Z	TP14	TP16	TP17	TP3	TP4	TP502	TP503	TP505	TP506
Depth(m)						0.5 - 0.8	0.5 - 0.65	0.5-0.55	0.4-0.5	0.5-0.65	0.25-0.33	0.3	0.5	2.4	0.5	1	0.3	0.3	0.3	0.3
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,2,4-Trichlorobenzene	0.1	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.1	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.1	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.1	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1-Methylnapthalene		No Criteria	None Found	5.22	Calculated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.1	157	Dutch SRC	134	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	0.1	207	Dutch SRC	15.2	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	0.1	62.0	Dutch SRC	0.618	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	0.1	1220	USEPA R9 (Residential)	2.67	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dinitrotoluene	0.1	122	USEPA R9 (Residential)	0.135	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,6-Dinitrotoluene	0.1	61.1	USEPA R9 (Residential)	0.284	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	0.1	26.6	Dutch SRC	6.73	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorophenol	0.1	20.4	USEPA R9 (Residential)	5.79	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	0.1	1560	USEPA R3 (Residential)	5.72	Calculated	0.148	0.141	nd	nd	nd	nd	0.421	nd	nd	6.547	10.464	0.261	nd	0.734	1.928
2-Methylphenol	0.1	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitroaniline	0.1	1.75	USEPA R9 (Residential)	0.00354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitrophenol	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3-Nitroaniline	0.1	23.5	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Bromophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloro-3-Methylphenol	0.1	No Criteria	None Found	No Criteria	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloroaniline	0.1	244	USEPA R9 (Residential)	0.559	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Methylphenol	0.1	306	USEPA R9 (Residential)	0.346	USEPA Region 9 (pathway specific)	0.214	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.137	nd	nd	nd	nd
4-Nitroaniline	0.1	31.9	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitrophenol	0.1	626	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	0.136	0.255	0.401	nd	nd	0.185	nd
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	nd	nd	nd	nd	nd	nd	0.225	nd	nd	nd	nd	nd	nd	nd	nd
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.384	0.279	1.047	0.204	0.217	nd	nd	nd	0.306
Azobenzene	0.1	4.42	USEPA R9 (Residential)	0.0465	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	1.069	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Anthracene	0.1	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	0.259	0.223	nd	1.017	nd	0.174	1.101	0.616	1.195	0.341	nd	nd	0.394	0.22	1.058
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	0.197	nd	nd	nd	nd	0.147	0.571	0.205	0.121	nd	nd	nd	0.427	0.184	0.775
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	0.269	0.152	nd	2.239	nd	0.306	0.74	0.321	0.388	0.513	nd	nd	0.687	0.387	0.935
Benzo(ghi)perylene	0.1	1600	URS GAC	60.2	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	0.427	0.165	0.214	0.174	nd	nd	2.009	nd	0.324
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	0.281	0.16	nd	nd	nd	0.102	0.332	0.138	0.17	0.189	nd	nd	0.447	0.232	0.909
Benzyl alcohol	0.1	18300	USEPA R9 (Residential)	2.91	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biphenyl	0.1	350	USEPA R9 (Residential)	3.00	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-Chloroethoxy)Methane	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	0.1	0.211	USEPA R9 (Residential)	0.0000286	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	0.1	34.7	USEPA R9 (Residential)	26.5	WHO DWG	nd	nd	1.587	nd	2.409	0.556	nd	nd	nd	nd	nd	nd	0.716	nd	nd
Butylbenzylphthalate	0.1	12200	USEPA R9 (Residential)	16000	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	968.617	6.747	1.26	nd
Carbazole	0.1	24.3	USEPA R9 (Residential)	0.0223	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.145	0.482	1.077	1.116	0.69	nd	nd	nd	0.129
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	0.356	0.233	nd	2.083	nd	0.199	1.071	0.65	1.171	1.061	0.103	0.181	0.436	0.389	1.312
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.122	nd	nd	nd	nd	nd	0.833	nd	nd
Dibenzofuran	0.1	291	USEPA R9 (Residential)	1.71	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.223	0.16	0.527	6.294	4.547	nd	nd	0.286	0.672
Diethyl phthalate	0.1	48900	USEPA R9 (Residential)	320	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.719	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dimethyl phthalate	0.1	100000	USEPA R9 (Residential)	617	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-butylphthalate	0.1	6110	USEPA R9 (Residential)	4700	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	0.168	nd	nd	nd	nd	nd	1.006	nd	1.084	nd
Di-n-octylphthalate	0.1	2440	USEPA R9 (Residential)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.733	nd	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.422	0.389	nd	nd	nd	0.259	1.88	1.329	2.594	3.407	0.974	0.123	0.419	0.38	1.887
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.235	nd	0.44	0.118	nd	0.117	nd	nd	0.228
Hexachlorobenzene	0.1	1.40	Dutch SRC	0.0912	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.1	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	0.1	365	USEPA R9 (Residential)	1660	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachloroethane	0.1	34.7	USEPA R9 (Residential)	0.325	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	0.109	0.564	0.229	0.284	0.252	nd	nd	1.144	nd	0.288
Isophorone	0.1	512	USEPA R9 (Residential)	0.128	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.377	nd	0.113	5.52	10.955	nd	nd	nd	1.113
Nitrobenzene	0.1	19.6	USEPA R9 (Residential)	0.00657	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	0.1	0.0695	USEPA R9 (Residential)	0.00000906	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pentachlorophenol	0.1	11.1	URS GAC	0.0451	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.516	0.311	nd	nd	nd	0.262	1.712	1.467	4.616	7.117	3.993	1.036	nd	0.592	2.291
Phenol	0.1	36000	URS GAC	0.0316	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.379	nd	nd	nd	nd
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.314	0.328	nd	1.292	nd	0.199	1.505	0.981	2.081	2.082	0.481	0.206	0.456	0.325	1.445

Notes

MDL	Method detection limit
MRL	
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
Dutch SRC	Dutch Serious Risk Concentration
URS GAC	URS Generic assessment criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 6
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						TP507	TP508	TP510	TP511	TP512	TP513	TP513	TP514	TP515	TP516	TP517	TP518	TP519	TP521	TP522
Depth(m)						0.3	0.4	0.8	0.3	0.4	0.3	1.4	0.35	0.3	0.45	0.4	0.4	0.4	0.7	0.2
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,2,4-Trichlorobenzene	0.1	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.1	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.1	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.1	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1-Methylnapthalene		No Criteria	None Found	5.22	Calculated	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.1	157	Dutch SRC	134	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	0.1	207	Dutch SRC	15.2	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	0.1	62.0	Dutch SRC	0.618	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	0.1	1220	USEPA R9 (Residential)	2.67	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dinitrotoluene	0.1	122	USEPA R9 (Residential)	0.135	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,6-Dinitrotoluene	0.1	61.1	USEPA R9 (Residential)	0.284	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	0.1	26.6	Dutch SRC	6.73	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorophenol	0.1	20.4	USEPA R9 (Residential)	5.79	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	0.1	1560	USEPA R3 (Residential)	5.72	Calculated	0.355	0.76	nd	nd	nd	nd	nd	0.142	1.61	0.145	nd	0.212	**nd**	0.119	**nd**
2-Methylphenol	0.1	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitroaniline	0.1	1.75	USEPA R9 (Residential)	0.00354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitrophenol	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3-Nitroaniline	0.1	23.5	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Bromophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloro-3-Methylphenol	0.1	No Criteria	None Found	No Criteria	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloroaniline	0.1	244	USEPA R9 (Residential)	0.559	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Methylphenol	0.1	306	USEPA R9 (Residential)	0.346	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitroaniline	0.1	31.9	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitrophenol	0.1	626	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	0.531	nd	nd	0.56	nd	nd	nd
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	0.133	nd	0.315	nd	nd	nd	nd	0.585	nd	nd	nd	nd	0.164	nd
Azobenzene	0.1	4.42	USEPA R9 (Residential)	0.0465	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Anthracene	0.1	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	0.269	0.325	nd	0.78	nd	nd	0.192	nd	5.694	0.122	nd	nd	nd	0.516	0.196
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	0.197	0.191	nd	0.639	nd	nd	0.203	nd	**5.457**	nd	nd	nd	nd	0.732	0.129
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	0.339	0.306	nd	0.894	nd	nd	0.314	nd	5.51	0.124	nd	nd	nd	0.843	0.137
Benzo(ghi)perylene	0.1	1600	URS GAC	60.2	ENGLAND DWS (2000)	0.125	nd	nd	0.346	nd	nd	0.145	nd	2.667	nd	nd	nd	nd	0.781	nd
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	0.373	0.261	nd	0.494	nd	nd	0.193	nd	5.61	0.127	nd	nd	nd	0.576	0.183
Benzyl alcohol	0.1	18300	USEPA R9 (Residential)	2.91	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Biphenyl	0.1	350	USEPA R9 (Residential)	3.00	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Bis(2-Chloroethoxy)Methane	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	0.1	0.211	USEPA R9 (Residential)	0.0000286	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	0.1	34.7	USEPA R9 (Residential)	26.5	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.705	nd
Butylbenzylphthalate	0.1	12200	USEPA R9 (Residential)	16000	USEPA Region 9 (pathway specific)	nd	4.487	nd	nd	nd	nd	nd	nd	nd	nd	nd	3.374	188.543	nd	nd
Carbazole	0.1	24.3	USEPA R9 (Residential)	0.0223	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	0.167	nd	nd	nd	nd	0.189	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	0.437	0.422	nd	0.881	nd	nd	0.303	nd	6.02	0.187	nd	nd	nd	0.513	0.232
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	0.662	nd	nd	nd	nd	0.401	nd
Dibenzofuran	0.1	291	USEPA R9 (Residential)	1.71	USEPA Region 9 (pathway specific)	0.312	0.259	nd	nd	nd	nd	nd	nd	0.669	0.276	nd	0.557	nd	0.123	nd
Diethyl phthalate	0.1	48900	USEPA R9 (Residential)	320	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dimethyl phthalate	0.1	100000	USEPA R9 (Residential)	617	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-butylphthalate	0.1	6110	USEPA R9 (Residential)	4700	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-octylphthalate	0.1	2440	USEPA R9 (Residential)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.79	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.445	0.587	nd	2.185	nd	nd	0.401	nd	12.259	0.206	0.162	0.209	nd	0.146	0.329
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	0.126	nd	0.144	nd	nd	nd	nd	0.502	nd	nd	0.342	nd	0.127	nd
Hexachlorobenzene	0.1	1.40	Dutch SRC	0.0912	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.1	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	0.1	365	USEPA R9 (Residential)	1660	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachloroethane	0.1	34.7	USEPA R9 (Residential)	0.325	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	0.117	nd	nd	0.26	nd	nd	nd	nd	2.572	nd	nd	nd	nd	0.572	nd
Isophorone	0.1	512	USEPA R9 (Residential)	0.128	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	0.978	nd	nd	nd	nd	nd	nd
Nitrobenzene	0.1	19.6	USEPA R9 (Residential)	0.00657	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	0.1	0.0695	USEPA R9 (Residential)	0.00000906	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pentachlorophenol	0.1	11.1	URS GAC	0.0451	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.635	0.828	nd	1.501	0.188	nd	0.288	0.141	5.562	0.365	0.167	0.449	nd	0.35	0.216
Phenol	0.1	36000	URS GAC	0.0316	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.343	0.463	nd	1.705	nd	nd	0.323	nd	10.215	0.192	0.175	0.55	nd	nd	0.269

Notes

MDL	Method detection limit
MRL	
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
Dutch SRC	Dutch Serious Risk Concentration
URS GAC	URS Generic assessment criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 6
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						TP523	TP524	TP525	TP8	WS108A	WS109	WS109A	WS111	WS112	WS115	WS117	WS119	WS121	WS123	WS126
Depth(m)						0.25	0.5	0.3	0.9	0.65 - 0.85	0.1-0.3	1.2 - 1.4	0.1-0.4	1.5-1.8	0.3-0.6	0.2-0.5	0.4-0.5	0.7-1.0	0.2-0.5	0.3-0.5
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,2,4-Trichlorobenzene	0.1	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.1	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.1	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.1	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1-Methylnapthalene		No Criteria	None Found	5.22	Calculated	-	-	-	-	-	nd	-	nd	nd	7.9	0.8	0.2	0.6	3.7	nd
2,4,5-Trichlorophenol	0.1	157	Dutch SRC	134	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	0.1	207	Dutch SRC	15.2	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	0.1	62.0	Dutch SRC	0.618	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	0.1	1220	USEPA R9 (Residential)	2.67	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dinitrotoluene	0.1	122	USEPA R9 (Residential)	0.135	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,6-Dinitrotoluene	0.1	61.1	USEPA R9 (Residential)	0.284	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	0.1	26.6	Dutch SRC	6.73	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorophenol	0.1	20.4	USEPA R9 (Residential)	5.79	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	0.1	1560	USEPA R3 (Residential)	5.72	Calculated	0.265	2.038	0.202	0.607	nd	0.2	nd	1.3	nd	13.8	1.2	0.4	1	7.5	nd
2-Methylphenol	0.1	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitroaniline	0.1	1.75	USEPA R9 (Residential)	0.00354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitrophenol	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3-Nitroaniline	0.1	23.5	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Bromophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloro-3-Methylphenol	0.1	No Criteria	None Found	No Criteria	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloroaniline	0.1	244	USEPA R9 (Residential)	0.559	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Methylphenol	0.1	306	USEPA R9 (Residential)	0.346	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitroaniline	0.1	31.9	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitrophenol	0.1	626	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	1.255	nd	1.135	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	nd	nd	nd	0.468	nd	nd	nd	nd	nd	nd	-	-	-	-	-
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	2.186	nd	1.973	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Azobenzene	0.1	4.42	USEPA R9 (Residential)	0.0465	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Anthracene	0.1	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	nd	8.157	nd	1.753	nd	nd	nd	nd	nd	2	nd	nd	nd	nd	nd
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	nd	**7.03**	nd	0.646	nd	nd	nd	nd	nd	**1.6**	nd	nd	nd	nd	nd
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	nd	7.613	nd	0.814	nd	nd	nd	nd	nd	2.1	nd	nd	nd	nd	nd
Benzo(ghi)perylene	0.1	1600	URS GAC	60.2	ENGLAND DWS (2000)	nd	3.637	nd	0.3	nd	nd	nd	nd	nd	1.3	nd	nd	nd	nd	nd
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	nd	6.004	nd	0.373	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzyl alcohol	0.1	18300	USEPA R9 (Residential)	2.91	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	nd	nd	nd	nd	nd
Biphenyl	0.1	350	USEPA R9 (Residential)	3.00	Freshwater EQS (AA)	-	-	-	-	-	nd	-	nd	nd	1.2	nd	nd	nd	0.6	nd
Bis(2-Chloroethoxy)Methane	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	0.1	0.211	USEPA R9 (Residential)	0.0000286	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	0.1	34.7	USEPA R9 (Residential)	26.5	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Butylbenzylphthalate	0.1	12200	USEPA R9 (Residential)	16000	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbazole	0.1	24.3	USEPA R9 (Residential)	0.0223	USEPA Region 9 (pathway specific)	nd	1.823	nd	0.633	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	nd	8.457	nd	1.415	nd	nd	nd	nd	nd	2.5	0.3	nd	nd	0.4	nd
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	**1.118**	nd	0.124	nd	nd	nd	nd	nd	nd	-	-	-	-	-
Dibenzofuran	0.1	291	USEPA R9 (Residential)	1.71	USEPA Region 9 (pathway specific)	nd	1.389	nd	1.415	nd	nd	nd	nd	nd	3.3	**nd**	nd	nd	1.1	nd
Diethyl phthalate	0.1	48900	USEPA R9 (Residential)	320	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dimethyl phthalate	0.1	100000	USEPA R9 (Residential)	617	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-butylphthalate	0.1	6110	USEPA R9 (Residential)	4700	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-octylphthalate	0.1	2440	USEPA R9 (Residential)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.241	17.226	nd	3.282	nd	nd	nd	nd	nd	3.5	0.3	0.2	**nd**	0.4	nd
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	1.52	nd	1.699	nd	nd	nd	nd	nd	nd	nd	nd	nd	0.5	nd
Hexachlorobenzene	0.1	1.40	Dutch SRC	0.0912	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.1	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	0.1	365	USEPA R9 (Residential)	1660	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachloroethane	0.1	34.7	USEPA R9 (Residential)	0.325	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	3.64	nd	0.46	nd	nd	nd	nd	nd	1.1	nd	nd	nd	nd	nd
Isophorone	0.1	512	USEPA R9 (Residential)	0.128	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	1.414	nd	0.718	nd	nd	nd	nd	nd	13.1	0.6	0.4	0.4	3.9	nd
Nitrobenzene	0.1	19.6	USEPA R9 (Residential)	0.00657	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	0.1	0.0695	USEPA R9 (Residential)	0.00000906	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pentachlorophenol	0.1	11.1	URS GAC	0.0451	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.32	13.147	0.142	4.564	nd	nd	nd	nd	nd	8.7	0.8	0.4	0.7	2	nd
Phenol	0.1	36000	URS GAC	0.0316	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.221	13.196	nd	2.766	nd	nd	nd	nd	nd	2.7	0.3	nd	nd	0.3	nd

Notes

MDL	Method detection limit
MRL	
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
Dutch SRC	Dutch Serious Risk Concentration
URS GAC	URS Generic assessment criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 6
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						WS127	WS130	WS131	WS133	WS135	WS139	WS141	WS142	WS143	WS144	WS145	WS147	WS148	WS151	WS151
Depth(m)						0.3-0.4	0.5-0.8	1.9-2.0	0.2-0.5	0.25-0.5	0.3-0.5	0.2-0.5	0.5-1.0	0.2-0.4	0.5-1	1.5-1.8	0.5-1	0.75-0.95	0.25-0.5	0.5-0.7
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,2,4-Trichlorobenzene	0.1	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.1	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.1	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.1	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1-Methylnapthalene		No Criteria	None Found	5.22	Calculated	nd	nd	nd	9.2	1.2	4.3	0.5	1.1	0.3	nd	nd	nd	0.3	nd	nd
2,4,5-Trichlorophenol	0.1	157	Dutch SRC	134	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	0.1	207	Dutch SRC	15.2	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	0.1	62.0	Dutch SRC	0.618	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	0.1	1220	USEPA R9 (Residential)	2.67	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dinitrotoluene	0.1	122	USEPA R9 (Residential)	0.135	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,6-Dinitrotoluene	0.1	61.1	USEPA R9 (Residential)	0.284	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	0.1	26.6	Dutch SRC	6.73	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorophenol	0.1	20.4	USEPA R9 (Residential)	5.79	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	0.1	1560	USEPA R3 (Residential)	5.72	Calculated	0.2	nd	nd	14.5	1.4	5.8	0.7	1.7	0.5	nd	nd	nd	0.3	nd	nd
2-Methylphenol	0.1	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitroaniline	0.1	1.75	USEPA R9 (Residential)	0.00354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitrophenol	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3-Nitroaniline	0.1	23.5	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	**nd**	**nd**	**nd**	**nd**	**nd**	nd	**nd**	**nd**	**nd**	**nd**	nd	nd
4-Bromophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloro-3-Methylphenol	0.1	No Criteria	None Found	No Criteria	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloroaniline	0.1	244	USEPA R9 (Residential)	0.559	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Methylphenol	0.1	306	USEPA R9 (Residential)	0.346	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitroaniline	0.1	31.9	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitrophenol	0.1	626	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	-	nd	-	-	nd	-	-	-	nd	nd	nd	nd	nd	-	-
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Azobenzene	0.1	4.42	USEPA R9 (Residential)	0.0465	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Anthracene	0.1	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	nd	0.2	nd	2.3	0.4	0.4	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	nd	nd	nd	**1.6**	0.4	nd	nd	0.5	nd	nd	nd	nd	nd	nd	nd
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	nd	nd	nd	1.5	0.4	nd	nd	0.5	nd	nd	nd	nd	nd	nd	nd
Benzo(ghi)perylene	0.1	1600	URS GAC	60.2	ENGLAND DWS (2000)	nd	nd	nd	nd	0.3	nd	nd	0.5	nd	nd	nd	nd	nd	nd	nd
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	nd	nd	nd	1.1	0.3	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzyl alcohol	0.1	18300	USEPA R9 (Residential)	2.91	USEPA Region 9 (pathway specific)	nd	-	nd	nd	**-**	nd	nd	nd	-	-	-	-	-	nd	nd
Biphenyl	0.1	350	USEPA R9 (Residential)	3.00	Freshwater EQS (AA)	nd	nd	nd	1.3	0.9	0.5	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethoxy)Methane	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	0.1	0.211	USEPA R9 (Residential)	0.0000286	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	0.1	34.7	USEPA R9 (Residential)	26.5	WHO DWG	nd	2.3	0.6	nd	nd	0.9	nd	nd	nd	0.5	nd	nd	2.6	nd	nd
Butylbenzylphthalate	0.1	12200	USEPA R9 (Residential)	16000	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	4.8	nd	nd	nd
Carbazole	0.1	24.3	USEPA R9 (Residential)	0.0223	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	nd	0.2	nd	2.6	0.6	0.7	nd	0.7	nd	nd	nd	nd	nd	nd	nd
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	-	nd	-	-	nd	-	-	-	nd	nd	nd	nd	nd	-	-
Dibenzofuran	0.1	291	USEPA R9 (Residential)	1.71	USEPA Region 9 (pathway specific)	nd	nd	nd	3.4	nd	1.7	nd	nd	nd	nd	nd	nd	nd	nd	nd
Diethyl phthalate	0.1	48900	USEPA R9 (Residential)	320	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dimethyl phthalate	0.1	100000	USEPA R9 (Residential)	617	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-butylphthalate	0.1	6110	USEPA R9 (Residential)	4700	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-octylphthalate	0.1	2440	USEPA R9 (Residential)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	1.1	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	nd	0.3	nd	3.2	0.8	0.3	nd	0.7	nd	nd	nd	nd	0.3	nd	nd
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	nd	nd	1.8	nd	nd	-	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobenzene	0.1	1.40	Dutch SRC	0.0912	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.1	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	0.1	365	USEPA R9 (Residential)	1660	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachloroethane	0.1	34.7	USEPA R9 (Residential)	0.325	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	nd	nd	nd	0.3	nd	nd	0.5	nd	nd	nd	nd	nd	nd	nd
Isophorone	0.1	512	USEPA R9 (Residential)	0.128	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	6.4	0.6	2.9	0.3	0.9	0.3	nd	nd	nd	nd	nd	nd
Nitrobenzene	0.1	19.6	USEPA R9 (Residential)	0.00657	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	0.1	0.0695	USEPA R9 (Residential)	0.00000906	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pentachlorophenol	0.1	11.1	URS GAC	0.0451	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.3	0.3	nd	8.5	1.2	3.1	0.6	1.1	0.3	nd	nd	nd	nd	nd	0.3
Phenol	0.1	36000	URS GAC	0.0316	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	nd	0.3	nd	2.9	0.6	0.3	nd	0.6	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
MRL	
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
Dutch SRC	Dutch Serious Risk Concentration
URS GAC	URS Generic assessment criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 6
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						WS153	WS155	WS155	WS157	WS159	WS161	WS163	WS402	WS403	WS407	WS409	WS411	WS412	WS413	WS415
Depth(m)						0.1-0.4	0.5-0.7	1.9-2	0.5-0.8	0.5-0.7	0.3-0.5	0.05-0.5	0.5	0.5	0.3	1.5	2.1	0.5	0.45	0.7
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
1,2,4-Trichlorobenzene	0.1	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	0.1	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	0.1	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	0.1	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1-Methylnapthalene		No Criteria	None Found	5.22	Calculated	nd	nd	nd	0.3	5	nd	nd	-	-	-	-	-	-	-	-
2,4,5-Trichlorophenol	0.1	157	Dutch SRC	134	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	0.1	207	Dutch SRC	15.2	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	0.1	62.0	Dutch SRC	0.618	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	0.1	1220	USEPA R9 (Residential)	2.67	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dinitrotoluene	0.1	122	USEPA R9 (Residential)	0.135	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,6-Dinitrotoluene	0.1	61.1	USEPA R9 (Residential)	0.284	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	0.1	26.6	Dutch SRC	6.73	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorophenol	0.1	20.4	USEPA R9 (Residential)	5.79	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	0.1	1560	USEPA R3 (Residential)	5.72	Calculated	nd	nd	nd	0.4	6.7	nd	nd	1.573	nd	nd	nd	0.755	nd	nd	nd
2-Methylphenol	0.1	No Criteria	None Found	No Criteria		nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitroaniline	0.1	1.75	USEPA R9 (Residential)	0.00354	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitrophenol	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3-Nitroaniline	0.1	23.5	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Bromophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloro-3-Methylphenol	0.1	No Criteria	None Found	No Criteria	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloroaniline	0.1	244	USEPA R9 (Residential)	0.559	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Methylphenol	0.1	306	USEPA R9 (Residential)	0.346	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitroaniline	0.1	31.9	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	**nd**	nd	nd	nd	nd	nd	nd	nd
4-Nitrophenol	0.1	626	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd	nd	nd	**nd**	nd	**nd**	nd	nd	nd	nd	nd	nd	nd
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	5.3	nd	0.628	nd	nd	nd	nd	nd	nd	nd
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	nd	nd	nd	-	nd	-	-	nd	nd	nd	nd	nd	nd	nd	nd
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	9.6	31.6	0.834	nd	nd	nd	nd	nd	nd	nd
Azobenzene	0.1	4.42	USEPA R9 (Residential)	0.0465	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Anthracene	0.1	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	nd	nd	nd	0.7	1.3	**36.8**	**116**	1.437	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	nd	nd	nd	0.8	nd	**45**	**114**	1.078	nd	nd	nd	nd	nd	nd	nd
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	nd	nd	nd	0.6	nd	**42**	**104**	1.188	nd	nd	nd	nd	nd	nd	nd
Benzo(ghi)perylene	0.1	1600	URS GAC	60.2	ENGLAND DWS (2000)	nd	nd	nd	0.4	nd	20.8	54.7	0.5	nd	nd	nd	nd	nd	nd	nd
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	nd	nd	nd	0.7	nd	**27.5**	**94.8**	1.316	nd	nd	nd	nd	nd	nd	nd
Benzyl alcohol	0.1	18300	USEPA R9 (Residential)	2.91	USEPA Region 9 (pathway specific)	-	-	-	3.9	-	nd	nd	-	-	-	-	-	-	-	-
Biphenyl	0.1	350	USEPA R9 (Residential)	3.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	-	-	-	-	-	-	-	-
Bis(2-Chloroethoxy)Methane	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	0.1	0.211	USEPA R9 (Residential)	0.0000286	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	0.1	34.7	USEPA R9 (Residential)	26.5	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Butylbenzylphthalate	0.1	12200	USEPA R9 (Residential)	16000	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbazole	0.1	24.3	USEPA R9 (Residential)	0.0223	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	0.3	nd	nd	nd	nd	nd	nd	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	nd	nd	nd	0.8	1.9	38.7	**122**	1.625	nd	nd	nd	nd	nd	nd	nd
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	nd	nd	-	nd	-	-	0.191	nd	nd	nd	nd	nd	nd	nd
Dibenzofuran	0.1	291	USEPA R9 (Residential)	1.71	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	1.047	nd	0.148	nd	0.273	nd	nd	nd
Diethyl phthalate	0.1	48900	USEPA R9 (Residential)	320	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dimethyl phthalate	0.1	100000	USEPA R9 (Residential)	617	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-butylphthalate	0.1	6110	USEPA R9 (Residential)	4700	USEPA Region 9 (pathway specific)	nd	nd	nd	4.5	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-n-octylphthalate	0.1	2440	USEPA R9 (Residential)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	nd	nd	nd	1.5	1.4	65.3	**247**	3.689	nd	nd	nd	nd	nd	nd	nd
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	1.4	6.4	nd	0.8	nd	nd	nd	nd	nd	nd	nd
Hexachlorobenzene	0.1	1.40	Dutch SRC	0.0912	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	0.1	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	0.1	365	USEPA R9 (Residential)	1660	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachloroethane	0.1	34.7	USEPA R9 (Residential)	0.325	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	nd	nd	0.5	nd	**26.6**	**65.6**	0.444	nd	nd	nd	nd	nd	nd	nd
Isophorone	0.1	512	USEPA R9 (Residential)	0.128	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	2.3	nd	nd	nd	nd	nd	nd	0.508	nd	nd	nd
Nitrobenzene	0.1	19.6	USEPA R9 (Residential)	0.00657	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	0.1	0.0695	USEPA R9 (Residential)	0.00000906	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pentachlorophenol	0.1	11.1	URS GAC	0.0451	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	nd	nd	nd	1	7.2	42.3	116	3.538	nd	nd	nd	0.618	0.279	nd	nd
Phenol	0.1	36000	URS GAC	0.0316	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	nd	nd	nd	1.3	1.3	57.3	198	2.817	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
MRL	
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
Dutch SRC	Dutch Serious Risk Concentration
URS GAC	URS Generic assessment criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 6
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						WS416	WS418	WS420
Depth(m)						1.2	1.25	1.5
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*			
1,2,4-Trichlorobenzene	0.1	42.0	Dutch SRC	67.4	USEPA Region 9 (pathway specific)	nd	nd	nd
1,2-Dichlorobenzene	0.1	259	Dutch SRC	14.4	WHO DWG	nd	nd	nd
1,3-Dichlorobenzene	0.1	15.9	USEPA R9 (Residential)	0.354	USEPA Region 9 (pathway specific)	nd	nd	nd
1,4-Dichlorobenzene	0.1	251	Dutch SRC	7.04	WHO DWG	nd	nd	nd
1-Methylnapthalene		No Criteria	None Found	5.22	Calculated	-	-	-
2,4,5-Trichlorophenol	0.1	157	Dutch SRC	134	USEPA Region 9 (pathway specific)	nd	nd	nd
2,4,6-Trichlorophenol	0.1	207	Dutch SRC	15.2	WHO DWG	nd	nd	nd
2,4-Dichlorophenol	0.1	62.0	Dutch SRC	0.618	USEPA Region 9 (pathway specific)	nd	nd	nd
2,4-Dimethylphenol	0.1	1220	USEPA R9 (Residential)	2.67	USEPA Region 9 (pathway specific)	nd	nd	nd
2,4-Dinitrotoluene	0.1	122	USEPA R9 (Residential)	0.135	USEPA Region 9 (pathway specific)	nd	nd	nd
2,6-Dinitrotoluene	0.1	61.1	USEPA R9 (Residential)	0.284	USEPA Region 9 (pathway specific)	nd	nd	nd
2-Chloronaphthalene	0.1	26.6	Dutch SRC	6.73	USEPA Region 9 (pathway specific)	nd	nd	nd
2-Chlorophenol	0.1	20.4	USEPA R9 (Residential)	5.79	Freshwater EQS (AA)	nd	nd	nd
2-Methylnaphthalene	0.1	1560	USEPA R3 (Residential)	5.72	Calculated	1.415	0.161	4.876
2-Methylphenol	0.1	No Criteria	None Found	No Criteria		nd	nd	nd
2-Nitroaniline	0.1	1.75	USEPA R9 (Residential)	0.00354	USEPA Region 9 (pathway specific)	nd	nd	nd
2-Nitrophenol	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd
3-Nitroaniline	0.1	23.5	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd
4-Bromophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd
4-Chloro-3-Methylphenol	0.1	No Criteria	None Found	No Criteria	Freshwater EQS (AA)	nd	nd	nd
4-Chloroaniline	0.1	244	USEPA R9 (Residential)	0.559	USEPA Region 9 (pathway specific)	nd	nd	nd
4-Chlorophenylphenylether	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd
4-Methylphenol	0.1	306	USEPA R9 (Residential)	0.346	USEPA Region 9 (pathway specific)	nd	nd	nd
4-Nitroaniline	0.1	31.9	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd
4-Nitrophenol	0.1	626	USEPA R3 (Residential)	No Criteria	None Found	nd	nd	nd
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	nd	nd
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	nd	nd	0.444
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	nd	nd
Azobenzene	0.1	4.42	USEPA R9 (Residential)	0.0465	USEPA Region 9 (pathway specific)	nd	nd	nd
Benzo(A)Anthracene	0.1	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	nd	nd	0.436
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	nd	nd	nd
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	nd	nd	0.41
Benzo(ghi)perylene	0.1	1600	URS GAC	60.2	ENGLAND DWS (2000)	nd	nd	nd
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	nd	nd	0.352
Benzyl alcohol	0.1	18300	USEPA R9 (Residential)	2.91	USEPA Region 9 (pathway specific)	-	-	-
Biphenyl	0.1	350	USEPA R9 (Residential)	3.00	Freshwater EQS (AA)	-	-	-
Bis(2-Chloroethoxy)Methane	0.1	No Criteria	None Found	No Criteria	None Found	nd	nd	nd
Bis(2-Chloroethyl)Ether	0.1	0.211	USEPA R9 (Residential)	0.0000286	USEPA Region 9 (pathway specific)	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	0.1	34.7	USEPA R9 (Residential)	26.5	WHO DWG	nd	nd	nd
Butylbenzylphthalate	0.1	12200	USEPA R9 (Residential)	16000	USEPA Region 9 (pathway specific)	nd	nd	nd
Carbazole	0.1	24.3	USEPA R9 (Residential)	0.0223	USEPA Region 9 (pathway specific)	nd	nd	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	nd	nd	0.436
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	nd	nd
Dibenzofuran	0.1	291	USEPA R9 (Residential)	1.71	USEPA Region 9 (pathway specific)	0.238	nd	0.925
Diethyl phthalate	0.1	48900	USEPA R9 (Residential)	320	USEPA Region 9 (pathway specific)	nd	nd	nd
Dimethyl phthalate	0.1	100000	USEPA R9 (Residential)	617	USEPA Region 9 (pathway specific)	nd	nd	nd
Di-n-butylphthalate	0.1	6110	USEPA R9 (Residential)	4700	USEPA Region 9 (pathway specific)	nd	nd	nd
Di-n-octylphthalate	0.1	2440	USEPA R9 (Residential)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	nd	nd	0.619
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	nd	nd
Hexachlorobenzene	0.1	1.40	Dutch SRC	0.0912	Freshwater EQS (AA)	nd	nd	nd
Hexachlorobutadiene	0.1	6.24	USEPA R9 (Residential)	0.204	Freshwater EQS (AA)	nd	nd	nd
Hexachlorocyclopentadiene	0.1	365	USEPA R9 (Residential)	1660	USEPA Region 9 (pathway specific)	nd	nd	nd
Hexachloroethane	0.1	34.7	USEPA R9 (Residential)	0.325	USEPA Region 9 (pathway specific)	nd	nd	nd
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	nd	nd
Isophorone	0.1	512	USEPA R9 (Residential)	0.128	USEPA Region 9 (pathway specific)	nd	nd	nd
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	nd	nd	16.641
Nitrobenzene	0.1	19.6	USEPA R9 (Residential)	0.00657	USEPA Region 9 (pathway specific)	nd	nd	nd
N-Nitroso-Di-N-Propylamine	0.1	0.0695	USEPA R9 (Residential)	0.00000906	USEPA Region 9 (pathway specific)	nd	nd	nd
Pentachlorophenol	0.1	11.1	URS GAC	0.0451	Freshwater EQS (AA)	nd	nd	nd
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.448	0.172	1.172
Phenol	0.1	36000	URS GAC	0.0316	Freshwater EQS (AA)	nd	nd	nd
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	nd	nd	0.372

Notes

MDL	Method detection limit
MRL	
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
Dutch SRC	Dutch Serious Risk Concentration
URS GAC	URS Generic assessment criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 7
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN SOIL (mg/Kg)

Sample Location						**TP10**	**TP11**	**TP12**	**TP13**	**TP14**	**TP16**	**TP17**	**TP2**	**TP3**	**TP4**
Depth						**1.5**	**0.4**	**0.5**	**0.3**	**0.3**	**0.5**	**2.4**	**3.2**	**0.5**	**1**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***										
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	0.035	0.371	1.046	0.003	1.119	0.848	19.511	0.017	4.775	1.085
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	0.13	1.905	0.96	0.012	2.696	0.486	2.228	0.008	0.589	0.554
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	0.127	4.095	0.971	0.01	6.331	6.082	6.08	0.012	2.109	2.012
Benz(a)anthracene	0.001	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	0.378	**11.407**	4.149	0.008	**16.32**	9.365	2.292	0.011	2.924	0.695
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	0.306	**4.523**	**1.92**	0.002	**9.553**	**3.865**	0.328	0.005	0.455	0.155
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	0.372	8.937	4.904	0.005	7.423	6.93	1.549	0.005	5.742	0.522
Benzo(G,H,I)Perylene	0.01	1600	URS GAC	60.2	ENGLAND DWS (2000)	0.206	2.354	1.733	nd	6.577	2.468	0.526	nd	1.762	0.115
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	0.193	1.978	1.321	0.005	**12.101**	1.93	0.532	0.008	1.81	0.212
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	0.443	8.512	5.053	0.01	12.928	7.812	2.138	0.014	9.362	0.704
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	0.047	0.893	0.286	nd	**1.899**	0.817	0.094	nd	0.355	0.036
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.776	16.35	10.528	0.02	28.363	19.332	21.317	0.036	35.844	7.306
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	0.065	2.053	0.443	0.019	3.507	1.072	11.466	0.025	0.272	0.34
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	0.178	2.272	1.043	nd	5.728	2.085	0.389	nd	1.271	0.111
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.441	14.124	5.956	0.078	28.131	23.467	68.226	0.198	102.06	36.688
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.668	11.431	7.852	0.012	19.656	13.167	11.571	0.015	16.562	3.961
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	0.308	3.178	2.204	0.101	6.188	12.595	**70.631**	0.098	22.936	**74.913**
PAH 16 Total	-	-	-	-	-	4.673	94.383	50.369	0.285	168.52	112.321	218.878	0.452	208.828	129.409
Sum of UK 4	-	-	-	-	-	0.949	15.541	9.001	0.01	31.829	13.413	2.996	0.013	10.585	0.96
TOTAL of (sum of PAHs)	-	-	-	-	-	4.673	94.383	50.369	0.285	168.52	112.321	218.878	0.452	208.828	129.409

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 7
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN SOIL (mg/Kg)

Sample Location						**TP5**	**TP502**	**TP503**	**TP505**	**TP506**	**TP507**	**TP508**	**TP510**	**TP511**	**TP512**
Depth						**1.9**	**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**0.8**	**0.3**	**0.4**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***										
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	0.009	0.017	nd	0.119	0.241	0.094	0.143	0.028	0.042	0.019
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	0.008	0.016	0.008	0.059	0.282	0.13	0.176	0.015	0.029	0.017
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	0.033	0.022	0.016	0.096	0.721	0.277	0.311	0.031	0.112	0.015
Benz(a)anthracene	0.001	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	0.023	0.028	0.045	0.203	2.889	0.568	0.54	0.071	0.357	0.042
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	0.007	0.019	0.041	0.035	**1.624**	0.393	0.271	0.034	0.325	0.019
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	0.023	0.021	0.033	0.129	1.886	0.473	0.29	0.037	0.309	0.039
Benzo(G,H,I)Perylene	0.01	1600	URS GAC	60.2	ENGLAND DWS (2000)	nd	0.018	0.022	2.844	1.848	0.385	0.243	0.029	0.241	0.057
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	0.019	nd	nd	0.065	0.936	0.212	0.112	nd	0.172	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	0.053	0.044	0.047	0.286	3.225	0.772	0.665	0.087	0.413	0.071
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	nd	nd	0.903	0.756	0.099	0.061	0.009	0.05	0.011
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.207	0.058	0.054	0.386	3.97	0.989	0.867	0.256	0.723	0.052
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	0.056	0.025	0.014	0.149	0.742	0.258	0.638	0.017	0.048	0.015
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	0.013	0.02	2.959	2.122	0.344	0.151	0.024	0.261	0.024
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.444	0.197	0.08	0.753	6.622	1.924	2.897	0.135	0.564	0.235
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.059	0.056	0.049	0.283	2.961	0.786	0.694	0.209	0.572	0.05
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	0.407	0.15	0.071	0.797	4.228	1.46	2.842	0.235	0.32	0.384
PAH 16 Total	-	-	-	-	-	1.348	0.684	0.5	10.066	35.053	9.164	10.901	1.217	4.538	1.05
Sum of UK 4	-	-	-	-	-	0.042	0.052	0.075	5.997	6.792	1.414	0.796	0.09	0.983	0.12
TOTAL of (sum of PAHs)	-	-	-	-	-	1.348	0.684	0.5	10.066	35.053	9.164	10.901	1.217	4.538	1.05

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 7
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN SOIL (mg/Kg)

Sample Location						TP513	TP513	TP514	TP515	TP516	TP517	TP519	TP521	TP522	TP523
Depth						0.3	1.4	0.35	0.3	0.45	0.4	0.4	0.7	0.2	0.25
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*										
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	nd	nd	0.081	1.45	0.091	0.049	nd	0.029	0.063	0.065
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	0.008	0.091	0.048	0.259	0.044	0.048	0.009	0.042	0.091	0.143
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	nd	0.148	0.145	2.142	0.086	0.097	0.012	0.083	0.233	0.321
Benz(a)anthracene	0.001	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	0.015	0.49	0.562	10.705	0.305	0.061	0.026	0.116	1.111	0.511
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	nd	0.52	0.555	**10.877**	0.162	0.041	0.032	0.091	0.634	0.425
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	nd	0.534	0.471	9.005	0.183	0.094	0.028	0.088	0.604	0.749
Benzo(G,H,I)Perylene	0.01	1600	URS GAC	60.2	ENGLAND DWS (2000)	0.022	0.451	0.357	5.586	0.105	0.086	0.029	0.07	0.573	0.274
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	nd	0.271	0.239	4.603	0.072	0.033	nd	0.033	0.363	0.254
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	0.026	0.729	0.636	10.892	0.438	0.154	0.033	0.168	1.132	0.632
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	nd	nd	0.078	**1.433**	0.024	0.061	nd	0.016	0.218	0.086
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.027	1.294	0.974	21.495	0.559	0.162	0.052	0.22	1.502	1.344
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	nd	nd	0.114	1.443	0.156	0.058	nd	0.084	0.119	0.195
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	nd	0.404	0.317	6.284	0.071	0.051	0.027	0.049	0.565	0.229
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	0.095	0.563	1.032	13.086	1.376	0.452	0.066	0.623	1.913	1.409
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.024	1.447	0.81	17.663	0.484	0.168	0.048	0.163	1.269	1.043
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	0.203	0.416	0.64	5.965	0.948	0.43	0.038	0.328	2.465	0.483
PAH 16 Total	-	-	-	-	-	0.42	7.358	7.059	122.888	5.104	2.045	0.4	2.203	12.855	8.163
Sum of UK 4	-	-	-	-	-	0.022	1.66	1.384	25.478	0.431	0.264	0.084	0.24	2.105	1.506
TOTAL of (sum of PAHs)	-	-	-	-	-	0.42	7.358	7.059	122.888	5.104	2.045	0.4	2.203	12.855	8.163

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 7
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN SOIL (mg/Kg)

Sample Location						TP524	TP525	TP6	TP7	TP8	TP9	WS402	WS403	WS407	WS409
Depth						0.5	0.3	0.5	1	0.6	0.8	0.5	0.5	0.3	1.5
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*										
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	2.084	0.035	0.101	0.01	17.371	0.047	1.27	0.162	0.02	0.018
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	0.332	0.025	0.023	0.015	6.306	0.032	0.178	0.271	0.013	0.009
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	6.708	0.096	0.287	0.01	56.825	0.152	0.996	0.327	0.012	0.016
Benz(a)anthracene	0.001	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	**23.896**	0.241	0.378	0.025	**53.193**	0.159	0.853	0.854	0.019	0.04
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	**20.693**	0.24	0.184	0.01	**31.465**	0.026	0.679	0.474	0.015	0.031
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	**17.847**	0.205	0.338	0.035	**42.251**	0.234	0.677	0.542	0.017	0.031
Benzo(G,H,I)Perylene	0.01	1600	URS GAC	60.2	ENGLAND DWS (2000)	13.534	0.143	0.063	0.007	10.522	0.009	0.489	0.499	0.017	0.021
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	9.702	0.104	0.156	0.023	**14.042**	0.111	0.309	0.235	nd	nd
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	23.398	0.269	0.517	0.049	44.895	0.331	0.971	0.933	0.041	0.046
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	**4.341**	0.034	0.034	0.003	**4.064**	0.019	0.151	0.146	nd	nd
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	40.01	0.459	1.223	0.059	100.16	0.709	2.39	1.271	0.031	0.1
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	3.76	0.069	0.148	0.032	38.582	0.096	1.2	0.517	0.027	0.019
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	**15.81**	0.137	0.052	0.003	**11.631**	0.022	0.484	0.429	nd	0.021
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	34.471	0.657	1.51	0.136	136.58	0.703	4.724	2.849	0.203	0.104
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	28.578	0.347	0.768	0.044	67.101	0.483	1.779	1.065	0.032	0.083
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	4.827	0.493	0.353	0.201	20.021	0.245	2.622	4.706	0.326	0.14
PAH 16 Total	-	-	-	-	-	249.991	3.554	6.135	0.662	655.009	3.378	19.772	15.28	0.773	0.679
Sum of UK 4	-	-	-	-	-	56.893	0.589	0.609	0.068	78.446	0.376	1.959	1.705	0.034	0.073
TOTAL of (sum of PAHs)	-	-	-	-	-	249.991	3.554	6.135	0.662	655.009	3.378	19.772	15.28	0.773	0.679

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 7
POLYCYCLIC AROMATIC HYDROCARBONS (PAHs) IN SOIL (mg/Kg)

Sample Location						**WS411**	**WS412**	**WS413**	**WS415**	**WS416**	**WS418**	**WS420**
Depth						**2.1**	**0.5**	**0.45**	**0.7**	**1.2**	**1.25**	**1.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***							
Acenaphthene	0.001	1000	URS GAC	63.4	USEPA Region 9 (pathway specific)	0.051	0.136	0.173	0.03	0.436	0.147	0.574
Acenaphthylene	0.001	95.0	URS GAC	6.85	None Found	0.069	0.181	0.052	0.029	0.258	0.175	1.082
Anthracene	0.001	16000	URS GAC	1820	USEPA Region 9 (pathway specific)	0.086	0.221	0.168	0.028	0.14	0.375	0.733
Benz(a)anthracene	0.001	11.1	URS GAC	0.698	USEPA Region 9 (pathway specific)	0.164	0.66	0.255	0.127	0.415	0.885	2.129
Benzo(A)Pyrene	0.001	1.10	URS GAC	0.691	ENGLAND DWS (2000)	0.093	0.227	0.243	0.068	0.125	0.46	0.158
Benzo(B)Fluoranthene	0.001	11.1	URS GAC	2.09	ENGLAND DWS (2000)	0.112	0.289	0.401	0.123	0.21	0.573	2.064
Benzo(G,H,I)Perylene	0.01	1600	URS GAC	60.2	ENGLAND DWS (2000)	0.106	0.524	0.29	0.401	3.095	0.402	5.006
Benzo(K)Fluoranthene	0.001	11.1	URS GAC	3.71	ENGLAND DWS (2000)	0.047	0.085	0.148	0.062	0.075	0.264	1.17
Chrysene	0.001	110	URS GAC	27.2	USEPA Region 9 (pathway specific)	0.251	1.129	0.449	0.178	0.698	1.118	2.61
Dibenzo(ah)anthracene	0.001	1.10	URS GAC	0.581	USEPA Region 9 (pathway specific)	0.024	0.141	0.081	0.101	**1.282**	0.102	**2.607**
Fluoranthene	0.001	110	URS GAC	3050	USEPA Region 9 (pathway specific)	0.234	0.457	0.675	0.192	0.493	1.765	3.206
Fluorene	0.001	2200	URS GAC	131	USEPA Region 9 (pathway specific)	0.079	0.289	0.118	0.065	0.761	0.39	0.867
Indeno(123cd)pyrene	0.001	11.1	URS GAC	13.2	ENGLAND DWS (2000)	0.05	0.177	0.168	0.33	1.353	0.339	6.609
Phenanthrene	0.001	1000	URS GAC	78.3	Calculated	1.074	3.1	1.72	0.417	4.331	2.119	6.66
Pyrene	0.001	1100	URS GAC	577	USEPA Region 9 (pathway specific)	0.183	0.423	0.59	0.143	0.404	1.398	1.835
Naphthalene	0.001	31.0	URS GAC	0.304	USEPA Region 9 (pathway specific)	1.492	1.555	1.217	0.4	5.022	2.091	**52.605**
PAH 16 Total	-	-	-	-	-	4.115	9.594	6.748	2.694	19.098	12.603	89.915
Sum of UK 4	-	-	-	-	-	0.315	1.075	1.007	0.916	4.733	1.578	14.849
TOTAL of (sum of PAHs)	-	-	-	-	-	4.115	9.594	6.748	2.694	19.098	12.603	89.915

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						BH 302	BH303	S16	S17	SB1	SB10	SB10	SB11	SB12
Depth						0.5 - 0.8	0.5 - 0.65	0.8	0.9	2.6-2.7	0.5-0.6	3.1-3.2	0.5-0.6	0.6-0.7
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	0.331	-	-	-	-	-	-	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	17.911	-	-	-	-	-	-	-	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	14.761	-	-	-	-	-	-	-	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	38.916	-	-	-	-	-	-	-	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	71.919	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	0.018	-	-	-	-	-	-	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	1.265	-	-	-	-	-	-	-	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	4.207	-	-	-	-	-	-	-	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	26.25	-	-	-	-	-	-	-	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	31.74	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	0.349	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	103.659	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	nd	nd	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	-	-	nd	nd	nd	nd	nd	nd	nd
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	3	nd	nd	-	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	-	14	11	nd	nd	22.3	**585**	nd	14.5
C16-C21		1600	URS GAC	No Criterion	No Criterion	-	31	69	21	nd	78.6	1220	nd	nd
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	18	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	442	687	nd	110
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	108	nd	nd	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	-	174	80	26	nd	542.9	2492	nd	124.5
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	-	-	-	-	-	-	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	nd	-	-	-	-	-	-	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	nd	-	-	-	-	-	-	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	-	-	-	-	-	-	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	nd	-	-	-	-	-	-	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	0.018	-	-	-	-	-	-	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						SB13	SB14	SB14	SB15	SB16	SB19	SB2	SB20	SB21
Depth						1.95-2.05	0.4-0.6	2.4-2.5	0.4-0.5	1.1-1.2	2.5-2.6	0.5-0.6	2.1-2.2	1.2-1.3
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	nd	nd	14.3	nd	nd	nd	nd	nd	nd
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	nd	73.8	nd	50.3	nd	nd	51.7	**1280**	93.7
C16-C21		1600	URS GAC	No Criterion	No Criterion	nd	nd	nd	136	nd	nd	169	**2020**	61.4
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	20.6	108	36.9	168	28.5	nd	833	1160	39.4
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	20.6	181.8	51.2	354.3	28.5	nd	1053.7	4460	194.5
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	-	-	-	-	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	-	-	-	-	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						SB22	SB23	SB4	SB5	SB6	SB6	SB7	SB8	SB8
Depth						0.9-1	0.8-0.9	0.7-0.8	0.5-0.6	1.7-1.8	2.6-2.7	1-1.1	1.2-1.4	4.5-4.6
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	30.4	nd	nd	67.9	127	12.2	nd	nd	nd
C16-C21		1600	URS GAC	No Criterion	No Criterion	46	nd	nd	143	383	nd	nd	nd	nd
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	130	nd	nd	45.6	138	nd	nd	nd	nd
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	206.4	nd	nd	256.5	648	12.2	nd	nd	nd
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	-	-	-	-	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	-	-	-	-	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						SB9	STAGE3AA	STAGE3W	STAGE3X	STAGE3Y	TP502	TP503	TP503	TP505
Depth						1.6-1.7	0.5-0.55	0.5-0.55	0.4-0.5	0.5-0.65	0.3	0.3	0.7	0.3
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	nd	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	nd	nd	-	-	-	-	nd	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	nd	nd	-	-	-	-	nd	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	nd	nd	-	-	-	-	nd	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	23.7	**839.8**	-	-	-	-	0.629	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	1438.59	6596.952	-	-	-	-	0.573	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	468.075	2847.568	-	-	-	-	0.228	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	1930	10284	-	-	-	-	1.43	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	nd	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	nd	nd	-	-	-	-	nd	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	nd	nd	-	-	-	-	0.058	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	nd	nd	-	-	-	-	nd	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	**3176**	158	-	-	-	-	0.371	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	1016	245	-	-	-	-	0.366	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	165	54	-	-	-	-	0.279	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	4356	457	-	-	-	-	1.074	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	0.058	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	2.504	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	**6286**	**10741**	-	-	-	-	2.504	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	nd	nd	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	nd	-	-	nd	nd	-	-	-	-
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	**410**	nd	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	nd	-	-	**15787**	**2437**	-	-	-	-
C16-C21		1600	URS GAC	No Criterion	No Criterion	nd	-	-	**30056**	**18142**	-	-	-	-
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	**17115**	nd	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	nd	nd	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	nd	-	-	63368	20945	225	nd	-	258
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	-	-	-	-	nd	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	-	-	-	-	nd	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	0.058	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	nd	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	-	-	-	-	nd	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	-	-	-	-	nd	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						TP506	TP507	TP508	TP510	TP510	TP511	TP511	TP512	TP513
Depth						0.3	0.3	0.4	0.25	0.8	0.3	3	0.4	0.3
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	0.017	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	0.104	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	3.359	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	13.778	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	-	-	0.285	-	0.549	**1261.689**	-	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	0.363	-	0.215	1584.144	-	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	0.786	-	0.776	461.43	-	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	1.434	-	1.54	3324.521	-	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	nd	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	nd	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	5.527	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	nd	20.668	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	0.144	24.996	-	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	-	-	0.103	-	0.37	162.065	-	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	-	-	0.645	-	11.703	232.718	-	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	0.748	-	12.217	445.974	-	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	nd	-	nd	43.453	-	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	2.182	-	13.757	**3770.495**	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	-	-	2.182	-	13.757	**3770.495**	-	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21		1600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	1327	410	653	-	108	-	-	65	nd
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	nd	-	nd	nd	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	nd	-	nd	0.146	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	nd	-	nd	nd	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	nd	-	nd	nd	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	nd	-	nd	0.342	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	nd	-	nd	nd	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						TP513	TP514	TP515	TP515	TP516	TP519	TP520	TP521	TP522
Depth						1.4	0.35	0.3	0.6	0.45	0.4	0.3	0.7	0.2
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	-	-	-	0.424	-	-	-	0.107
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	0.32	-	-	-	nd
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	0.436	-	-	-	0.393
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	1.18	-	-	-	0.5
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	0.336
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	-	-	-	0.278	-	-	-	0.325
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	-	-	-	0.435	-	-	-	0.326
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	0.713	-	-	-	0.987
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	nd
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	1.893	-	-	-	1.487
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	-	-	-	1.893	-	-	-	1.487
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21		1600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	866	328	1051	1374	-	187	1538	313	269
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	-	nd	-	-	-	nd
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	-	nd	-	-	-	nd
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	nd	-	-	-	nd
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	nd	-	-	-	nd
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	-	nd	-	-	-	nd
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	-	nd	-	-	-	nd
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						TP523	TP524	TP525	WS108	WS108A	WS109A	WS115	WS124	WS131
Depth						0.25	0.5	0.3	0.2-0.5	0.65 - 0.85	1.2 - 1.4	4-4.4	0.2-0.4	1.9-2.0
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	0.652	-	-	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	nd	-	-	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	nd	-	-	-	0.023	-	-	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	0.062	-	-	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	8.352	-	-	-	413.32	-	-	-	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	39.152	-	-	-	3127.652	-	-	-	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	121.69	-	-	-	390.57	-	-	-	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	169.194	-	-	-	3932.28	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	nd	-	-	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	nd	-	-	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	nd	-	-	-	0.035	-	-	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	nd	-	-	-	0.094	-	-	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	nd	-	-	-	22.863	-	-	-	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	2.725	-	-	-	34.737	-	-	-	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	28.781	-	-	-	72.753	-	-	-	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	31.506	-	-	-	130.481	-	-	-	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	0.866	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	**200.7**	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	200.7	-	-	-	**4062.761**	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	-	-	-	nd	-	-	nd	nd	nd
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	nd	-	-	nd
C12-C16		550	URS GAC	No Criterion	No Criterion	-	-	-	**818**	-	4	nd	nd	nd
C16-C21		1600	URS GAC	No Criterion	No Criterion	-	-	-	**2160**	-	1	nd	nd	nd
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	1	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	-	-	-	752	-	-	nd	41	77.1
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	nd	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	-	2421	82	3730	-	6	nd	41	77.1
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	nd	-	-	-	nd	-	-	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	nd	-	-	-	nd	-	-	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	nd	-	-	-	nd	-	-	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	nd	-	-	-	nd	-	-	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	nd	-	-	-	nd	-	-	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	nd	-	-	-	nd	-	-	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						WS133	WS136	WS141	WS144	WS153	WS156	WS159	WS402	WS403
Depth						0.2-0.5	0.5-0.8	0.2-0.5	0.1-0.4	0.1-0.4	0.5-0.6	1.75-2	0.5	0.5
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	**27.6**	nd	nd	nd	nd	nd	nd	-	-
C10-C12		75.0	URS GAC	No Criterion	No Criterion	20.9	-	nd	nd	nd	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	96.2	122	nd	nd	nd	nd	nd	-	-
C16-C21		1600	URS GAC	No Criterion	No Criterion	169	212	nd	15.6	nd	nd	nd	-	-
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	701	350	nd	29.3	25.5	25.5	25.5	-	-
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	1014.7	684	nd	44.9	25.5	25.5	25.5	580	661
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	-	-	-	-	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	-	-	-	-	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						WS407	WS409	WS411	WS412	WS413	WS415	WS416	WS418	WS418
Depth						0.3	1.5	2.1	0.5	0.45	0.7	1.2	1.15	1.25
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***									
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-	-	-	-	0.042	nd	-	-	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-	-	-	-	0.089	nd	-	-	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	nd	-	-	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	nd	-	-	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-	-	-	-	0.107	7.704	-	0.282	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	0.102	1.25	-	nd	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-	-	-	-	0.261	1.666	-	0.331	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	0.601	10.62	-	0.613	-
						-	-	-	-	-	-	-	-	-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	nd	-	-	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-	-	-	-	0.039	nd	-	-	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-	-	-	-	0.061	nd	-	-	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-	-	-	-	nd	nd	-	-	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-	-	-	-	0.297	nd	-	nd	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-	-	-	-	0.135	0.139	-	0.271	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-	-	-	-	0.193	0.143	-	0.391	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	0.725	0.282	-	0.662	-
						-	-	-	-	-	-	-	-	-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	0.244	nd	-	0.662	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-	-	-	-	1.326	10.902	-	1.275	-
						-	-	-	-	-	-	-	-	-
C6-C8		No Criterion	No Criterion			-	-	-	-	-	-	-	-	-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C12-C16		550	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C16-C21		1600	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C28		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	89	270	207	552	-	-	691	-	2065
						-	-	-	-	-	-	-	-	-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-	-	-	-	nd	nd	-	-	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-	-	-	-	nd	nd	-	-	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	0.036	nd	-	-	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-	-	-	-	0.013	nd	-	-	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-	-	-	-	0.011	nd	-	-	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-	-	-	-	0.039	nd	-	-	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 8
TOTAL PETROLEUM HYDROCARBON (TPH) CONCENTRATIONS IN SOIL

Sample Location						WS420
Depth						1.5
Target Compound	MDL	***Human Health***	***Source***	***Controlled Waters***	***Source***	
C5-C6 Aliphatic	0.01	21.0	URS GAC	No Criterion	No Criterion	-
C6-C8 aliphatic	0.01	60.0	URS GAC	No Criterion	No Criterion	-
C8-C10 aliphatic	0.01	15.3	URS GAC	No Criterion	No Criterion	-
C10-C12 aliphatic	0.01	75.0	URS GAC	No Criterion	No Criterion	-
C12-C16 aliphatic	0.1	600	URS GAC	No Criterion	No Criterion	-
C16-C21 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-
C21-C35 aliphatic	0.1	110000	URS GAC	No Criterion	No Criterion	-
Total Aliphatics (C5-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-
						-
C6-C7 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-
C7-C8 aromatic	0.01	70.0	URS GAC	No Criterion	No Criterion	-
C8-C10 aromatic	0.01	24.0	URS GAC	No Criterion	No Criterion	-
C10-C12 aromatic	0.01	120	URS GAC	No Criterion	No Criterion	-
C12-C16 aromatic	0.1	550	URS GAC	No Criterion	No Criterion	-
C16-C21 aromatic	0.1	1600	URS GAC	No Criterion	No Criterion	-
C21-C35 aromatic	0.1	1700	URS GAC	No Criterion	No Criterion	-
Total Aromatics(C6-C35)	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-
						-
Total TPH-PRO (C4-C10)		No Criterion	No Criterion	No Criterion	No Criterion	-
Pro C4-C12	0.1	No Criterion	No Criterion	No Criterion	No Criterion	-
Pro C10-C12		75.0	URS GAC	No Criterion	No Criterion	-
Tph (Sum Aliphatics&Aromatics C5-C35)	0.1	3290	Adjusted DIV	No Criterion	No Criterion	-
						-
C6-C8		No Criterion	No Criterion			-
C8-C10		15.3	URS GAC	No Criterion	No Criterion	-
C10-C12		75.0	URS GAC	No Criterion	No Criterion	-
C12-C16		550	URS GAC	No Criterion	No Criterion	-
C16-C21		1600	URS GAC	No Criterion	No Criterion	-
C21-C28		1700	URS GAC	No Criterion	No Criterion	-
C21-C35		1700	URS GAC	No Criterion	No Criterion	-
C28-C40		No Criterion	No Criterion	No Criterion	No Criterion	-
Total TPH-DRO	1	No Criterion	No Criterion	No Criterion	ENGLAND DWS 2000	1234
						-
Benzene	0.01	0.154	URS GAC	0.0724	Freshwater EQS (AA)	-
Ethylbenzene	0.01	80.0	UK SGV	4.16	WHO DWG	-
M,P-Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-
Mtbe	0.01	65.9	Adjusted DIV	0.00678	USEPA Region 9 (pathway specific)	-
O-Xylene	0.01	156000	USEPA R3 (Residential)	156000	USEPA Region 3 (Residential)	-
Toluene	0.01	15.0	UK SGV	0.269	Freshwater EQS (AA)	-
Xylene	0.01	35.0	URS GAC	0.225	Freshwater EQS (AA)	-

Notes

MDL	Method detection limit
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
WHO DWG	World Health Organisation Drinking Water Guidelines
Freshwater EQS	Freshwater Environmental Quality standard
URS GAC	URS Generic Assessment Criteria
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						SB1	SB10	SB10	SB11	SB12	SB13	SB14	SB14	SB15	SB16	SB19
Depth						2.6-2.7	0.5-0.6	3.1-3.2	0.5-0.6	0.6-0.7	1.95-2.05	0.4-0.6	2.4-2.5	0.4-0.5	1.1-1.2	2.5-2.6
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	nd	nd	nd	nd	nd	36.7	22.6	nd	35.7	15.4	25
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	nd	nd	nd	nd	nd	36.5	31.5	nd	13.3	18.1	342.4
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						SB2	SB20	SB21	SB22	SB23	SB4	SB5	SB6	SB6	SB7	SB8
Depth						0.5-0.6	2.1-2.2	1.2-1.3	0.9-1	0.8-0.9	0.7-0.8	0.5-0.6	1.7-1.8	2.6-2.7	1-1.1	1.3-1.4
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	nd	4.1	16.9	nd	7	nd	nd	nd	nd	nd	8
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	nd	2.9	19.3	nd	8.1	nd	nd	nd	nd	nd	72
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						SB8	SB9	TP502	TP503	TP503	TP505	TP506	TP507	TP508	TP510	TP511
Depth						4.5-4.6	1.6-1.7	0.3	0.3	0.7	0.3	0.3	0.3	0.4	0.25	0.3
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	nd	nd	nd	6	-	10	14	13	**42**	7	**22**
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	nd	nd	nd	-	2	1	5	nd	2	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	153900	158300	-	81840	115200	161500	2934	83990	52590
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	4	9	12	12	-	36	50	44	42	44	36
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	9	57	9	8	-	43	112	67	4	20	27
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	8265	9173	-	**56160**	**37410**	17370	**43970**	**24240**	**58460**
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	nd	nd	4	3	-	56	49	19	65	14	24
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	3300	2321	-	2877	12430	6379	128	4775	6466
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	nd	nd	8	7	-	45	25	18	43	23	21
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	-	**1830**	**164**	-	**2478**	**3860**	**8416**	**2924**	**1153**	**637**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	nd	2	nd	-	16	nd	nd	nd	nd	nd
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	nd	nd	22	14	-	94	146	149	100	94	130
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	nd	nd	-	2	1	nd	nd	nd	nd
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	757	657	-	1645	1306	925	1282	2929	2581
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	783	4686	-	1097	1588	477	641	500	594

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						TP512	TP513	TP514	TP514	TP515	TP516	TP517	TP518	TP519	TP520	TP521
Depth						0.4	0.3	0.35	2	0.3	0.45	0.4	0.4	0.4	0.3	0.7
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	9	11	7	-	**26**	4	8	9	5	3	5
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	nd	nd	-	nd	8	nd	nd	12	5	3
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	9150	8582	134300	-	109800	332000	8874	349200	125900	86560	110000
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	26	22	17	-	15	18	24	10	84	55	167
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	26	20	21	-	22	10	26	2	10	nd	329
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	**36350**	**30770**	**26960**	-	**30000**	5228	9854	8545	11160	21330	11300
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	12	18	295	-	38	10	11	7	3	10	18
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	4083	2705	5147	-	3756	6376	663	4977	3529	6327	5989
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	27	24	20	-	21	18	6	14	17	48	20
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**414**	**455**	**167**	-	**609**	**1353**	**19680**	**1225**	**16300**	**4784**	**47040**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	nd	11	-	7	nd	2	nd	nd	nd	nd
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	61	62	26	-	37	184	23	14	230	171	382
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	nd	nd	5	-	4	nd	3	nd	nd	2	2
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	3586	2047	2386	-	3920	547	7188	933	2913	7113	5217
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	545	515	682	-	682	576	531	600	524	557	1891

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						TP522	TP523	TP524	TP525	WS108	WS110	WS111	WS112	WS112	WS114	WS115
Depth						**0.2**	**0.25**	**0.5**	**0.3**	**0.2-0.5**	**0.1-0.5**	**0.1-0.4**	**0.75**	**1.5-1.8**	**0.8-1**	**0.3-0.6**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	15	3	**30**	8	**22**	8	-	**23**	6	5	-
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	-
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	30820	251800	8161	107400	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	20	19	42	23	35	14	-	23	19	4	-
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	19	7	116	4	66	34	-	32	21	6	-
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	**33320**	12330	**49770**	14550	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	38	326	105	7	112	45	-	92	17	**nd**	-
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	3038	5641	1582	3919	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	nd	**30**	1	-	3	nd	nd	-
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	15	13	51	14	52	29	-	31	52	nd	-
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**676**	**1538**	**1113**	**682**	-	-	nd	-	-	**458**	**700**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	nd	nd	nd	0.63	0.98	-	1.47	0.86	4.13	-
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	67	40	179	35	104	39	-	93	73	10	-
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	1	3	nd	nd	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	2436	1957	2772	1379	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	297	717	587	621	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						**WS115**	**WS116**	**WS117**	**WS119**	**WS120**	**WS121**	**WS122**	**WS123**	**WS124**	**WS126**	**WS127**
Depth						**4-4.4**	**0.5-0.75**	**0.2-0.5**	**0.4-0.5**	**0.3-0.6**	**0.7-1.0**	**0.25-0.5**	**0.2-0.5**	**0.1-0.2**	**0.3-0.5**	**0.3-0.4**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	-	17	-	-	**58**	-	**26**	-	**20**	3	-
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	-	nd	-	-	nd	-	nd	-	nd	nd	-
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	-	14	-	-	7	-	19	-	31	29	-
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	-	110	-	-	75	-	42	-	15	18	-
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	-	32	-	-	136	-	43	-	12	45	-
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	-	nd	-	-	nd	-	nd	-	0.7	nd	-
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	-	14	-	-	27	-	33	-	13	33	-
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**700**	-	**482**	**352**	**221**	**nd**	**371**	**209**	-	**3900**	**804**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	-	1.09	-	-	4.81	-	1.71	-	0.56	1.77	-
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	-	115	-	-	41	-	126	-	31	126	-
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						WS128	WS130	WS131	WS133	WS134	WS134	WS135	WS136	WS137	WS139	WS141
Depth						0.5-0.7	0.5-0.8	1.9-2.0	0.2-0.5	0.4-0.6	0.5-1.0	0.25-0.5	0.3-0.5	1.1-1.4	0.3-0.5	0.2-0.5
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	8	4	**24**	-	**66**	nd	-	9	**22**	19	-
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	nd	21	-	4	nd	-	nd	nd	nd	-
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	29	32	**748**	-	26	19	-	43	21	13	-
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	5	50	185	-	87	27	-	62	28	46	-
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	20	334	107	-	358	18	-	81	53	20	-
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	-	nd	nd	-	nd	nd	nd	-
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	27	17	**114**	-	**92**	37	-	22	32	31	-
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	-	**2520**	**41800**	**1770**	**25800**	-	**5170**	**6130**	**1680**	**597**	**6690**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	1.2	4.54	-	4.42	0.53	-	1.51	1.11	1.57	-
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	45	98	1660	-	735	42	-	107	63	22	-
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						**WS142**	**WS143**	**WS143**	**WS144**	**WS144**	**WS145**	**WS147**	**WS148**	**WS150**	**WS151**	**WS152**
Depth						**0.5-1.0**	**0.2-0.4**	**2.1-2.4**	**0.1-0.4**	**0.5-1**	**1.5-1.8**	**0.5-1.0**	**0.75-0.95**	**0.5-1.0**	**0.25-0.5**	**0.3-0.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	**30**	-	18	8	-	19	14	9	15	8	6
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	nd	-	nd	nd	-	nd	nd	nd	nd	nd	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	19	-	25	12	-	22	34	20	14	21	24
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	35	-	14	14	-	22	6	18	34	8	26
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	56	-	18	25	-	22	23	43	26	15	18
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	-	nd	nd	-	nd	nd	nd	nd	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	33	-	**89**	6	-	24	51	17	30	18	17
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**588**	nd	-	**853**	nd	-	-	**470**	**427**	-	**2230**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	1.51	-	1.91	1.61	-	0.64	0.67	1.61	0.95	nd	1.87
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	58	-	216	30	-	58	64	45	61	51	46
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						**WS153**	**WS153**	**WS154**	**WS155**	**WS156**	**WS157**	**WS158**	**WS159**	**WS160**	**WS161**	**WS162**
Depth						**0.1-0.4**	**0.3-0.5**	**0.5-0.7**	**1.9-2**	**0.5-1.6**	**0.5-0.8**	**0.3-0.9**	**0.5-0.7**	**0.5-1.0**	**0.3-0.5**	**0.25-0.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	-	-	11	**68**	12	-	5	-	7	-	14
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	-	-	nd	nd	nd	-	nd	-	nd	-	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	-	-	21	139	26	-	35	-	27	-	68
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	-	-	16	231	49	-	11	-	7	-	21
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	-	-	79	52	60	-	9	-	18	-	36
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	-	-	nd	nd	0.7	-	0.7	-	nd	-	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	-	-	17	**130**	50	-	11	-	27	-	22
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**842**	nd	-	-	**403**	**1280**	**1510**	**982**	**436**	**218**	-
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	-	-	1.61	1.26	1.38	-	2.25	-	nd	-	2.68
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	-	-	45	51	77	-	31	-	36	-	77
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						**WS163**	**WS164**	**WS165**	**WS402**	**WS403**	**WS406**	**WS407**	**WS409**	**WS411**	**WS411**	**WS412**
Depth						**0.05-0.5**	**1.9-2.4**	**0.3-0.6**	**0.3**	**0.5**	**0.3**	**0.2**	**0.4**	**0.5**	**2.5**	**0.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	-	6	**35**	**30**	**20**	**56**	4	13	-	**23**	5
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	-	nd	nd	nd	nd	nd	nd	nd	-	nd	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	-	-	-	25640	29640	16010	77310	4838	-	39340	6017
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	-	17	20	20	30	22	6	28	-	19	23
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	-	13	54	139	65	80	5	23	-	45	93
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	-	-	-	**30520**	**35870**	**50970**	4847	**36510**	-	**26070**	15800
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	-	18	184	66	56	66	6	16	-	57	7
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	-	-	-	3948	3771	4793	1760	2217	-	6108	1314
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	-	1	nd	nd	nd	nd	nd	nd	-	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	-	24	59	40	30	45	8	38	-	41	**96**
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**1430**	**383**	**578**	**398**	**10960**	**1071**	**132**	**380**	-	**1294**	**139**
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	-	1.27	0.96	nd	29	nd	nd	nd	-	nd	nd
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	-	47	94	133	85	83	13	63	-	64	25
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	-	-	-	nd	4	2	nd	nd	-	nd	nd
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	-	-	-	1151	1151	1191	808	5298	-	2828	2196
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	-	-	-	628	1151	584	542	255	-	690	589

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 9
TOTAL METAL CONCENTRATIONS IN SOIL (mg/Kg)

Sample Location						**WS413**	**WS415**	**WS416**	**WS418**	**WS420**
Depth						**0.8**	**0.2**	**0.45**	**0.5**	**1.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***					
Total Arsenic	1	20	UK SGV(1,3)	10	Freshwater EQS (AA)	**76**	9	**47**	13	**35**
Total Cadmium	1	30	UK SGV(1,4)	3.36E-02	Freshwater EQS (AA)	1	nd	nd	nd	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	12440	38330	15270	76920	1666
Total Chromium	1	200	UK SGV(1,5)	11.1	Freshwater EQS (AA)	13	54	16	19	14
Total Copper	1	8600	Dutch SRC	0.022	Freshwater EQS (AA)	39	15	68	18	26
Total Iron	1	23460	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	**35840**	**31330**	**33190**	10540	**106200**
Total Lead	1	450	UK SGV(1,7)	0.398	Freshwater EQS (AA)	73	30	66	81	43
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	2293	5062	4870	7590	2113
Total Mercury	1	15	UK SGV	0.0521	USEPA Region 9	nd	nd	nd	nd	nd
Total Nickel	1	75	UK SGV(1)	7.5	Freshwater EQS (AA)	50	18	47	6	65
Total Phosphorus	1	1.564	USEPA R9 (Residential)	No criterion	ENGLAND DWS (2000)	**567**	**603**	**1075**	**3870**	-
Total Selenium	1	260	UK SGV(1,6)	2.73E-02	ENGLAND DWS (2000)	nd	nd	nd	nd	nd
Total Zinc	1	46100	Dutch SRC	0.132	Freshwater EQS (AA)	50	168	130	143	243
Water Soluble Boron	1	15620	USEPA R9 (Residential)	2.062	Freshwater EQS (AA)	nd	1	nd	5	nd
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	3717	4951	3367	2053	3281
Sodium (dissolved)	4	No criterion	No criterion	17005	Freshwater EQS (AA)	913	2039	429	695	500

Notes

MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 10
POLYCHLORINATED BIPHENYLS (PCBs) IN SOIL (mg/Kg)

Sample Location						**TP502**	**TP503**	**TP505**	**TP506**	**TP507**	**TP508**	**TP510**	**TP511**	**TP512**	**TP513**	**TP513**	**TP514**	**TP515**	**TP516**	**TP517**	**TP519**	**TP521**
Depth						**0.3**	**0.3**	**0.3**	**0.3**	**0.3**	**0.4**	**0.8**	**0.3**	**0.4**	**0.3**	**1.4**	**0.35**	**0.3**	**0.45**	**0.4**	**0.4**	**0.7**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***																	
Pcb Congener 101	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.002	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 118	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.002	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 138	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.001	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 153	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.001	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 180	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.001	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 28	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.024	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 52	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.006	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total 7 Congener Pcbs	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.037	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total PCBs		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 10
POLYCHLORINATED BIPHENYLS (PCBs) IN SOIL (mg/Kg)

Sample Location						TP522	TP524	TP525	WS110	WS112	WS134	WS134	WS141	WS150	WS151	WS151	WS156	WS159	WS162	WS165
Depth						0.2	0.5	0.3	0.1-0.5	0.75	0.4-0.6	0.5-1.0	0.2-0.5	0.5-1.0	0.25-0.5	0.5-0.7	0.5-0.6	0.5-0.8	0.25-0.5	0.3-0.6
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
Pcb Congener 101	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Pcb Congener 118	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Pcb Congener 138	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Pcb Congener 153	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Pcb Congener 180	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Pcb Congener 28	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Pcb Congener 52	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Total 7 Congener Pcbs	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	-	-	-	-	-	-	-	-	-	-	-	-
Total PCBs		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	nd	0.77	0.06	0.35	0.09	0.16	nd	0.67	0.22	0.31	nd	1.33

Notes

MDL	Method detection limit
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 10
POLYCHLORINATED BIPHENYLS (PCBs) IN SOIL (mg/Kg)

Sample Location						WS402	WS403	WS407	WS409	WS411	WS412	WS413	WS415	WS416	WS418	WS420
Depth						**0.5**	**0.5**	**0.3**	**1.5**	**2.1**	**0.5**	**0.45**	**0.7**	**1.2**	**1.25**	**1.5**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
Pcb Congener 101	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 118	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 138	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 153	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 180	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 28	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 52	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total 7 Congener Pcbs	0.001	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total PCBs		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 11
METHYL BLUE ACTIVE SUBSTANCES (MBAS) - AND OTHER MISCELLANEOUS COMPOUNDS IN GROUNDWATER (µg/L)

Sample Location						SB1	SB10	SB11	SB13	SB14	SB15	SB19	SB2	SB20	SB21	SB22	SB5	SB6	SB8	SB9	WS108	WS109	WS114	WS115	WS120	WS124	WS125	WS126
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***																							
Bicarbonate Alkalinity	2000	No Criterion	No Criterion	No Criterion	No Criterion	215000	-	-	-	-	-	-	190000	-	-	-	-	-	-	-	265000	70000	-	-	-	-	-	-
BOD in unfiltered water	1000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.O.D.	5000	No Criterion	No Criterion	No Criterion	No Criterion	nd	79000	-	-	nd	610000	840000	-	-	nd	nd	-	200000	nd	-	-	-	-	-	6000	14000	-	-
C.O.D. in unfiltered Sample	10000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	1000	250000	ENGLAND DWS (2000)	250000	Freshwater EQS (AA)	40000	-	-	-	-	-	-	41000	-	-	-	-	-	-	-	32000	27000	-	-	-	-	-	-
Fluoride		1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	800	-	-	-	-	-	-	700	-	-	-	-	-	-	-	1000	**1800**	-	-	-	-	-	-
Free sulphur	50	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd	-	nd	-	-
MBAS		No Criterion	No Criterion	200	ENGLAND DWS (2000)	200	nd	nd	nd	nd	80	116000	200	nd	60	nd	nd	14400	480	nd	4500	4200	81	nd	nd	nd	42	850
Nitrate As N	300	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	nd	-	-	-	-	-	-	7400	-	-	-	-	-	-	-	600	nd	-	-	-	-	-	-
Ph	1	No Criterion	No Criterion	No Criterion	No Criterion	8.16	-	-	-	-	-	-	8.36	-	-	-	-	-	-	-	8.21	7.65	-	-	-	-	-	-
Phosphate		No Criterion	No Criterion	250000	ENGLAND DWS (2000)	nd	-	-	-	-	-	-	520	-	-	-	-	-	-	-	nd	nd	100	-	-	-	nd	26400
Sulphate (soluble)	0	No Criterion	No Criterion	250000	ENGLAND DWS (2000)	484000	-	-	-	-	-	-	140000	-	-	-	-	-	-	-	338000	841000	-	313000	-	928000	-	-
Sulphide	50	No Criterion	No Criterion	0.25	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd	-	nd	-	-
Thiocyanate	200	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	500	-	nd	-	-
Total Cyanide	50	No Criterion	No Criterion	50	No Criterion	nd	-	-	-	-	-	-	nd	-	-	-	-	-	-	-	-	nd	-	1670	-	nd	-	-
Total Dissolved Solids	5000	No Criterion	No Criterion	No Criterion	No Criterion	422000	614000	-	-	677000	840000	1540000	-	-	nd	466000	-	1130000	696000	-	-	-	-	-	248000	1240000	-	-
Total Phenols	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd	-	nd	-	-

Notes

MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 11
METHYL BLUE ACTIVE SUBSTANCES (MBAS) - AND OTHER MISCELLANEOUS COMPOUNDS IN GROUNDWATER (µg/L)

Sample Location						WS130	WS136	WS141	WS147	WS148	WS150	WS151	WS152	WS153	WS156	WS157	WS157	WS159	WS160	WS161	WS162	WS164	WS411	WS412	WS413
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***																				
Bicarbonate Alkalinity	2000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	220000	230000	-	-	-	-	-	30000	120000	330000
BOD in unfiltered water	1000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.O.D.	5000	No Criterion	No Criterion	No Criterion	No Criterion	280000	-	-	nd	50000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
C.O.D. in unfiltered Sample	10000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Chloride	1000	250000	ENGLAND DWS (2000)	250000	Freshwater EQS (AA)	-	102000	-	-	-	-	-	-	-	49000	48000	46000	-	-	**562000**	55000	-	41000	54000	69000
Fluoride		1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	1100	900	-	-	-	-	-	nd	1400	800
Free sulphur	50	No Criterion	No Criterion	No Criterion	No Criterion	400	-	-	-	-	-	-	-	-	-	-	-	nd	nd	-	-	nd	-	-	-
MBAS		No Criterion	No Criterion	200	ENGLAND DWS (2000)	5090	-	-	nd	300	34	nd	50	nd	290	110	50	-	-	330	50	-	50	50	50
Nitrate As N	300	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	-	4100	-	-	-	-	-	-	-	3400	700	nd	-	-	500	3000	-	500	7200	21600
Ph	1	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	8.24	7.99	-	-	-	-	-	9.18	7.95	7.94
Phosphate		No Criterion	No Criterion	250000	ENGLAND DWS (2000)	-	39040	64000	-	-	nd	100	nd	-	80	460	460	-	-	1720	nd	-	nd	nd	1030
Sulphate (soluble)	0	No Criterion	No Criterion	250000	ENGLAND DWS (2000)	27000	70000	-	-	-	-	-	-	-	1462000	1148000	1140000	1790000	1799000	38000	387000	1378000	1423000	385000	329000
Sulphide	50	No Criterion	No Criterion	0.25	No Criterion	nd	-	-	-	-	-	-	-	-	-	-	-	70	nd	-	-	nd	-	-	-
Thiocyanate	200	No Criterion	No Criterion	No Criterion	No Criterion	nd	-	-	-	-	-	-	-	-	-	-	-	nd	nd	-	-	nd	-	-	-
Total Cyanide	50	No Criterion	No Criterion	50	No Criterion	nd	nd	-	-	-	-	-	-	-	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total Dissolved Solids	5000	No Criterion	No Criterion	No Criterion	No Criterion	2990000	-	-	790000	1070000	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Total Phenols	10	No Criterion	No Criterion	No Criterion	No Criterion	160	-	-	-	-	-	-	-	-	-	-	-	nd	nd	-	-	nd	-	-	-

Notes

MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 11
METHYL BLUE ACTIVE SUBSTANCES (MBAS) - AND OTHER MISCELLANEOUS COMPOUNDS IN GROUNDWATER (µg/L)

Sample Location						**WS415**	**WS416**	**WS418**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***			
Bicarbonate Alkalinity	2000	No Criterion	No Criterion	No Criterion	No Criterion	155000	130000	20000
BOD in unfiltered water	1000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-
C.O.D.	5000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-
C.O.D. in unfiltered Sample	10000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-
Chloride	1000	250000	ENGLAND DWS (2000)	250000	Freshwater EQS (AA)	37000	34000	32000
Fluoride		1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	**2100**	**16400**	1000
Free sulphur	50	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-
MBAS		No Criterion	No Criterion	200	ENGLAND DWS (2000)	52	50	50
Nitrate As N	300	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	14600	nd	14900
Ph	1	No Criterion	No Criterion	No Criterion	No Criterion	7.98	7.74	9.62
Phosphate		No Criterion	No Criterion	250000	ENGLAND DWS (2000)	130	nd	nd
Sulphate (soluble)	0	No Criterion	No Criterion	250000	ENGLAND DWS (2000)	109000	1666000	859000
Sulphide	50	No Criterion	No Criterion	0.25	No Criterion	-	-	-
Thiocyanate	200	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-
Total Cyanide	50	No Criterion	No Criterion	50	No Criterion	nd	nd	nd
Total Dissolved Solids	5000	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-
Total Phenols	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-

Notes	
MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 12
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						WS108	WS109	WS114	WS115	WS124	WS125	WS126	WS128	WS130	WS136	WS141
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
1,1,1,2-Tetrachloroethane	1	0.432	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	1	2000	WHO DWG	100.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	1	811	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	1	30.0	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	1	0.00560	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	1	194	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	1	12.3	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	1	0.6	nd	nd	nd	nd	nd	nd
1,2-Dibromo-3-Chloropropane	1	1.00	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	1	0.400	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	1	1000	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	1	3.00	ENGLAND DWS (2000)	10.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	1	40.0	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	1	12.3	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	1	5.48	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichloropropane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	1	300	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,2-Dichloropropane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorotoluene	1	122	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromobenzene	1	20.3	USEPA Region 9 (pathway specific)	20.3	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	1	see sum of 4	ENGLAND DWS (2000)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	1	see sum of 4	ENGLAND DWS (2000)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	1	8.66	USEPA Region 9 (pathway specific)	8.66	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulfide	1	1040	USEPA Region 9 (pathway specific)	1040	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	1	2.00	WHO DWG	12.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	1	4.64	USEPA Region 9 (pathway specific)	4.64	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	1	see sum of 4	ENGLAND DWS (2000)	12.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	0.6	nd	nd	nd	nd
Chloromethane	1	1.51	USEPA Region 9 (pathway specific)	1.51	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	1	60.8	USEPA Region 9 (pathway specific)	60.8	USEPA Region 9 (pathway specific)	nd	nd	nd	1	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	1	20.0	WHO DWG	20.0	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	1	see sum of 4	ENGLAND DWS (2000)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	1	60.8	USEPA Region 9 (pathway specific)	60.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	0.8	nd	nd	nd	nd
Dichlorodifluoromethane	1	395	USEPA Region 9 (pathway specific)	395	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	1	20.0	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	1	0.600	WHO DWG	0.100	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	1	658	USEPA Region 9 (pathway specific)	658	USEPA Region 9 (pathway specific)	nd	nd	nd	4	nd	nd	nd	nd	nd	nd	nd
Methyl T-Butyl Ether	1	13.3	USEPA Region 9 (pathway specific)	13.3	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Butylbenzene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	1	6.20	USEPA Region 9 (pathway specific)	6.20	USEPA Region 9 (pathway specific)	nd	nd	nd	**49**	0.6	nd	nd	nd	nd	nd	nd
P-Isopropyltoluene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Propylbenzene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	1	nd	nd	nd	nd	nd	nd	nd
Sec-Butylbenzene	1	240	USEPA Region 9 (pathway specific)	240	USEPA Region 9 (pathway specific)	nd	nd	nd	3	nd	nd	nd	nd	nd	nd	nd
Styrene	1	20.0	WHO DWG	50.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tert-Butylbenzene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	1	No Criterion	ENGLAND DWS (2000)	10.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,2-Dichloroethene	1	122	USEPA Region 9 (pathway specific)	122	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	1	20.0	WHO DWG	20.0	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	1	see sum of 2	ENGLAND DWS (2000)	10.00	Freshwater EQS (AA)	nd	nd	nd	1	nd	nd	nd	nd	nd	11	nd
Trichlorofluoromethane	1	1290	USEPA Region 9 (pathway specific)	1290	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Vinyl Chloride	1	0.500	ENGLAND DWS (2000)	0.500	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzene	1	1.00	ENGLAND DWS (2000)	30.0	Freshwater EQS (AA)	nd	nd	nd	**5**	nd	nd	nd	nd	nd	nd	nd
Toluene	1	700	WHO DWG	50.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	1	300	WHO DWG	300	WHO DWG	nd	nd	nd	2	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	1	500	WHO DWG	30.0	Freshwater EQS (AA)	nd	nd	nd	1	nd	nd	nd	nd	nd	nd	nd
O-Xylene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	3	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
WHO DWG	World Health Organisation Drinking Water Standards
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 12
VOLATILE ORGANIC COMPOUND (VOC) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						WS150	WS151	WS152	WS156	WS157	WS165	WS411	WS412	WS413	WS415	WS416	WS418
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***												
1,1,1,2-Tetrachloroethane	1	0.432	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1,1-Trichloroethane	1	2000	WHO DWG	100.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethane	1	811	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloroethene	1	30.0	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,1-Dichloropropene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichlorobenzene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,3-Trichloropropane	1	0.00560	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trichlorobenzene	1	194	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2,4-Trimethylbenzene	1	12.3	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromo-3-Chloropropane	1	1.00	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dibromoethane	1	0.400	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	1	1000	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloroethane	1	3.00	ENGLAND DWS (2000)	10.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichloropropane	1	40.0	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3,5-Trimethylbenzene	1	12.3	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	1	5.48	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichloropropane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	1	300	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,2-Dichloropropane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorotoluene	1	122	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorotoluene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromobenzene	1	20.3	USEPA Region 9 (pathway specific)	20.3	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromochloromethane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromodichloromethane	1	see sum of 4	ENGLAND DWS (2000)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromoform	1	see sum of 4	ENGLAND DWS (2000)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bromomethane	1	8.66	USEPA Region 9 (pathway specific)	8.66	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Disulfide	1	1040	USEPA Region 9 (pathway specific)	1040	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Carbon Tetrachloride	1	2.00	WHO DWG	12.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chlorobenzene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroethane	1	4.64	USEPA Region 9 (pathway specific)	4.64	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloroform	1	see sum of 4	ENGLAND DWS (2000)	12.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Chloromethane	1	1.51	USEPA Region 9 (pathway specific)	1.51	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,2-Dichloroethene	1	60.8	USEPA Region 9 (pathway specific)	60.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Cis-1,3-Dichloropropene	1	20.0	WHO DWG	20.0	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromochloromethane	1	see sum of 4	ENGLAND DWS (2000)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibromomethane	1	60.8	USEPA Region 9 (pathway specific)	60.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichlorodifluoromethane	1	395	USEPA Region 9 (pathway specific)	395	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dichloromethane	1	20.0	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	1	0.600	WHO DWG	0.100	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isopropylbenzene	1	658	USEPA Region 9 (pathway specific)	658	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Methyl T-Butyl Ether	1	13.3	USEPA Region 9 (pathway specific)	13.3	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Butylbenzene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	1	6.20	USEPA Region 9 (pathway specific)	6.20	USEPA Region 9 (pathway specific)	0.7	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
P-Isopropyltoluene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Propylbenzene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Sec-Butylbenzene	1	240	USEPA Region 9 (pathway specific)	240	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Styrene	1	20.0	WHO DWG	50.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tert-Butylbenzene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Tetrachloroethene	1	No Criterion	ENGLAND DWS (2000)	10.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,2-Dichloroethene	1	122	USEPA Region 9 (pathway specific)	122	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trans-1,3-Dichloropropene	1	20.0	WHO DWG	20.0	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichloroethene	1	see sum of 2	ENGLAND DWS (2000)	10.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Trichlorofluoromethane	1	1290	USEPA Region 9 (pathway specific)	1290	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Vinyl Chloride	1	0.500	ENGLAND DWS (2000)	0.500	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzene	1	1.00	ENGLAND DWS (2000)	30.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Toluene	1	700	WHO DWG	50.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Ethylbenzene	1	300	WHO DWG	300	WHO DWG	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
M,P-Xylene	1	500	WHO DWG	30.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
O-Xylene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
WHO DWG	World Health Organisation Drinking Water Standards
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 13
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						WS108	WS109	WS114	WS125	WS126	WS141	WS150	WS151	WS152	WS157	WS411	WS412
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***												
1,2,4-Trichlorobenzene	1	194	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,2-Dichlorobenzene	1	1000	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,3-Dichlorobenzene	1	5.48	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
1,4-Dichlorobenzene	1	300	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,5-Trichlorophenol	1	3650	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4,6-Trichlorophenol	1	200	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dichlorophenol	1	0.300	WHO DWG	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dimethylphenol	1	730	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,4-Dinitrotoluene	1	73.0	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2,6-Dinitrotoluene	1	36.5	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chloronaphthalene	1	487	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Chlorophenol	1	0.100	WHO DWG	30.4	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylnaphthalene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Methylphenol	1	No Criterion	No Criterion	1.82E+02	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitroaniline	1	1.04	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
2-Nitrophenol	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
3-Nitroaniline	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Bromophenyl Phenyl Ether	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloro-3-Methylphenol	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chloroaniline	1	146	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Chlorophenyl Phenyl Ether	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Methylphenol	1	182	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	66	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitroaniline	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
4-Nitrophenol	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthene	1	365	USEPA Region 9 (pathway specific)	365	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Acenaphthylene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Anthracene	1	1830	USEPA Region 9 (pathway specific)	1830	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Azobenzene	1	0.611	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Anthracene	1	0.0921	USEPA Region 9 (pathway specific)	0.0921	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(A)Pyrene	1	0.0100	ENGLAND DWS (2000)	0.0100	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(b)fluoranthene	1	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Benzo(k)fluoranthene	1	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	**2**	nd	nd	nd
Bis(2-Chloroethoxy)Methane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	1	0.00978	USEPA Region 9 (pathway specific)	0.00978	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	68	nd	6	nd	nd	nd	nd
Carbazole	1	3.36	USEPA Region 9 (pathway specific)	3.36	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-N-Butylphthalate	1	3650	USEPA Region 9 (pathway specific)	3650	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Di-N-Octylphthalate	1	1460	USEPA Region 9 (pathway specific)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibenz(A,H)Anthracene	1	0.00921	USEPA Region 9 (pathway specific)	0.00921	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dibenzofuran	1	24.3	USEPA Region 9 (pathway specific)	24.3	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Diethylphthalate	1	29200	USEPA Region 9 (pathway specific)	29200	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Dimethylphthalate	1	365000	USEPA Region 9 (pathway specific)	365000	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fluoranthene	1	1460	USEPA Region 9 (pathway specific)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Fluorene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobenzene	1	1.00	WHO DWG	0.0300	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorobutadiene	1	0.600	WHO DWG	0.100	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachlorocyclopentadiene	1	219	USEPA Region 9 (pathway specific)	219	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Hexachloroethane	1	4.80	USEPA Region 9 (pathway specific)	4.80	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	1	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Isophorone	1	70.8	USEPA Region 9 (pathway specific)	70.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	1	0.00960	USEPA Region 9 (pathway specific)	0.00960	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Naphthalene	1	6.20	USEPA Region 9 (pathway specific)	6.20	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Nitrobenzene	1	3.40	USEPA Region 9 (pathway specific)	3.40	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pentachlorophenol	1	9.00	WHO DWG	2.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenanthrene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Phenol	1	21900	USEPA Region 9 (pathway specific)	30.0	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pyrene	1	183	USEPA Region 9 (pathway specific)	183	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 13
SEMIVOLATILE ORGANIC COMPOUND (SVOC) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						WS413	WS415	WS416	WS418
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***				
1,2,4-Trichlorobenzene	1	194	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
1,2-Dichlorobenzene	1	1000	WHO DWG	No criterion	No criterion	nd	nd	nd	nd
1,3-Dichlorobenzene	1	5.48	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
1,4-Dichlorobenzene	1	300	WHO DWG	No criterion	No criterion	nd	nd	nd	nd
2,4,5-Trichlorophenol	1	3650	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
2,4,6-Trichlorophenol	1	200	WHO DWG	No criterion	No criterion	nd	nd	nd	nd
2,4-Dichlorophenol	1	0.300	WHO DWG	No criterion	No criterion	nd	nd	nd	nd
2,4-Dimethylphenol	1	730	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
2,4-Dinitrotoluene	1	73.0	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
2,6-Dinitrotoluene	1	36.5	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
2-Chloronaphthalene	1	487	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
2-Chlorophenol	1	0.100	WHO DWG	30.4	Freshwater EQS (AA)	nd	nd	nd	nd
2-Methylnaphthalene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
2-Methylphenol	1	No Criterion	No Criterion	1.82E+02	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
2-Nitroaniline	1	1.04	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
2-Nitrophenol	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
3-Nitroaniline	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
4-Bromophenyl Phenyl Ether	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
4-Chloro-3-Methylphenol	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
4-Chloroaniline	1	146	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
4-Chlorophenyl Phenyl Ether	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
4-Methylphenol	1	182	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
4-Nitroaniline	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
4-Nitrophenol	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
Acenaphthene	1	365	USEPA Region 9 (pathway specific)	365	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Acenaphthylene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
Anthracene	1	1830	USEPA Region 9 (pathway specific)	1830	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Azobenzene	1	0.611	USEPA Region 9 (pathway specific)	No criterion	No criterion	nd	nd	nd	nd
Benzo(A)Anthracene	1	0.0921	USEPA Region 9 (pathway specific)	0.0921	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Benzo(A)Pyrene	1	0.0100	ENGLAND DWS (2000)	0.0100	ENGLAND DWS (2000)	nd	nd	nd	nd
Benzo(b)fluoranthene	1	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd
Benzo(k)fluoranthene	1	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd
Bis(2-Chloroethoxy)Methane	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
Bis(2-Chloroethyl)Ether	1	0.00978	USEPA Region 9 (pathway specific)	0.00978	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Bis(2-Ethylhexyl)Phthalate	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
Carbazole	1	3.36	USEPA Region 9 (pathway specific)	3.36	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Di-N-Butylphthalate	1	3650	USEPA Region 9 (pathway specific)	3650	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Di-N-Octylphthalate	1	1460	USEPA Region 9 (pathway specific)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Dibenz(A,H)Anthracene	1	0.00921	USEPA Region 9 (pathway specific)	0.00921	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Dibenzofuran	1	24.3	USEPA Region 9 (pathway specific)	24.3	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Diethylphthalate	1	29200	USEPA Region 9 (pathway specific)	29200	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Dimethylphthalate	1	365000	USEPA Region 9 (pathway specific)	365000	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Fluoranthene	1	1460	USEPA Region 9 (pathway specific)	1460	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Fluorene	1	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Hexachlorobenzene	1	1.00	WHO DWG	0.0300	Freshwater EQS (AA)	nd	nd	nd	nd
Hexachlorobutadiene	1	0.600	WHO DWG	0.100	Freshwater EQS (AA)	nd	nd	nd	nd
Hexachlorocyclopentadiene	1	219	USEPA Region 9 (pathway specific)	219	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Hexachloroethane	1	4.80	USEPA Region 9 (pathway specific)	4.80	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	1	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd
Isophorone	1	70.8	USEPA Region 9 (pathway specific)	70.8	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
N-Nitroso-Di-N-Propylamine	1	0.00960	USEPA Region 9 (pathway specific)	0.00960	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Naphthalene	1	6.20	USEPA Region 9 (pathway specific)	6.20	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Nitrobenzene	1	3.40	USEPA Region 9 (pathway specific)	3.40	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Pentachlorophenol	1	9.00	WHO DWG	2.00	Freshwater EQS (AA)	nd	nd	nd	nd
Phenanthrene	1	No Criterion	No Criterion	No criterion	No criterion	nd	nd	nd	nd
Phenol	1	21900	USEPA Region 9 (pathway specific)	30.0	Freshwater EQS (AA)	nd	nd	nd	nd
Pyrene	1	183	USEPA Region 9 (pathway specific)	183	USEPA Region 9 (pathway specific)	nd	nd	nd	nd

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 14
POLYCYCLIC AROMATIC HYDROCARBON (PAH) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						WS108	WS109	WS115	WS124	WS130	WS136	WS156	WS157	WS159	WS160	WS161	WS162	WS164	WS411	WS412
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***															
Acenaphthene	0.01	365	USEPA Region 9 (pathway specific)	365	USEPA Region 9 (pathway specific)	nd	0.03	1.121	0.02	0.186	nd	nd	nd	0.039	0.938	0.037	nd	nd	nd	nd
Acenaphthylene	0.01	No Criterion	No Criterion	No Criterion	No Criterion	nd	0.231	0.854	0.014	0.106	nd	nd	nd	0.016	0.158	0.019	nd	nd	nd	nd
Anthracene	0.01	1830	USEPA Region 9 (pathway specific)	1830	USEPA Region 9 (pathway specific)	nd	0.015	0.158	nd	0.119	nd	nd	nd	0.024	0.115	0.085	nd	nd	nd	nd
Benzo(a)anthracene	0.01	0.0921	USEPA Region 9 (pathway specific)	0.0921	USEPA Region 9 (pathway specific)	nd	0.034	**0.108**	nd	**0.523**	nd	nd	nd	nd	nd	0.067	nd	nd	nd	nd
Benzo(A)Pyrene	0.01	0.0100	ENGLAND DWS (2000)	0.0100	ENGLAND DWS (2000)	nd	nd	**0.021**	nd	**0.228**	nd	nd	nd	nd	nd	**0.68**	nd	nd	nd	nd
Benzo(B)Fluoranthene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	0.027	nd	**0.388**	nd	nd	nd	nd	nd	**0.56**	nd	nd	nd	nd
Benzo(G,H,I)Perylene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd	**0.173**	nd	nd	nd	nd	nd	**0.422**	nd	nd	nd	nd
Benzo(K)Fluoranthene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	0.024	nd	**0.21**	nd	nd	nd	nd	nd	**0.316**	nd	nd	nd	nd
Chrysene	0.01	9.21	USEPA Region 9 (pathway specific)	9.21	USEPA Region 9 (pathway specific)	nd	0.011	0.058	nd	0.38	nd	nd	nd	nd	nd	0.18	nd	nd	nd	nd
Dibenzo(A,H)Anthracene	0.01	0.00921	USEPA Region 9 (pathway specific)	0.00921	USEPA Region 9 (pathway specific)	nd	nd	nd	nd	**0.062**	nd	nd	nd	nd	nd	**0.148**	nd	nd	nd	nd
Fluoranthene	0.01	1460	USEPA Region 9 (pathway specific)	1460	USEPA Region 9 (pathway specific)	nd	0.086	0.701	nd	0.41	nd	nd	nd	0.033	0.018	0.081	nd	nd	nd	nd
Fluorene	0.01	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	0.03	0.5	nd	0.316	nd	nd	nd	0.069	0.607	0.017	nd	nd	nd	nd
Indeno(1,2,3-cd)pyrene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd	**0.163**	nd	nd	nd	nd	nd	**0.39**	nd	nd	nd	nd
Naphthalene	0.01	6.20	USEPA Region 9 (pathway specific)	6.20	USEPA Region 9 (pathway specific)	nd	0.611	0.459	0.61	1.433	nd	nd	nd	0.184	0.292	0.149	nd	nd	nd	nd
PAH 16 Total	0	No Criterion	No Criterion	No Criterion	No Criterion	-	0.87		-	-	nd	nd	-	-	-	3.319	nd	-	-	-
Phenanthrene	0.01	No Criterion	No Criterion	No Criterion	No Criterion	nd	0.028	0.047	nd	0.57	nd	nd	nd	0.046	0.171	0.067	nd	nd	nd	nd
Pyrene	0.01	183	USEPA Region 9 (pathway specific)	183	USEPA Region 9 (pathway specific)	nd	0.013	0.612	nd	0.327	nd	nd	nd	0.09	0.019	0.101	nd	nd	nd	nd
Sum of UK 4		0.100	ENGLAND DWS (2000)	No Criterion	No Criterion	0	0	0.051	0	**0.934**	0	0	0	0	0	**1.688**	0	0	0	0
TOTAL of (sum of PAHs)	0.01	No Criterion	No Criterion	0.200	ENGLAND DWS (2000)	0	0.87	4.69	0.644	5.594	0	0	0	0.501	2.318	3.319	0	0	0	0

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 14
POLYCYCLIC AROMATIC HYDROCARBON (PAH) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						WS413	WS415	WS416	WS418
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***				
Acenaphthene	0.01	365	USEPA Region 9 (pathway specific)	365	USEPA Region 9 (pathway specific)	nd	nd	0.016	nd
Acenaphthylene	0.01	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd
Anthracene	0.01	1830	USEPA Region 9 (pathway specific)	1830	USEPA Region 9 (pathway specific)	nd	nd	0.034	nd
Benzo(a)anthracene	0.01	0.0921	USEPA Region 9 (pathway specific)	0.0921	USEPA Region 9 (pathway specific)	nd	nd	**0.106**	nd
Benzo(A)Pyrene	0.01	0.0100	ENGLAND DWS (2000)	0.0100	ENGLAND DWS (2000)	nd	nd	nd	nd
Benzo(B)Fluoranthene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	0.05	nd
Benzo(G,H,I)Perylene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd
Benzo(K)Fluoranthene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd
Chrysene	0.01	9.21	USEPA Region 9 (pathway specific)	9.21	USEPA Region 9 (pathway specific)	nd	nd	0.094	nd
Dibenzo(A,H)Anthracene	0.01	0.00921	USEPA Region 9 (pathway specific)	0.00921	USEPA Region 9 (pathway specific)	nd	nd	nd	nd
Fluoranthene	0.01	1460	USEPA Region 9 (pathway specific)	1460	USEPA Region 9 (pathway specific)	nd	nd	0.161	nd
Fluorene	0.01	243	USEPA Region 9 (pathway specific)	243	USEPA Region 9 (pathway specific)	nd	nd	0.019	nd
Indeno(1,2,3-cd)pyrene	0.01	0.100	ENGLAND DWS (2000)	0.100	ENGLAND DWS (2000)	nd	nd	nd	nd
Naphthalene	0.01	6.20	USEPA Region 9 (pathway specific)	6.20	USEPA Region 9 (pathway specific)	nd	nd	0.098	nd
PAH 16 Total	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-
Phenanthrene	0.01	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	0.128	nd
Pyrene	0.01	183	USEPA Region 9 (pathway specific)	183	USEPA Region 9 (pathway specific)	nd	nd	0.112	nd
Sum of UK 4		0.100	ENGLAND DWS (2000)	No Criterion	No Criterion	0	0	0.05	0
TOTAL of (sum of PAHs)	0.01	No Criterion	No Criterion	0.200	ENGLAND DWS (2000)	0	0	0.818	0

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 15
TOTAL PETROLEUM HYDROCARBONS (TPH) IN GROUNDWATER (µg/L)

Sample Location						SB1	SB10	SB14	SB15	SB19	SB21	SB22	SB6	SB8	WS108	WS109	WS114	WS120
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***													
C5-C6 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C6-C8 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C7-C8 Aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C8-C10 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C10-C12 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C12-C16 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C16-C21 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
>C21-C35 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
Total Aliphatics (C5-C35)	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
C6-C7 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
C7-C8 aromatic		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
C8-C10 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
C10-C12 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
C12-C16 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
C16-C21 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
C21-C35 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
Total Aromatics (C6-C35)	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
Pro C4-C12	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
PRO C5-8	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
PRO C5-10	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
PRO >C8-10	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Pro C10-C12	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Tph-Gro	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	10	No Criterion	No Criterion	10	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	nd	-	-
C6 - C8	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
C8 - C10	10	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd	-	-	nd	nd
>C10-C12		No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	46600	nd	170	nd	nd	1320	-	-	nd	nd
>C12-C16		No Criterion	No Criterion	No Criterion	No Criterion	160	nd	nd	12200	nd	360	nd	180	570	-	-	nd	nd
>C16-C21		No Criterion	No Criterion	No Criterion	No Criterion	600	nd	nd	nd	nd	140	nd	210	140	-	-	nd	nd
>C21-C35		No Criterion	No Criterion	No Criterion	No Criterion	150	nd	nd	1150	nd	230	nd	350	nd	-	-	nd	nd
Total DRO	10	No Criterion	No Criterion	No Criterion		910	-	-	59950	-	900	-	740	2030	975	-	-	-
Total TPH	10	No Criterion	No Criterion	10	ENGLAND DWS (2000)	1000	200	-	61500	-	900	-	800	2100	-	-	-	-
Benzene	10	1.00	ENGLAND DWS (2000)	30.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	nd	-	-
Ethylbenzene	10	300	WHO DWG	300	WHO DWG	-	-	-	-	-	-	-	-	-	-	nd	-	-
M,P-Xylene	10	500	WHO DWG	30.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	nd	-	-
Mineral Oil	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-	-	-
Mtbe	10	13.3	USEPA Region 9 (Pathway Specific)	13.3	USEPA Region 9 (Pathway Specific)	-	-	-	-	-	-	-	-	-	-	nd	-	-
O-Xylene	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	nd	-	-
Toluene	10	700	WHO DWG	50.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	nd	-	-
Xylene	10	500	WHO DWG	30.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
England DWS	England Drinking Water Standards
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 15
TOTAL PETROLEUM HYDROCARBONS (TPH) IN GROUNDWATER (µg/L)

Sample Location						WS124	WS125	WS126	WS130	WS136	WS141	WS147	WS148	WS150	WS151	WS152
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***											
C5-C6 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C6-C8 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C7-C8 Aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C8-C10 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C10-C12 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C12-C16 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C16-C21 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
>C21-C35 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
Total Aliphatics (C5-C35)	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C6-C7 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C7-C8 aromatic		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C8-C10 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C10-C12 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C12-C16 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C16-C21 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
C21-C35 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
Total Aromatics (C6-C35)	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
Pro C4-C12	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
PRO C5-8	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	-	-	-
PRO C5-10	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	-	-	-
PRO >C8-10	0	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	-	-	-
Pro C10-C12	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
Tph-Gro	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	10	No Criterion	No Criterion	10	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-
C6 - C8	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	nd	-	-	-	-	-	-	-
C8 - C10	10	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd
>C10-C12		No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd
>C12-C16		No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	1100	1755	-	nd	nd	nd	nd	nd	nd
>C16-C21		No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	600	2678	-	nd	nd	nd	nd	nd	nd
>C21-C35		No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd	933	-	110	nd	nd	nd	nd	nd
Total DRO	10	No Criterion	No Criterion	No Criterion		-	-	1700	5366	-	110	-	-	-	-	-
Total TPH	10	No Criterion	No Criterion	10	ENGLAND DWS (2000)	-	-	1800	5366	-	530	-	-	260	-	-
Benzene	10	1.00	ENGLAND DWS (2000)	30.0	Freshwater EQS (AA)	-	-	-	nd	-	-	-	-	-	-	-
Ethylbenzene	10	300	WHO DWG	300	WHO DWG	-	-	-	nd	-	-	-	-	-	-	-
M,P-Xylene	10	500	WHO DWG	30.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-
Mineral Oil	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	nd	-	-	-	-	-	-
Mtbe	10	13.3	USEPA Region 9 (Pathway Specific)	13.3	USEPA Region 9 (Pathway Specific)	-	-	-	nd	-	-	-	-	-	-	-
O-Xylene	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-	-
Toluene	10	700	WHO DWG	50.0	Freshwater EQS (AA)	-	-	-	nd	-	-	-	-	-	-	-
Xylene	10	500	WHO DWG	30.0	Freshwater EQS (AA)	-	-	-	nd	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
England DWS	England Drinking Water Standards
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 15
TOTAL PETROLEUM HYDROCARBONS (TPH) IN GROUNDWATER (µg/L)

Sample Location						WS156	WS157	WS161	WS162	WS411	WS412	WS413	WS415	WS416	WS418
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***										
C5-C6 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C6-C8 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C7-C8 Aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C8-C10 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C10-C12 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C12-C16 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C16-C21 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
>C21-C35 Aliphatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
Total Aliphatics (C5-C35)	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
C6-C7 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
C7-C8 aromatic		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
C8-C10 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
C10-C12 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
C12-C16 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
C16-C21 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
C21-C35 aromatic	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
Total Aromatics (C6-C35)	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
Pro C4-C12	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
PRO C5-8	0	No Criterion	No Criterion	No Criterion	No Criterion	nd	-	nd	nd	-	-	-	-	-	-
PRO C5-10	0	No Criterion	No Criterion	No Criterion	No Criterion	nd	-	nd	nd	-	-	-	-	-	-
PRO >C8-10	0	No Criterion	No Criterion	No Criterion	No Criterion	nd	-	nd	nd	-	-	-	-	-	-
Pro C10-C12	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
Tph-Gro	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
Tph (Sum Aliphatics&Aromatics C5-C35)	10	No Criterion	No Criterion	10	ENGLAND DWS (2000)	-	nd	-	-	-	nd	nd	nd	nd	nd
C6 - C8	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
C8 - C10	10	No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
>C10-C12		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
>C12-C16		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
>C16-C21		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
>C21-C35		No Criterion	No Criterion	No Criterion	No Criterion	-	-	-	-	-	-	-	-	-	-
Total DRO	10	No Criterion	No Criterion	No Criterion		-	-	-	-	nd	-	-	nd	nd	-
Total TPH	10	No Criterion	No Criterion	10	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-
Benzene	10	1.00	ENGLAND DWS (2000)	30.0	Freshwater EQS (AA)	-	nd	-	-	-	nd	nd	nd	nd	nd
Ethylbenzene	10	300	WHO DWG	300	WHO DWG	-	nd	-	-	-	nd	nd	nd	nd	nd
M,P-Xylene	10	500	WHO DWG	30.0	Freshwater EQS (AA)	-	nd	-	-	-	nd	nd	nd	nd	nd
Mineral Oil	10	No Criterion	No Criterion	No Criterion	No Criterion	nd	-	280	nd	-	-	-	-	-	-
Mtbe	10	13.3	USEPA Region 9 (Pathway Specific)	13.3	USEPA Region 9 (Pathway Specific)	-	nd	-	-	-	nd	nd	nd	nd	nd
O-Xylene	10	No Criterion	No Criterion	No Criterion	No Criterion	-	nd	-	-	-	nd	nd	nd	nd	nd
Toluene	10	700	WHO DWG	50.0	Freshwater EQS (AA)	-	nd	-	-	-	nd	nd	nd	nd	nd
Xylene	10	500	WHO DWG	30.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-

Notes

MDL	Method detection limit
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
Freshwater EQS (AA)	Freshwater Environmental Quality Standard
England DWS	England Drinking Water Standards
WHO DWG	World Health Organisation Drinking Water Guidelines
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 16
METALS IN GROUNDWATER (µg/L)

Sample Location						SB1	SB10	SB11	SB13	SB14	SB15	SB19	SB2	SB20	SB21	SB22	SB5	SB6	SB8	SB9	VOID1	WS108
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*																	
Arsenic	1	10.00	ENGLAND DWS (2000)	50.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	2
Boron	10	1000	ENGLAND DWS (2000)	2000	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	138
Cadmium	0.4	5.00	ENGLAND DWS (2000)	5.00	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd
Calcium	5	250000	ENGLAND DWS (2000)	250000	ENGLAND DWS (2000)	199200	-	-	-	-	-	-	102100	-	-	-	-	-	-	-	26640	146400
Chromium	1	50.0	ENGLAND DWS (2000)	5.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	-	nd	nd	nd	nd	nd	nd	nd	-	2
Copper	1	2000	ENGLAND DWS (2000)	1.00	Freshwater EQS (AA)	1	nd	nd	nd	10	nd	10	nd	nd	nd	nd	nd	nd	nd	nd	nd	4
Fluoride	0	1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd	-
Hexavalent Chromium	30	109	USEPA Region 9 (pathway specific)	109	USEPA Region 9 (pathway specific)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Iron	5	200	ENGLAND DWS (2000)	1000	Freshwater EQS (AA)	85	-	-	-	-	-	-	93	-	-	-	-	-	-	-	nd	**1287**
Lead	1	25.0	ENGLAND DWS (2000)	4.00	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd
Magnesium	5	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	10550	-	-	-	-	-	-	8757	-	-	-	-	-	-	-	3187	7408
Mercury	0.05	1.00	ENGLAND DWS (2000)	1.00	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd
Nickel	1	20.0	ENGLAND DWS (2000)	50.0	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	9
Phosphorus	10	2200	ENGLAND DWS (2000)	2200	USEPA Region 9 (pathway specific)	52	-	-	-	-	-	-	140	-	-	-	-	-	-	-	-	nd
Potassium	200	10000	ENGLAND DWS (2000)	10000	ENGLAND DWS (2000)	6300	-	-	-	-	-	-	6200	-	-	-	-	-	-	-	3200	**12200**
Selenium	1	10.00	ENGLAND DWS (2000)	10.00	ENGLAND DWS (2000)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	nd
Sodium	200	200000	ENGLAND DWS (2000)	170000	Freshwater EQS (AA)	40500	-	-	-	-	-	-	18000	-	-	-	-	-	-	-	198000	41300
Zinc	3	3000	WHO DWG	8.00	Freshwater EQS (AA)	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	-	41

Notes	
MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 16
METALS IN GROUNDWATER (µg/L)

Sample Location						WS109	WS114	WS115	WS120	WS124	WS125	WS126	WS130	WS136	WS141	WS147	WS148	WS150	WS151	WS152
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*															
Arsenic	1	10.00	ENGLAND DWS (2000)	50.0	Freshwater EQS (AA)	1	-	**14**	-	6	nd	**40**	6	-	**90**	-	-	nd	nd	nd
Boron	10	1000	ENGLAND DWS (2000)	2000	Freshwater EQS (AA)	105	80	-	-	225	70	190	52	-	270	-	-	170	390	200
Cadmium	0.4	5.00	ENGLAND DWS (2000)	5.00	Freshwater EQS (AA)	nd	nd	nd	-	nd	nd	140	nd	-	nd	-	-	**10**	nd	nd
Calcium	5	250000	ENGLAND DWS (2000)	250000	ENGLAND DWS (2000)	**270000**	-	-	-	-	-	-	-	6963	-	-	-	-	-	-
Chromium	1	50.0	ENGLAND DWS (2000)	5.00	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd	nd	3	-	40	nd	nd	nd	nd	nd
Copper	1	2000	ENGLAND DWS (2000)	1.00	Freshwater EQS (AA)	3	nd	nd	nd	nd	nd	10	10	13	60	nd	10	nd	nd	nd
Fluoride	0	1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	nd	-	-	-	-	-	-	-	**2700**	-	-	-	-	-	-
Hexavalent Chromium	30	109	USEPA Region 9 (pathway specific)	109	USEPA Region 9 (pathway specific)	-	-	nd	-	nd	-	-	nd	-	-	-	-	-	-	-
Iron	5	200	ENGLAND DWS (2000)	1000	Freshwater EQS (AA)	**15550**	-	-	-	-	-	-	-	82	-	-	-	-	-	-
Lead	1	25.0	ENGLAND DWS (2000)	4.00	Freshwater EQS (AA)	nd	nd	1	-	2	nd	nd	2	-	nd	-	-	nd	nd	nd
Magnesium	5	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	10800	-	-	-	-	-	-	-	1097	-	-	-	-	-	-
Mercury	0.05	1.00	ENGLAND DWS (2000)	1.00	ENGLAND DWS (2000)	nd	nd	nd	-	nd	nd	nd	nd	-	nd	-	-	nd	nd	nd
Nickel	1	20.0	ENGLAND DWS (2000)	50.0	Freshwater EQS (AA)	6	nd	**20**	-	5	nd	**190**	6	-	**40**	-	-	**90**	nd	**30**
Phosphorus	10	2200	ENGLAND DWS (2000)	2200	USEPA Region 9 (pathway specific)	nd	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Potassium	200	10000	ENGLAND DWS (2000)	10000	ENGLAND DWS (2000)	**13200**	-	-	-	-	-	-	-	**29300**	-	-	-	-	-	-
Selenium	1	10.00	ENGLAND DWS (2000)	10.00	ENGLAND DWS (2000)	nd	4	1	-	1	8	**63**	2	-	3	-	-	4	**13**	4
Sodium	200	200000	ENGLAND DWS (2000)	170000	Freshwater EQS (AA)	61500	-	-	-	-	-	-	-	-	-	-	-	-	-	-
Zinc	3	3000	WHO DWG	8.00	Freshwater EQS (AA)	41	10	83	-	48	nd	1820	78	-	130	-	-	540	20	20

Notes

MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 16
METALS IN GROUNDWATER (µg/L)

Sample Location						WS153	WS156	WS157	WS159	WS160	WS161	WS162	WS164	WS411	WS412	WS413	WS415	WS416	WS418
Target Compound	*MDL*	*Human Health*	*Source*	*Controlled Waters*	*Source*														
Arsenic	1	10.00	ENGLAND DWS (2000)	50.0	Freshwater EQS (AA)	-	-	2	5	1	-	-	4	5	2	4	3	5	3
Boron	10	1000	ENGLAND DWS (2000)	2000	Freshwater EQS (AA)	-	-	365	**1406**	**1162**	-	-	309	68	47	77	143	100	106
Cadmium	0.4	5.00	ENGLAND DWS (2000)	5.00	Freshwater EQS (AA)	-	-	1.4	0.4	nd	-	-	nd	nd	nd	nd	nd	nd	nd
Calcium	5	250000	ENGLAND DWS (2000)	250000	ENGLAND DWS (2000)	-	**535600**	**555800**	-	-	70620	160800	-	**491700**	175600	229000	68480	**391200**	**325200**
Chromium	1	50.0	ENGLAND DWS (2000)	5.00	Freshwater EQS (AA)	nd	-	5	1	1	-	-	16	3	14	2	3	2	**83**
Copper	1	2000	ENGLAND DWS (2000)	1.00	Freshwater EQS (AA)	nd	11	17	5	3	2	5	7	5	5	4	3	5	4
Fluoride	0	1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	-	600	-	-	-	900	**1500**	-	-	-	-	-	-	-
Hexavalent Chromium	30	109	USEPA Region 9 (pathway specific)	109	USEPA Region 9 (pathway specific)	-	-	-	nd	40	-	-	nd	-	-	-	-	-	-
Iron	5	200	ENGLAND DWS (2000)	1000	Freshwater EQS (AA)	-	**295**	94	-	-	**1021**	**2741**	-	89	**1382**	171	46	**453**	129
Lead	1	25.0	ENGLAND DWS (2000)	4.00	Freshwater EQS (AA)	-	-	1	nd	1	-	-	1	nd	3	nd	1	5	**nd**
Magnesium	5	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	-	18860	11610	-	-	3592	9252	-	2145	2021	22380	6412	**63840**	1452
Mercury	0.05	1.00	ENGLAND DWS (2000)	1.00	ENGLAND DWS (2000)	-	-	nd	nd	nd	-	-	nd	nd	nd	nd	nd	nd	nd
Nickel	1	20.0	ENGLAND DWS (2000)	50.0	Freshwater EQS (AA)	-	-	10	10	6	-	-	7	10	6	7	5	**206**	6
Phosphorus	10	2200	ENGLAND DWS (2000)	2200	USEPA Region 9 (pathway specific)	-	-	204	-	-	-	-	-	**nd**	24	226	65	238	**nd**
Potassium	200	10000	ENGLAND DWS (2000)	10000	ENGLAND DWS (2000)	-	**13500**	**34500**	-	-	**14600**	**12800**	-	**37500**	**11000**	**12900**	6500	**13400**	**15000**
Selenium	1	10.00	ENGLAND DWS (2000)	10.00	ENGLAND DWS (2000)	-	-	1	**43**	1	-	-	**13**	4	3	6	3	**10**	**nd**
Sodium	200	200000	ENGLAND DWS (2000)	170000	Freshwater EQS (AA)	-	30000	31500	-	-	**314300**	78800	-	142500	31500	43500	33000	135000	21000
Zinc	3	3000	WHO DWG	8.00	Freshwater EQS (AA)	-	-	516	122	116	-	-	58	**8478**	45	480	40	375	236

Notes

MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 17
POLYCHLORINATED BIPHENYL (PCB) CONCENTRATIONS IN GROUNDWATER (μg/L)

Sample Location						**WS108**	**WS109**	**WS157**	**WS411**	**WS412**	**WS413**	**WS415**	**WS416**	**WS418**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***									
Pcb Congener 101	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 118	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 138	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 153	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 180	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 28	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Pcb Congener 52	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total 7 Congener Pcbs	0.01	No criterion	No criterion	No criterion	No criterion	nd	nd	nd	nd	nd	nd	nd	nd	nd
Total PCBs		No criterion	No criterion	No criterion	No criterion									

Notes

MDL	Method detection limit
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 18
SOIL ANALYTICAL RESULTS FROM THE UFEX LANDFILL (mg/Kg)

Metals and Cations

Sample Location						**UFEX1**	**UFEX2**	**UFEX3**
Depth						**0.1**	**0.1**	**0.1**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***			
Total Arsenic	1	20.0	UK SGV(1,3)	10.0	Freshwater EQS (AA)	8	5	6
Total Cadmium	1	30.0	UK SGV(1,4)	0.0336	Freshwater EQS (AA)	nd	nd	nd
Total Calcium	1	No criterion	No criterion	1020	ENGLAND DWS (2000)	4388	89940	43660
Total Chromium	1	200	UK SGV(1,5)	5.00	Freshwater EQS (AA)	24	14	17
Total Copper	1	8600	Dutch SRC	1.00	Freshwater EQS (AA)	8	6	11
Total Iron	1	23500	USEPA R9 (Residential)	54.6	Freshwater EQS (AA)	**32260**	**22310**	**29910**
Total Lead	1	450	UK SGV(1,7)	4.00	Freshwater EQS (AA)	22	14	15
Total Magnesium	1	No criterion	No criterion	275	ENGLAND DWS (2000)	1674	13190	7060
Total Mercury	1	15.0	UK SGV	0.0521	USEPA Region 9	nd	nd	nd
Total Nickel	1	75.0	UK SGV(1)	50.0	Freshwater EQS (AA)	21	16	19
Total Phosphorus	1	1.56	USEPA R9 (Residential)	2200	ENGLAND DWS (2000)	**319**	**326**	**352**
Total Selenium	1	260	UK SGV(1,6)	0.0273	ENGLAND DWS (2000)	nd	nd	nd
Total Zinc	1	46100	Dutch SRC	8.00	Freshwater EQS (AA)	40	47	57
Water Soluble Boron	1	15600	USEPA R9 (Residential)	2.06	Freshwater EQS (AA)	nd	nd	nd
Potassium (dissolved)	4	No criterion	No criterion	55.1	ENGLAND DWS (2000)	1642	2581	2407
Sodium (dissolved)	4	No criterion	No criterion	17000	Freshwater EQS (AA)	429	684	630

pH and Anions

Sample Location						**UFEX1**	**UFEX2**	**UFEX3**
Depth (m)						**0.1**	**0.1**	**0.1**
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***			
Chloride Soluble	5	No Criterion	No Criterion	No Criterion	No Criterion	32	40	20
Fluoride Soluble	3	3670	USEPA R9 (Residential)	No Criterion	No Criterion	nd	nd	nd
Nitrate Soluble	1	No Criterion	No Criterion	No Criterion	No Criterion	4	1	nd
Ph	1	No Criterion	No Criterion	No criterion	No criterion	7.74	11.64	11.02
Phosphate Soluble	1	No Criterion	No Criterion	No Criterion	No Criterion	nd	nd	nd
Water Soluble Sulphate	300	No Criterion	No Criterion	No Criterion	No Criterion	2500	55600	46200

Notes	
MDL	Method detection limit
UK SGV	UK Soil Guideline Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
Dutch SRC	Dutch Serious Risk Concentrations
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Not detected

TABLE 19
LEACHATE ANALYTICAL RESULTS FROM THE UFEX LANDFILL (µg/L)

Metals and Cations

Sample Location						UFEX1	UFEX2	UFEX3	UFEX4	UFEX5	UFEX6
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***						
Arsenic	1	10	ENGLAND DWS (2000)	50	Freshwater EQS (AA)	3	3	1	1	**25**	4
Boron	10	1000	ENGLAND DWS (2000)	2000	Freshwater EQS (AA)	nd	nd	nd	nd	nd	nd
Cadmium	0.4	5	ENGLAND DWS (2000)	5	Freshwater EQS (AA)	nd	nd	nd	nd	**24.2**	nd
Calcium	5	250000	ENGLAND DWS (2000)	250000	ENGLAND DWS (2000)	**541900**	**524900**	**356200**	**323000**	**525300**	**543700**
Chromium	1	50	ENGLAND DWS (2000)	5	Freshwater EQS (AA)	3	3	nd	27	**3517**	4
Copper	1	2000	ENGLAND DWS (2000)	1	Freshwater EQS (AA)	57	50	32	6	52	33
Iron	5	200	ENGLAND DWS (2000)	1000	Freshwater EQS (AA)	nd	38	13	97	8	55
Lead	1	25	ENGLAND DWS (2000)	4	Freshwater EQS (AA)	6	3		5	nd	4
Magnesium	5	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	11	27	12	26270	35	8
Mercury	0.05	1	ENGLAND DWS (2000)	1	ENGLAND DWS (2000)	nd	nd	nd	nd	nd	nd
Nickel	1	20	ENGLAND DWS (2000)	50	Freshwater EQS (AA)	**83**	**91**	**70**	7	**72**	**91**
Phosphorus	10	2200	ENGLAND DWS (2000)	2200	USEPA Region 9 (pathway specific)	54	74	nd	97	nd	nd
Potassium	200	10000	ENGLAND DWS (2000)	10000	ENGLAND DWS (2000)	**450000**	**532500**	**315000**	**28500**	**675000**	**472500**
Selenium	1	10	ENGLAND DWS (2000)	10	ENGLAND DWS (2000)	nd	nd	nd	1	**384**	5
Sodium	200	200000	ENGLAND DWS (2000)	170000	Freshwater EQS (AA)	**262500**	**255000**	135000	165000	**6397500**	**180000**
Zinc	3	3000	WHO DWG	8	Freshwater EQS (AA)	11	10	10	46	**4104**	25

pH and Anions

Sample Location						UFEX1	UFEX2	UFEX3	UFEX4	UFEX5	UFEX6
Target Compound	***MDL***	***Human Health***	***Source***	***Controlled Waters***	***Source***						
Chloride	1000	250000	ENGLAND DWS (2000)	250000	Freshwater EQS (AA)	30000	31000	37000	43000	47000	30000
Fluoride		1500	ENGLAND DWS (2000)	1500	ENGLAND DWS (2000)	900	900	800	nd	1800	800
Nitrate As N	300	50000	ENGLAND DWS (2000)	50000	ENGLAND DWS (2000)	1500	900	400	7100	1300	nd
Ph	1	No Criterion	No Criterion	No Criterion	No Criterion	12.76	12.71	12.5	8.28	12.92	12.67
Phosphate		No Criterion	No Criterion	250000	ENGLAND DWS (2000)	nd	nd	nd	250	nd	nd
Sulphate (soluble)	0	No Criterion	No Criterion	250000	ENGLAND DWS (2000)	157000	160000	237000	998000	**26466000**	188000

Notes	
MDL	Method detection limit
MRL	
Adjusted DIV	Adjusted Dutch Intervention Value
USEPA R9	US Envronmental Protection Agency Region 9 or Region 3 Preliminary Remedial Goal
England DWS	England Drinking Water Standards
Freshwater EQS	Freshwater Environmental Quality standard
BOLD	Indicates results in excess of Human Health guidelines value
	Indicates results in excess of Controlled Water Guideline value
nd	Non detect

TABLE 20
DEEP GROUNDWATER AND SURFACE WATER ANALYTICAL RESULTS (µg/l)
ROUND 1 RESULTS - February 2004

			Deep Monitoring Wells						Surface Water Locations			
			St.Bees Shale	Magnesian Limestone		Whitehaven Sandstone			Byerstead Spring	Bellhouse Gill	Sandwith Beck	
Determinand		MRL	BH201	BH101	BH202S	BH202D	BH203	BH204			Upstream	Downstream
Anionic Surfactant, pH	Anionic Surfactant (MBAS)	1,000	nd	nd	nd	nd	nd	nd	8,000	nd	nd	nd
	pH value	-	11.0	8.3	10.0	12.2	8.0	8.2	7.6	8.3	11.2	7.8
Metals	Copper	1	3	3	2	16	3	2	3	2	7	11
	Iron	5	56	78	87	31	55	37	110	59	25	63
	Total Cyanide	50	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
Major Cations	Calcium	5	253,500	189,700	66,740	148,000	215,900	96,300	322,700	69,820	159,300	62,110
	Magnesium	5	845	90,970	147,200	29	21,310	9,862	76,940	12,310	3,546	5,196
	Sodium	200	156,000	46,000	147,000	195,000	69,000	34,500	318,800	22,500	55,000	30,000
	Potassium	200	50,300	12,500	3,500	9,000	24,800	12,300	14,600	3,200	12,200	19,500
Major Anions	Chloride	1,000	96,000	38,000	50,000	56,000	167,000	49,000	322,000	32,000	32,000	30,000
	Phosphate (Ortho as PO4)	80	nd	nd	nd	nd	nd	nd	52,320	710	nd	500
	Nitrate	300	nd	1,400	500	2,200	93,100	16,400	nd	11,300	5,700	12,900
	Bicarbonate	2,000	680,000	230,000	110,000	15,000	275,000	85,000	335,000	205,000	205,000	175,000
	Sulphate (soluble)	3,000	883,000	857,000	924,000	36,000	289,000	122,000	1,234,000	64,000	401,000	141,000
	Fluoride	500	1,400	nd	600	700	nd	nd	1,000	nd	nd	nd
Total Petroleum Hydrocarbons	TPH C6-40*	100	1,875	nd	nd	nd	nd	nd	3,233	nd	nd	nd
Polycyclic Aromatic Hydrocarbons	Naphthalene	0.01	nd	nd	0.44	0.55	0.41	0.56	0.33	nd	0.36	0.39
	Acenaphthylene	0.01	nd	nd	nd	nd	0.01	nd	0.03	nd	0.01	nd
	Acenaphthene	0.01	nd	nd	0.06	0.06	0.06	0.06	0.05	nd	0.08	0.05
	Fluorene	0.01	nd	nd	0.05	0.03	0.06	0.03	0.06	nd	0.03	0.03
	Phenanthrene	0.01	nd	nd	0.07	0.05	0.07	0.03	0.10	nd	0.05	0.03
	Anthracene	0.01	nd	nd	0.02	0.01	0.02	nd	0.02	nd	0.02	0.01
	Fluoranthene	0.01	nd	nd	0.01	0.01	0.02	nd	0.02	nd	nd	nd
	Pyrene	0.01	nd	nd	0.01	0.02	0.02	nd	0.02	nd	nd	nd
	Benz(a)anthracene	0.01	nd	nd	nd	nd	0.04	nd	nd	nd	nd	nd
	Chrysene	0.01	nd	nd	nd	nd	0.01	nd	nd	nd	nd	nd
	Benzo(b)fluoranthene	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Benzo(k)fluoranthene	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Benzo(a)pyrene	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Indeno(1,2,3-cd)pyrene	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Dibenzo(a,h)anthracene	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	Benzo(g,h,i)perylene	0.01	nd	nd	nd	nd	nd	nd	nd	nd	nd	nd
	PAH 16 Total	0.01	nd	nd	0.66	0.73	0.74	0.68	0.63	nd	0.56	0.51

Note: Round 1 sampling undertaken between 11th and 13th February 2004
All values except pH are expressed in µg/l

* TPH C6-C40 may include humic acids and PAHs hence the concentration is not necessarily indicative of mineral oil
MRL Method Reporting Limit
nd Not detected above method reporting limit

Tabe 21 - Leachate Results

Sample Location			**TP510**	**TP511**	**TP520**	**TP522**	**TP523**	**TP525**	**WS411**	**WS418**
Depth			**0.25**	**0.3**	**0.3**	**0.2**	**0.25**	**0.3**	**2.5**	**0.75**
Target Compound	***MDL***	***MRL***	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE	LEACHATE
			METALDIS_NR	ETALDIS_NR	ETALDIS_NR	ETALDIS_NR	ETALDIS_NR	ETALDIS_NR	ETALDIS_NR	ETALDIS_NRA
			04/01/2005	04/01/2005	04/01/2005	04/01/2005	04/01/2005	04/01/2005	04/01/2005	04/01/2005
Leachable Arsenic	1	1	16	3	6	2	< DL	< DL	< DL	2
Leachable Boron	10	10	11	77	141	23	28	< DL	68	68
Leachable Cadmium	0.4	0.4	< DL	< DL	1.4	< DL	< DL	< DL	< DL	< DL
Leachable Chromium	1	1	10	598	3	2	2	10	1	< DL
Leachable Copper	1	1	21	23	3	4	16	7	1	13
Leachable Lead	1	1	3	8	< DL	< DL	< DL	6	2	3
Leachable Nickel	1	1	2	9	24	2	5	5	1	5
Leachable Selenium	1	1	3	< DL	38	5	3	3	1	2
Leachable Zinc	3	3	46	109	34	28	15	20	23	23
Mercury	0.05	0.05	< DL	< DL	< DL	< DL	< DL	< DL	< DL	< DL

Data reported with 2 Significant figures

Appendix C - Human Health Quantitative Risk Assessment

APPENDIX C
HUMAN HEALTH QUANTITATIVE RISK ASSESSMENT

C.1 INTRODUCTION

The primary objective of the Human Health Quantitative Risk Assessment (HHQRA) was to assess the potential risk to human health assuming the site is opened to the general public for a right-to-roam open space usage. Risks to human health are also assessed for proposed commercial and existing residential, directly adjacent to the study site to the north and north-east respectively. All risks are derived in relation to the current condition of subsurface soil and groundwater beneath the site as detected by investigations undertaken at the site to date.

C.2 ASSESSMENT METHODOLOGY

C.2.1 Legislative and Regulatory Context

An effective detailed risk assessment must take into account the regulatory context of the work, provide information that is fit for purpose, and be in accordance with UK good practice. In this subsection, URS has reviewed the relevant legislation that applies to this site and outlines the good practice guidance for assessing risks to human health from land contamination.

The statutory regime for the identification and remediation of contaminated land in England came into effect from 1 April 2000. It is based on the "suitable for use" approach and focuses on the risks caused by land contamination to defined receptors including human health, controlled waters, buildings and other forms of property, and certain specified ecosystems. Regulatory guidance on the regime is set out in DETR Circular 02/2000 *Contaminated Land: Implementation of Part IIA of the Environmental Protection Act 1990*.

Under Section 78A(2) of the Environmental Protection Act 1990 (as amended), contaminated land is defined 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) *pollution of controlled waters is being, or is likely to be, caused."*

Part (b) of this definition is expected to be amended under Section 88(2)(a) of the proposed Water Bill, to insert the word *significant* in relation to controlled waters.

Each local authority has a duty to cause its area to be inspected from time to time for the purpose of identifying contaminated land. Before the local authority can make the judgment that any land appears to be contaminated land on the basis that significant harm is being caused to human health, or that there is a significant possibility of such harm being caused, the authority must identify a significant pollutant linkage, comprising:

- a contaminant;
- a relevant receptor; and
- a pathway by means of which the contaminant is causing significant harm to the receptor or there is a significant possibility of such harm.

Land contamination and its risk to human health is also a material consideration under planning and development control as it applies to the intended use of a site. Existing guidance on assessing risks to health under the Town and Planning Acts 1990 is contained within the recently published guidance from the UK Government (*Planning Policy Statement 23: Planning and Pollution Control* (2004)) that firmly places the emphasis of risk assessment for planning purposes on being consistent with the requirements under Part IIA, and is consistent with the practical requirements that a site under planning for its intended or proposed use should not fail the requirements of Part IIA when the site is occupied and in use.

In addition to the regulatory context, UK Government departments and agencies have published technical guidance to support the assessment of risks to health from soil contamination. Overarching this detailed work is the framework for assessing and managing environmental risk, which was published by the then DETR (Department of Environment, Transport and Regions), the Environment Agency and the Institute for Environment and Health[1]. Figure illustrates the framework presented, which sets out a tiered approach to risk assessment and an integrated approach to risk management.

Additional guidance on risk assessment is contained in various Environment Agency publications including; in particular, joint Environment Agency / Defra reports CLR7-10 and the *Model Procedures for the Management of Land Contamination* (CLR11).

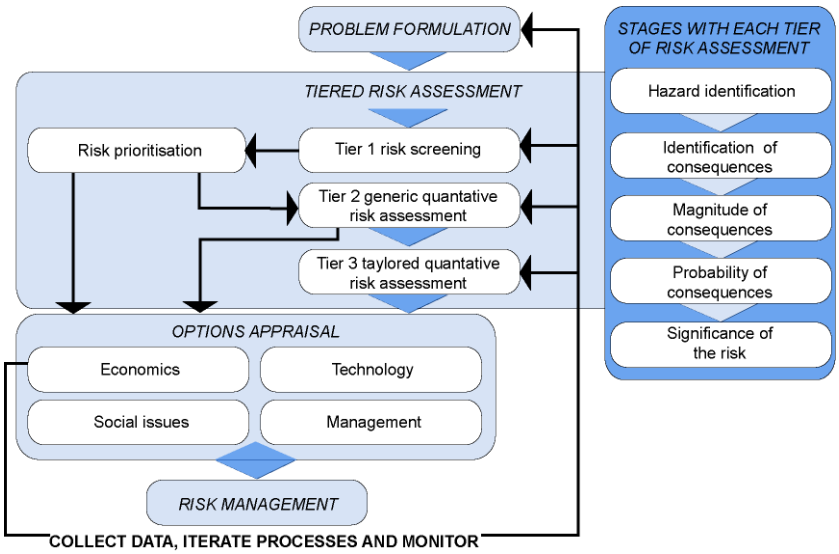


Figure C1 - Tiered Approach to Risk Assessment and Risk Management (after DETR and the Environment Agency, 2000)

[1] Guidelines for Environmental Risk Assessment and Management – Revised Departmental Guidance, DETR/EA/IEH, 2000.

The basic approach to risk assessment, as followed in this report, involves four stages:

- **Hazard identification** – establishing contaminant sources, pathways and receptors (the conceptual model);
- **Hazard assessment** – analysing the potential for unacceptable risks (what linkages could be present, what the effects could be);
- **Risk estimation** – trying to establish the magnitude and probability of the possible consequences (what degree of harm might result and to what receptors, and how likely is it);
- **Risk evaluation** – deciding whether the risk is unacceptable.

C.2.2 Outline Structure of the Assessment

The presentation of the human health risk assessment (HHRA) for this site is organised as follows:

Stage 1: Hazard Identification - Development of Conceptual Site Model includes the

- identification of the presence of chemicals which may have potential human health effects, and which may affect the suitability of the site for its proposed public open space use;
- assessment of potential pathways via which contamination may reach receptors at the site (and off-site); and
- identification of sensitive receptor groups under existing and future land-use.

Stage 2: Hazard Assessment includes the

- generic Tier 1 screening of analytical data;
- identification of acute and chronic exposure hazards, based on an initial toxicological review of identified contaminants of concern; and
- qualitative assessment of potentially significant pollutant linkages (SPLs).

The aim of stages one and two is to identify potentially significant human health hazards associated with both short-term and long-term exposure.

Stage 3: Risk Estimation, based on the:

- assessment of identified contamination in terms of type, and spatial distribution;
- review of toxicological criteria for identified contaminants;
- assessment of the physical characteristics of potential exposure areas such as geological setting, land-use, vegetation and identification of soil characteristics;

- integration of information on sources, releases, fate and transport and exposure routes;
- assumption of characteristics of exposed populations, and of exposure patterns across potential exposure areas, which can involve assessing the percentage time exposed in contaminated areas and the time spent indoors or outdoors (as applicable);
- consideration of sensitive potential sub-populations within the exposure area, such as small children who may be more susceptible to environmental contaminants or female workers;
- calculation of site-specific assessment criteria (SSAC) where appropriate; and
- quantitative assessment of potentially significant pollutant linkages.

Stage 4: Risk Evaluation aims to identify whether the health risks posed by the hazards identified in stages one and two, and calculated in stage three, are significant. Significance is assessed considering the nature and scale of the risks and technical uncertainties within the risk assessment process and the sensitivity of the model used.

C.3 STAGE ONE – DEVELOPMENT OF A CONCEPTUAL SITE MODEL

The purpose of developing a conceptual model of a site is to establish contaminant sources, pathways and receptors appropriate to the environmental setting and history of the site, so that potential hazards can be identified and assessed.

C.3.1 Contaminant Sources

C.3.1.1 Contaminant Types

Previous site investigations and assessments undertaken by URS (and other parties) at the facility identified a limited number of metals, total petroleum hydrocarbons (TPH) and volatile organic compounds with potential to impact human health. URS undertook further investigations during March and April 2005, the results of which are reported in full in the main text of this report.

The results of historic and current soil sampling at the site (January 2001 to April 2005), combined with more recent groundwater monitoring (January 2004 to April 2005) have been used in this assessment to Human Health.

C.3.1.2 Contaminant Location

The concentrations of contaminants detected in soil and groundwater are not evenly distributed below the site, resulting (at least in part) to the differing manufacturing processes undertaken in different areas of the former facility.

Due to the large site area and variability of concentrations of potential contaminants, contamination has been conceptualised as present ubiquitously in the shallow soils beneath the site. This is a conservative assumption and will highlight any potential hot-spots which can subsequently be assessed.

C.3.1.3 Shallow Subsurface Conceptualisation

Whilst the strata constituents below the surface of the site are generally consistent, the depths and thicknesses of these strata vary considerably over the area covered by the site.

Conceptualisation of the subsurface has been undertaken using suitably conservative estimates of thickness.

The shallow strata were found to generally comprise the following:

- Either grassed soils or concrete present at the surface, underlain by;
- Made ground becoming generally deeper to the south of the site and thinning to the north and the site perimeter. It comprised of either (or a combination of):
  - various “gravels” of limestone, shale, slag, crushed brick, crushed concrete, in places combined with silty coarse sands. These extend to depths between 0.2m (WS137, WS146 and TP521) and 4.2m (WS150);
  - reinforced concrete was proven with thickness of over 0.6m and was encountered on site at depths >2m.bgl;
  - reworked clay with frequent gravels including limestone and coal to a maximum proven depth of 1.5m.bgl (WS160).
- This was underlain by natural clay strata, sometimes sandy and with rare sand bands. These clays extended to the base of the majority of intrusive investigations and proven to overlay bedrock;
- Bedrock was encountered at generally shallower depths in the north of the site (e.g. 1.5m.bgl in WS111), with the majority of excavations elsewhere on the site failing encounter rock in excess of 4m.bgl.

For the purposes of the human health risk assessment, the geological conceptual model was simplified to represent ‘average’ (and typically conservative) conditions at the site.

The fate and transport of potential contaminants affecting humans is most important in strata nearest the ground surface. These strata were conceptualised as comprising of two units: a shallow sand/ gravel and deeper clay. The properties of the former are considered to be analogous with properties presented in CLR10 for a “Sandy” soil whilst the latter are considered a USDA “Sandy Clay”

The log from each exploratory location within the site was examined and the maximum depth of generally sandy or gravelly material recorded. These depths were all in the made ground but did not include made ground of a clayey or silty nature. Similarly, depths to clay or sandy clay material were also examined and recorded and included soils both within the made ground and natural strata.

The shallow (or perched) groundwater levels at the site were present in the made ground or natural clay strata. Soil contamination within the saturated zone can typically only affect human heath when leached or present in or on the groundwater.

For the study site, depths of the two identified units, in addition to shallow groundwater are recorded in Table C3.1 below. Also included are depth statistics for the area beyond the northern boundary[2] to be redeveloped to a commercial end use and also boreholes in the vicinity of the area to the north-east where existing residential properties are present. The residential area has not been subject to intrusive investigation hence adjacent excavations[3] are used in lieu of site specific data and are assumed to be representative of the neighbouring land.

Table C3.1– Summary of Shallow Geology and Groundwater

	Minimum Depth (m)	Mean Depth (m)	Maximum Depth (m)
Study Site			
CLR10 Sandy	0.2	1.16	4.2
USDA Sandy Clay	n/a*	n/a*	5.0
Groundwater	0.04	1.3 (geometric = 0.88)	3.4
Commercial Area (north)			
CLR10 Sandy	0	0.28	0.6
USDA Sandy Clay	n/a*	n/a*	2.65
Groundwater	0.57	0.86 (geometric = 0.82)	0.16
Area Adjacent to Residential area (northeast)			
CLR10 Sandy	0	0.44	0.8
USDA Sandy Clay	n/a*	n/a*	3.8
Groundwater	0.57	1.09 (geometric = 1.01)	1.88

n/a* as shallow groundwater depth limits the assessment of contaminants below water table (and in deeper USDA Sandy Clay strata)

Groundwater was encountered beneath the site within the made ground and clay strata. Impacts to human health are only assumed to be present from the shallow groundwater. On-site measurements indicate that shallow groundwater flow in made ground in the vicinity of the off-site residential properties is to the west, and hence the migration of contaminated groundwater from the site to beneath the residential properties is considered unlikely. Migration of groundwater from the study site to the proposed commercial redevelopment beyond the northern boundary is also considered unlikely.

It is therefore proposed that the simplified conceptual model comprises:

- unsaturated “shallow” soils: a sand and gravel modelled as “CLR10 Sandy” with some parameters necessary for modelling taken from a “USDA sand”. This is represented as a 1m thickness beneath the main site, 0.3m below the proposed commercial area and 0.5 in the vicinity of existing housing;
- unsaturated “deep” soils: clays and sandy clays modelled as “USDA Sandy Clay”. This is represented by appropriate thicknesses from the base of the Sandy strata to below the water table (strata set to 4m.bgl); and
- groundwater table: the average depth to groundwater on the site was calculated from surveys undertaken in 2004 and 2005. Due to the variability of the depths to shallow (and perched) groundwater a conservative option was taken whereby for modelling soils a larger unsaturated zone was assumed (mean depth to groundwater) and for risks

[2] Represented by boreholes WS101 – WS105

[3] WS101-106, 108-111, 113 and SB1, 2, 6

from groundwater, a shallower water table was assumed (geometric[4] mean to groundwater). For soil modelling, groundwater was assumed at 1.3, 0.86 and 1.09m.bgl for the study site, commercial and residential scenarios respectively. Similarly for groundwater modelling, depths of 0.88, 0.82 and 1.01m.bgl were adopted.

C.3.2 Receptors

DETR Circular 02/2000 defines the various types of receptor to be considered in assessing whether land should be classified as contaminated land for the purposes of Part IIA of the Environmental Protection Act 1990. Potential receptors to be considered include human beings, certain categories of protected living organisms or ecosystem, property in the form of crops, livestock and owned animals, property in the form of buildings, and controlled waters.

From a human health perspective, the main site is understood to be open to the general public for general right-to-roam open space usage, with the minimum of site preparation expected (such as the removal of protruding trip hazards, but not cut and fill). Beyond the northern boundary, an area is proposed for future commercial redevelopment. Furthermore, it is considered prudent to examine the potential effects to the dwellers of neighbouring (off-site) residential properties.

The principal potential receptors directly relevant to these modelled scenarios are considered to be:

- visitors to the public open space;
- workers at the proposed commercial site; and
- residents of adjacent properties.

The risks to maintenance, remediation or potential redevelopment workers who may be involved in subsurface working (more likely for the proposed commercial redevelopment) are not specifically assessed as part of this report. The health and safety of workers in the UK is controlled under the Health and Safety at Work Act 1974 and associated regulations (such as the Control of Substances Hazardous to Health (COSHH) regulations 1994). The statutory guidance for Part IIA in paragraph 71[5] notes that the Health and Safety at Work Act and associated regulations are concerned with risks to the public or employees at business and other premises and that risks of these kinds could arise as a result of land contamination. The guidance states that liaison between Part IIA enforcing authorities and the Health and Safety Executive will help to avoid unnecessary duplication of controls and that the most appropriate regime is used to deal with identified issues. URS does not therefore consider it appropriate to include these receptors in this form of assessment at present and advises that separate activity related risk assessments should be carried out as required to highlight the need for any preventative measures (such as the use of PPE) prior to such activities being carried out. The results of this assessment could be used to inform decision-making on this issue.

[4] This provides a smaller number where the dataset is skewed, more conservative with regard to risks from volatile substances in groundwater as they are nearer the receptor.

[5] DETR Circular 02/2000, Contaminated Land Environmental Protection Act 1990: Part IIA

C.3.3 Exposure Pathways

Standard human exposure pathways for both commercial and residential with gardens land-uses have been published by Defra and the Environment Agency in R&D Publication CLR10, although these assume on-site exposure. As there is no such guidance for the public open space land use, URS consider the *outdoor* pathways for a residential with gardens scenario appropriate and suitably conservative. Table C3.2 lists the applicable exposure pathways for these end uses, for soil. CLR10 does not consider exposure to contaminants from groundwater, however, on the basis of the recorded concentrations of TPH and VOCs in groundwater, URS considers it appropriate to include potential exposure to vapours originating from contaminated groundwater and have also been included.

A public open space is considered to be entirely outdoors with no possibility of the consumption of fruit or vegetables grown at the site. It is assumed that visitors to the site will not excavate the ground nor directly contact perched or shallow groundwater.

The worker in the commercial scenario is expected to work inside the premises for the majority of the day and spend a limited period outdoors.

The occupier in a residential with gardens scenario is expected to have ready access to either a private garden or adjacent public open space and consume home grown garden produce.

C.3.3.1 Appropriate Pathways for Off-site Receptors

The exposure pathways presented in Table C3.2 assume on-site use. URS consider these pathways as overly-conservative when assessing the risks to off-site receptors. The UK risk assessment regime has not published guidance with respect to off-site receptors. It is considered appropriate that, given certain site-specific factors of the neighbouring land-uses (both current and proposed) certain exposure pathways can be excluded.

For the residential scenario, soils in the gardens are unlikely to have been influenced by contamination from the study site and hence vegetable uptake and direct ingestion of these soils are deemed inappropriate. Furthermore, the shallow groundwater is shown to be flowing away from the properties in this area and hence mobile contaminants are unlikely to have migrated beneath the residences. It is conceivable that vapours derived from soil or groundwater sources on the study site might migrate (via outdoor air) to the properties. Given that indoor vapours are assumed to be sourced from contamination below the foundations, this pathway is excluded[6]. Exposure to indoor soil-derived dust is however included.

[6] A conservative check regarding indoor exposure to outdoor air vapours is undertaken in Section C.5.4.2.1

Table C3.2 - Exposure Pathways

Exposure Pathway	*Public Open Space*	*Residential with Gardens*	*Commercial*
Ingestion of soil and fugitive dust outdoors	✓	✓	✓
Ingestion of indoor dust	×	✓	✓
Ingestion of contaminated home grown vegetables	×	✓	×
Ingestion of soil attached to home grown vegetables	×	✓	×
Ingestion of groundwater/ surface water	×	×	×
Dermal contact with soil outdoors	✓	✓	✓
Dermal contact with indoor dust	×	✓	✓
Dermal contact with groundwater/ surface water	×	×	×
Inhalation of fugitive dust outdoors	✓	✓	✓
Inhalation of indoor dust	×	✓	✓
Inhalation of vapours outdoors from soil	✓	✓	✓
Inhalation of vapours indoors from soil	×	✓	✓
Inhalation of vapours from groundwater outdoors	✓	✓	✓
Inhalation of vapours from groundwater indoors	×	✓	✓

Notes:

× Pathway not applicable
✓ Pathway applicable

The pathways for residential with gardens scenario assumes the residence and garden are located on the contaminated land. As the residences are on neighbouring land, not all of these pathways may be applicable.

For the proposed commercial scenario, impacts to human health are assessed only from sources within the study site (i.e. *not* from potentially contaminated soils beneath the redeveloped land, which would be addressed as part of the redevelopment strategy). As for the residential scenario, the shallow groundwater is demonstrated not to flow from the study site to the proposed commercial area and hence the only exposure pathways for on-site sources impacting off-site receptors are: outdoor vapours and dust both in and outdoors.

For both scenarios it is acknowledged that the assessment tools assume the land use is placed directly on the contaminated land and not some distance remote. Likewise, fate and transport algorithms for dust and vapours will likely be overly conservative.

C.4 STAGE TWO – HAZARD IDENTIFICATION AND HAZARD ASSESSMENT

C.4.1 Generic Tier 1 Screening

C.4.1.1 Introduction

This section presents the generic risk assessment used in this report. It comprises a comparison of measured contaminant concentrations with appropriate criteria in order to identify those contaminants that are not of concern (on the basis that they have not been detected in excess of the criteria) and those that *could* be of concern.

Soil data has been compared with the UK Soil Guideline Values (SGVs), where available, URS Generic Assessment Criteria (URS GAC), Dutch Serious Risk Concentrations (SRC), adjusted Dutch Intervention Values (aDIVs) and US EPA[7] Region 9 preliminary remediation goals (PRGs).

For the study site, the above criteria were based on a residential without plant uptake scenario. These criteria are also considered conservative with respect to a commercial end use.

When considering the neighbouring off-site residential end use, the residential *without* gardens screening criteria is still considered appropriate given that historical mapping indicates that the residences are unlikely to have been constructed on contaminated ground resulting from industrial activity at the site. Furthermore, the shallow groundwater flow direction is away from the properties, preventing associated migration of water mobile contaminants to soils beneath these sites. The criteria remain conservative as assumptions regarding other direct exposure pathways to potentially contaminated soils at the residences prevail.

SGVs are published by the Department of Environment, Food and Rural Affairs (Defra) and Environment Agency, having been developed using the Contaminated Land Exposure Assessment (CLEA) model. SGVs were developed to protect the critical human receptor for specific land uses (residential with gardens, residential without gardens, commercial/industrial and allotments). The site may be deemed suitable for use at this level of assessment where chemicals are present at concentrations below the relevant SGV and the exposure assumptions within the CLEA model are consistent with predicted site use.

URS GACs are generic risk-based soil and groundwater concentrations that are protective of chronic risks to human health. They have been generated by URS for a number of different generic land uses in accordance with technical guidance issued by the Environment Agency and Defra. The selected generic soil types are similar to those adopted by Defra for the recently published SGVs for Toluene and Ethylbenzene. The selected GACs have been chosen with due regard for soil organic matter contents in the shallow soil.

The Dutch Intervention Values (DIVs) were developed in the Netherlands to protect the multi-functionality of soils and are based on human toxicological *and* ecotoxicological considerations. Some site-specific soil data collected during the site

[7] United States – Environmental Protection Agency

investigation were used to adjust DIVs appropriately for measured organic carbon and clay content. Further development in the Netherlands led to the production of Serious Risk Concentrations (SRC) for some contaminants, these are adopted where available in preference of DIV.

Where either the UK SGVs, URS GACs or the DIVs/ SRCs do not consider a substance, the preliminary remediation goals (PRGs) published by Region 9 of the US EPA have been adopted. These are derived for use in the US statutory contaminated land regime and are designed to afford adequate protection to receptors.

The DIVs/ SRCs and PRGs have no legal status in the UK. However, as they have been derived using internationally recognised risk assessment techniques, they are considered to be acceptable as an initial screen at sites such as this in the absence of published UK SGVs (and the use of these is considered consistent with current guidance and practice in the UK).

Groundwater data were reviewed against Water Target Values (WTVs), which are based on UK Drinking Water Standards (DWS). Where UK values were not available for a compound in water, the guidelines for drinking water quality issued by the WHO and US EPA values were used. Drinking water standards are considered to be very conservative as the underlying groundwater is not being extracted for human consumption at the site nor is likely to be in direct contact with visitors.

C.4.1.2 Results

All individual soil sample results from the site have been screened against the Tier 1 criteria for a residential without gardens scenario, the full results of which are detailed in the tables of Appendix B (Tables 4 to 10) and summarised below in Table C4.1. Contaminants detected in excess of their Tier 1 screening levels were:

- **Metals, metalloids and inorganic** – arsenic, nickel, chromium, mercury, iron and phosphorus;
- **SVOC & PAH** – benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo[a,h]anthracene, fluoranthene, indeno[1,2,3-cd]pyrene and naphthalene;
- **TPH** – various TPH Criteria Working Group (TPHCWG) fractions; and
- **VOC** – trichloroethene (TCE);

Table C4.1 – Summary of Tier 1 Soil Exceedances

Substance	*Screening Level (mg/kg)*	*Min (mg/kg)*	*Max (mg/kg)*	*Number of Exceedances*
Arsenic	20	<DL	76	21
Nickel	75	<DL	130	4
Chromium	200	<DL	748	1
Iron	23,400	<DL	106,200	22
Mercury	15	<DL	30	1
Phosphorous	1.56	<DL	47,040	37
Benzo(a)anthracene	11.1	<DL	116	6
Benzo(a)pyrene	1.1	<DL	114	12
Benzo(b)fluoranthene	11.1	<DL	104	4
Benzo(k)fluoranthene	11.1	<DL	94.8	4
Chrysene	110	<DL	122	1
Dibenzo[a,h]anthracene	1.1	<DL	4.34	6
Fluoranthene	110	<DL	247	1
Indeno[1,2,3-cd]pyrene	11.1	<DL	65.6	4
Naphthalene	31	<DL	132.7	4
Trichloroethene	0.62	<DL	3.67	1
Total Petroleum hydrocarbons (all TPHCWG fractions included for reference)				
>EC5-7 aromatic	70	<DL	<DL	0
>EC7-8 aromatic	70	<DL	0.039	0
>EC8-10 aromatic	24	<DL	5.53	0
>EC10-12 aromatic	120	<DL	20.7	0
>EC12-16 aromatic	550	<DL	3176	1 (6*)
>EC16-21 aromatic	1,600	<DL	1016	0 (4*)
>EC21-35 aromatic	1,700	<DL	233	0 (1*)
>EC5-6 aliphatic	21	<DL	0.652	0
>EC6-8 aliphatic	60	<DL	0.104	0
>EC8-10 aliphatic	15.3	<DL	3.36	0 (1*)
>EC10-12 aliphatic	75	<DL	13.8	0 (1*)
>EC12-16 aliphatic	600	<DL	1262	2
>EC16-21 aliphatic	110,000	<DL	6597	0
Notes: *Includes non speciated TPH fractions, most conservative assumption				

All groundwater sample results from the site have been screened against applicable Tier 1 criteria, the full results of which are detailed in Tables 11 to 17 (Appendix B) and summarised below in Table C4.2. Contaminants detected in excess of their Tier 1 screening levels were:

- **Metals and metalloids** – iron, phosphorus, arsenic, boron, cadmium, chromium, nickel, magnesium, selenium, sodium, sulphur and zinc;

- **Inorganics** – fluoride, chloride, phosphate and nitrate;
- **SVOC and PAH** – benzo(a)anthracene, benzo(a)pyrene, dibenzo(a,h)anthracene, Sum of 4 PAHs { benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene, Indeno[1,2,3-cd]pyrene }; and
- **TPH** – various TPH Criteria Working Group (TPHCWG) fractions;

Table C4.2 – Summary of Tier 1 Groundwater Exceedances

Substance	*Screening Level (µg/l)*	*Min (µg/l)*	*Max (µg/l)*	*Number of Exceedances*
Phosphorous	2,200	<DL	9,599	2
Arsenic	10	<DL	90	4
Boron	1,000	<DL	1,406	2
Cadmium	5	<DL	140	3
Chromium	50	<DL	3,157	2
Iron	200	8	15,530	10
Nickel	20	<DL	206	11
Magnesium	50,000	8	85,650	8
Selenium	10	<DL	384	6
Sodium	200,000	16,500	6,397,500	5
Zinc	3,000	10	8478	2
Fluoride	1,500	<DL	16,400	4
Chloride	250,000	27,000	279,000	1
Phosphorous	0.73	24	9,599	2
Nitrate	50,000	300	91,200	1
Benzo(a)anthracene	0.09	<DL	0.523	3
Benzo(a)pyrene	0.01	<DL	0.68	3
Dibenzo[a,h]anthracene	0.0092	<DL	0.148	2
*Benzo(b)fluoranthene	Sum of 4	<DL	0.56	Sum of 4
*Benzo(k)fluoranthene	Sum of 4	<DL	2.0	Sum of 4
*Benzo(g,h,i)perylene	Sum of 4	<DL	0.422	Sum of 4
*Indeno[1,2,3-cd]pyrene	Sum of 4	<DL	0.39	Sum of 4
Sum of 4(*) PAHs	*0.1*	*<DL*	*2.0*	*3*

C.4.1.3 Evaluation

These and previous investigations have identified surfactants present in groundwater. No screening values were sourced at Tier 1. Surfactants are not assumed to be volatile and no direct contact with groundwater is anticipated for any of the three considered scenarios. The presence of surfactants in groundwater may increase the solubility of other compounds detected in groundwater and may actually reduce their volatility slightly due to a greater partitioning to the aqueous phase than would occur without surfactant.

With a number of exceptions, each of the substances found to exceed the appropriate soil screening criteria for the residential without gardens scenario or groundwater screening criteria were assessed further with Tier 2 modelling.

The following section (C.4.1.3.1) discusses substances that were not considered further at Tier 2 and Section 0 considers substances without Tier 1 screening criteria that are evaluated at Tier 2.

C.4.1.3.1 Metals and Inorganic Substances

The phosphorous results for soil and groundwater are for phosphate (as phosphorous) and as such do not represent concentrations of the elemental form. The Tier 1 screening criterion is for elemental phosphorus, not phosphate, and hence URS does not consider at this stage that the toxicological basis for the derivation of the phosphorous criterion is necessarily relevant to exposure from phosphate compounds. No screening criteria could be sourced for phosphate compounds and hence it is excluded from Tier 2 modelling for both soils and groundwater. The UK Food Standards Agency conclude in the Expert Group on Vitamins and Minerals (2003) report on Phosphate that it is widely found in common food groups with concentrations up to 4,000 mg/kg (fish). This direct intake to the human body is an order of magnitude lower than the maximum concentrations identified on the site.

Iron is a naturally occurring element and is not considered a priority substance by Defra and the Environment Agency with respect to human health. The elevated concentrations are likely from constituents in the made ground such as iron-rich ash and clinker. With the exception of a single analysis, all exceedances are in the same order of magnitude as the screening criteria (23,463mg/kg).

Exceedances of groundwater screening criteria for metals, metalloid and inorganic substances are not considered significant. The only pathway applicable to contaminants in groundwater for each of the three considered scenarios is the inhalation of vapours. Given that these metals and inorganic constituents are not volatile, they are excluded from Tier 2 assessment.

C.4.1.4 Additional Substances Modelled at Tier 2

In addition to substances in excess of their Tier 1 screening criteria (or excluded, as discussed in previous subsection), the following have also been *included* in modelling and are outlined as follows:

C.4.1.4.1 Bis(2-ethylhexyl)phthalate

This compound has no Tier 1 criteria in groundwater, yet was detected in relatively elevated concentrations (up to 68 µg/l, WS141). Toxicological health criteria values have been sourced from the World Health Organisation (WHO).

C.4.1.4.2 Total Petroleum Hydrocarbons

There are currently no Tier 1 screening criteria for TPH in groundwater. Concentrations of up to 59,950µg/l total TPH (SB15) were recorded in samples it is considered that potential may exist for human health impact from TPH in groundwater. Toxicological health criteria values have been sourced from the TPH Criteria Working Group publications.

C.4.2 Hazard Assessment

Hazard identification and assessment aims to identify potential acute and chronic hazards associated with the contaminants identified at the site in question. This assessment is based on toxicological reviews of identified contaminants of concern and incorporated into the Tier 1 screening process as discussed in preceding sections. All contaminants where a potentially significant hazard has been identified are therefore assessed further at Tier 2 and discussed in the following sections of this report.

Tier 1 screening has therefore reduced the number of soil and groundwater contaminants brought forward to this more detailed hazard identification and assessment stage.

C.4.3 Summary Pollutant Linkages

Contaminants at this stage have been grouped into broad categories to reduce the complexity of the pollutant linkages identified. Significant pollutant linkages (if identified) will be categorised for individual substances at Stage 4.

A summary of the pollutant linkages identified for the contaminant sources and receptors detailed in the sections above based is provided in Table C4.3 below. These are based on consideration of physico-chemical properties and the preliminary toxicological review presented above

Table C4.3 - Tabulated summary of complete pollutant linkages

Contaminant Type	*Exposure Pathways*	*Relevant Receptor*
Organic Contaminants	Incidental ingestion of surficial soil	Visitor to open-space land
	Dermal contact with surficial soil outdoors	Visitor to open-space land
	Dermal contact with indoor dust	Commercial worker and resident
	Inhalation of fugitive dust outdoors	Visitor to open-space land, commercial worker and resident
	Inhalation of fugitive dust indoors	Commercial worker and resident
	Inhalation of vapours from subsurface soil indoors	Commercial worker and resident
	Inhalation of vapours from subsurface soil outdoors	Visitor to open-space land, commercial worker and resident
	Inhalation of vapours from groundwater indoors	Commercial worker and resident
	Inhalation of vapours from groundwater outdoors	Visitor to open-space land, commercial worker and resident
Inorganic Contaminants	Incidental ingestion of surficial soil	Visitor to open-space land
	Dermal contact with surficial soil outdoors	Visitor to open-space land
	Dermal contact with indoor dust	Commercial worker and resident
	Inhalation of fugitive dust outdoors	Visitor to open-space land, commercial worker and resident
	Inhalation of fugitive dust indoors	Commercial worker and resident

C.5 STAGE THREE – RISK ESTIMATION

C.5.1 Overview

Current good-practice prescribes an iterative approach to risk estimation (as noted in Section C.2) starting at Tier 1 with the qualitative development of a conceptual model that identifies appropriate pollutant linkages with respect to the types of sources and receptors identified at the site, and the comparison of measured concentrations against appropriately defined generic assessment criteria. Compounds failing the Tier 1 evaluation are progressed to Tier 2 where appropriate.

C.5.2 Tier 1 Generic Assessment

This is defined in Section C.4.1.

C.5.3 Tier 2 Site-Specific Assessment

Contaminants of potential concern highlighted by the Tier 1 assessment and subsequently assessed at Tier 2 highlighted a number of metals, metalloids, TPH, PAHs, SVOC Bis(2-ethylhexyl)phthalate and the VOC trichloroethene

The structure of the methodology used to derive the Tier 2 numerical risk estimation and Site-Specific Assessment Criteria (SSACs) for the priority contaminants is as follows:

1 Toxicity Assessment;
2 Development of a quantitative conceptual exposure model (CEM) for public open space, off-site commercial and off-site residential land-uses characterising human exposure;
3 Model choice for each exposure pathway;
4 Derivation of appropriate SSACs for contaminants designed to facilitate the identification of areas of the site that may require some form of risk management.

C.5.3.1 Toxicity and Physchem Assessment

The selection of appropriate human health criteria for use in this risk assessment has been carried out in accordance with the guidelines set out in R&D Publication CLR9 published by Defra and the Environment Agency[8]. The principles of this guidance are described in the "Toxicity Assessment" section at the end of this Appendix and are followed by a summary of the selection and derivation of the health criteria values (HCV) for each of the observed contaminants.

Physchem (physical and chemical) parameters for the chemicals assessed at this level have been sourced from the priority listing below:

[8] R&D Publication CLR9, Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans, Defra/EA, 2002.

- Environment Agency (2004) Review of the Fate and Transport of Selected Contaminants in the Soil Environment, Draft Technical Report, P5-079/TR1
- European Chemicals Bureau European Chemical Substances Information System (http://ecb.jrc.it/);
- US EPA Users Guide for Evaluating Subsurface Vapour Intrusion into Buildings, 2003;
- US National Library of Medicine TOXNET database (http://toxnet.nlm.nih.gov/);
- US Department of Energy Risk Assessment Information System (http://risk.lsd.ornl.gov/);
- Physical-chemical Properties and Environmental Fate Handbook, CD-ROM, Mackay D., W.Y Shiu, K.C Ma, Chapman & Hall, 2000.

C.5.3.2 Conceptual Exposure Model Development

Central to the development of land-use specific conceptual exposure models (CEMs) has been data contained within CLR10, a document published by Defra and the Environment Agency that consolidates available data on UK exposure for standard land-uses[9]. Exposure parameters in CLR10 have been subsequently updated with information contained in three briefing notes published by the Environment Agency:

- CLEA Briefing Note 1: Update on the Dermal Exposure Pathway (CLEA BN1);
- CLEA Briefing Note 2: Update on Estimating Vapour Intrusion Into Buildings (CLEA BN2); and
- CLEA Briefing Note 3: Update on Supporting Values and Assumptions Describing UK Building Stock (CLEA BN3).

It is noted that guidance regarding standard exposures for a public open space scenario have not been published.

In developing a reasonable and appropriate quantitative CEM for this site that is representative of typical UK exposure for public open space, commercial and residential uses, URS has used time-weighted average/mean/median values for key parameters such as bodyweight. The choice of other exposure characteristics is based on maintaining an appropriate consistency between related parameters such as body weight and skin surface area for example, based on the information provided in CLR10.

It is understood that it is the current aim to open the site up to the general public via a right-to-roam agreement once any health and safety issues are resolved. Neighbouring land uses include a proposed commercial area immediately to the north of the site and a number of residential dwellings already present to the north east. Where appropriate, site-specific data has been utilised (including soil descriptions and depth to sources) supplemented by information provided in CLR10 and CLEA briefing notes.

9 Residential with gardens, residential without gardens, allotments and commercial/ Industrial.

The methodology used in this assessment is deterministic and therefore the results will not be the same as those derived from a distributional model such as CLEA 2002.

C.5.3.2.1 Exposure Assumptions

The model was run for;

- Public open space, shallow soils (0-1m);
- Public open space, deeper soils (>1m, unsaturated zone);
- Public open space, groundwater;
- Adjacent commercial, shallow soils (0-0.3m);
- Adjacent commercial, deep soils (>0.3m, unsaturated zone);
- Adjacent commercial, groundwater;
- Adjacent residential, shallow soils (0-0.5m);
- Adjacent residential, deep soils (>0.5m, unsaturated zone); and
- Adjacent residential, groundwater.

Each model was run to approximate the characteristics of the whole site, or aspects of the site nearest to the off-site area (for commercial and residential scenarios). These models were created with reference to the qualitative CSM detailed in Section C.3.1.3 and following the guidance outlined within the EA/Defra CLR10 document and Briefing Notes, the following human exposure assumptions have been made:

Residential (off-site):

A residential scenario when assessed on-site is considered the most sensitive of the land uses assessed in this exercise. The following apply to the off-site scenario:

- critical receptor is a female child (age 0 – 6 years)
- the duration of exposure covers the first six years of life;
- the mean body weight for 0-6 year old females in the UK is 14.5 kg;
- the mean body height for 0-6 year old females in the UK is 93 cm;
- for vapour and dust inhalation, the exposure frequency is a maximum 365 days per year, of which on average, 92% of time is spent indoors, and 8% outdoors;
- for dermal contact, the time weighted average exposure to household dust is 334 days per year for 0-6 year old females in the UK;
- the time weighted average breathing rate indoors, accounting for passive and active breathing rates and durations, is 0.16 m^3/hour for 0-6 year old females in the UK;
- the time weighted average breathing rate outdoors, accounting for passive and active breathing rates and durations, is 0.43 m^3/hour for 0-6 year old females in the UK;
- the 75th percentile of the exposed skin area, for the mean total skin area of 0-6 year old females in the UK is 1,349 cm^2 indoors and 1,076 cm^2 outdoors;

- skin adherence for dust 0.06 mg/m^3 based on a reasonable worst-case proposed by US EPA in 2001.

Open Space:

There are no standard exposure scenarios or critical receptors published in UK guidance for public open spaces land use. Given that the residential with gardens scenario is considered the most sensitive with regard to both critical receptor and exposure scenarios, this was judged a suitable basis on which to devise modelling for the parks and open spaces scenario.

Much the same activity could be expected of a 0-6 year old female child (the critical receptor) outside in a residential garden as outside in a public space. The exposure parameters are therefore identical to those used for modelling of standard residential land-use with the following exclusions:

- all indoor pathways not considered; and
- home grown vegetables are not considered.

The exposure scenario for a parks and open spaces end use is highly variable, making the selection of modelling parameters subjective, principally because of the diverse exposure scenarios possible. In recognition of this, URS considers that currently it is appropriate to use a modified residential exposure scenario to account for a generic assessment of recreational exposure, accepting that this does not specifically address likely recreational exposures that could vary from sports playing fields and community landscaped areas to naturalised wildlife areas. On balance, the use of a modified residential scenario is likely to be conservative, since higher potential exposure activities – such as playing sports like rugby – must be set against lower exposure frequencies compared with a residential setting. The use of the 0-6 year old female child outdoors as the critical receptor, with the same characteristics as when in a residential garden environment is considered appropriate and suitably conservative, and based on a similar judgement to that made in CLR10 for residential exposure; namely that female children are typically more sensitive to toxicological effects because of their lower body weight relative to males.

Exposure assumptions:

- critical receptor is a female child;
- the duration of exposure covers the first six years of life;
- the mean body weight for 0-6 year old females in the UK is 14.5 kg;
- the mean body height for 0-6 year old females in the UK is 93 cm;
- for vapour and dust inhalation, the exposure frequency is a maximum 365 days per year, of which on average, 8% is spend outdoors;
- for soil and dust ingestion, the time weighted average exposure frequency is 119 days per year for 0-6 year old females in the UK;
- for dermal contact, the time weighted average exposure to dust is 119 days per year;
- the time weighted average breathing rate outdoors, accounting for passive and active breathing rates and durations, is 0.43 m^3/hour for 0-6 year old females in the UK;

- the soil and dust ingestion rate is 215mg/day for 0-6 year old females in the UK, representing the 50th percentile;
- the 75th percentile of the exposed skin area, for the mean total skin area of 0-6 year old females in the UK is 1,076 cm^2;
- skin adherence for soil is 1 mg/m^3, and dust adherence 0.06 mg/m^3 based on a reasonable worst-case proposed by US EPA in 1992, and 2001 respectively;

Commercial (off-site):

For the standard commercial land-use (single storey warehouse) as defined in CLR10 and Briefing Notes, and with reference to the qualitative CSM detailed in Section C.3.1.3, the following assumptions have been made:

- critical receptor is a female working adult (age 16–59);
- the mean body weight for 16-59 year old females in the UK is 68.5 kg;
- the mean body height for 16-59 year old females in the UK is 162 cm;
- for vapour and dust inhalation, the exposure frequency is a maximum 230 days per year, of which on average, 31% of the total (24hr) day is spent indoors, and 4% outdoors on site;
- for dermal contact, the time weighted average exposure to indoor dust is 230 days per year, for 16-59 year old females in the UK;
- the time weighted average breathing rate indoors, accounting for passive and active breathing rates and durations, is 0.63 m^3/hour for 16-59 year old females in the UK;
- the time weighted average breathing rate outdoors, accounting for passive and active breathing rates and durations, is 0.96 m^3/hour for 16-59 year old females in the UK;
- the exposed skin surface area for indoor and outdoor dust exposure is 816 cm^2 for 16-59 year old females in the UK (note this assumes that only the hands and face are likely to be exposed to contaminative dust); and
- skin adherence for dust is 0.06 mg/cm^2.

(All data sourced from CLR10 and CLEA Briefing Notes 1-3. Public open space parameters adapted from the residential without gardens guidance).

C.5.3.2.2 General Assumptions

Table C5.1 details the parameter values used to define the soil, dust and outdoor air fate and transport models used to calculate the exposure point PCOC concentrations. Details of the models used are given in C.5.3.2. Guidelines for parameter values provided in CLR10 have been adhered to where appropriate.

Table C5.1 - General Parameter Assumptions

Parameter	*Units*	*Value*	*Justification*
Outdoor Box Model			
Height of box (0-6 yr old female receptor)	m	0.47	Equal to half the mean body height for the critical receptor, as advised in CLR10.
Height of box (16-59 yr old female receptor)	m	0.81	Equal to half the mean body height for the critical receptor, as advised in CLR10.
Length of box	m	15	Length of box the Johnson and Ettinger/ ASTM outdoor air model calibrated to and presented in CLR10. Site specific (and larger) values are considered overly conservative
Wind speed	ms^{-1}	3	Value recommended in CLR10
Dust Parameters			
Normalised annual average concentration of dust	$kg.m^3$ per $g/m^2/s$	0.016	Value recommended in CLR10
Flux of respirable particles	$g/m^2/s$	0.00001	Value recommended in CLR10
Fraction of site with building or vegetative cover	-	0.8	Value recommended in CLR10
Equivalent threshold value of wind speed at 7 m agl	m/s	11.32	Value recommended in CLR10
Wind speed distribution function	-	0.194	Value recommended in CLR10
Annual average PM10 concentration	mg/m^3	1.19E-3	Calculated value using formula in CLR10
Fraction of outdoor dust originating from soil	%	100	Value recommended in CLR10
Fraction of indoor dust originating from soil (commercial and residential scenarios)	%	75	Value recommended in CLR10
Building Parameters –generic Two Storey House (residential scenario)			
Building air exchange rate	hr^{-1}	0.5	Value recommended in CLEA BN3
Height of living space	cm	480	Value recommended in CLEA BN3
Building length	cm	640	Value recommended in CLEA BN3
Building Width	cm	640	Value recommended in CLEA BN3
Foundation or slab thickness	cm	15	Value recommended in CLEA BN3
Floor-wall seam crack width	cm	0.2	Value recommended in CLEA BN3
Indoor/outdoor pressure differential	$g/cm/s^2$	30	Value recommended in CLEA BN3
Averaging time for surface emission vapour flux	yrs	6	Value recommended in CLR10
Building Parameters –generic Single Storey Warehouse (commercial scenario)			
Building air exchange rate	hr^{-1}	1	Value recommended in CLEA BN3
Height of living space	cm	460	Value recommended in CLEA BN3
Building length	cm	4500	Value recommended in CLEA BN3
Building width	cm	4500	Value recommended in CLEA BN3
Foundation or slab thickness	cm	15	Value recommended in CLEA BN3
Floor-wall seam crack width	cm	0.2	Value recommended in CLEA BN3
Indoor/outdoor pressure differential	$g/cm/s^2$	30	Value recommended in CLEA BN3
Averaging time for surface emission vapour flux	yrs	43	Value recommended in CLR10
Unsaturated Zone – Shallow soil – CLR10 "Sandy"			
Soil type	-	(CLR10) Sandy	An approximation of the varied granular nature of made ground and underlying alluvial deposits
Total porosity	-	0.46	Published value for soil type
Air content	-	0.31	Published value for soil type
Water content	-	0.15	Published value for soil type
Soil bulk density	gcm^{-3}	1.6	Published value for soil type
Fraction of organic carbon	-	0.038	Average of 20 TOC samples from upper 1m of soils on site
Effective air permeability	cm^2	7.20E-8	Calculated value for soil type
Dust/soil enrichment factor	-	6	Value recommended in CLR10 for soil type

Parameter	*Units*	*Value*	*Justification*
Unsaturated Zone – Deeper soil – USDA "Sandy Clay"			
Soil type	-	(USDA) Sandy Clay	Approximation of the natural strata (and some reworked made ground) underlying the upper granular materials
Total porosity	-	0.615	Published value for soil type
Air content	-	0.498	Published value for soil type
Water content	-	0.117	Published value for soil type
Soil bulk density	gcm^{-3}	1.63	Published value for soil type
Fraction of organic carbon	-	0.019	Average of three FOC results from on-site soils sampled from >1m
Soil & Groundwater parameters			
Depth to groundwater (Soil modelling – open space)	m	1.3	Mean GW level from boreholes screened in shallow/perched groundwater.
Depth to groundwater (Groundwater modelling open space)	m	0.89	Geometric mean of GW levels from boreholes screened in shallow/perched groundwater.
Depth to groundwater (Soil modelling – off-site residential)	m	1.09	Mean GW level from boreholes screened in shallow/perched groundwater in NE site.
Depth to groundwater (Groundwater modelling off-site residential)	m	1.01	Geometric mean of GW levels from boreholes screened in shallow/perched groundwater in NE site.
Depth to groundwater (Soil modelling – off-site commercial)	m	0.86	Mean GW level from boreholes screened in shallow/perched groundwater in N site.
Depth to groundwater (Groundwater modelling off-site commercial)	m	0.82	Geometric mean of GW levels from boreholes screened in shallow/perched groundwater in N site.
Depth to shallow soil sources	m	0.5	Allowance made for a nominal diffusive path length of 50cm blow ground surface. CLR guidance suggests 100cm, 50cm is more conservative and considered more representative.
Depth to deep soil sources (open space)	m	1	Approximate depth to change in strata
Depth to deep soil sources (commercial)	m	0.3	Approximate depth to change in strata in vicinity of proposed commercial devt
Depth to deep soil sources (residential)	m	0.5	Approximate depth to change in strata in vicinity of existing residential properties
Shallow soil thickness (open space)	m	1.0	Approximation based on observed ground conditions similar to defined "CLR10 Sandy" over main site
Shallow soil thickness (commercial)	m	0.3	Approximation based on observed ground conditions similar to defined "CLR10 Sandy" in north of site
Shallow soil thickness (residential)	m	0.5	Approximation based on observed ground conditions similar to defined "CLR10 Sandy" in northeast of site
Deep soil thickness	m	To 4.0	Arbitrary depth to ensure "deep" soil extends to below the shallow / perched groundwater table.
Depth to base of unsaturated zone contamination (soil modelling)	m	1.3	Contamination assumed present throughout unsaturated zone, therefore limited by water table @ 1.3 m.bgl

C.5.3.2.3 Bioaccessibility

A key assumption made in the CLEA methodology is that exposure to a chemical from soil is the same as exposure to a chemical in the form used in relevant toxicological studies, usually food or water for oral studies, and vapour for inhalation studies. The CLEA model essentially estimates intake, which is the amount of chemical entering the body at the point of entry. It takes no account of the

bioavailability of a chemical in soil and therefore may over predict exposure compared to the data on which the toxicological studies are based.

Bioaccessibility of a contaminant, which is its effective solubility in conditions that simulate the ingestion/digestion and inhalation systems, can be used to evaluate the relative bioavailability of contaminants in soil compared to forms in food and water.

One such bioaccessibility test that has been used for arsenic determinations in the UK is known as the PBET (Physiologically Based Extraction Test). BGS (2002[10]) and Environment Agency (2005[11]) have evaluated its use in the UK and the reproducibility of the results. A key uncertainty in the use of the test has been the link between such lab-studies and in-vivo experimental data from humans and animals. The link for arsenic is limited and therefore PBET data must be applied with caution.

The PBET test is just one of a number of bioaccessibility tests available (BGS, 2002), and has been used for this project on the basis that it is the most widely used test currently in the UK.

Local Bioaccessibility of Arsenic in Soil

The dominant exposure pathway driving the exposure in the SGV for arsenic is direct ingestion of soil.

The arsenic SGV of 20 mg/kg is based on the assumption that 100% of the arsenic ingested becomes accessible for absorption by the body (as original toxicological data for arsenic is based on groundwater). The significance of the arsenic concentrations detected at this site could be less on the basis of evidence published by the Environment Agency and BGS that suggests that arsenic in UK soils is generally significantly less bioaccessible to humans. The relative bioaccessibility of arsenic in three soil samples[12] from the site have been tested using the Physiologically Based Extraction Test (PBET) developed by Ruby et al (1996[13]), and modified by BGS (2002), results are summarised in **Table C5.2**.

Table C5.2 – PBET Results

Substance	*Bioaccessibility (%)*			
	TP510	*TP511*	*TP512*	*Average*
Arsenic	21.7	13.3	<10.2*	*15.0*

*Value conservatively assumed = 10.2 for calculation of average

The measurement of bioaccessibility is only relevant to the soil ingestion exposure routes, and therefore the site-specific assessment criteria (SSAC) for arsenic was derived with this taken into account.

[10] Measurement of the Bioaccessibility of Arsenic in UK Soils, R&D Project Report P5-062/TR1, (Environment Agency/BRE, 2002)

[11] Science Update on the Use of Bioaccessibility Testing in Risk Assessment of Land Contamination, (Environment Agency, February 2005).

[12] TP510, TP511, TP512

[13] Estimation of Lead and Arsenic Bioavailability Using a Physiologically Based Extraction Test, M.V Ruby, A. Davis, R. Schoof, S. Eberle, C.M Sellstone, Environmental Science and Technology, Volume 30, Number 2, 1996

C.5.3.3 Model Choice

Although the Environment Agency published a software version of R&D Publication CLR10 called CLEA 2002, URS does not support its use for the derivation of SSAC because of:

- Both its vapour intrusion and dermal exposure algorithms are no longer consistent with the latest Environment Agency guidance (Environment Agency 2004a and b).
- Its lack of functionality makes it impossible to use as a Tier II risk assessment tool.
- Potential user problems have been reported with the addition of new contaminants.

It is important to note that the Environment Agency has never recommended CLEA 2002 for use as a site-specific risk assessment tool. Other software packages are available including RISC 4, RISC HUMAN, and GSI RBCA Toolkit, however, none of these packages have been designed to work within the CLEA framework and many have in-built functions that are contrary to the UK approach that cannot be altered.

In the absence of a commercially available site-specific model designed specifically to reflect the guidance contained within R&D Publications CLR 7-10, URS has chosen to code the published algorithms in CLR10 and accompanying CLEA Briefing Notes 1-3 into an integrated Excel™ spreadsheet model.

Human7 has been developed by URS in response to the need to identify a UK compatible risk tool that has the flexibility to derive generic Tier I criteria, consistent with the principles of R&D Publications CLR7 – 10, and yet has the functionality to be used for Tier II risk assessment. The algorithms combine contaminant fate and transport and human intake/uptake to a) estimate point of exposure concentrations (for indirect exposure pathways such as dust and vapour pathways), and b) estimate bodily intake and/or uptake of the contaminant, so that average daily exposure (ADE) can be estimated and site-specific assessment criteria (SSAC) calculated. The SSACs are calculated to be protective of human health for the scenario modelled. Table C5.3 summarises the exposure pathway models used for this assessment.

Table C5.3 – Model Choice

Exposure Pathway	*Modelling approach*	*Reference*	*Justification*
Soil and dust ingestion	Direct contact pathway. No fate & transport modelling necessary	CLR10	Preferred UK Regulatory approach
Dermal contact	Direct contact pathway. No fate & transport modelling necessary. Approach uses the concept of compound specific dermal absorption factors to estimate intake from soil adhered to skin surface	CLEA Briefing Note 1 & US EPA 2001	Updated approach to that referenced in CLR 10 (US EPA 1992), and included in an anticipated revision to the CLEA 2002 model, as detailed in CLEA Briefing Note 1.
Dust inhalation	US EPA 1996	CLR10	Preferred UK Regulatory approach
Indoor air vapour inhalation	Johnson & Ettinger model (US EPA 2003 version)	US EPA 2003 &	Updated approach to that referenced in CLR10 and to

Exposure Pathway	Modelling approach	Reference	Justification
		CLEA Briefing Notes 2 & 3	be included in the anticipated update to the CLEA 2002 software, as detailed in CLEA Briefing Notes 2 & 3. Updated approach to that
Outdoor air vapour inhalation	ASTM 2000 algorithm used to estimate exposure concentration in ambient air based on vapour diffusion through soil and mixing in an ambient air box model.	CLR10, ASTM E 2081-00	Preferred UK Regulatory approach

C.5.3.4 Risk Estimation Results

C.5.3.4.1 Site-Specific Assessment Criteria (SSAC)

Site-Specific Assessment Criteria (SSAC) have been developed for compounds identified with the Tier 1 screening at this site. These SSACs have been derived in accordance with the methodology detailed in Sections C.5.3.1 to 0 above for the three scenarios discussed. These criteria provide threshold values below which contamination is considered unlikely to be of concern for the modelled end-use. Above this threshold, it is considered that there is a need for some form of further risk management, potentially including remedial action. These criteria are detailed in Table C5.4, Table C5.5 and Table C5.6 for contaminated media for each of the identified source scenarios.

Soil SSACs include both oral and inhalation pathways such as direct contact, soil ingestion[14] and inhalation of dust and vapours. Groundwater SSACs were derived with due regard to inhalation of vapour pathway(s) only.

Table C5.4 – Tier 2 SSACs Study Site for a public right-to-roam open space use

Compound	SSAC Shallow Unsaturated Soils (0-1m) (mg/kg)	SSAC Deep Unsaturated Soils (>1m) (mg/kg)	SSAC Groundwater (µg/l)
Metals and Metalloids			
Arsenic	104*	n/a	n/a
Nickel	75##	n/a	n/a
Chromium (VI)	200##	n/a	n/a
Mercury (inorganic)	15	n/a	n/a
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)anthracene	11.5	>vap	>vap
Benzo(a)pyrene	1.15	>vap	>vap
Benzo(b)fluoranthene	11.5	>vap	>vap
Benzo(g,h,i)perylene	n/a	n/a	>vap
Benzo(k)fluoranthene	11.5	>vap	>vap
Chrysene	115 (>sol)	>vap	n/a
Dibenzo[a,h]anthracene	1.15	>vap	>vap
Fluoranthene	115	>vap	n/a
Indeno[1,2,3-cd]pyrene	11.5 (>sol)	>vap	>vap
Naphthalene	1130	6920 (>sol)	n/a

[14] Public open space scenario only

Compound	*SSAC Shallow Unsaturated Soils (0-1m) (mg/kg)*	*SSAC Deep Unsaturated Soils (>1m) (mg/kg)*	*SSAC Groundwater (µg/l)*
Semi -Volatile Organic Compounds (SVOC)			
Bis(2-ethylhexyl)phthalate	n/a	n/a	>vap
Volatile Organic Compounds (VOC)			
Trichloroethene (TCE)	255	2360	n/a
Total Petroleum Hydrocarbons			
>EC5-7 aromatic	8640	>vap	>vap
>EC7-8 aromatic	8640 (>sol)	>vap	1200000 (>sol)
>EC8-10 aromatic	2070	>vap	>vap
>EC10-12 aromatic	2170	>vap	>vap
>EC12-16 aromatic	2370 (>sol)	>vap	>vap
>EC16-21 aromatic	1800 (>sol)	>vap	>vap
>EC21-35 aromatic	1800 (>sol)	>vap	>vap
>EC5-6 aliphatic	248000 (>sol)	>vap	>vap
>EC6-8 aliphatic	248000 (>sol)	>vap	>vap
>EC8-10 aliphatic	5560 (>sol)	>vap	>vap
>EC10-12 aliphatic	5840 (>sol)	>vap	>vap
>EC12-16 aliphatic	5970 (>sol)	>vap	>vap
>EC16-21 aliphatic	120000 (>sol)	>vap	>vap

Notes:
>sol: solubility limit exceeded at this concentration (substance present as free product)
>vap: vapour limit exceeded at SSAC concentration (substance can not significantly impact receptor
n/a: not applicable, no pathway
*: includes PBET bioaccessibility results incorporated into ingestion pathway
##: Due to conservatism of Human7 model and/or policy decision regarding UK SGV, the derived SSAC was less than Tier 1 screen. The Tier 1 screen (UK SGV) is retained.

Table C5.5 – Tier 2 SSACs for Study Site in vicinity of residential properties

Compound	*SSAC Shallow Unsaturated Soils (0-0.5m) (mg/kg)*	*SSAC Deep Unsaturated Soils (>0.5m) (mg/kg)*	*SSAC Groundwater (µg/l)*
Metals and Metalloids			
Arsenic	333	n/a	n/a
Nickel	3610	n/a	n/a
Chromium (VI)	3010	n/a	n/a
Mercury (inorganic)	903000	n/a	n/a
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)anthracene	54.3 (>sol)	>vap	>vap
Benzo(a)pyrene	5.29	>vap	>vap
Benzo(b)fluoranthene	54.3 (>sol)	>vap	>vap
Benzo(g,h,i)perylene	n/a	n/a	>vap
Benzo(k)fluoranthene	54.3 (>sol)	>vap	>vap
Chrysene	543 (>sol)	>vap	n/a
Dibenzo[a,h]anthracene	5.43	>vap	>vap
Fluoranthene	543	>vap	n/a
Indeno[1,2,3-cd]pyrene	54.3 (>sol)	>vap	>vap
Naphthalene	4170 (>sol)	3450 (>sol)	n/a
Semi -Volatile Organic Compounds (SVOC)			
Bis(2-ethylhexyl)phthalate	n/a	n/a	>vap
Volatile Organic Compounds (VOC)			
Trichloroethene (TCE)	1210	1200	n/a
Total Petroleum Hydrocarbons			
>EC5-7 aromatic	36900	>vap	>vap
>EC7-8 aromatic	36900 (>sol)	>vap	826000 (>sol)

Compound	SSAC Shallow Unsaturated Soils (0-0.5m) (mg/kg)	SSAC Deep Unsaturated Soils (>0.5m) (mg/kg)	SSAC Groundwater (µg/l)
>EC8-10 aromatic	10300 (>sol)	>vap	>vap
>EC10-12 aromatic	11700 (>sol)	>vap	>vap
>EC12-16 aromatic	13900 (>sol)	>vap	>vap
>EC16-21 aromatic	10600 (>sol)	>vap	>vap
>EC21-35 aromatic	10600 (>sol)	>vap	>vap
>EC5-6 aliphatic	>100%	>vap	>vap
>EC6-8 aliphatic	>100%	>vap	>vap
>EC8-10 aliphatic	29900 (>sol)	>vap	>vap
>EC10-12 aliphatic	33800 (>sol)	>vap	>vap
>EC12-16 aliphatic	35200 (>sol)	>vap	>vap
>EC16-21 aliphatic	706000 (>sol)	>vap	>vap

Notes:
>sol: solubility limit exceeded at this concentration (substance present as free product)
>vap: vapour limit exceeded at SSAC concentration (substance cannot significantly impact receptor)
n/a: not applicable, no pathway

Table C5.6 – Tier 2 SSACs for Study Site in vicinity of proposed commercial redevelopment

Compound	SSAC Shallow Unsaturated Soils (0-0.3m) (mg/kg)	SSAC Deep Unsaturated Soils (>0.3m) (mg/kg)	SSAC Groundwater (µg/l)
Metals and Metalloids			
Arsenic	5880	n/a	n/a
Nickel	59900	n/a	n/a
Chromium (VI)	36900	n/a	n/a
Mercury (inorganic)	>100%	n/a	n/a
Polycyclic Aromatic Hydrocarbons (PAHs)			
Benzo(a)anthracene	983 (>sol)	>vap	>vap
Benzo(a)pyrene	94.7	>vap	>vap
Benzo(b)fluoranthene	983 (>sol)	>vap	>vap
Benzo(g,h,i)perylene	n/a	n/a	>vap
Benzo(k)fluoranthene	983 (>sol)	>vap	>vap
Chrysene	9830 (>sol)	>vap	n/a
Dibenzo[a,h]anthracene	98.3 (>sol)	>vap	>vap
Fluoranthene	9830 (>sol)	>vap	n/a
Indeno[1,2,3-cd]pyrene	983 (>sol)	>vap	>vap
Naphthalene	97800 (>sol)	>vap	n/a
Semi -Volatile Organic Compounds (SVOC)			
Bis(2-ethylhexyl)phthalate	n/a	n/a	>vap
Volatile Organic Compounds (VOC)			
Trichloroethene (TCE)	32300 (>sol)	>vap	n/a
Total Petroleum Hydrocarbons			
>EC5-7 aromatic	>100%	>vap	>vap
>EC7-8 aromatic	>100%	>vap	>vap
>EC8-10 aromatic	250000 (>sol)	>vap	>vap
>EC10-12 aromatic	253000 (>sol)	>vap	>vap
>EC12-16 aromatic	255000 (>sol)	>vap	>vap
>EC16-21 aromatic	192000 (>sol)	>vap	>vap
>EC21-35 aromatic	192000 (>sol)	>vap	>vap
>EC5-6 aliphatic	>100%	>vap	>vap
>EC6-8 aliphatic	>100%	>vap	>vap
>EC8-10 aliphatic	633000 (>sol)	>vap	>vap

Compound	SSAC Shallow Unsaturated Soils (0-0.3m) (mg/kg)	SSAC Deep Unsaturated Soils (>0.3m) (mg/kg)	SSAC Groundwater (µg/l)
>EC10-12 aliphatic	637000 (>sol)	>vap	>vap
>EC12-16 aliphatic	639000 (>sol)	>vap	>vap
>EC16-21 aliphatic	>100%	>vap	>vap

Notes:
>sol: solubility limit exceeded at this concentration (substance present as free product)
>vap: vapour limit exceeded at SSAC concentration (substance can not significantly impact receptor)
n/a: not applicable, no pathway

C.5.4 Stage Four – Risk Evaluation

Based on the Tier 1 assessment in Section C.4.1, it is considered that there was potential risk to human receptors both on and off the study site from contaminants in both soil and groundwater.

Site-specific assessment criteria (SSAC) have been calculated to further the assessment of potential risk to human health posed by the current condition of the land. These criteria are designed to indicate concentrations below which exposure is considered to be acceptable within the context of current UK statutory guidance on land contamination.

The following sections examine which contaminants have been reported on the site in excess of Tier 2 criteria and a discussion of the sensitivity of and uncertainties associated with the modelling.

C.5.4.1 Exceedances of SSACs

The SSACs derived for the open space, off-site residential and off-site commercial scenarios are presented in Table C5.4, Table C5.5 and Table C5.6 respectively above. As the criteria demonstrate, each of these scenarios have differing sensitivity to modelled risks, with the public open space being most sensitive and off-site commercial, the least. Contaminants in shallow soil are shown to be the most critical in comparison to those in other media considered ("deeper" soil and groundwater).

For contaminants in shallow soil, the derived SSAC was exceeded for a number of substances, these are presented in Table 5.7 below.

Table 5.7 – Exceedances of Shallow Soil SSACs

Substance	Max. Value	Open Space		Off-Site Residential		Off-Site Commercial	
		SSAC	Exceeds	SSAC	Exceeds	SSAC	Exceeds
Nickel	96	**75**	**2**	3610	0	59900	0
Mercury	30	**15**	**1**	9E+5	0	n/a	-
Benzo(a)anthracene	116	**11.5**	**5**	**54.3**	**1**	983	0
Benzo(a)pyrene	114	**1.15**	**12**	**5.29**	**6**	**94.7**	**1**
Benzo(b)fluoranthene	104	**11.5**	**1**	**54.3**	**1**	983	0
Benzo(k)fluoranthene	94.8	**11.5**	**4**	**54.3**	**1**	983	0
Chrysene	122	**115**	**1**	543	0	9830	0
Dibenzo(a,h)	4.3	**1.15**	**4**	5.43	0	98.3	0

Substance	Max. Value	Open Space		Off-Site Residential		Off-Site Commercial	
		SSAC	Exceeds	SSAC	Exceeds	SSAC	Exceeds
anthracene							
Fluoranthene	247	**115**	**1**	543	0	9830	0
Indeno(1,2,3-cd) pyrene	65.6	**11.5**	**4**	**54.3**	**1**	983	0

Note: Maximum value and SSAC presented in mg/kg
Exceedances are shaded and **bold**.

The substances recording exceedances of Tier 2 SSACs are relatively few and are generally associated with reported concentrations from the same limited set of samples.

These are discussed in the following sections, and where appropriate have been assessed utilising statistical analysis presented in CLR7, Appendix A (the mean value test and maximum value tests).

C.5.4.1.1 Nickel

There are two exceedances of the 75 mg/kg screening criteria at WS134 (0.4-0.6m, 92 mg/kg) and WS412 (0.5m, 96 mg/kg). These are not regarded as statistical outliers and averaging of all concentrations in the shallow soil derives a US95 concentration of 27.3 mg/kg. Overall, there is considered to be no significant risk to human health from nickel at the site.

C.5.4.1.2 Mercury

The single mercury exceedance (WS108 0.2-0.5m, 30mg/kg) is a statistical outlier and as such can be considered a hot-spot. Given that the majority of other samples (93%) were below laboratory detection limits and the next highest concentration was 3mg/kg, mercury overall is not considered a significant risk to human health at the site. However, it would be prudent to delineate the extent of exceedances in the soil in this area and establish whether the soil may require remediated. No exceedances for off-site receptors were reported.

C.5.4.1.3 Polycyclic Aromatic Hydrocarbons (PAHs)

Exceedances up to two orders of magnitude were recorded for PAHs benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, chrysene, dibenzo(a,h)anthracene, fluoranthene and indeno(1,2,3-cd)pyrene.

The greatest exceedances were all associated with the sample obtained from WS163 (0.05 – 0.5m.bgl) although both benzo(a)pyrene and dibenzo(a,h)anthracene were not analysed in this sample.

Similarly, results from WS161 (0.3 – 0.5m.bgl) and, to a lesser extent, TP8 (0.6m.bgl) were also elevated in comparison to results from other samples.

The area in the vicinity of WS163, in the south east of the site was not subject to a high sampling density and as such, the elevated concentrations may be indicative (in the worst case) of contamination to an area in excess of 200m x 80m.

WS161, located in the far south east of the site is located near sampling locations (WS162, WS413 and TP515) where elevated PAHs were not reported, indicating a potentially localised area of contamination. Similarly, TP8 is located within a dense network of other trial pits towards the north of the site. The proximity of other trial pits

without elevated PAHs indicate that these concentrations are likely very localised in this area.

Table C5.8 – Summary of Statistics Applied to PAH results

Compound	*SSAC (mg/kg)*	*US95 (mg/kg)*	*Maximum Conc^{n} (mg/kg)*	*Statistical outlier?**
Benzo(a)anthracene	11.5	8.36	116	No
Benzo(a)pyrene	1.15	7.41	114	No
Benzo(b)fluoranthene	11.5	7.35	104	No
Benzo(k)fluoranthene	11.5	5.47	**94.8**	**Yes**
Chrysene	115	8.5	122	No
Dibenzo(a,h)anthracene	1.15	0.78	4.3	No
Fluoranthene	115	17.1	247	No
Indeno(1,2,3-cd)pyrene	11.5	4.33	**65.6**	**Yes**

Notes:
*: Maximum value test applied to the maximum result when compared to the entire shallow soil dataset for that substance.

URS believes that for the on-site open space scenario, human receptors are unlikely to be in a static location during each exposure event (visit to the site). Therefore it is considered applicable that an *average* concentration across the site may be more representative of likely exposure. Using the methodology presented in CLR7, a US95 concentration was calculated for each of the PAHs with recorded exceedances of Tier 2 criteria. These results are presented in Table C5.8 above.

The statistical outlier test was applied to the maximum concentration reported for each of the PAHs exceeding SSAC. This compares the value with the entire shallow soil dataset for that substance. Statistically, only the maximum value for benzo(b)fluoranthene and indeno(1,2,3-cd)pyrene are considered “outliers” (both WS163), although practically, it may be wise to consider each elevated concentration as a potential “hot spot”.

For each PAH, the US95 concentration was below the applicable SSAC providing confidence that despite the limited number of exceedances, any visitor to the open space would not be considered in significant risk. However, this assumes that exposure to the receptor is indeed averaged over the entire site. Given the large dimensions of the source site, it is considered prudent that additional measures are undertaken to break pollutant linkages where concentrations in soil (particularly those in the shallowest of soils) are greatly above the SSAC.

As discussed previously, the greatest exceedances were in samples obtained from WS163 and WS161. Remedial action to these areas is considered a sensible precautionary measure especially when considered an outlier or hot-spot.

C.5.4.2 Sensitivity and Uncertainty Analysis

Uncertainty is inherent in quantitative human health risk assessment and in the context of this assessment, can be seen to be derived from principally four sources – toxicological data, assumptions made characterising human exposure at the site, assumptions made characterising the ground conditions at the site, and the fate and transport algorithms used to predict exposure point concentrations.

The characterisation of human exposure is based on R&D Publication CLR10 and subsequent CLEA Briefing Notes. These are designed to be protective of sensitive receptors by taking into account reasonable and typical land-use patterns in the UK based on social studies and the professional judgement of policy makers to provide a CEM suitable for generic conditions. A precautionary approach has been taken using UK regulatory standard land-use exposure models to characterise exposure, modified with site-specific data where appropriate. Generally, the most sensitive parameters are body weight, exposure frequency, soil ingestion rate, breathing rate and fraction of time indoors. The values used for these parameters are based on European research that focused on the UK population, and for the most sensitive critical receptor – a female child (open space and residential scenarios) and female worker (commercial scenario) – the parameter values used are considered appropriate.

C.5.4.2.1 Exposure to Volatile Contaminants

For exposure to volatile contaminants, the indoor air vapour inhalation is on balance the risk driving pathway, when considered. This pathway does not exist for the open-space scenario and has been excluded in modelling of the residential and commercial scenarios with justifications presented in Section C.3.3.1. Given that a pathway may be considered to exist whereby vapours from the study site migrate (in the open air) to "outdoor air" in the off-site residential and commercial scenarios, it is also possible that this outdoor air could also influence concentrations in indoor air.

Assuming the study site consists of concentrations equal to the derived SSACs, at this "worst case" scenario, the fate and transport algorithms were used to derive contaminant vapour concentrations in outdoor air. These outdoor air concentrations were conservatively input as the concentrations present in *indoor* air, hence ignoring the potential dilution of ambient air. With the indoor air source concentrations, hazard indices (HI) were derived, indicative of risk. Where a HI is in excess of 1.0, potential harm to the human receptor is considered possible.

Table C5.9 presents summary data of the aforementioned check for justifying the exclusion of the indoor vapour inhalation pathways in deriving SSACs protective of off-site receptors.

Table C5.9 – Off-Site Indoor Vapour Inhalation. Worst Case Hazard Indices

Compound	*Study Site SSAC (ppm)*	*Concentration in Outdoor Air* (mg/m^3)*		*Hazard Index (HI) in Indoor Air*		*Significant Risk?*
		Resi	*Comm*	*Resi*	*Comm*	
Soil						
Benzo(a)anthracene	11.5	4.53E-09	2.27E-09	6.29E-06	4.93E-07	N
Benzo(a)pyrene	1.15	5.89E-12	2.95E-12	2.34E-05	1.83E-06	N
Benzo(b)fluoranthene	11.5	1.16E-10	5.80E-11	1.61E-07	1.26E-08	N
Benzo(k)fluoranthene	11.5	3.31E-11	1.66E-11	4.60E-08	3.61E-09	N
Chrysene	115	9.73E-08	4.87E-08	1.35E-05	1.06E-06	N
Dibenzo[a,h]anthracene	1.15	8.47E-13	4.27E-13	1.18E-08	9.28E-10	N
Fluoranthene	115	1.83E-08	9.13E-09	2.54E-06	1.98E-07	N
Indeno[1,2,3-cd]pyrene	11.5	1.22E-11	6.08E-12	1.69E-08	1.32E-09	N
Naphthalene	1130	1.18E-03	9.10E-04	4.62E-01	9.35E-02	N
Trichloroethene (TCE)	255	1.33E-02	6.66E-03	7.10E-01	5.57E-02	N

Compound	Study Site SSAC (ppm)	Concentration in Outdoor Air* (mg/m^3)		Hazard Index (HI) in Indoor Air		Significant Risk?
		Resi	Comm	Resi	Comm	
TPH >EC5-7 aromatic	8640	4.51E-01	2.25E-01	**1.10E+00**	8.58E-02	**Y**
TPH >EC7-8 aromatic	8640	4.51E-01	2.25E-01	**1.10E+00**	8.58E-02	**Y**
TPH >EC8-10 aromatic	2070	1.08E-01	5.41E-02	5.26E-01	4.13E-02	N
TPH >EC10-12 aromatic	2170	7.48E-02	3.74E-02	3.64E-01	2.85E-02	N
TPH >EC12-16 aromatic	2370	7.31E-03	3.66E-03	3.56E-02	2.79E-03	N
TPH >EC16-21 aromatic	1800	2.12E-04	1.06E-04	1.96E-03	1.54E-04	N
TPH >EC21-35 aromatic	1800	1.09E-07	5.44E-08	1.01E-06	7.88E-08	N
TPH >EC5-6 aliphatic	248000	1.29E+01	6.46E+00	6.82E-01	5.34E-02	N
TPH >EC6-8 aliphatic	248000	1.29E+01	6.46E+00	6.82E-01	5.34E-02	N
TPH >EC8-10 aliphatic	5560	2.90E-01	1.45E-01	2.82E-01	2.20E-02	N
TPH >EC10-12 aliphatic	5840	1.02E-01	5.12E-02	9.91E-02	7.78E-03	N
TPH >EC12-16 aliphatic	5970	9.75E-03	4.88E-03	9.47E-03	7.42E-04	N
TPH >EC16-21 aliphatic	120000	3.01E-04	1.50E-04	4.18E-05	3.26E-06	N
Groundwater						
Benzo(a)anthracene	#	7.05E-07	3.53E-07	9.79E-04	7.67E-05	N
Benzo(a)pyrene	#	2.77E-07	1.39E-07	**1.10E+00**	8.63E-02	**Y**
Benzo(b)fluoranthene	#	6.63E-08	3.32E-08	9.21E-05	7.22E-06	N
Benzo(g,h,i)perylene	#	1.55E-08	7.75E-09	7.29E-05	3.06E-05	N
Benzo(k)fluoranthene	#	1.36E-08	6.81E-09	1.89E-05	1.48E-06	N
Dibenzo[a,h]anthracene	#	1.28E-07	6.45E-08	1.78E-03	1.40E-04	N
Indeno[1,2,3-cd]pyrene	#	3.11E-11	1.55E-11	4.32E-08	3.37E-09	N
Bis(2-ethylhexyl)phthalate	#	3.42E-08	1.71E-08	4.32E-07	3.38E-08	N
TPH >EC5-7 aromatic	#	1.45E-01	7.26E-02	3.53E-01	2.77E-02	N
TPH >EC7-8 aromatic	1200	1.61E+00	8.05E-01	**3.92E+00**	3.07E-01	**Y**
TPH >EC8-10 aromatic	#	1.62E-01	8.08E-02	7.89E-01	6.16E-02	N
TPH >EC10-12 aromatic	#	1.75E-02	8.77E-03	8.53E-02	6.69E-03	N
TPH >EC12-16 aromatic	#	1.55E-03	7.77E-04	7.55E-03	5.93E-04	N
TPH >EC16-21 aromatic	#	4.64E-05	2.32E-05	4.30E-04	3.36E-05	N
TPH >EC21-35 aromatic	#	3.73E-08	1.87E-08	3.45E-07	2.71E-08	N
TPH >EC5-6 aliphatic	#	1.73E+01	8.65E+00	9.14E-01	7.15E-02	N
TPH >EC6-8 aliphatic	#	2.14E+01	1.07E+01	**1.13E+00**	8.85E-02	**Y**
TPH >EC8-10 aliphatic	#	1.75E-01	8.74E-02	1.70E-01	1.33E-02	N
TPH >EC10-12 aliphatic	#	2.15E-02	1.08E-02	2.09E-02	1.64E-03	N
TPH >EC12-16 aliphatic	#	2.05E-03	1.02E-03	1.99E-03	1.55E-04	N
TPH >EC16-21 aliphatic	#	6.31E-05	3.16E-05	8.76E-06	6.87E-07	N

*subsequently used as indoor air source concentration

SSAC was limited by vapour saturation hence source concentration set at arbitrary 1E+06ppm to force maximum outdoor air vapour concentration

As the above table shows, even assuming a worst case that the entire study site has contamination equal to the derived SSACs and that modelled outdoor air on the site equals the indoor air in off-site receptors, the majority of substances are not considered to pose a significant risk to human heath via the indoor vapour inhalation pathway.

For substances exceeding the derived HI of 1.0 for the (more sensitive) residential scenario, concentrations measured on site in either soil or groundwater were at greatly reduced amounts than assumed in the above simulation, as summarised:

- TPH C5-7 Aromatic was not reported in soils above detection limit;

- TPH C7-8 Aromatic recorded a maximum of 0.039mg/kg in soils;
- Benzo(a)pyrene in groundwater recorded a maximum concentration of 0.68mg/l. Utilising this concentration provided an outdoor air concentration an order of magnitude smaller than for the worst case scenario;
- TPH C7-8 aromatic in groundwater was not reported above detection limits; and
- TPH C8-8 aliphatic in groundwater was not reported above detection limits.

Overall, the SSACs derived for off-site residential and commercial scenarios are considered appropriate even though risks from inhalation of vapours indoors are excluded.

C.5.4.2.2 Ground Conditions

Uncertainty in the ground conditions is usually managed by the appropriate assessment of site-specific data. Generally, the most sensitive parameters are the soil organic carbon content, the depth and thickness of contaminated soil, and soil air permeability. In this case, some site-specific data have been used where available (e.g. FOC and strata depths) resorting to published US soil type parameter values where necessary.

The made ground unsaturated zone is characterised as various “gravels” including limestone hardcore, crushed brick and slag. Other made ground included reworked natural clays, beneath these strata are alluvial deposits which include “stiff clay”, “boulder clay” and “sandy clay”. Overall these strata have been conceptualised as having physical properties akin to ”sand” and “sandy clay” respectively and are not considered to be an overly conservative assumption.

C.5.4.2.3 Building Parameters

Several parameters that are associated with the indoor vapour algorithm, and often characterised with “default values” due to the scarcity of research into indoor vapour flux originating from sub-surface ground contaminated with petroleum hydrocarbons, are important. These parameters include the building air exchange rate, the building volume / area ratio and the width of the perimeter gap – generic parameters that are designed to be conservative regardless of actual building design. In the case of this assessment for justification of excluding the indoor air pathways (Section C.5.4.2.1), the building type is based on the details in CLEA BN3 for a two storey house or warehouse. The choice of building generic parameters are a UK Government policy decision, and whilst not necessarily representative of neighbouring residences or future commercial developments, are designed to be appropriately protective of human health.

Toxicity Assessment

TOXICITY ASSESSMENT

The selection of appropriate human health criteria for use in this risk assessment has been carried out in accordance with the guidelines set out in R&D Publication CLR9 published by Defra and the Environment Agency[15]. The principles of this guidance are described in this Appendix and are followed by a summary of the selection and derivation of the health criteria values (HCV) for each of the key contaminants.

PRINCIPLES

R&D Publication CLR9 describes a framework for the collation of toxicological data to support to support the assessment of risks to health posed by long-term or chronic exposure to contaminants in soil. The framework is supported by the UK Department of Health and the Food Standards Agency and is consistent with the advice from the Government's Expert Committees on Toxicology (COT) and Carcinogenicity (COC).

In common with other countries, the UK distinguishes between chemicals whose effect on health requires an intake threshold to be exceeded and those for which there is no known threshold (that is, there is a theoretical risk to health at any level of exposure. For threshold contaminants, the UK applies a Tolerable Daily Intake (TDI), taking into account background exposure to other sources - such as food, air, and water – to derive a Tolerable Daily Soil Intake (TDSI[16]). For non-threshold contaminants, the UK uses an Index Dose, which applies solely to soil sources (therefore exposure to non-soil background is not included). An Index Dose is not a cancer slope factor nor is it explicitly related to a quantified level of risk. It is derived from a national or international exposure standard (which may itself be based on a quantified risk) and for most purposes it is applied in the same way as a TDSI in a health risk assessment with the exception that ALARP applies to the management of such exposures.

Collectively, TDSI, Index Doses and other relevant toxicological benchmarks are termed heath criteria values (HCVs). HCVs are typically derived from a study of the health affects arising from a single route of entry into the body (commonly via ingestion or inhalation). Chemicals may exhibit different adverse health effects depending on the route of entry and this needs to be considered and accounted for during the risk assessment. In particular, the assessor needs to consider whether the adverse health effects are systemic (that is, after transportation through the blood stream to the target organ) or localised. Where a contaminant is considered to behave systemically in the human body, the different pathways of exposure can normally be treated additively (in the absence of toxicological advice to the contrary). There is very limited toxicological information relating to the health risks that may arise from exposure to a mixture of compounds. Where such mixtures are present, a common situation on contaminated sites, the adverse health effects of two or more chemicals may be considered additive where they impact on the same target organ via the same toxicological pathway and where there is clear scientific evidence to

[15] R&D Publication CLR9, Contaminants in Soil: Collation of Toxicological Data and Intake Values for Humans, Defra/EA, 2002.

[16] Effectively, exposure from other sources is subtracted from the TDI to derive the component allowable from soil sources. Where background exposures are high then the minimum value of the TDSI is always 20% of the TDI – this was applied to modelling of both nickel and barium.

support this view. Methods for accounting for additivity are discussed in CLR9 and require expert toxicological judgement.

SELECTION OF HEALTH CRITERIA VALUES

R&D Publication CLR9 sets out the framework for the review and selection of health criteria value for use in the Soil Guideline Value R&D Programme and more widely as part of a health risk assessment for matters of land contamination (see Figure). The document also describes the hierarchy for review of the recommendations on health effects made by other authoritative bodies.

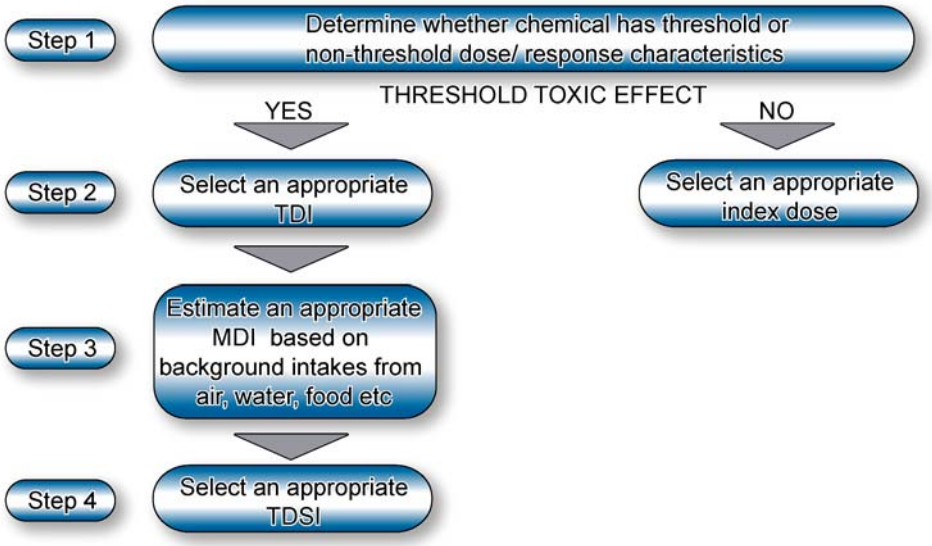


Figure C2 - Framework for the review and selection of health criteria values

The hierarchy of toxicological information recommended in CLR9 proposes a priority order of authoritative sources, with the highest preference for authoritative bodies in the UK, such as:

- Department of Health committees on Toxicology, Carcinogenicity & Mutagenicity;
- Expert Panel on Air Quality Standards (EPAQS);
- Health and Safety Commission's Advisory Committee on Toxic Substances;
- Working Group on Assessment of Toxic Substances; and
- Toxicological criteria documents produced by the HSE.

Of decreasing priority are then European Commission committees and international authoritative organisations such as the various bodies within WHO[17], then other national organisations such as USEPA, RIVM and ATSDR.

In the review of toxicological data, the use of this hierarchy does not therefore necessary result in the use of the most conservative toxicological value, but one that is intended to be most consistent with UK Government policy.

[17] World Health Organisation

Review and selection of health criteria values requires expert judgement. When evaluating the threshold and minimal risk levels recommended by different authoritative bodies, it is important to take into account the quality of the data and expert judgement used in deriving the recommendations made. Such judgements involve using a weight-of-evidence approach to draw overall conclusions in the context of TDSIs and Index Doses that are applicable to assessing soil contamination in the UK.

LIMITATIONS AND UNCERTAINTIES

Part IIA of the Environmental Protection Act 1990 is silent on the appropriate sources for toxicological data for use in health risk assessments. While R&D Publication CLR9 outlines a hierarchy for the review and selection of information provided by other authoritative bodies, it does not provide detailed information on the selection criteria nor does it replace the need for expert toxicological judgement.

Where able to do so, URS has used relevant toxicological advice published as part of the TOX series of reports by Defra and the Environment Agency for this risk assessment. In the absence of any TOX report, URS have reviewed guidance published by other authoritative bodies in line with R&D CLR9, but at this stage without expert toxicological judgement. These "indicative health criteria" should be considered to be provisional and although reasonable effort has been made to comply with the requirements of R&D Publication CLR9, no guarantee can be provided that these values will be consistent with future publications under the TOX series of reports.

The toxicological data sources reviewed for this study are listed in the table below

Toxicological Sources Reviewed

Organisation	*Key Documents*
Authoritative Bodies in the UK	
Incidental ingestion of surficial soil and fugitive dust outdoors	Joint Annual Reports and COT Statements
Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT)	Joint Annual Reports and COC Statements
Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC)	Joint Annual Reports, COM Statements and COM Papers
Committee on Mutagenicity of Chemicals in Food, Consumer Products and the Environment (COM)	Reports and Statements
Committee on the Medical Effects of Air Pollutants (COMEAP)	EPAQS Substance Specific Reports
Expert Panel on Air Quality Standards (EPAQS)	Minutes of Advisory Meetings
Health and Safety Commission's Advisory Committee on Toxic Substances (ACTS	Minutes of Advisory Meetings, Advisory Notes and Papers
Advisory Committee on Pesticides (ACP)	EH40/2002 Occupational Exposure Limits 2002 and 2003 Supplement
Health and Safety Executive	UK Drinking Water Standards

Organisation	*Key Documents*
Drinking Water Inspectorate	Joint Annual Reports and COT Statements
European Commission's committees	
Scientific Committee for Toxicity, Ecotoxicity and the Environment (CSTEE)	Opinions and Meeting Minutes
European Chemicals Bureau (ECB)	Substance risk assessment reports
Scientific Committee on Food (SCF)	Opinions, Meeting Minutes and Reports (to 1997)
EU Drinking Water Standards	Council Directive 98/83/EC and supporting UK legislation
EU Working Group on Ambient Air Pollution	
International Authoritative Organisations	
World Health Organisation - Drinking Water Standards	Guidelines for Drinking Water Quality (second and third editions)
World Health Organisation - Air Quality Guidelines for Europe	Air Quality Guidelines for Europe (2nd edition)
World Health Organisation - Environmental Health Criteria (EHC)	Environmental Health Criteria Monographs
World Health Organisation - International Programme on Chemical Safety (IPCS)	Concise International Chemical Assessment Documents
World Health Organisation - Joint FAO/WHO Expert Committee on Food Additives (JECFA)	FAO Nutrition Meetings Report Series / WHO Food Additives Series
World Health Organisation - International Agency for Research on Cancer	IARC Monographs on the Evaluation of the Carcinogenic Risk of Chemicals to Humans
Other National Organisations	
US EPA - Integrated Risk Information System (IRIS)	IRIS Guidance Documents (web-based)
National Institute for Public Health and the Environment (RIVM), The Netherlands	Re-evaluation of human-toxicological maximum permissible risk levels, Report 711701025, March 2001
US Agency for Toxic Substances and Disease Registry (ATSDR)	Toxicological Profile Reports

TOXICOLOGICAL REVIEWS

The table below summarises the chosen toxicological values for the contaminants evaluated in this assessment.

Toxicological Parameter Summary for Contaminants

Compound	*Oral HCV*	*Type*	*MDI*	*Source*	*Inhalation HCV*	*Type*	*MDI*	*Source*
	µg/kgBW/day		*µg/day*		*µg/kgBW/day*		*µg/day*	
Metals and Metalloids								
Arsenic	0.3	ID	-	Defra	0.003	ID	-	Defra
Nickel	5.0	TDI	160	Defra	0.006	TDI	2.8	Defra
Chromium (VI)	3	TDI	13	Defra	0.001	ID	0.06	Defra
Mercury (inorganic)	0.3	TDI	25	Defra	0.3	TDI	-	Defra
Polycyclic Aromatic Hydrocarbons (PAHs)								
Benzo(a)anthracene	0.2	ID	-	Defra/RIVM	-	-	-	-

Compound	Oral HCV	Type	MDI	Source	Inhalation HCV	Type	MDI	Source
	µg/kgBW/day		µg/day		µg/kgBW/day		µg/day	
Benzo(a)pyrene	0.02	ID	-	Defra	0.00007	ID	-	Defra
Benzo(b)fluoranthene	0.2	ID	-	Defra/EA	-	-	-	-
Benzo(g,h,i)perylene	30	TDI	0.063	TPHCWG/ FSA	-	-	-	-
Benzo(k)fluoranthene	0.2	ID	-	Defra/EA	-	-	-	-
Chrysene	2	ID	-	Defra/EA	-	-	-	-
Dibenzo[a,h]anthracene	0.02	ID	-	Defra/RIVM	-	-	-	-
Fluoranthene	2	ID	-	Defra	-	-	-	-
Indeno[1,2,3-cd]pyrene	0.2	ID	-	Defra/EA	-	-	-	-
Naphthalene	20	TDI	7	Defra	0.86	TDI	2.8	Defra
Semi -Volatile Organic Compounds (SVOC)								
Bis(2-ethylhexyl)phthalate	25	TDI	200	WHO	22	TDI	-	PRG3/9
Volatile Organic Compounds (VOC)								
Trichloroethene (TCE)	5.2	ID	-	Defra	5.2	ID	-	Defra
Total Petroleum Hydrocarbons								
TPH (>EC5-6) aliphatic	5000	TDI	-	TPHCWG	5260	TDI	-	TPHCWG
TPH (>EC6-8) aliphatic	5000	TDI	-	TPHCWG	5260	TDI	-	TPHCWG
TPH (>EC8-10) aliphatic	100	TDI	-	TPHCWG	286	TDI	-	TPHCWG
TPH (>EC10-12) aliphatic	100	TDI	-	TPHCWG	286	TDI	-	TPHCWG
TPH (>EC12-16) aliphatic	100	TDI	-	TPHCWG	286	TDI	-	TPHCWG
TPH (>EC16-21) aliphatic	2000	TDI	-	TPHCWG	-	TDI	-	TPHCWG
TPH (>EC5-7) aromatic	200	TDI	-	TPHCWG	114	TDI	-	TPHCWG
TPH (>EC7-8) aromatic	200	TDI	-	TPHCWG	114	TDI	-	TPHCWG
TPH (>EC8-10) aromatic	40	TDI	-	TPHCWG	57	TDI	-	TPHCWG
TPH (>EC10-12) aromatic	40	TDI	-	TPHCWG	57	TDI	-	TPHCWG
TPH (>EC12-16) aromatic	40	TDI	-	TPHCWG	57	TDI	-	TPHCWG
TPH (>EC16-21) aromatic	30	TDI	-	TPHCWG	-	TDI	-	TPHCWG
TPH (>EC21-35) aromatic	30	TDI	-	TPHCWG	-	TDI	-	TPHCWG

"-" indicates that no data were available from this source for this compound.

Appendix D - Controlled Waters Quantitative Risk Assessment

APPENDIX D – CONTROLLED WATERS RISK ASSESSMENT

D.1 INTRODUCTION

The controlled water risk assessment presented in this appendix incorporates two types of assessment:

- An assessment of the potential risks to controlled waters from soil and shallow groundwater contamination observed at the site using the standard approach preferred by the Environment Agency, as defined in the publication "*Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources*" (R&D Publication 20, 1999)". The risk are assessed from two primary transport pathways: from soil and shallow groundwater through the shallow aquifer system to discharge at the coast (seepage along the steep coastline) and the Sandwith Beck. This is discussed in detail in Section D3

- An assessment of the risks from residual contamination within the shallow and deep aquifers through the complex sub-surface transport pathways to discharge to the Byerstead fault and the Bell House Gill using the mass balance technique developed by URTS and presented in the report "*Further Monitoring Works and Risk Assessment Approach for the Environment Agency*", 21 January 2005, Draft Issue No 2, reference 44557-045-787 / R1771-B02. This is discussed in detail in Section D2.

The same shallow contaminant sources have been included in each assessment, where in reality, only a proportion of the contamination will flow within the shallow and deep horizons. However, given the uncertainty in the understanding of the transport pathways, the non-conservation of mass is considered acceptable and conservative.

D.2 DEEP AQUIFER TRANSPORT PATHWAY

No "off-the-shelf" software could easily be adapted for the Whitehaven deep aquifer situation, and, therefore, it was considered more likely that an alternative risk assessment technique, based on the same principles as advocated by the Environment Agency guidelines, would be required. The method described below was developed and tested against measured data in order to gain confidence that the risks could be assessed.

D.2.1 Pollutant Linkages and Assessment Methodology

The Environment Agency and various consultants have developed "standard" risk assessment tools such as CONSIM (Golders) and RAM (ESI) to calculate the contaminant concentrations at identified receptors/compliance points of individual pollutant linkages related to subsurface contaminant migration. Each of these methods generally follow the tiered approach defined in the Agency guidance document "Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources" (R&D Publication 20, 1999)". However, the pollutant linkages between the site and the Byerstead Fault discharge and the Bellhouse Gill are

considered hydrogeologically complex, with many interdependencies and, as such, the development of a unique risk assessment model is considered more appropriate.

The key pollutant linkages, in relation to the Byerstead Fault discharge and the Bellhouse Gill are shown in Table D.1. In summary, the primary pollutant linkage has been the spillage of chemicals on site or leaked from the drainage system, migrating within the complex subsurface environment, with this migration being influenced by:

- natural solution features in the subsurface geology (e.g. the Magnesium Limestone);
- enhanced solution features created by acid spills in all formations, particularly the made ground, Boulder Clay and St Bees Shales;
- the location of infilled and abandoned mine adits and roadways; and
- the apparently highly conductive Byerstead Fault.

The main receptor from deep groundwater migration is the coast at the Byerstead fault and the Bell House Gill. In addition, the groundwater of the major aquifers in the vicinity of the site is considered controlled waters receptors: St Bees Sandstone and St Bees Evaporites (Magnesium Limestone).

Table D.1 Principal Pollutant Linkages

Source	Pathway	Receptor
Leakages from Site Drainage Spillages/Accidental Releases Landfill Leachate Contaminated Soils & the infiltration of precipitation Contamination stored within Coal Mine and associated shafts and adits Contamination stored within Anhydrite and associated shafts and adits.	Infiltration through granular nature of the made ground and superficial deposits at ground surface Shallow groundwater flow (e.g. St Bees Shales, Whitehaven Sandstone). Rapid migration through enhanced solution features in the made ground, Boulder Clay and other deposits at ground surface (shallow deposits). Rapid **lateral** migration through enhanced and natural solution features in the Whitehaven Sandstone, St Bees Sandstone and St Bees Evaporites (Magnesium Limestone) and along the Byerstead Fault (Deep groundwater flow) Rapid **vertical** migration through shallow and deep geology, including through solution features, to the adits and shafts of the anhydrite and coal mines (deep mine storage) and subsequent release to the Byerstead Fault.	Springs of the Sandwith Beck Bell House Gill and other surface water receptors Coastal Discharge at Byerstead Fault Groundwater of the St Bees Sandstone and St Bees Evaporites (Magnesium Limestone) as Major Aquifers.

The pollutant linkages are further complicated by the presence of the anhydrite and coal mines. These may be acting as sinks to the contamination originating at ground surface, with a slow release of contamination along from storage to the Byerstead fault. Overall, the pollutant linkages are extremely complex and difficult to quantify using the standard approaches adopted in contaminated land projects, which are normally based on analytical equations of retardation dilution and attenuation within a homogeneous aquifer system. This is not a homogeneous system and, therefore, an alternative approach is required.

D.2.1.1 Mass Balance Approach

Rather than adopt analytical equations describing the migration of contaminants within the complex sub-surface as adopted in the shallow migration risk assessment models of Section 2, URS consider that the most appropriate method is to consider a simple mass balance approach. Each contaminant and water mass flux term is characterised and the overall mass/water balance used to establish the likely range of contaminant concentrations of water discharged via the Byerstead fault.

A mass balance approach has been adopted for a number of reasons, including:

- the contaminant migration velocities between the site and the fault are known to be extremely fast, as a result of tracer experiments conducted by URS and, therefore, the majority of contaminant migration from the site drainage system will be through "conduits" within the sub-surface, where the primary attenuation mechanisms will be dilution with other waters within the conduits;
- a key question that the Environment Agency and URS has with regards to mass balance is that the sum of the known sources does not add up to the observed water discharging via the Byerstead Fault to the beach. Accounting for these uncertainties will form an integral part of this risk assessment; and
- the development of a mass balance approach is relatively simple and easily understood. The adoption of more complex 3-dimensional modelling may be something that is considered in the future. However, complex modelling will require a more accurate understanding of the contaminant migration mechanisms and the parameters that influence the migrations, which are not available at present.

The mass balance approach is described by the following simple equation:

$$\sum_{i=1}^{n}(Q_i C_i) = \left(\sum_{i=1}^{n} Q_i\right) C_o$$

Where

Q_i = discharge rate of water from source "i"

C_i = concentration of contaminants from source "i"

C_o = concentration of water discharged at the fault

Each source has been characterised from an assessment of potential discharge rate using standard analytical techniques and a representation of the concentration from available data. Given the large uncertainty in many of the parameters, a "monte-carlo" approach has been adopted where each parameters is defined within plausible distributions and the model run over a 5000 iterations to simulate a distribution of output contaminant concentrations. The ranges adopted are described in Section the following sections

D.2.1.2 Limitations in the Assessment Methodology

Due to the complexity of the sub-surface environment, the mass balance approach to understanding risk introduces limitations. Apart from uncertainties in the basic parameters defining the water and mass balance components, no storage losses or attenuation through retardation and chemical and biological degradation are simulated. A component of the historical spillages and leachate infiltration of contaminants through the subsurface will be stored in the aquifers, mines and mine shafts and adits, and slowly released to the coast through seepage along the coast as well as the Byerstead fault, similar to the effect of baseflow on river flow. Similarly there will be some components of retardation and biological/chemical reactions within the pathway, although this may be limited to the to the component of contaminant mass stored within the subsurface, rather than the rapid movement from the site through the solution features, fractured geology and adits to the Byerstead fault.

D.2.2 Model Set Up

The discharge rate from each source is defined in Table D.2 below.

Table D.2 Source Characterisation

Source No.	Source	Assessment Method	Plausible Distribution
1	Infiltration recharge through non-contaminated areas	Rainfall rate multiplied by an infiltration factor, Q=ARI Area, A – approximated to 810,000 m^3, estimated from the St Bees Sandstone aquifer area that may contribute to the fault, although there is a large degree of uncertainty, particularly as the deeper groundwater catchment is unlikely to coincide with the surface catchment. Area B - approximately 100,000 m2 of Magnesium Limestone and Coal Measures linking site with Bellhouse Gill, although our understanding of the transport pathway from the site to Bellhouse Gill is highly uncertain Infiltration Rate – 7.5 – 22.5%, depending upon surface deposits. Low over Boulder, high over St Bees Sandstone, a typical rate adopted for drift covered sandstone. Mean annual rainfall, R – 1500mm/annum (Meteorological Office	Set as triangular distribution, Min I=7.5% Most likely I=15% Max I=22.5% Range above accounts for potential variations in contributing area and infiltration rate
2	Infiltration through site	Rainfall rate multiplied by an infiltration factor, Q=ARI Area, A = 335,000 Infiltration Rate, I = 7.5 – 22.5%. Maintained at the greenfield runoff rate, balancing potential additional losses at the drainage system with the reduced infiltration at buildings and roads Mean annual rainfall, R – 1500mm/annum (Meteorological Office) Likely to vary considerably with the impact of the drainage system and the large areas of concrete cover. The final infiltration rate will be dependent upon the state of the land cover once the site has been decommissioned.	Set as triangular distribution, Min I=7.5% Most likely I=15% Max I=22.5% Range above accounts for potential variations in contributing area and infiltration rate
3	Leachate from Hutbank Landfill	Rainfall rate multiplied by an infiltration factor, Q=ARI Area, A = 35,000 Infiltration Rate, I = 105%. Reduced because the Landfill materials will have a significantly lower transmissivity and	Set as triangular distribution, Min I=1% Most likely I=3% Max I=5% Range above accounts for

Table D.2 Source Characterisation			
Source No.	**Source**	**Assessment Method**	**Plausible Distribution**
		the landfill is capped with low conductivity clays. Mean annual rainfall, R – 1500mm/annum (Meteorological Office)	potential variations in infiltration rate
4	Anhydrite and coal mine discharges	Estimated at between 1 and 5 % of the discharge from Zones 1 and 2	Set as triangular distribution, Min =1% Most likely =3% Max=5%
5	Deep Groundwater (Whitehaven Sandstone)	Two sources: vertical through the Brockram above and inflow from up-gradient (beneath the site, not including a southern portion for the Site where the Whitehaven Sandstone) is not present. Leakage from above calculated using Darcy's equation, with the groundwater head difference calculated from the existing observation boreholes and an estimate of the hydraulic conductivity. Groundwater flow.	Vertical conductivity, set to a low value as the Brockram is a conglomerate with little pore space Min =0.00001m/d Most likely =0.0001m/d Max=0.001m/d Horizontal conductivity of the Whitehaven Sandstone, estimated from comparable carboniferous aquifers as defined in the Aquifer Properties database (Allan et al, 1999) Min =0.0086m/d Most likely =0.086m/d Max=0.86m/d
Note the contributing areas are schematically presented in Figure D.1			

For the contaminants, all available data were interpolated in order to define appropriate distributions. The chemical concentrations for each source above was defined from the analytical results obtained from URS sampling in 2002 to 2004, as defined in Table D.3.

Table D.3: Data Source			
Analyte Studied	**Source Area 2-Site**	**Source Area 3- Hutbank Landfill**	**Source Area 4- Anhydrite Mine**
pH	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	Jul-Aug 2000 (Historic Site Data), August 2003 (URS-033), Dec 2002 (URS-032), Bill Telfer (2003)
MBAS	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032)	August 2003 (URS-033), Dec 2002 (URS-032)
Chloride	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	Jul-Aug 2000 (Historic Site Data)
Sulphate	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	August 2003 (URS-033), Bill Telfer (2003)
Sodium	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	Jul-Aug 2000 (Historic Site Data), Bill Telfer (2003)
Potassium	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	Jul-Aug 2000 (Historic Site Data), Bill Telfer (2003)
Calcium	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	Jul-Aug 2000 (Historic Site Data), Bill Telfer (2003)
Magnesium	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	Jul-Aug 2000 (Historic Site Data), Bill Telfer (2003)
Copper	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	August 2003 (URS-033), Dec 2002 (URS-032), Bill Telfer (2003)
Iron	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032), 1986-2001 (Historic Site Data)	August 2003 (URS-033), Dec 2002 (URS-032), Bill Telfer (2003)
Phosphorus	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032)	August 2003 (URS-033), Dec 2002 (URS-032), Bill Telfer (2003)
TPH	Quarterly monitoring 2004-2005 (URS)	Dec 2002 (URS-032)	August 2003 (URS-033), Dec 2002 (URS-032)

For MBAS, the probability density functions were evaluated for the shallow and deep groundwater data. The resultant distribution is shown in Figure D2.

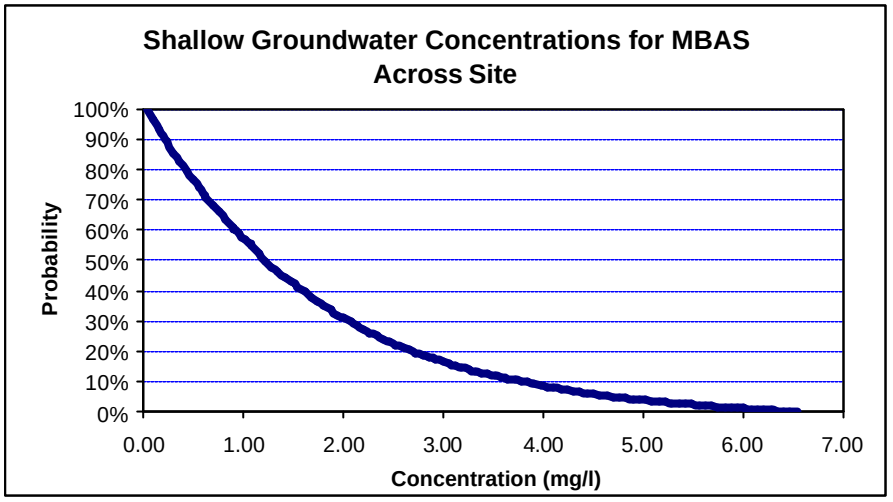


Figure D2: MBAS Concentration – Shallow Groundwater Across the Site

With these concentrations adopted, the model could not simulate the levels of MBAS observed to discharge from the Byerstead fault: 2.2 to 15.8 mg/l between Feb 20045 and April 2005, effectively more than the input concentration. It was, therefore concluded that the MBAS observed at the fault had to be related to on-going site processes and not just the residual shallow and deep groundwater contamination. Consequently an additional function was added to the model: a drainage function in which high concentration MBAS (0 to 200 mg/l) was added to contribute to the mass flux leaving the site via the effluent drainage system to the highly conductive Magnesium Limestone, faults and anthropogenic subsurface influences to the Byerstead fault. The resultant MBAS input to the model is shown in Figure D3.

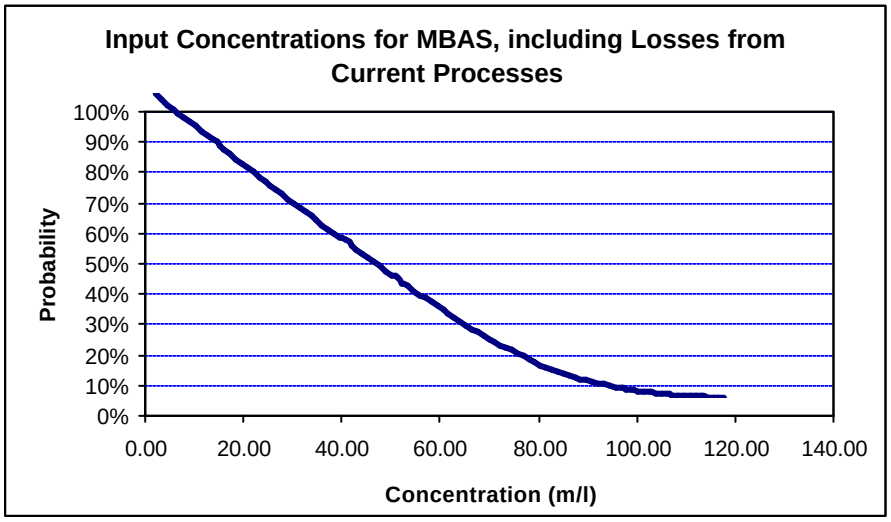


Figure D3: MBAS Input Concentration PDF – Including Current Process Losses

D.2.3 Results

D.2.3.1 Current Situation

The model was set up to calculate the groundwater flows and mass fluxes contributing to flow/flux along the Byerstead fault and to calculate the concentration at the fault, as well as calculating the groundwater input (flow and mass flux) from the site to the Bellhouse Gill. The model parameters (infiltration rates and hydraulic conductivities) were altered until a reasonable estimate of the contaminant concentration at the fault were simulated to be discharged at the Byerstead fault (i.e. in comparison with 2004/2005 sampling), along with a reasonable estimate of the flow rate at the fault. In the latter, however, actual measurements of the flow have not been possible and are estimated to be around 10l/s.

Simulated Discharge to Beach from Byerstead Fault.

The contribution from each source area is shown in the Figure D4. This indicates a total range of between 4.2 and 13.2 l/s, of the same order of magnitude of the estimated discharge of around 10 l/s, with the majority of the contribution coming from rainwater infiltration through the St Bees Sandstone to the south west of the fault and the site to the north west, and from deep groundwater flow within the coal measures and Whitehaven sandstone.

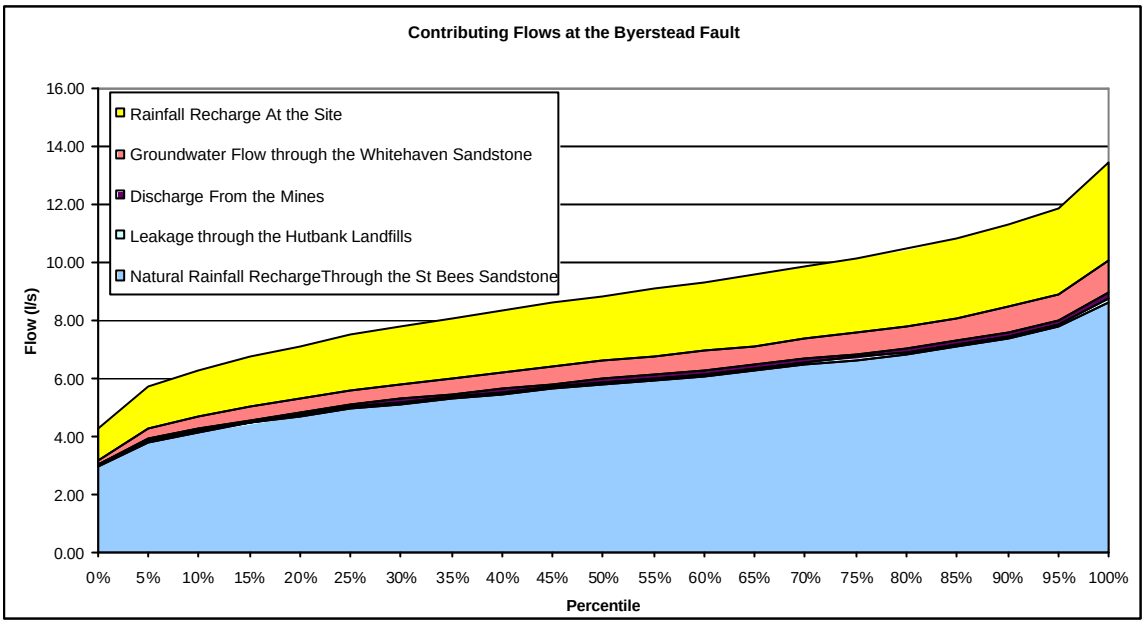


Figure D4: Simulated Flows at Byerstead Fault

Contaminant Concentrations

The range of concentrations simulated at the Byerstead fault is shown in Table D4. The results indicate that the simulations are of the correct order of magnitude. For chemicals such as calcium, sulphate and sodium, the measured concentrations are greater than the average simulated (i.e. 50 percentile), or the extreme simulated concentration (95 percentile). This is because the model does not include the rainwater chemistry or the natural background chemistry of the groundwater and thus the concentrations are underestimated. However, anthropogenic contaminant concentrations are more accurate. The simulated 50 percentile MBAS concentration is 11.6 mg/l, while the observed concentration in 2004/5 was between 2.2 and 15.8 mg/l, suggesting that the mass balance is calculating the correct order of magnitude from each source. The simulated MBAS concentration is shown in Figure D5.

Table E5 shows the simulated concentrations at the Bellhouse Gill. There is significantly more uncertainty in the transport mechanism between the site and the Bellhouse Gill although it is known not to be a continuous transport pathways as MBAS has only been detected in one of five occasions. Therefore, there is significantly less accuracy in the simulated concentrations. The simulated concentrations of iron, copper and MBAS are significantly greater than the observed concentrations in the stream. However the model does not include surface water dilution, which will greatly reduce concentrations in the river.

Table D4 Simulated Concentrations at the Byerstead Fault (mg/l)											
Simulated Percentile	Chloride	Sulphate	Sodium	Potassium	Calcium	Magnesium	Iron	Copper	MBAS	Total Phosphorus	TPH
5%	10.9	55.5	17.5	2.2	18.8	1.852	0.024	0.007	1.37	0.07	0.008
10%	12.8	70.0	20.7	2.7	24.1	2.277	0.035	0.013	2.51	0.10	0.009
15%	14.5	81.1	23.1	3.1	28.7	2.587	0.043	0.019	3.68	0.13	0.011
20%	16.1	92.0	25.4	3.4	33.2	2.913	0.054	0.027	4.72	0.17	0.012
25%	17.6	102.8	27.8	3.7	37.6	3.182	0.066	0.036	5.83	0.20	0.013
30%	19.0	113.6	29.8	4.0	42.4	3.457	0.080	0.047	6.96	0.24	0.014
35%	20.5	123.7	31.9	4.3	46.7	3.724	0.097	0.060	8.10	0.27	0.015
40%	22.0	136.5	34.0	4.5	51.6	3.987	0.114	0.076	9.16	0.31	0.016
45%	23.6	150.3	36.0	4.8	57.9	4.289	0.136	0.093	10.45	0.36	0.017
50%	25.3	162.7	38.0	5.1	64.2	4.609	0.165	0.114	11.58	0.41	0.017
55%	27.0	178.6	40.3	5.4	70.3	5.007	0.201	0.143	12.93	0.46	0.018
60%	29.3	194.9	42.6	5.8	77.9	5.398	0.237	0.180	14.19	0.52	0.019
65%	31.5	214.0	45.3	6.1	85.9	5.817	0.288	0.227	15.45	0.60	0.020
70%	34.1	232.8	48.4	6.5	94.8	6.320	0.347	0.288	16.82	0.69	0.021
75%	37.1	256.9	52.0	6.9	105.2	6.974	0.423	0.370	18.12	0.78	0.023
80%	40.8	286.2	56.0	7.5	118.7	7.655	0.546	0.497	19.85	0.91	0.024
85%	45.8	327.5	61.5	8.1	135.0	8.527	0.727	0.712	21.77	1.07	0.026
90%	52.9	392.8	68.9	9.0	160.4	9.933	1.088	1.094	24.23	1.29	0.028
95%	69.7	491.7	81.7	10.4	204.8	12.130	1.960	2.137	28.35	1.64	0.032
DWS	***250***	***250***	***200***	***12***	***250***	***50***	***0.2***	***2.0***	***0.2***	***5***	***0.01***
EQS (Freshwater)	***N/A***	***N/A***	***170***	***N/A***	***500***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
EQS (coastal)	***N/A***	***N/A***	***N/A***	***N/A***	**250**	***N/A***	**1**	**0.005**	***N/A***	***N/A***	***N/A***
Observed											
15 Feb 04	322	1234	318.8	14.6	322.7	76.94	0.11	0.003	8	0	0.031
20 May 04	351	982	225	12.3	381	87.92	1.295	0.005	5.6	9.843	-
6 August 04	605	1053	555	22.5	373.1	108.1	0.18	0.001	2.2	45.6	-
10 Nov 04	323	855	255	12.5	319.4	73.28	0.794	-	6.7	11.5	0.701
04-Apr-05	279.0	983.0	217.5	9.5	323.1	74.300	1.404	0.000	15.80	9.60	0.000

Table D5 Simulated Concentrations at the Bellhouse Gill (mg/l)											
Simulated Percentile	Chloride	Sulphate	Sodium	Potassium	Calcium	Magnesium	Iron	Copper	MBAS	Total Phosphorus	TPH
5%	4.9	10.6	3.4	1.2	4.0	0.171	0.009	0.010	12.3	0.0	0.000
10%	6.3	22.1	4.9	1.7	8.7	0.346	0.016	0.019	24.9	0.1	0.000
15%	7.4	33.9	6.4	2.2	13.5	0.557	0.025	0.029	35.9	0.1	0.000
20%	8.4	45.8	7.7	2.6	19.3	0.783	0.036	0.041	48.6	0.2	0.000
25%	9.4	58.5	9.2	2.9	25.7	1.053	0.048	0.055	60.6	0.2	0.000
30%	10.5	71.8	10.7	3.3	33.1	1.383	0.062	0.073	72.1	0.3	0.000
35%	11.5	89.2	12.2	3.8	39.4	1.674	0.083	0.094	84.5	0.3	0.000
40%	12.6	107.3	13.9	4.2	46.9	2.016	0.106	0.117	96.8	0.4	0.000
45%	13.7	126.5	15.8	4.6	55.7	2.423	0.135	0.147	110.7	0.5	0.000
50%	15.1	148.9	17.9	5.1	64.5	2.857	0.172	0.183	124.6	0.6	0.000
55%	16.8	173.7	20.4	5.6	74.7	3.331	0.222	0.235	139.0	0.7	0.000
60%	18.3	204.2	22.8	6.1	87.9	3.886	0.279	0.292	152.7	0.8	0.000
65%	20.5	238.9	25.9	6.8	102.6	4.539	0.354	0.374	168.3	0.9	0.000
70%	23.2	279.5	29.8	7.5	118.4	5.289	0.455	0.488	184.1	1.1	0.000
75%	26.9	329.3	34.2	8.3	139.2	6.237	0.592	0.628	201.4	1.3	0.000
80%	31.8	390.9	40.6	9.3	168.3	7.555	0.769	0.853	221.0	1.5	0.000
85%	38.8	483.5	49.1	10.5	207.2	9.044	1.111	1.230	246.8	1.8	0.000
90%	51.6	600.1	61.1	12.3	257.8	12.001	1.788	1.916	283.9	2.3	0.000
95%	84.7	846.6	83.0	15.7	356.2	16.536	3.322	4.095	337.9	3.1	0.000
DWS	***250***	***250***	***200***	***12***	***250***	***50***	***0.2***	***2.0***	***0.2***	***5***	***0.01***
EQS (Freshwater)	***N/A***	***N/A***	***170***	***N/A***	***500***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***	***N/A***
EQS (coastal)	***N/A***	***N/A***	***N/A***	***N/A***	**250**	***N/A***	**1**	**0.005**	***N/A***	***N/A***	***N/A***
Observed											
11-Feb-04	32.0	64.0	22.5	3.2	69.8	12.310	0.059	0.002	nd	nd	nd
12-May-04	57.0	24.0	26.3	8.4	48.4	5.150	0.141	0.003	nd	0.2	nd
04-Aug-04	32.0	27.0	48.0	9.9	47.3	4.413	0.146	0.004	nd	1.6	nd
12-May-04	53.0	23.0	33.8	12.0	54.5	7.236	1.487	0.002	nd	nd	nd
01-Apr-05	77.0	45.0	55.5	10.4	41.9	5.155	0.218	0.004	3.3	2.3	nd

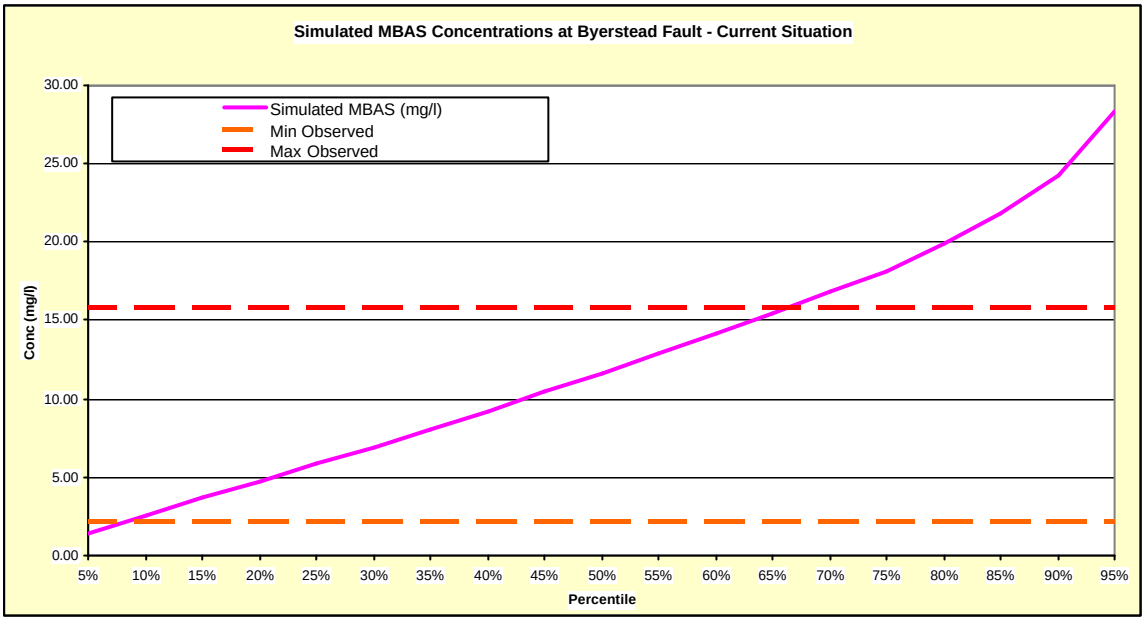


Figure D5 Simulated MBAS Concentrations at the Byerstead Fault

Comparison with Drinking Water Standards and Environmental Quality Standards

Tables D4 and D5 also define appropriate water target values for the discharge of chemicals at the coast and inland waters: UK drinking water standards (DWS) and coastal and freshwater environmental quality standards (EQS). It is worth noting, however, that not many EQS are currently available. Based on the comparison of simulated concentrations with the relevant standards, there are five key contaminants of concern:

- Sulphate, though this is related to the anhydrite mine and not related to the site;
- Iron, though this is primarily related to the magnesium limestone and not the site;
- Copper
- MBAS/surfactants
- TPH (including PAHs)

D.2.3.2 Sensitivity Analysis

In the above assessment, there is a large degree of uncertainty on the different water balance and mass flux components. Key uncertainties in the assessment are the rainfall infiltration rate adopted, the proportion of water discharged through the Byerstead fault derived from deep sources compared with shallow sources and the impact of current above ground process losses at the coast and

Bell House Gill. As a result a number of basic sensitivity model runs were carried out. These are described in Table D6.

Table D6: Sensitivity Analysis

Runs	Aim	Influence on Simulated Water Balance	Influence of Simulated Concentrations at the Fault	Influence of Simulated Concentrations at the Bell House Gill	Conclusions
SA1	Assess impact of rainfall infiltration at the site, raising and lowering infiltration range from 7.5-22.5% to 15-30%	Increase in discharge of 12% - remaining plausible	Increased mean concentrations by 40-50%, e.g. MBAS mean concentration raised from 11.6 to 16.2 mg/l.	Increased by 25%	The level of infiltration of 7.5% to 22.5% defined across the site is considered more plausible, given the large area of site covered by concrete/tarmac
SA2 & SA3	Increase & decrease minewater discharge from 1 % 5% of rainfall infiltration flux to 10-20% and 0 respectively	Limited impact = +/- 5%	Limited impact +/- 3%	Limited impact +/- 3%	Unlikely that the minewater discharge is as significant a contributor to the Byerstead fault in terms of flow and mass flux than flux from the site. However, there could be considerable mass in storage which is currently camouflaged by the near surface process losses
SA4 & SA5	Increase and decrease Whitehaven Sandstone flow by increasing and decreasing the effective hydraulic conductivity by an order of magnitude	Flows vary by +/- 20% - remaining plausible	Increased flow result in greater dilution for contaminants arising from the site, with concentrations reducing by as a much as 25%	No impact, as Whitehaven Sandstone not linked with the Bell House Gill.	Greater flow from the Whitehaven Sandstone only possible if there is a much greater mass of contamination stored in the Whitehaven Sandstone, which the available data does not suggest exists
SA6 & SA7	Variations to the PDFs adopted the shallow contamination and Ste Bees Sandstone/ Magnesium Limestone contamination	No change in flows	Variations of up to 15%	Variations of up to 15%	Model is sensitive to the PDFS (a combination of normal distributions and lognormal distributions). However, the results remain within acceptable ranges

D.2.3.3 Simulated Concentrations Without Surface Processes

In order to assess the residual contamination of groundwater at the site, the model has been re-run without the additional MBAS input from the surface processes. In effect, this is a more realistic assessment of the risks of surfactants at the Byerstead fault and the Bell House Gill. The simulated concentrations of MBAS both with and without surface processes at the Byerstead fault and the Bell House Gill is shown in Figures D6 and D7 respectively.

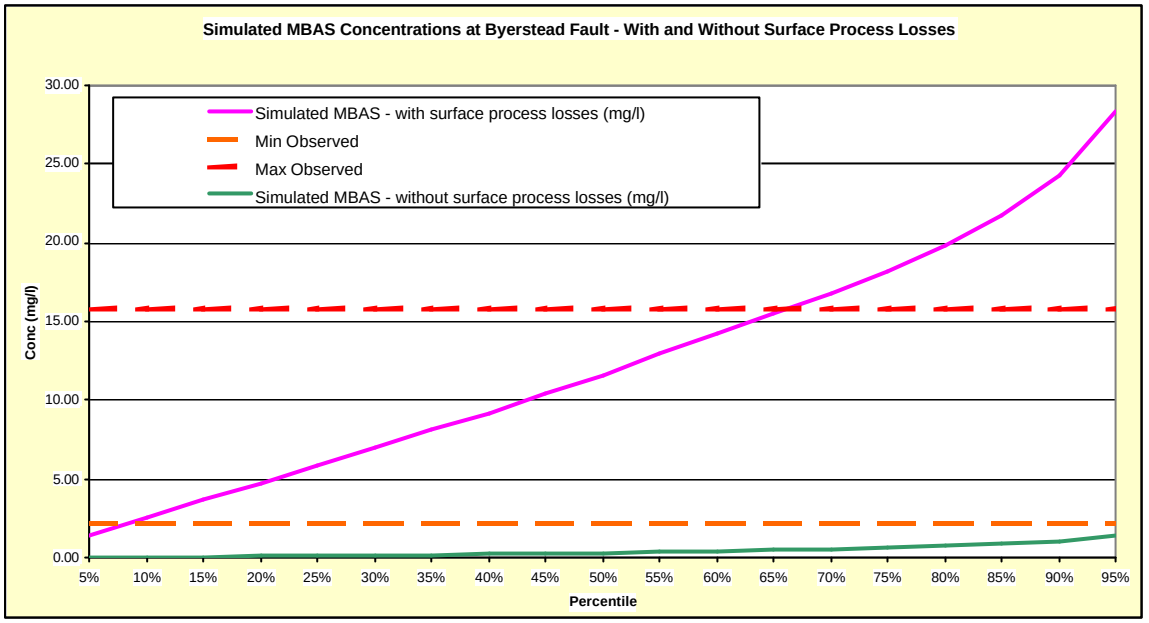


Figure D6 – Simulated MBAS Concentrations at the Byerstead Fault – With & Without Surface Process Losses

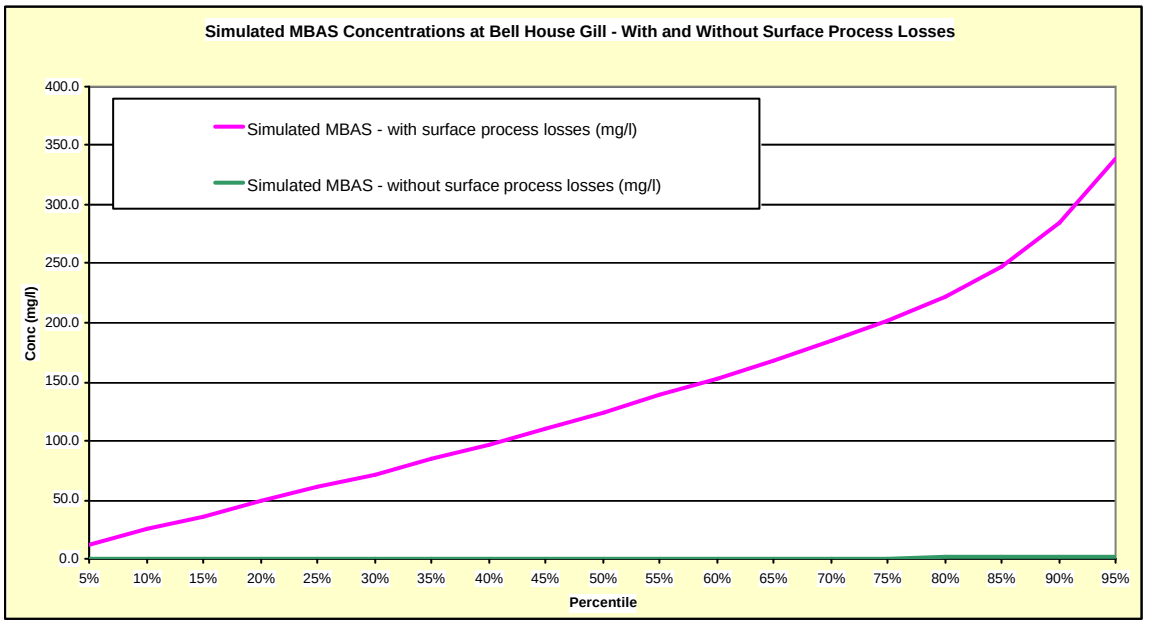


Figure D6 – Simulated MBAS Concentrations at the Bell House Gill Fault – With & Without Surface Process Losses

With the removal of the surface processes, the impacts of the surfactants at the two main receptors is likely to reduce substantially – from 28.4mg/l 1.5 mg/l to and 337.9 mg/l to 2.5 mg/l at the Byerstead fault and Bell House Gill respectively. With continued infiltration of rainfall recharge through the site soils and shallow groundwater the residual surfactants will be quickly washed out of the subsurface.

D.2.3.4 Conclusions

Based on the deep groundwater transport model developed for this study, the following key conclusions can be made:

- The concentrations of contaminants, primarily surfactants, discharging at the Byerstead fault is sourced from surface process and residual shallow groundwater contamination directly beneath the site. In particular the key contributor to the Fault is the continuing surface process which leak through voids and other rapid pathways to the Byerstead fault.

- The observation low levels of MBAS observed in the Bell House Gill in April 2005 indicates that a pollutant linkage between the site and this surface water body exits. However, the mechanism of migration is uncertain, although the mass balance model has been set up to indicate the likely level of groundwater concentrations entering the surface water from the site.

- The Magnesium Limestone and St Bees Sandstone formations are rapid pathways, with little residual contamination held in storage that will be a long-term risk to receptors.

- It is unlikely that the minewater discharge is as significant a contributor to the Byerstead fault in terms of flow and mass flux than flux from the site. However, there could be considerable mass in storage which is currently camouflaged by the near surface process losses, which is not known at this stage.

- The model and sensitivity analysis indicates that with the cessation of surface processes over the next 12 to 18 months, there will be a considerable reduction on surfactant concentrations at the Fault and the Bell House Gill. Monitoring will need to be continued, however, to both prove this and establish more accurately the contributions from storage within the coal measures that may exist.

D.3 SHALLOW SOIL AND GROUNDWATER RISK ASSESSMENT

This section presents the methodology and findings of a quantitative risk assessment for potential impacts to the quality of surface water bodies from soil and shallow groundwater beneath the site. The Conceptual Site Model (CSM) presented in Section 4 indicated that two of the key pollutant linkages for the Whitehaven site are from the horizontal migration of dissolved phase contaminants detected both in on-site soil and shallow groundwater towards the Sandwith Beck to the south of the site and coastal waters of the Irish Sea to the north of the site.

The remainder of this Tier 2/3 controlled waters risk assessment will focus on whether potentially significant risks exist to these receptors from existing soil and shallow groundwater contamination beneath the Whitehaven site.

Since there are two identified receptors at the site, each with their own catchment area, for the Tier 2/3 assessment the site has been split into two hydrogeological zones based on the inferred shallow groundwater flow directions presented on Figure 10. It has been inferred that contamination within the northern third of the site will migrate towards the coast (this model is called the 'coastal model') whilst contamination within the southern two thirds of the site will migrate towards Sandwith Beck (this model is called the 'Beck model').

D.3.1 Site Specific Methodology and Approach

The approach for the assessment of risk to controlled water receptors is based on the UK Environment Agency's "Integrated Methodology".[1] Throughout the assessment, URS has applied what we believe is best professional practice for the assessment of risk. Applicable guidelines have been followed throughout the site assessment process. Above all, necessarily conservative assumptions have been applied throughout the QRA in order to make the findings of this work as defensible as possible.

This risk assessment has included the potential risks from measured on-site soil concentrations and current shallow groundwater concentrations from the Made Ground and alluvial Drift.

Soils

For on-site soils the following steps have been followed in order to assess the potential risks to each receptor:

- In soil, leaching of compounds which had adsorbed onto soil particles into the soil pore water (Tier 1).
- Mixing of the pore waters into the underlying groundwater (Tier 2).
- Horizontal migration of dissolved phase contamination to either the Sandwith Beck (Beck model) or coastal waters (Coastal model) through the Made Ground and drift deposits with attenuation and degradation along the flow path (dilution in the receiving watercourse has not been applied) (Tier 3).

Step 1 outlined above is analogous to the derivation of the Tier 1 guideline values for soil (refer to Appendix B). However, where leachate data have been

[1] *Methodology for the Derivation of Remedial Targets for Soil and Groundwater to Protect Water Resources.* Environment Agency R&D Publication 20 (1999). Research Contractor Aspinwall & Company.

collected (in the case of heavy metals), these data can be substituted for the soils data and Steps 2 and 3 undertaken only.

Groundwater

The assessment of potential risks to the two receptors from groundwater considers the horizontal migration of dissolved phase contamination through the Made Ground and drift deposits with attenuation and degradation along the flow path. Similar to soil, dilution in the receiving watercourse has not been applied. This is analogous to Step 3 (Tier 3) above.

The modelling described above has been undertaken with URS's deterministic continuous source spreadsheet model, which uses the same equations as the UK Environment Agency's P20 methodology. In accordance with this methodology, the simulation of contaminant migration from beneath the source area to the receptor is achieved using the Domenico analytical solution.

D.3.1.1 Water Target Values (WTVs)

The modelled concentrations of each determinand at the receptor are compared against water target values (WTVs) appropriate to the receptor to assess whether potentially significant risks are likely. They are also used to back-calculate an appropriate on-site soil or groundwater concentration that would give rise to a concentration in the receptor equal to the WTV. This is termed a risk based screening level or RBSL, which is used to guide the remedial requirements.

The same Water Target Values (WTVs) have been used as for the Tier 1 assessment for controlled waters as follows:

- Freshwater Environmental Quality Standards (EQS) for the Beck model;
- Marine and Estuarine EQS for the Coastal model.

Where EQS are not available, the following have been used (in order or priority):

- UK Drinking Water Standards (UK DWS);
- European/World Health Organisation (WHO) Drinking Water Standards;
- USEPA Region 9 or Region 3 guidelines for industrial use; and
- a water target value calculated using WHO guidelines.

In the case of TPH there is no EQS value or current UK DWS. Consequently, the former UK DWS of 10 µg/l for mineral oil has been adopted as the WTV for the Whitehaven QRA.

D.3.1.2 Tier 2 Parameters

A number of parameters are required for the Tier 2/3 risk assessment. These comprise source area parameters, input concentrations, geological parameters for the unsaturated and saturated zones, hydrogeological parameters as well as physico-chemical parameters specific to each compound included in the Tier 2/3 assessment. These are described in more detail below.

Input Concentrations

As an initial conservative assessment at the Tier 2/3 level the maximum concentration of each determinand which exceeded the Tier 1 screening criteria is used as the input concentration. This has been undertaken as a separate exercise for each of the two catchment areas for the two different models, hence different maximum concentrations have been used in each model.

Source Areas for Risk Assessment

The risk assessment requires source width (perpendicular to groundwater flow) and source length (parallel to groundwater flow) to be input for all determinands included in the models. Source areas have been defined for each determinand and for each model by calculating the area in which concentrations exceeded specific Tier 1 screening criteria. Consequently, the distributions of some contaminant source zones are site-wide, whereas others are limited to single or several isolated hotspots, sometimes dispersed around the site.

Saturated & Unsaturated Zone Parameters

The unsaturated zone parameters used in the initial partitioning of soil to pore water leachate are consistent with that of the Tier 1 assessment, and were presented within the table included in Appendix B. The subsequent dilution of the pore water into the underlying shallow groundwater (Tier 2) and the contaminant migration towards the receptor (Tier 3) require the input of a number of other parameters. These include hydraulic conductivity, hydraulic gradient, saturated fraction of organic carbon, infiltration rate, saturated depth of aquifer, dry bulk density, porosity and values of dispersivity. Where possible, these parameters have been derived from data measured on site (e.g. hydraulic gradient calculated from the groundwater contour map produced). For others, literature values have been used. Parameters relating to the saturated zone are presented in the following table. These are identical for each model.

Table 3.1 Saturated Zone Parameters

Saturated Zone Parameter	Value	Rationale
Hydraulic Conductivity (m/d)	1.0	Taken as a likely value for the variable nature of the gravelly Made Ground and clay found on site.
Hydraulic Gradient	0.0424	Calculated from site water levels
Fraction of Organic Carbon (Foc, %)	0.46%	Site specific data

Table 3.1 Saturated Zone Parameters		
Saturated Zone Parameter	**Value**	**Rationale**
Infiltration rate (m/yr)	0.16	Assumed based on 20% of total annual rainfall of 1070mm (FEH,1999) for partial concrete and grass cover
Saturated depth of aquifer	2m	Approximate thickness of saturated shallow aquifer (Made Ground/drift) likely to be in contact with Sandwith Beck or the Coast
Dry Bulk Density (g/cm^3)	1.92	Literature value (Gravelly Made Ground)
Effective Porosity (%)	27.5	Literature value (Gravelly Made Ground)
Longitudinal dispersivity	Determinand specific*	$1/10^{th}$ receptor distance
Transverse dispersivity	Determinand specific*	$1/10^{th}$ longitudinal dispersivity
Vertical dispersivity	Determinand specific*	$1/100^{th}$ longitudinal dispersivity

*Dispersivity values have been calculated from the distance between the source and receptor for each determinand.

Receptor Distance

Receptor distance is a key input parameter and in the case of the Whitehaven site is based upon the distance from the downgradient edge of the source area for a particular determinand to the receptor. In the case of the Beck Model, the receptor distance has been defined as the distance between the downgradient edge of the source area and the site boundary added to a 20m distance between the site boundary and the upstream point of the Beck. For the Coastal model, the distance between the downgradient edge of the source and the site boundary has been added to the 400m distance between the site boundary and the coast has been taken as the receptor distance.

Degradation along the Flow Path

It is considered that biodgradation along the saturated flow path will occur for organic compounds detected beneath the site. Degradation has therefore been applied to each model using relatively conservative degradation rates in the absence of site specific data. Degradation of inorganic compounds does not readily occur, and therefore was not applied to these determinands.

D.3.2 RESULTS

The results tables for the Tier 2/3 assessment are presented in Tables D.3.2 to. D.3.7 which are presented at the end of this appendix.

The tables indicate that for both the Coastal model and the Sandwith Beck Model, metals make up the majority of Tier 2 and 3 exceedences in soil. In addition to metals, the VOC's Chloromethane and Naphthalene, the SVOC Carbazole and MBAS exceed, whilst in the Sandwith Beck model an additional SVOC, Azobenzene, also exceeds.

In leachate, Chromium, Copper and Zinc exceed Tier 2 and 3 criteria in both the Coastal and Sandwith Beck models, whilst the Sandwith Beck model also shows exceedences in Lead and Selenium. In groundwater, both models show Tier 3 exceedences in metals and MBAS only.

D.3.3 SENSITIVITY ANALYSIS

A sensitivity analysis has been performed on the two models. This was primarily undertaken without degradation along the flow path simulated, although additional runs were carried out for selected parameters with degradation applied.

Sensitivity analysis was carried out in order to test how sensitive the model is to the site specific and estimated parameters used. For example parameters such as hydraulic conductivity and the saturated depth of aquifer were estimated from borehole logs from the recent site investigation, whilst the fraction of organic carbon (FOC) of the saturated zone has been estimated from an average of three samples taken from within this zone. Slight changes to these parameters can impact on the Risk Based Screening Levels (RBSLs) of compounds found on site and as such may effect the final conclusions of the QRA.

Sensitivity Analysis was performed on three compounds (Chromium, Naphthalene and Carbazole) taken forward to the Tier 2/3 assessment. The tables below present the results of the sensitivity analysis on each basic model (without degradation) and on the combined impact of two parameters (Hydraulic Conductivity (K) and FOC). This shows the effect on the soil RBSLs only. No significant differences in RBSLs were noted in groundwater following sensitivity analysis. However, it should be noted that changing the hydraulic conductivity and hydraulic gradient for both the soil and groundwater models will result in a quicker estimated travel time from source to receptor.

Table 3.8 Summary of Sensitivity Analysis Results on Soils

Basic Parameter	Change in Parameter	Effect on Risk Based Screening Levels (RBSLs)
K = 1m/day	Multiplied by a factor of 5	Increases the RBSL by a factor of between 2.87 and 3.1 for the Sandwith Beck model and between 2.14 and 3.64 for the Coast model.
K = 1m/day	Multiplied by a factor of	Increases the RBSL by a factor of between 5.21 and 5.73 for the Beck model and

Table 3.8 Summary of Sensitivity Analysis Results on Soils		
Basic Parameter	**Change in Parameter**	**Effect on Risk Based Screening Levels (RBSLs)**
	10	between 3.56 and 6.93 for the Coast model.
Hydraulic Gradient = 0.0424m/m	Multiplied by a factor of 10	Increases the RBSL by a factor of between 5.21 and 5.73. This result is identical to multiplying K by a factor of 10 and is the expected response of the model.
$FOC_{SATURATED}$ = 0.46	Multiplied by a factor of 10	Changes to FOC resulted in no change to the RBSL of metals and only slight changes to the RBSL of other compounds.
Infiltration Rate = 0.16m/yr	Multiplied by a factor of 2	Reduces the RBSL of all compounds by approximately 25% for Sandwith Beck model and by between 15% and 33% for the Coast model.
Saturated Depth of Aquifer = 2m	Multiplied by a factor of 2	Increased the RBSL by a factor of 1.47 to 1.53 for the Sandwith Beck model and by between 1.29 and 1.66 for the Coast model.
Effective Porosity = 27.5%	Reduced to 20%	No impact on RBSLs for either model
$FOC_{UNSATURATED}$ = 3.8%	Multiplied by a factor of 2	RBSL of other compounds doubled – therefore a highly sensitive parameter.
*K = 1m/day, $FOC_{SATURATED}$ = 0.46%	K multiplied by a factor of 5, FOC Multiplied by a factor of 10	Increases the RBSL by a factor of between 2.87 and 3.1 for the Sandwith Beck model and between 2.14 and 3.64 for the Coast model. This is almost identical to the results of only varying K by a factor of 5. There was no impact on the metals and only a slight increase in the RBSL on other compounds.
*K = 1m/day, $FOC_{SATURATED}$ = 0.46%	K multiplied by a factor of 10, FOC Multiplied by a factor of 10	Increases the RBSL by a factor of between 5.21 and 5.73 for the Beck model and between 3.56 and 6.93 for the Coast model. This is almost identical to the results of only varying K by a factor of 10. There was no impact on the metals and only a slight increase in the RBSL on other compounds.
* Indicates where sensitivity was undertaken with degradation.		

To summarise the above, the effect of increasing the hydraulic conductivity (K) and the hydraulic gradient had equivalent impacts on RBSLs, resulting in a change of just over 50% relative to the change in parameter. The use of a relatively low K value of 1m/day is therefore conservative with respect to soils, as higher values result in a greater dilution factor at the Tier 2 stage and, hence, higher RBSLs.

Changing saturated FOC had little effect on RBSLs, whilst changing the unsaturated FOC resulted in a doubling of the RBSLs. This is particularly significant as the unsaturated FOC is averaged from many samples taken across the site, whilst saturated FOC is an average of only three sample locations.

Infiltration rate is shown to be only moderately sensitive, with a 25% reduction in RBSL as a result of a 200% increase in the parameter value, whilst saturated depth is also only moderately sensitive with a 50% increase in RBSL as a result of a 200% increase in the parameter. A change in the effective porosity has no discernable impact on the RBSLs at all and degradation does not appear to significantly impact the sensitivity of the model, probably because $FOC_{SATURATED}$ has such a small impact on RBSLs.

In conclusion, the Sandwith Beck model shows slightly more variability with respect to sensitivity. This is likely to be due to the greater variability of distance to the compliance point in this model, than the Coastal model.

TABLE D 3.2
POTENTIAL RISKS TO COASTAL RECEPTOR FROM OBSERVED SOIL CONTAMINATION

Determinand	Maximum Observed Soil Concentration (mg/kg)	Simulated groundwater concentration beneath contaminated soil (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l)	Tier 1	Tier 2	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Soil Preliminary RBSL (mg/kg)	Contaminant Transport Time to Receptor (years)
			With Degradation							
Aromatic >C12-C16	932	3440	0							1,151
Aromatic >C16-C21	1450	1690	0							3,625
Aromatic >C21-C35	318	46.8	0							28,745
Aliphatic >C12-C16	4960	18.3	0							1,144,097
Aliphatic >C16-C21	38900	1.14	0							144,032,451
Aliphatic >C21-C35	16800	0.041	0							1,732,615,153
Total TPH	63400	5200	0	×	×	✓	10	<1	IR	-
Sum of 4 PAHs	56.3	1.03	0	×	×	✓	0.1	<1	IR	-
Arsenic	58	149	143	×	×	×	50	2.86	20	9,932
Cadmium	5	369	352	×	×	×	2.5	141	0.04	339
Chromium	36.7	8.84	8	×	×	×	5	1.60	23	109,580
Copper	139	3260	3250	×	×	×	5	650	0.21	1,108
Lead	136	727	717	×	×	×	10	72	1.90	4,944
Mercury	30	950	327	×	×	×	0.3	1089	0.03	749
Nickel	65	66.4	15.4	×	×	×	15	1.03	63	7,786
Selenium	16	4120	3910	×	×	×	10	391	0.04	141
Phosphorous	8420	118000	65800	×	×	×	2200	30	281	1,428
Zinc	243	10400	9850	×	×	×	10	985	0.25	823
Magnesium	12400	1200000	1190000	×	×	×	50	23707	0.52	279
Iron	106000	1030000	1020000	×	×	×	1000	1020	104	2,717
Cyanide	2	89.6	84.9	×	×	×	50	1.70	1.18	498
Chloromethane	0.143	230	190	×	×	×	1.51	126	0.00	8
Chloroform	0.172	28.1	11.3	×	×	✓	12	<1	IR	27
Tetrachloroethene	0.154	5.15	4.41	×	✓	✓	10	<1	IR	78
Benzene	0.143	4.85	0.001	×	✓	✓	30	<1	IR	31
Toluene	3.66	216	0.011	×	×	✓	40	<1	IR	49
Xylenes	1.15	36.2	0.001	×	×	✓	30	<1	IR	57
Naphthalene	133	1440	1420	×	×	×	5	284	0.47	302
Chlorobenzene	0.092	2.79	2.27	✓	✓	✓	300	<1	IR	83
1,2,4-Trimethylbenzene	0.238	1.08	0.007	✓	✓	✓	150	<1	IR	165
1,3,5-Trimethylbenzene	0.685	3.11	0.384	✓	✓	✓	150	<1	IR	225
Phenol	0.379	79.6	14.4	×	×	✓	30	<1	IR	18
Acenaphthylene	6.31	35.2	0	✓	✓	✓	90	<1	IR	580
Benzo[a]anthracene	53.2	3.00	0	×	×	✓	0.41	<1	IR	50,799
Benzo[a]pyrene	31.5	0.195	0	×	×	✓	0.01	<1	IR	462,210
Benzo[b]fluoranthene*	42.3	0.866	0				see sum 4 PAHs			125,559
Benzo[k]fluoranthene*	14	0.162	0				see sum 4 PAHs			223,033
Dibenzo[a,h]anthracene	4.34	0.0263	0	×	×	✓	0.01	<1	IR	407,366
Phenanthrene	137	83.5	0	×	✓	✓	90	<1	IR	5,235
1-Methylnaphthalene	7.9	40.4	0.001	×	✓	✓	60	<1	IR	589
2-Methylnaphthalene	13.8	77.0	0.002	×	×	✓	60	<1	IR	580
Dibenzofuran	6.29	21.2	0.001	×	×	✓	12	<1	IR	467
MBAS	2930	24900000	14300000	×	×	×	200	71458	0.04	7

TABLE D 3.2
POTENTIAL RISKS TO COASTAL RECEPTOR FROM OBSERVED SOIL CONTAMINATION

Determinand	Maximum Observed Soil Concentration (mg/kg)	Simulated groundwater concentration beneath contaminated soil (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l)	Tier 1	Tier 2	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Soil Preliminary RBSL (mg/kg)	Contaminant Transport Time to Receptor (years)
			With Degradation							
Carbazole	1.82	130	126	×	×	×	**3.36**	37	0.05	47
Azobenzene	0.1	0.349	0.125	×	✓	✓	**0.611**	<1	IR	620

(1) compliance point at : Determinand Specific m

- • not applicable
- ✓ passes relevant screening criteria
- × fails relevant screening criteria
- IR Insignificant Risk

Notes
1. only detected chemicals for which screening criteria have been identified are modelled.
2. please see report text for basis of screening criteria

TABLE D 3.3
POTENTIAL RISKS TO COASTAL RECEPTOR FROM OBSERVED LEACHATE CONTAMINATION

Determinand	Maximum observed leachate concentration (µg/l)	Maximum estimated pore water leachate concentration (µg/l)	Simulated groundwater concentration beneath leached soil (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l)	Receptor Dilution Factor	Tier 2	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Soil Preliminary RBSL (based on Leachate results) (mg/kg)	Contaminant Transport Time to Receptor (years)
				With Degradation							
Chromium	15	15	7.98	7.22	1.00	×	×	5.00	1.44	25	109,580
Copper	60	60	31	31	1.00	×	×	5.00	6.23	22	1,108
Lead	6.00	6.00	3.19	3.15	1.00	✓	✓	10	<1	IR	4,944
Selenium	3.00	3.00	2.11	2.00	1.00	✓	✓	10	<1	IR	141
Zinc	110	110	77	73	1.00	×	×	10	7.34	33	823

(1) compliance point at :

- • not applicable
- ✓ passes relevant screening criteria
- × fails relevant screening criteria
- IR Insignificant Risk

Notes

1. only detected chemicals for which screening criteria have been identified are modelled.
2. please see report text for basis of screening criteria

TABLE D 3.4
POTENTIAL RISKS TO COASTAL RECEPTOR FROM OBSERVED GROUNDWATER CONTAMINATION

Determinand	Maximum recorded water concentration (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l) With Degradation	Receptor Dilution Factor	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Groundwater Preliminary RBSL (µg/l)	Contaminant Transport Time to Receptor (years)
Aromatic >C16-C21	26	0.00	1.00					3,625
Aromatic >C21-C35	27	0.00	1.00					28,745
Aliphatic >C12-C16	1435	0.00	1.00					1,144,097
Aliphatic >C16-C21	233	0.00	1.00					144,032,451
Aliphatic >C21-C35	310	0.00	1.00					1,732,615,153
Total TPH	2030.00	0.00	1.00	✓	10	<1	IR	-
Sum of 4 PAHs	-	-	1.00	•	0.10	-	-	-
Cadmium	140	50	1.00	×	2.50	20	6.96	449
Copper	10	6.04	1.00	×	5.00	1.21	8.27	1,441
Lead	5.00	1.06	1.00	✓	10	<1	IR	7,292
Nickel	206	128	1.00	×	15	8.54	24	7,451
Selenium	63	18	1.00	×	10	1.75	36	210
Phosphorous	238	72	1.00	✓	2200	<1	IR	1,679
Zinc	1820	1610	1.00	×	10	161	11	946
Magnesium	63800	13600	1.00	×	50	271	235	411
Iron	15600	3890	1.00	×	1000	3.89	4000	4,516
Acenaphthylene	0.85	0.00	1.00	✓	90	<1	IR	609
Benzo[a]anthracene	0.11	0.00	1.00	✓	0.41	<1	IR	53,653
Benzo[a]pyrene	0.02	0.00	1.00	✓	0.01	<1	IR	457,016
Phenanthrene	0.13	0.00	1.00	✓	90	<1	IR	5,235
MBAS	14400	10200	1.00	×	200	51	281	7

(1) compliance point at : Determinand Specific m

- • not applicable
- ✓ passes relevant screening criteria
- × fails relevant screening criteria
- IR Insignificant Risk
- * Risks assessed as sum of 6 PAHs

Notes

1. only detected chemicals for which screening criteria have been identified are modelled.
2. please see report text for basis of screening criteria

TABLE D 3.5
POTENTIAL RISKS TO SANDWITH BECK FROM OBSERVED SOIL CONTAMINATION

Determinand	Maximum Observed Soil Concentration (mg/kg)	Simulated groundwater concentration beneath contaminated soil (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l)	Tier 1	Tier 2	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Soil Preliminary RBSL (mg/kg)	Contaminant Transport Time to Receptor (years)
			With Degradation							
Aromatic C7-C8	-	-	-							-
Aromatic >C8-C10	170	2020	0.281							230
Aromatic >C12-C16	506	1890	0.012							719
Aromatic >C16-C21	230	272	0							2,266
Aromatic >C21-C35	329	49	0							17,966
Aliphatic C7-C8	71.6	1500	0							118
Aliphatic >C6-C8	152	689	0							572
Aliphatic >C12-C16	182	0.683	0							715,061
Aliphatic >C16-C21	174	0.005	0							90,020,282
Aliphatic >C21-C35	445	0.001	0							1,082,884,471
Total TPH	2260	6420	0.293	×	×	✓	10	<1	IR	-
Sum of 4 PAHs	264	4.67	0	×	×	✓	0.1	<1	IR	-
Arsenic	76	274	274	×	×	×	50	5.48	14	497
Boron	5	1860	1860	×	✓	✓	2000	<1	IR	13
Cadmium	21	2220	2220	×	×	×	5	445	0.05	76
Chromium	748	241	240	×	×	×	2	120	6.24	26,025
Copper	342	11500	11500	×	×	×	0.5	22905	0.01	55
Lead	358	2380	2380	×	×	×	4	596	0.60	247
Mercury	1	22.1	17.1	×	×	×	1	17	0.06	239
Nickel	130	446	442	×	×	×	8	55	2.35	2,608
Selenium	29	7840	7840	×	×	×	10	784	0.04	7
Phosphorous	47000	1120000	1120000	×	×	×	2200	508	93	1,016
Zinc	1660	74400	74400	×	×	×	8	9297	0.18	41
Magnesium	7590	914000	914000	×	×	×	50	18272	0.42	14
Iron	58500	709000	709000	×	×	×	1000	709	82	136
Cyanide	2	38	25.7	×	✓	✓	50	<1	IR	536
Trichloroethene	0.147	13.8	3.61	×	×	✓	10	<1	IR	49
Tetrachloroethene	0.121	7.03	7.03	×	✓	✓	10	<1	IR	3
Naphthalene	6.4	84.5	84.5	×	×	×	10	8.45	0.76	15
Acenaphthylene	0.271	1.72	0.038	✓	✓	✓	90	<1	IR	29
Benzo[a]anthracene	116	9.03	0	×	×	✓	0.41	<1	IR	2,283
Benzo[a]pyrene	114	0.975	0	×	×	✓	0.01	<1	IR	20,773
Benzo[b]fluoranthene*	104	2.94	0				see sum 4 PAHs			6,278
Benzo[k]fluoranthene*	94.8	1.51	0				see sum 4 PAHs			11,152
Chrysene	122	18.4	0	✓	✓	✓	90	<1	IR	8,639
Dibenzo[a,h]anthracene	1.43	0.006	0	×	✓	✓	0.01	<1	IR	312,630
Indeno[1,2,3-cd]pyrene*	65.6	0.221	0				see sum 4 PAHs			386,161
Phenanthrene	116	99.1	0.251	×	×	✓	90	<1	IR	262
1-Methylnaphthalene	9.2	68.3	0.98	×	×	✓	60	<1	IR	166
2-Methylnaphthalene	14.5	108	41.2	×	×	✓	60	<1	IR	29
Dibenzofuran	3.4	8.28	0	×	✓	✓	12	<1	IR	558
MBAS	535	286000	116000	×	×	×	200	580	0.92	6

TABLE D 3.5
POTENTIAL RISKS TO SANDWITH BECK FROM
OBSERVED SOIL CONTAMINATION

Determinand	Maximum Observed Soil Concentration (mg/kg)	Simulated groundwater concentration beneath contaminated soil (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l)	Tier 1	Tier 2	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Soil Preliminary RBSL (mg/kg)	Contaminant Transport Time to Receptor (years)
With Degradation										
Carbazole	189	9710	8610	×	×	×	**3.36**	2562	0.07	34
Azobenzene	1.07	7.15	6.07	×	×	×	**0.611**	9.94	0.11	498

(1) compliance point at : Determinand Specific m

- • not applicable
- ✓ passes relevant screening criteria
- × fails relevant screening criteria
- IR Insignificant Risk

Notes
1. only detected chemicals for which screening criteria have been identified are modelled.
2. please see report text for basis of screening criteria

TABLE D 3.6
POTENTIAL RISKS TO SANDWITH BECK FROM OBSERVED LEACHATE CONTAMINATION

Determinand	Maximum observed leachate concentration (µg/l)	Maximum estimated pore water leachate concentration (µg/l)	Simulated groundwater concentration beneath leached soil (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l) With Degradation	Receptor Dilution Factor	Tier 2	Tier 3	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Soil Preliminary RBSL (based on Leachate results) (mg/kg)	Contaminant Transport Time to Receptor (years)
Chromium	598	598	426	423	1.00	×	×	2.00	212	3.53	26,025
Copper	23	23	17	17	1.00	×	×	0.50	34	10	55
Lead	8.00	8.00	5.30	5.30	1.00	×	×	4.00	1.33	270	247
Selenium	38	38	28	28	1.00	×	×	10	2.80	10	7
Zinc	109	109	80	80	1.00	×	×	8.00	10	165	41

(1) compliance point at :

- • not applicable
- ✓ passes relevant screening criteria
- × fails relevant screening criteria
- IR Insignificant Risk

Notes

1. only detected chemicals for which screening criteria have been identified are modelled.
2. please see report text for basis of screening criteria

TABLE D 3.7
POTENTIAL RISKS TO SANDWITH BECK FROM OBSERVED GROUNDWATER CONTAMINATION

Determinand	Maximum recorded water concentration (µg/l)	Simulated groundwater concentration at compliance point (1) (µg/l) With Degradation	Receptor Dilution Factor	Tier 2	Water Target Value (WTV) (µg/l)	Compliance Point Hazard Index (CWHI)	Groundwater Preliminary RBSL (µg/l)	Contaminant Transport Time to Receptor (years)
Aromatic >C16-C21	786	0.22	1.00					816
Aromatic >C21-C35	1551	0.00	1.00					6,468
Aliphatic >C21-C35	9161	0.00	1.00					389,838,409
Total TPH	61500	2.24	1.00	✓	**10**	<1	IR	-
Sum of 4 PAHs	3.37	0.00	1.00	✓	**0.10**	<1	IR	-
Arsenic	90	61	1.00	×	**50**	1.22	73	12,291
Cadmium	10	9.84	1.00	×	**5.00**	1.97	5.08	330
Chromium	83	83	1.00	×	**2.00**	41	2.00	5,479
Copper	60	60	1.00	×	**0.50**	120	0.50	55
Nickel	90	36	1.00	×	**8.00**	4.54	20	7,451
Selenium	43	43	1.00	×	**10**	4.30	10	7
Phosphorous	13800	13800	1.00	×	**2200**	6.26	2209	451
Zinc	8480	8480	1.00	×	**8.00**	1060	8.00	62
Iron	2740	2130	1.00	×	**1000**	2.13	1289	1,087
Acenaphthylene	0.16	0.00	1.00	✓	**90**	<1	IR	558
Benzo[a]anthracene	0.52	0.00	1.00	✓	**0.41**	<1	IR	55,936
Benzo[a]pyrene	0.68	0.00	1.00	✓	**0.01**	<1	IR	399,889
Benzo[b]fluoranthene*	0.56	0.00	1.00		**see sum 4 PAHs**			120,850
Benzo[g,h,i]perylene*	0.42	0.00	1.00		**see sum 4 PAHs**			3,471,515
Benzo[k]fluoranthene*	2.00	0.00	1.00		**see sum 4 PAHs**			239,760
Dibenzo[a,h]anthracene	0.15	0.00	1.00	✓	**0.01**	<1	IR	364,735
Indeno[1,2,3-cd]pyrene*	0.39	0.00	1.00		**see sum 4 PAHs**			762,420
Phenanthrene	0.57	0.00	1.00	✓	**90**	<1	IR	6,412
MBAS	116000	108000	1.00	×	**200**	540	215	7

(1) compliance point at : Determinand Specific m

- • not applicable
- ✓ passes relevant screening criteria
- × fails relevant screening criteria
- IR Insignificant Risk
- * Risks assessed as sum of 6 PAHs

Notes

1. only detected chemicals for which screening criteria have been identified are modelled.
2. please see report text for basis of screening criteria

Saltom Bay

Mean Low Water

Mean High Water

Path

Old Kells

Sch

Playing Fields

Liby

Tunnel

Works

Depots

Drain

Dismtd Rly

Track

Allot Gdns

Lodge

Cemetery

Snebra Beck

Pow Beck

Quarry (disused)

Sinks

Woodhouse

Issues

Coun Offs

PO

Parks

Greenbank

Mirehouse West

Playing Field

High House

Greenbank Farm

Air Shaft

Landfill Site

Mountain View

Townhead

Riverdale

Benhow Wood

Quarry (disused)

BM 130.25m

Aikbank Quarry (disused)

Birkhams Quarry (disused)

Cabbage Hall

SANDWITH BECK

Sandwith

Midtown Farm

Rose Cottage

Grovewood House

Overcroft

Croftfoot

Fair View

Demesne

Roskapark Wood

Summer Hill

Mast

Bellhouse

WILSON PIT ROAD

WOODHOUSE ROAD

MONKWRAY ROAD

SOUTH ROW

MID STREET

WEST ROW

CONISTON ROAD

ULDALE ROAD

GREENBANK AVENUE

GALE ANDR ROAD

ST BEES ROAD

DEEP GROUNDWATER CATCHMENT MAY BE SIGNIFICANTLY MORE EXTENSIVE THAN SURFACE CATCHMENT

?

?

0 100 200 300 400 500m

APPROXIMATE SCALE

KEY:

- Site boundary
- Line of fault
- Catchment area boundaries
- **St. Bees Sandstone** Zone 5 - 810,000m 2 Rainfall onto St. Bees Sandstone
- **Huntbank** Zone 2 - 35,000m 2
- **Site** Zone 1 - 335,000m 2

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Title RAINFALL DISCHARGE CONTRIBUTION (SURFACE WATER CATCHMENTS)

Location WHITEHAVEN, CUMBRIA

Client RHODIA

URS

App'd:	Drawn:	Date:
AJW	RH	MARCH 2007
		Ref: GS/DB/MCH
Scale: AS SHOWN		Job No: 44320110
Drg. Size: A3		**FIGURE 10**

Appendix E - Sampling Protocol for Site Investigations