

# SHELL SUTTON ELMS

## Environmental Site Assessment

GB-10019140-20230801-SA-Phase II ESA



# Shell Sutton Elms

## Environmental Site Assessment

Author Sameer Kadukar

Checker Shanth Belagodu

Approver Paul Wrigley

Report No GB-10019140-20230801-SA-Phase II ESA

Date 01 August 2023

### VERSION CONTROL

Version	Date	Author	Changes
01	01/06/2023	Sameer Kadukar	First Issue
02	29/06/2023	Sameer Kadukar	Client comments addressed
03	01/08/2023	Shanth Belagodu	Client comments addressed

This report dated 01 August 2023 has been prepared for Shell UK Oil Products Ltd (the "Client") in accordance with the terms and conditions of appointment dated 01 October 2020 (the "Appointment") between the Client and **Arcadis UK Limited** ("Arcadis") for the purposes specified in the Appointment. For avoidance of doubt, no other person(s) may use or rely upon this report or its contents, and Arcadis accepts no responsibility for any such use or reliance thereon by any other third party.

# CONTENTS

<b>1</b>	<b>INTRODUCTION .....</b>	<b>1</b>
1.1	Objectives .....	1
1.2	Scope of Work .....	1
1.3	Limitations .....	1
1.4	Previous Environmental Reports .....	1
1.1.1	Previous Third-Party Reports .....	1
1.1.2	Previous Arcadis Reports .....	2
<b>2</b>	<b>SITE INVESTIGATION METHODOLOGY .....</b>	<b>3</b>
2.1	Borehole Installation .....	3
2.1.1	Borehole Location Rationale .....	3
2.1.2	Monitoring Well Installation and Soil Sampling .....	4
2.2	Groundwater Monitoring .....	5
2.2.1	Groundwater Elevation Survey .....	5
2.2.2	Groundwater Monitoring and Sampling .....	5
2.3	Analytical Strategy .....	5
2.4	Quality Assurance and Quality Control .....	6
2.4.1	Storage, Preservation and Transport of Samples .....	6
2.4.2	Field Duplicate, Trip Blank and Equipment Blank .....	7
2.5	Waste Characterisation .....	7
<b>3</b>	<b>SITE INVESTIGATION FINDINGS .....</b>	<b>8</b>
3.1	Ground Conditions .....	8
3.2	Soil Quality .....	8
3.3	Hydrogeology .....	9
3.4	Groundwater Quality .....	9
3.5	Review of Quality Assurance/Quality Control Sampling .....	9
<b>4</b>	<b>GENERIC QUANTITATIVE RISK ASSESSMENT .....</b>	<b>11</b>
4.1	Comparison of Soil Sample Analysis Results to GAC .....	11
4.2	Comparison of Groundwater Analysis Results to GAC .....	12
4.3	Human Health .....	12
4.4	Water Resources .....	12
<b>5</b>	<b>SITE CONCEPTUALISATION .....</b>	<b>13</b>
5.1	Geology .....	13
5.2	Hydrogeology .....	13
5.3	Contaminant Concentrations & Distribution .....	13
5.3.1	Soil .....	13
5.3.2	Groundwater .....	14
<b>6</b>	<b>CONCLUSIONS .....</b>	<b>15</b>

# APPENDICES

## APPENDIX A

### Report Figures

Figure 1 – Site Location Plan

Figure 2 – Site Layout and Groundwater Elevation Plan

Figure 3 – Topographical and PAS 128 Utility Survey Plan

Figure 4A – Contaminant Distribution in Soil Boring Locations

Figure 4B – Contaminant Distribution in Soil Validation Samples.

Figure 5 – Contaminant Distribution in Groundwater Plot

## APPENDIX B

Study Limitations

## APPENDIX C

Borehole Logs

## APPENDIX D

Arcadis Laboratory QA/QC Policy

## APPENDIX E

Report Tables

## APPENDIX F

Laboratory Certificates of Analysis for Soil and Groundwater Samples

## APPENDIX G

Arcadis GAC Derivation

## APPENDIX H

Arcadis GACs for CPU

## APPENDIX I

Waste Transfer Notes

## Abbreviations

AECOM	AECOM Infrastructure & Environment UK Limited
AOD	Above Ordnance Datum
Arcadis	Arcadis (UK) Limited
COPC	Constituents of Potential Concern
CPU	Continued Petroleum Use
CSM	Conceptual Site Model
CVOC	Chlorinated Volatile Organic Compounds
EA	Environment Agency
ESA	Environmental Site Assessment
GAC	Generic Assessment Criteria
LNAPL	Light Non-Aqueous Phase Liquid
M AOD	Meters Above Ordnance Datum
m bgl	Meters Below Ground Level
MCerts	Monitoring Certification Scheme
MTBE	Methyl Tertiary Butyl Ether
NAPL	Non-Aqueous Phase Liquid
OS	Ordnance Survey
PAH	Polycyclic Aromatic Hydrocarbons
PFS	Petrol Filling Station
PID	Photo Ionization Detector
ppmV	Parts Per Milli Volt
Shell	Shell UK Oil Products Limited
TPH	Total Petroleum Hydrocarbons
UST	Underground Storage Tanks
VOC	Volatile Organic Compounds
WAC	Waste Acceptance Criteria

## Executive Summary

Executive Summary	
Background	Arcadis (UK) Limited (Arcadis) was commissioned by Shell UK Oil Products Limited (Shell) to undertake an environmental Site investigation at Shell Sutton Elms, located at Coventry Road, Broughton, Leicester, LE9 6QD (hereafter 'the Site').
Objectives	<p>The objectives of this phase of works were to:</p> <ul style="list-style-type: none"> <li>• Drilling up to four boreholes and installation of groundwater monitoring wells to allow current soil and groundwater conditions beneath the Site to be assessed; and,</li> <li>• Undertake Site-wide groundwater monitoring in order to assess current concentrations of petroleum hydrocarbons in groundwater.</li> </ul>
Borehole Drilling and Monitoring Well Installation	During the period of November 15th to 24th, 2022, four groundwater monitoring wells (MW101, MW104, MW105, and MW106) were installed on the Site. Progression of MW101 was attempted twice, and MW105 and MW106 were attempted once due to obstructions encountered within the initial inspection pits. The maximum depth achieved during drilling was 6.50 meters below ground level (m bgl). Ground conditions within the boreholes comprised Made Ground, which was present to a depth of 1.36 m bgl, and River Terrace Deposits, which were proven to a maximum depth of 6.50 m bgl.
Soil Samples Analysis	<p>A hydrocarbon odour was noted at MW106 within soil samples collected from 0.15m bgl to 1.84m bgl and a hydrocarbon sheen was observed between 1.59 mbgl to 1.79 m bgl. Field screening indicated a maximum Photo Ionization Detector (PID) value of 5,000 Parts per Million (ppm) recorded in MW106 at 1.59 to 1.79m bgl. No visual or olfactory evidence of contamination was identified in soil samples collected during the drilling of MW101, MW104 and MW105.</p> <p>The concentration of aliphatic hydrocarbons &gt;C8-C10 sampled in soils from MW106 was the only detection found to exceed the applicable GAC derived for the protection of human health receptors based on continued petroleum use. Constituents of Potential Concern (COPC) analysed in soil samples collected at MW106 also exceeded the Arcadis Generic Assessment Criterial (GAC) protective of water resources (aquifers and surface waters) with exceedances of BTEX and naphthalene; Concentrations of benzo(b,k)fluoranthene, benzo(g,h,i)pyrene and indeno(1,2,3-c,d)pyrene were measured in exceedance of the Arcadis GAC protective of water resources (aquifers) only within shallow soil samples collected from all four sampling locations.</p>
Groundwater Monitoring	<p>The depth to groundwater ranged from 0.61m bgl to 1.49m bgl during the January 2023 groundwater monitoring visit and 0.55m bgl to 1.46m bgl during the March 2023 groundwater elevation survey. The groundwater elevation data from each survey inferred a groundwater flow direction towards the west/southwest.</p> <p>No evidence of Non-Aqueous Phase Liquid (NAPL) was encountered within the monitoring well network during the monitoring visit.</p> <p>None of the COPC within groundwater samples were detected in exceedance of the Arcadis GAC protective of human health for continued petroleum use. Concentrations of benzene, sum TPH (&gt;C5-C35) Aliphatics/Aromatics, and naphthalene in MW106, along with benzo(a)pyrene in MW105, were detected in exceedance of the Arcadis GAC protective of water resources (aquifers and surface waters) and UK drinking water quality standards within the groundwater samples collected.</p>
Conclusions	Soil and groundwater samples collected from MW106 showed the maximum measured concentrations of COPCs, indicating possible localized contamination in the eastern part of the Site. However, a single COPC was detected exceeding the Arcadis GAC for the protection of human health receptors in soils based on a continued petroleum use. None of the COPC detected in groundwater exceeded the Arcadis GAC derived for the protection of human health receptors. Therefore, the risk to human health receptors is considered low.

## Executive Summary

Concentrations of BTEX in some soil and groundwater samples exceeded the GAC protective of water resource receptors, suggesting a potentially significant risk posed by these constituents.

The subsurface geology at the Site is complex, with interbedded sand, gravel and clay layers. The hydrogeology of the Site is also complex, with varying flow directions observed during previous works.

While a direct comparison of soil contaminant concentrations between 2011 and this 2023 intrusive investigation cannot be made due to variations in well locations and sampling depths, the contaminant concentrations documented in the 2023 investigation are consistent with the previous works (it is noted that sum TPH concentrations >3,000mg/kg [sample V7, Figure 4B] remained in-situ following the 2011 site redevelopment). The most elevated soil and groundwater detections identified in MW106 during this investigation were in a location not previously investigated.

Groundwater results have indicated impact from BTEX and mid-heavy end TPH constituents. As a result of the elevated impacts identified in MW106, there is considered a potential risk to the secondary A aquifer beneath the Site and the River Soar located 37m east of the Site.

# 1 Introduction

Arcadis (UK) Limited (Arcadis) was commissioned by Shell UK Oil Products Limited (Shell) to undertake an environmental Site investigation at Shell Sutton Elms (hereafter 'the Site'). The Site is an operational Petrol Filling Station (PFS) located at Coventry Road, Broughton, Leicester, LE9 6QD. A Site Location Plan is presented as Figure 1, Appendix A.

## 1.1 Objectives

The objective of this phase of works was to obtain additional/updated information on the soil and groundwater quality beneath the Site to further assess the Conceptual Site Model (CSM) for the Site developed during previous works (Section 1.4). The Site is planned to be continued to be operated as a Petrol Filling Station (Continued Petroleum Use (CPU)).

## 1.2 Scope of Work

The scope of work in this report is outlined below:

- Drilling of up to six boreholes and installation of groundwater monitoring wells (MW101 to MW106);
- Logging of soil samples and field headspace screening with a Photo Ionisation Detector (PID);
- Submission of soil samples to an accredited laboratory for analysis of selected Constituents of Potential Concern (COPC);
- Groundwater sampling of newly installed monitoring wells (MW101 to MW106) using low flow sampling methods with measurement of field parameters;
- Submission of groundwater samples to an accredited laboratory for analysis of selected COPC;
- A risk assessment including comparison of measured concentrations of COPC concentrations to Generic Assessment Criteria (GAC) and reporting of findings.

Scope deviation: Prior to commencing works on Site and a review of the proposed location it was deemed that MW102 and MW103 could not be drilled and installed due to impact on HGVs accessing and egressing the Site. Consequently, only four groundwater monitoring wells (MW101, MW104, MW105, and MW106) were installed, which still provided adequate information for the assessment of the groundwater flow direction and COPCs.

## 1.3 Limitations

Arcadis' liability, pursuant to the terms of the appointment of Arcadis by Shell, is strictly limited to the work undertaken and the matters contained and specifically referred to in this report. A copy of Arcadis' study limitations is presented in Appendix B.

## 1.4 Previous Environmental Reports

### 1.1.1 Previous Third-Party Reports

The environmental works undertaken by third party consultants appointed by Shell, associated with the Site are detailed in the following reports:

- Petroleum Risk Tier 1 Report by GeoDelft [Ref: C928.SG216.8784] dated October 2001;
- Geo-Environmental Report by GeoDelft [Ref: C2336.SG216] dated December 2003;
- Phase 1 Investigation Report by URS [Ref: 49328043] dated February 2011;
- Comprehensive Environmental Site Assessment by URS [Ref: MARP00002 Final] dated July 2011;
- Environmental Verification Report by URS [49328043/R001] dated June 2012;
- Comprehensive Groundwater Monitoring Events by URS [Ref: R49328043-005] dated January 2014;
- Comprehensive Groundwater Monitoring Event by URS [Ref: R49328043-006] dated August 2014;
- Well Decommissioning Report by URS [R49328043-007] dated September 2014.



Based on the above, there is known available soil and groundwater analytical data for the Site, however all the groundwater monitoring wells were decommissioned during in 2014.

### **1.1.2 Previous Arcadis Reports**

The environmental works undertaken by Arcadis associated with the Site is detailed in the following report:

- Phase 1 Environmental Assessment Report (ESA), Shell Sutton Elms (Report Ref: GB-10019140-20220818-SA-Phase 1 ESA) August 2022.

## 2 Site Investigation Methodology

### 2.1 Borehole Installation

#### 2.1.1 Borehole Location Rationale

The rationale for the installation of the four groundwater monitoring wells (MW101, MW104, MW105 and MW106) is presented below:

Borehole ID	Location Rationale	Installation
MW101	Located to the southwest of the tank farm in the southwest of the Site and anticipated to be downgradient of fuel infrastructure	50mm High-density polyethylene (HDPE) standpipe. Response zone within the Made Ground and River Terrace Deposits.
MW104	Located between the pump island and shop building to the northwest of the tank farm to assess conditions between commercial shop workers and fuel infrastructure.	50mm High-density polyethylene (HDPE) standpipe. Response zone within the Made Ground and River Terrace Deposits.
MW105	Located in the northeast of the Site and assumed to be upgradient of fuel infrastructure. Location to be used for triangulation of groundwater elevation profile.	50mm High-density polyethylene (HDPE) standpipe. Response zone within the Made Ground and River Terrace Deposits.
MW106	Located in the east of the Site and the current tank farm to assess any lateral migration of COPC.	50mm High-density polyethylene (HDPE) standpipe. Response zone within the Made Ground and River Terrace Deposits.

The locations of the monitoring wells are presented on Figure 2, Appendix A.

## 2.1.2 Monitoring Well Instillation and Soil Sampling

Data	Information
Investigation dates	15 to 24 November 2022.
Utility clearance	<p>Public utility plans for the Site were reviewed alongside the Topographical and PAS128 Utility Survey (Drawing Ref: 0922-ARC-15508, dated 28 September 2022) detailing the presence of underground services identified on Site. A copy of the Topographical and PAS128 Utility Survey Plan is presented as Figure 3 under Appendix A.</p> <p>Prior to breaking ground, the investigation locations were scanned using a Cable Avoidance Tool (CAT).</p> <p>Surface clearance pits were advanced to a minimum target depth of 1.2 meters below ground level (m bgl) via vacuum excavation and then backfilled to ground level. The boreholes were subsequently drilled through the backfilled trial pits. Where the target depth of 1.2m bgl could not be achieved drilling activities were not undertake at those locations.</p>
Drilling method	A Comacchio 305 was used initially, followed by a Comacchio 205 to undertake dynamic sampling and rotary coring.
Maximum drilled depth	6.50m bgl.
Monitoring well installation	<p>In each of the borehole locations, a 50mm HDPE monitoring well pipe comprising a slotted screen section and blank casing was installed. The annulus around the screen section was filled with gravel, and the annulus around the plain pipe was filled with bentonite, to prevent the formation of preferential pathways. The top of the monitoring well was grouted near the ground surface in accordance with industry standard practice.</p> <p>Monitoring well covers were installed flush to the ground.</p>
Soil logging	<p>Soil samples were logged with reference to British Standard (BS) 5930:2015+A1:2020, with reference made to any visual or olfactory evidence of contamination.</p> <p>Borehole logs are presented in Appendix C.</p>
Field screening	<ul style="list-style-type: none"> <li>• Where possible, soil samples were collected at approximately 0.5m intervals, or more frequently in accordance with changes in geology/field observations and placed into two polythene bags.</li> <li>• A Photo Ionization Detector (PID)* fitted with a 10.6eV ultraviolet (UV) lamp was used to measure soil headspace for ionisable hydrocarbons and other detectable COPC.</li> <li>• PID readings were recorded and are presented on the borehole logs presented in Appendix C.</li> </ul>
Surveying	The newly installed monitoring wells (MW101, MW104, MW105 and MW106) were levelled on 25 November 2022.
Monitoring well development	Prior to well development, the wells were checked for presence of Non-Aqueous Phase Liquid (NAPL) with an interface probe. Up to ten saturated well volumes were removed from each monitoring well following installation.
Waste disposal	<p>Waste soils were disposed of by under an appropriate duty of care. A soil sample from the skip (waste soil arisings) was also obtained and submitted to the laboratory for waste classification purposes.</p> <p>Purged groundwater collected during development of the newly installed monitoring wells (MW101, MW104, MW105 and MW106) was disposed of via the on-Site interceptor.</p>

\*The PID screening is a semi-quantitative method that results in a representation of the presence of Volatile Organic Compounds (VOC) in soil. The numerical output cannot be directly compared to measured soil concentrations of COPC. Nevertheless, PID readings are a useful field tool for assessing potential impacts in soil.

## 2.2 Groundwater Monitoring

The groundwater monitoring visit comprised a groundwater elevation survey and groundwater sampling, as detailed in the sections below.

### 2.2.1 Groundwater Elevation Survey

Data	Information
Date	18 January 2023 and 15 March 2023
Monitoring wells surveyed	The newly installed monitoring wells (MW101, MW104, MW105 and MW106) were gauged during the monitoring visit conducted on 18 January 2023 and elevation survey conducted on 15 March 2023.
Equipment used	Oil / water interface probe.
Details recorded	Depth to NAPL, if present; Depth to groundwater; and, Depth to base of monitoring well.

### 2.2.2 Groundwater Monitoring and Sampling

Data	Information
Date	18 January 2023
Monitoring wells sampled	The newly installed monitoring wells (MW101, MW104, MW105 and MW106) were gauged during the monitoring visit.
Sampling method	Purging and sampling was carried out by a battery-powered peristaltic pump, using dedicated sample tubing lowered into the well to the sample depth. The flow rate was set to low (generally <5l/min) to reduce turbidity and thus variability in results. New tubing was used for each monitoring well location. Sampling was undertaken from the approximate mid-point in the water column.
Data recorded	Water quality parameters, Dissolved Oxygen (DO), Oxidation Reduction Potential (ORP), electrical conductivity and pH, were measured using a multi-parameter meter. Readings were taken at approximately five-minute intervals until the electrical conductivity, DO, and ORP from three consecutive readings differed by less than 10%. Once the readings had stabilised, the water passing through the low flow pump was considered to be representative of the surrounding aquifer and groundwater samples were collected.

## 2.3 Analytical Strategy

Task	Information
Analytical Laboratory	Element Materials Technology (Element)
Accreditation	Element are United Kingdom Accreditation Service (UKAS) & Monitoring Certification Scheme (MCertS) accredited (for selected chemical analyses) and is an approved Arcadis subcontractor.
Chemical Analyses – Soil	<ul style="list-style-type: none"> <li>Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) by Gas Chromatography-Flame Ionisation Detection (GC-FID);</li> </ul>

Task	Information
	<ul style="list-style-type: none"> <li>• Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX) and fuel oxygenates [Methyl Tertiary-Butyl Ether (MTBE), Ethyl Tertiary-Butyl Ether (ETBE), Tertiary-Amyl Methyl Ether (TAME), Di-Isopropyl Ether (DIPE), Tertiary-Butyl Alcohol (TBA) and ethanol] by Gas Chromatography-Mass Spectrometry (GC-MS);</li> <li>• United States Environmental Protection Agency (US EPA) 16 Polycyclic Aromatic Hydrocarbon compounds (PAH) by GC-MS;</li> <li>• Alcohols by GC-MS; Fraction Organic Carbon by Eltra Total Organic Carbon (TOC) analyser</li> <li>• n-Hexane by GC-MS;</li> <li>• 2-methylnaphthalene by GC-MS; and</li> <li>• Asbestos screen by asbestos bulk Identification method.</li> </ul>
Chemical analyses (skip soil sample)	<ul style="list-style-type: none"> <li>• TPH CWG by GC-FID;</li> <li>• BTEX by GC-MS;</li> <li>• US EPA 16 PAH by GC MS;</li> <li>• pH by Metrohm Automated Probe Analyser;</li> <li>• Heavy Metals (suite of 12) by Inductively Couple Plasma (ICP) – Optical Emission Spectrometry (OES);</li> <li>• Asbestos screen by asbestos bulk Identification method;</li> <li>• Speciated Chromium by Discrete Analyser ;</li> <li>• Free Cyanide by Flow Injection Analyser and;</li> <li>• 10:1 Full Waste Acceptance Criteria (WAC) testing.</li> </ul>
Chemical Analyses – Water	<ul style="list-style-type: none"> <li>• Total Petroleum Hydrocarbons Criteria Working Group (TPH CWG) by Gas Chromatography-Flame Ionisation Detection (GC-FID);</li> <li>• Benzene, Toluene, Ethylbenzene, Total Xylenes (BTEX) and fuel oxygenates by Gas Chromatography-Mass Spectrometry (GC-MS);</li> <li>• United States Environmental Protection Agency (US EPA) 16 Polycyclic Aromatic Hydrocarbon compounds (PAH) by GC MS.</li> <li>• VOC by GC-MS.</li> </ul>

## 2.4 Quality Assurance and Quality Control

Full details of the Arcadis laboratory QA/QC policy are provided in Appendix D.

### 2.4.1 Storage, Preservation and Transport of Samples

Measures taken to ensure the quality and integrity of the samples, from collection to receipt of the soil and groundwater samples by the laboratory are summarised below:

Task	Details
Storage	<p><b>Soil Samples:</b> Plastic tubs and glass jars supplied by the laboratory were used for the collection of the soil samples. Soil samples stored in glass jars were used for the analysis of volatile compounds.</p> <p><b>Groundwater Samples:</b> Glass vials supplied by the laboratory were used for the collection of samples to be analysed for volatile compounds. Samples to be analysed for lower volatility compounds were stored in laboratory prepared glass bottles. Samples were stored in dedicated sample boxes provided by the laboratory.</p>
Preservation	<p>Sample containers were filled as far as practicable to minimise headspace and kept at a low storage temperature to minimise the potential for volatilisation and biodegradation of petroleum hydrocarbon compounds, VOC and Semi-Volatile Organic Compounds (SVOC) prior to analysis.</p>

Task	Details
Decontamination	<p><b>Soil Samples:</b> Disposable gloves were worn and changed between sample collections to prevent cross-contamination.</p> <p><b>Groundwater Sample:</b> Groundwater samples were collected using dedicated, disposable tubing which was changed between monitoring well locations in order to prevent cross-contamination.</p>
Transport	<p>Samples were stored in dedicated sample cool boxes with cooling aids following collection and during transit to the laboratory. Sample details and analytical requests were recorded on the laboratory chain of custody form included with the samples, prior to dispatching to laboratory for analysis.</p>

## 2.4.2 Field Duplicate, Trip Blank and Equipment Blank

Task	Information
Field Duplicate	<p>A soil duplicate sample, labelled as DUPSO, was collected from soil boring MW104 on 30th November 2022 and submitted for laboratory analysis.</p> <p>A field duplicate of groundwater sample, labelled as DUP, was collected from monitoring well MW106 on 18 January 2023 and submitted for laboratory analysis.</p>
Equipment Blank	<p>An equipment blank, collected by running deionised water supplied by the laboratory through the sampling equipment, was submitted to the laboratory for analysis on 18 January 2023.</p>
Trip Blank	<p>A trip blank, provided with the sample containers by the laboratory and not opened on Site, was dispatched to the laboratory with the groundwater samples for analysis on 18 January 2023. However, the Trip Blank sample was reported to be lost during transport.</p>

## 2.5 Waste Characterisation

Waste materials disposed from Site were assessed and classified according to the current UK legislation and guidance. Once the waste was classified as either non-hazardous or hazardous, the Waste Acceptance Criteria (WAC) testing then determined the requirements for the appropriate waste disposal. The results were compared against a set of legislative thresholds. WAC testing is used to indicate if non-hazardous waste is inert and therefore suitable for disposal in an inert landfill. WAC testing is only required for this purpose or to facilitate disposal at hazardous landfills. It is not required for disposal of non-hazardous wastes which are not inert.

The waste producer holds the responsibility for ensuring the proper classification of any waste materials generated on the site. Arcadis collected laboratory data to be provided to the waste receiver, who then made an independent determination of the material based on the data. The Waste Transfer Notes related to soil disposal are included in Appendix I.

### 3 Site Investigation Findings

The sections summarise the findings of the Arcadis investigation.

#### 3.1 Ground Conditions

The ground conditions encountered during the borehole drilling are summarised below:

Soil Type / Geological Unit	Maximum Depth (m bgl)	Soil Description
Made Ground	1.36	Concrete and bituminous surfacing overlaying dark grey to dark brown clayey gravelly SAND with frequent cobbles of brick.
River Terrace Deposits	6.50	Soft, greyish dark brown, sandy, gravelly CLAY with bands of clayey sands. Overlaying brown speckled cream clayey gravelly SAND and sandy GRAVEL.

Investigation locations MW101A, MW101B, MW105A and MW106B were terminated due to the presence of a secondary concrete slab within the inspection pits, these locations were progressed at MW101, MW105 and MW106 respectively.

Detailed ground descriptions can be found on the Borehole Logs in Appendix C.

#### 3.2 Soil Quality

Data	Findings
Visual or olfactory evidence of contamination	A hydrocarbon odour was noted in MW106 within soil samples collected from 0.15m bgl to 1.84m bgl and a hydrocarbon sheen was observed between 1.59 mbgl to 1.79 m bgl.
Asbestos Containing Material (ACM)	There was no detection of asbestos in any of the made ground or skip sample sent for asbestos screening.
Field screening	Field screening indicated Photo-Ionisation Detector (PID) readings below the equipment detection limit <1parts per million (ppm) in soils sampled from boreholes MW101, MW104, and MW105. The PID identified a maximum value of 5000 parts ppm recorded in soil samples collected from borehole MW106 at 1.5 and 1.7m bgl, coincidental with the observed sheen. The PID readings are shown on the borehole logs presented in Appendix C.
Laboratory Analysis	The laboratory data for the soil samples analysis are presented in Table 1. The results indicate the presence of mid-heavy end TPH constituents in the soils from MW104 and MW106 with detections of BTEX – correlating with the type of fuel stored and distributed at the Site. Majority of the detections are observed in soil sample samples obtained within 2m bgl. The laboratory certificates of analysis are presented in Appendix FF. Total 7 out of 12 soil samples were collected from saturated soils. The contaminant concentration in the soil samples in saturated soils can possibly be higher than what is reflected in the laboratory results due to contaminant mobility and migration into the groundwater, Therefore, the groundwater results are considered as the primary basis for the risk assessment.

### 3.3 Hydrogeology

Data	Information
Groundwater strikes	Groundwater strike was observed during the drilling of boreholes MW101, MW104, MW105 and MW106, details of which are presented on the borehole logs presented as Appendix C.
Range in depth to groundwater	<p>Groundwater Elevation Survey conducted on 18 January 2023, depth to groundwater was recorded between 0.61m bgl to 1.49m bgl and groundwater elevations ranged from 75.06m to 75.46m Above Ordnance Datum (AOD).</p> <p>Groundwater Elevation Survey conducted on 15 March 2023, depth to groundwater was recorded between 0.55m bgl to 1.46m bgl and groundwater elevations ranged from 75.09m to 75.51m AOD.</p> <p>The groundwater monitoring installation details and complete groundwater elevation data recorded on 11<sup>th</sup> November 2021 are presented on Table 2 in Appendix E.</p>
Groundwater flow direction	A groundwater elevation plan is presented in Figure 2 in Appendix A. Based on the available data, the groundwater flow direction beneath the Site is inferred towards the west/southwest. It should be noted that previous groundwater monitoring events, conducted by URS in August 2014 [Ref: Comprehensive Groundwater Monitoring Event [Ref: R49328043-006], reported an inferred groundwater flow direction toward east.

### 3.4 Groundwater Quality

Data	Findings
Visual or olfactory evidence of contamination	No visual or olfactory evidence of contamination was identified during the monitoring visit.
NAPL	No evidence of NAPL was encountered within the monitoring well network during the monitoring visit.
Hydrogeochemical data	The hydrogeochemical parameters recorded during monitoring are detailed in Table 3 in Appendix E.
Laboratory analysis	<p>The laboratory data for the groundwater analysis are presented in Table 4 to Appendix E.</p> <p>The results indicate the presence of mid-heavy end TPH constituents and BTEX in the groundwater sample collected from MW106. Minimal detections of Poly Aromatic Hydrocarbons (PAH) were recorded within groundwater samples collected across the Site.</p> <p>Laboratory certificates of analysis are presented in Appendix F.</p>

Groundwater quality has been examined in relation to established TPH thresholds. These thresholds, which are founded on the site's sensitivity and the prevalence of particular contaminants, form the basis of our groundwater quality assessment.

### 3.5 Review of Quality Assurance/Quality Control Sampling

The analytical data have been reviewed for QA/QC purposes:

- Concentrations of COPC in the equipment blank sample were below the laboratory limit of detection;



- Sampling variability was measured by the Relative Percent Difference (RPD)<sup>1</sup> from analysis of the duplicate groundwater sample collected from MW106 and MW104. Although the relative percentage difference for ethylbenzene within duplicate soil sample collected at MW104 is slightly above the acceptable limit, the fact that all other analytes are within the prescribed RPD% limits suggests that the data is still fit for the purpose. Based on the results of the QA/QC sampling, the dataset is considered appropriate for use.

---

<sup>1</sup> 1 Acceptable RPD for each Method Detection Limit (MDL) multiplier range are: 80 (1-10 x MDL); 50 (10-20 x MDL); 30 (>20 x MDL)

## 4 Generic Quantitative Risk Assessment

In order to assess the potential significance of the measured concentrations of COPC present in soil and groundwater samples, the concentrations of COPC present in soil and groundwater samples have been compared to Arcadis Generic Assessment Criteria (GAC) protective of human health and water resources receptors.

Based on the proposed continued use of the Site as a PFS and risk assessment findings of Phase 1 Environmental Site Assessment Report completed by Arcadis in August 2022 [Ref: GB-10019140-20220818-SA-Phase 1 ESA], the measured concentrations of COPC in soil and groundwater have been compared to applicable Arcadis GAC protective of human health for CPU. The Site is underlain by River Terrace Deposits, designated as a Secondary A Aquifer and Mercia Mudstone designated as Secondary B aquifer. The nearest surface water feature is River Soar located 37m southeast of the Site; therefore, COPC concentrations in soil and groundwater have also been compared to the Arcadis GAC protective of water resources for aquifers, surface waters and UK Drinking Water Standards applied to groundwater.

The GAC have been derived in line with guidance provided by the Environment Agency (EA). An overview of the derivation of the Arcadis GAC is presented in Appendix G and the Arcadis GAC for CPU are presented in Appendix H. In the absence of suitable legislative criteria for sum TPH, Arcadis typically adopts a value of 10µg/l split between the TPH fractions for more sensitive locations (e.g. Principal Aquifer, drinking water abstraction), and a value of 50µg/l split between the TPH fractions for locations considered less sensitive (e.g. lower permeability aquifers / lower sensitivity resources) or where a site is located in close proximity to a surface watercourse.

The concentrations of COPC in groundwater were also compared with the Shell Universal RBSL where the RBSL are more conservative than the human health GAC (applicable for naphthalene and xylene only).

### 4.1 Comparison of Soil Sample Analysis Results to GAC

Receptor	Exceedances of Arcadis GAC for CPU
On-Site Commercial Workers	>C8-C10 Aliphatics at MW106 (1.5 to 1.8m bgl).
Water Resources (Aquifers)	Toluene at MW106 (1.0 and 1.5 to 1.8m bgl); Naphthalene at MW106 (1.0m bgl).
Water Resources (Surface Water)	Benzo(b)fluoranthene at MW101(0.2 to 0.5m bgl), MW104(0.5m bgl), MW105(1.0 to 1.2m bgl) and MW106(1.0 and 1.5 to 1.8m bgl); Benzo(k)fluoranthene at MW101(0.2 to 0.5m bgl), MW104(0.5m bgl), MW105(1.0 to 1.2m bgl) and MW106(1.0 m bgl); Benzo(g,h,i)perylene at MW101(0.2 to 0.5m bgl), MW105(1.0 to 1.2m bgl) and MW106(1.0 m bgl); Indeno(1,2,3-c,d)pyrene at MW101(0.2 to 0.5m bgl), MW104(0.5m bgl), MW105(1.0 to 1.2m bgl) and MW106(1.0 m bgl).
Water Resources (Both Aquifers and Surface Waters)	Benzene at MW106 (1.0m bgl); Ethylbenzene at MW106 (1.0 and 1.5 to 1.8m bgl); Xylene (o) at MW106 (1.0 and 1.5 to 1.8m bgl); Naphthalene at MW106 (1.5 to 1.8m bgl).

## 4.2 Comparison of Groundwater Analysis Results to GAC

Receptor	Exceedances of Arcadis GAC for CPU
On-Site Commercial Workers	None
Water Resources (Surface Water)	Ethylbenzene, Xylene (Total) at MW106.
Water Resources (Both Aquifers and Surface Waters)	TPH >C5-C35 Aliphatics/Aromatics, Benzene and Naphthalene at MW106; Benzo(a)pyrene at MW105.

## 4.3 Human Health

The maximum measured concentrations of COPC did not exceed the relevant assessment criteria derived for the protection of human health receptors any of the of the soil and groundwater samples except for >C8-C10 Aliphatics at MW106 (1.5 to 1.8m bgl). This localized exceedance suggests the possibility of low-level risk posed to human health receptors in the eastern part of the Site.

## 4.4 Water Resources

Concentrations of BTEX and PAHs exceeded the Arcadis GAC for the protection of surface water receptors in soil samples collected from both unsaturated and saturated zones of the Site. However, no corresponding exceedances of these COPC were detected in the groundwater samples collected from MW101, MW104, and MW105. The measured COPC concentrations in soil and groundwater samples collected at MW106 indicate a possible localized contamination in the eastern part of the Site. Further information about the localized exceedance and potential migration of the contaminants is necessary to evaluate the risk posed to the surface water and groundwater receptors.

## 5 Site Conceptualisation

The following section provides an overview for conceptual understanding of the Site, reviewing the most recent intrusive investigation completed by Arcadis in January 2023 and the findings of the previous works undertaken at the Site between 2011 and 2014.

### 5.1 Geology

The overall geology beneath the Site is interpreted as complex, interbedded sand, gravel, and clay layers, and previous works (URS July 2011) have contributed useful information towards building a clear understanding of the geology. However, the 2023 investigation provides more detailed information on the discontinuous nature of the complex lithology beneath Site, with interbedded sand, gravel, and clay layers that are not separate and distinct but rather interbedded and discontinuous. This poses potential challenges in determining contaminant flow through the subsurface.

### 5.2 Hydrogeology

Following a review of the Regional Geology using the BGS GeoIndex and DEFRA Magic Maps, accessed on June 20, 2023, it was found that the Environment Agency classifies the superficial River Terrace Deposits beneath the site as a Secondary A Aquifer. This classification suggests that these deposits are capable of supporting local water supplies and are vital for providing base flow to rivers. In contrast, the Mercia Mudstone is classified as a Secondary B Aquifer, which implies that it can store and yield groundwater in limited amounts due to localized features such as fissures, thin permeable layers, and weathering.

The 2011 Site investigation indicated that the average depth to groundwater beneath the Site was observed at 1.08 m bgl, within the shallowest aquifer primarily comprising the superficial River Terrace Deposits. The report also inferred that the groundwater flow direction in the superficial deposits was towards the east. Based on the groundwater elevations measured during the groundwater monitoring rounds in 2014, depth to groundwater was observed to be between 0.47m bgl and 2.15m bgl, and the inferred groundwater flow direction across the Site was towards the east to south-east, and groundwater flow generally appeared to be in the direction of the nearby River Soar. Notably, the groundwater flow directions derived from the investigation activities in 2011 and 2014 did not factor in the groundwater elevations at all monitoring well locations to determine the inferred groundwater flow direction; this suggests that defining a true flow direction presented some challenges.

The 2023 findings indicate a groundwater flow direction towards west (opposite to that observed in the previous reports). Therefore, it is crucial to gain a clear understanding of the direction in which groundwater and contaminants may migrate through the subsurface to effectively manage potential risks associated with the Site.

### 5.3 Contaminant Concentrations & Distribution

#### 5.3.1 Soil

A Contaminant Distribution Plot for soil, representing the distribution of Benzene, Xylenes, TPH and PAH<sup>2</sup> during the 2011 and 2023 intrusive works is presented as Figure 4A; The highest concentrations of TPH and BTEX observed during the 2011 works were reported from URSMW103 and URSMW104 located near the forecourt area. The maximum PAH concentrations were detected in URSMW107 located close to the shop building. A comparison of soil analytical results against URS derived GAC protective of human health (on-Site petroleum workers) and controlled water receptors indicated concentrations of Benzene and Xylenes in one deep soil sample exceeded the Human Health GAC. A potential risk to Controlled Water receptors was identified from the measured BTEX, PAH and TPH soil concentrations. Following to the intrusive investigation,

---

<sup>2</sup> Benzene, Xylenes, Total TPH and Total PAH16 were used as key constituents for the distribution plots based on the historical use of the Site as PFS and exceedances/elevated concentrations observed during intrusive investigations conducted on Site to date.

the Site was partially redeveloped in 2011; URS undertook validation sampling around the removed fuel lines and beneath the fuel pump islands. A total of thirteen validation soil samples were collected and analysed for COPC. A Contaminant Distribution Plot for soil validation samples, representing the distribution of Benzene, Xylenes, TPH and PAH during the 2011 verification sampling is presented as Figure 4B. The maximum concentration of COPC's were reported at sample 'V7', collected at 1.5m bgl (in-situ soils) beneath the southwest portion of the pump island.

The contaminant distribution in soils from the 2023 intrusive works indicates relatively higher concentrations of Xylenes and TPH at MW106 located in the eastern part of the Site. The soil samples collected from MW101 and MW104 were shallow unsaturated soils (0.2 to 0.5m bgl) whereas the soil samples collected from MW105 and MW106 were noted to be saturated (1m bgl); the analysis results from both saturated and unsaturated soil samples are considered to be useful in providing insight into the location and magnitude of contaminant mass present beneath the Site.

Based on the findings of the Site investigations conducted in 2011 (incl. soil verification works) and Arcadis' 2023 intrusive works, it is important to note that an accurate comparison of contaminant concentrations in soils cannot be made due to the variation in well locations and sampling depths; a more suitable approach for comparison is considered to be review of the COPC concentrations in groundwater samples collected. Notwithstanding this limitation, a cursory evaluation indicates that the contaminant concentrations documented in 2023 do not conflict with the previous works (it is noted that sum TPH concentrations >3,000mg/kg [sample V7, Figure 4B] remained *in-situ* following the 2011 site redevelopment).

The observed contaminant concentrations in the eastern part of the Site indicate the presence of a localized contamination source within the smear zone.

### 5.3.2 Groundwater

The most recent groundwater monitoring conducted by URS is reported in the August 2014 GME. The report indicated the presence of BTEX, TPH, PAHs and metals in groundwater samples collected from monitoring wells across the Site. Arcadis' 2023 GME reports the presence of mid-heavy end TPH constituents and BTEX in the groundwater sample collected from MW106 (located in the eastern part of the Site) with minimal detections of PAHs recorded within groundwater samples collected across the Site. A contaminant Distribution Plot for groundwater is presented as Figure 5 representing the distribution of Benzene, Xylenes, Total TPH and PAH16 during 2014 and 2022 groundwater monitoring works. The most elevated groundwater impacts identified during this investigation (MW106) is noted to be in an area not thoroughly investigated previously (nearby monitoring well URSMW104 was not sampled in 2014). With the exception of MW106, groundwater quality across the remaining areas of the site assessed in 2023 appear to be in line with the previous investigation in 2011. The contaminants identified in groundwater have the potential to migrate off-Site via the shallow aquifer and impact nearby receptors, such as surface water bodies. Additionally, the presence of these contaminants in the groundwater may indicate sources of contamination at the Site that have yet to be identified. As a result of the elevated impacts identified in MW106, there is considered a potential risk to the secondary A aquifer beneath the Site and the River Soar located 37m east of the Site.

## 6 Conclusions

The environmental work summarised in this report comprises the installation of four groundwater monitoring wells across the Site in November 2022 and groundwater monitoring of the newly installed monitoring wells undertaken in January 2023. The findings of the environmental investigation indicated the following:

- No visual or olfactory evidence of contamination was identified in soil samples collected during the drilling of MW101, MW104 and MW105. A hydrocarbon odour was noted at MW106 within soil samples collected from 0.15m bgl to 1.84m bgl and a hydrocarbon sheen was observed between 1.59 mbgl to 1.79 m bgl.
- All monitoring wells installed screened the Made Ground and River Terrace Deposits. Groundwater was encountered at depths ranging between 0.61m bgl to 1.49m bgl during the January 2023 groundwater monitoring visit and between 0.55m bgl to 1.46m bgl during March 2023 groundwater elevation survey. The groundwater elevation data from both the groundwater elevation surveys inferred a groundwater flow direction towards the west/southwest. However previous groundwater monitoring conducted in August 2014 indicated the groundwater flow direction towards east.
- The laboratory analysis of COPC in soil samples collected in November 2022 indicated detectable concentrations of TPH, BTEX, PAH16 within shallow soil samples (approximately <2m bgl). The highest concentrations of COPC were observed in soil samples collected from MW106.
- The soil samples collected from MW101 and MW104 were shallow unsaturated soil (0.2 to 0.5m bgl) whereas the soil samples collected from MW105 and MW106 were saturated soil (1m bgl). The analysis results from both saturated and unsaturated soil samples are considered to be useful in providing insight into location and extent of contaminant mass present beneath the Site.
- The laboratory analysis of COPC in groundwater samples collected across the Site in January 2023 indicated detectable concentrations of TPH, BTEX, PAH16. The highest concentrations of COPC were observed in groundwater sample collected from MW106.
- Limited COPC were detected in soil samples collected in November 2022 which exceeded the Arcadis GAC protective of water resources (aquifers and surface waters) with exceedances of BTEX and naphthalene at MW106, benzo(b,k)fluoranthene, benzo(g,h,i)pyrene and indeno(1,2,3-c,d)pyrene within shallow soil samples collected from all four sampling locations.
- A single COPC in soils collected in November 2022 from MW106 exceeded the Arcadis GAC protective of human health for continued petroleum use (>C8-C10 Aliphatic hydrocarbons).
- None of the COPC were detected in exceedance of the Arcadis GAC protective of human health for continued petroleum use within groundwater samples collected from MW106.
- Concentrations of benzene, sum TPH (>C5-C35) Aliphatics/Aromatics, and naphthalene in MW106, along with benzo(a)pyrene in MW105, were detected in exceedance of the Arcadis GAC protective of water resources (aquifers and surface waters) and UK drinking water quality standards within the groundwater samples collected.
- The COPC concentrations measured in soil and groundwater samples collected and the olfactory evidence observed at MW106 indicates the possible presence of localised contamination in the eastern part of the Site.
- The subsurface geology of the Site is complex, with sand, gravel, and clay layers intermixed, presenting challenges in determining the contaminants flow through it. Additionally, the hydrogeology of the Site is complex, the previous reports have revealed varying flow directions.
- Given the findings of the investigations completed to date, there is considered to be a potential risk to the secondary A aquifer under the Site and the River Soar located 37m southeast of the Site.

## **APPENDIX A**

### **Report Figures**

**Figure 1 – Site Location Plan**

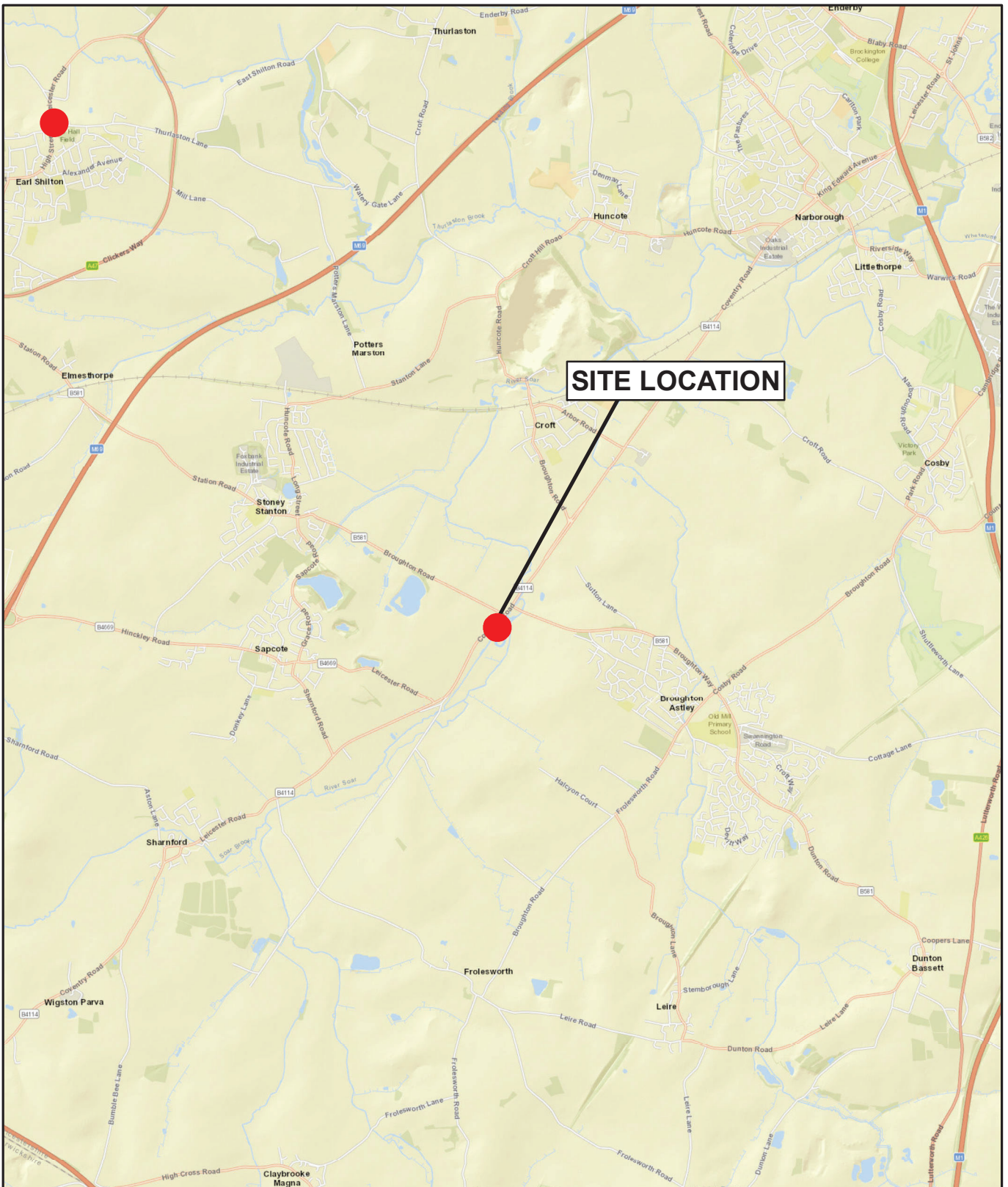
**Figure 2 – Site Layout and Groundwater Elevation Plan**

**Figure 3 – Topographical and PAS 128 Utility Survey Plan**

**Figure 4A – Contaminant Distribution in Soil Boring Locations**

**Figure 4B – Contaminant Distribution in Soil Validation Samples.**


**Figure 5 – Contaminant Distribution in Groundwater Plot**



Service Layer Credits: Sources: Esri, HERE, Garmin, USGS, Intermap, INCREMENT P, NRCan, Esri Japan, METI, Esri China (Hong Kong), Esri Korea, Esri (Thailand), NGCC, (c) OpenStreetMap contributors, and the GIS User Community

ORDNANCE SURVEY © CROWN COPYRIGHT 2022. ALL RIGHTS RESERVED. LICENSE NUMBER 100050351. CONTACT ARCADIS UK IN CASE ANY QUERY

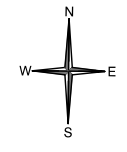
TITLE: <b>SITE LOCATION PLAN</b>	
SITE: <b>SHELL SUTTON ELMS</b>	
CLIENT: <b>SHELL UK OIL PRODUCTS LIMITED</b>	
PROJECT: <b>10044284</b>	<b>FIGURE 1</b>
DATE: 06/07/22	DRAWN BY: AP
DRG No.: 10044284-AUK-SHSE-XX-DR-ZZ-0412-P1.GIS	
SCALE: 1:50,000	PRINT: A4

LEGEND	
	SITE LOCATION

NOTES
SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE.







KEY

- MW101 GROUNDWATER MONITORING WELL
- (75.46) GROUNDWATER ELEVATION
- 75.40 GROUNDWATER ELEVATION CONTOUR LINE
- ← GROUNDWATER FLOW DIRECTION
- (75.51) GROUNDWATER ELEVATION (SECOND ROUND)
- 75.50 GROUNDWATER ELEVATION CONTOUR LINE (SECOND ROUND)
- ← GROUNDWATER FLOW DIRECTION (SECOND ROUND)

NOTES

BASED ON DRAWING BY ARTELIA  
DRAWING No: 10019140  
DATE: OCTOBER, 2018

REV	DATE	COMMENT	CAD

TITLE:  
GROUNDWATER MONITORING WELL  
LOCATION AND CONTOUR PLAN

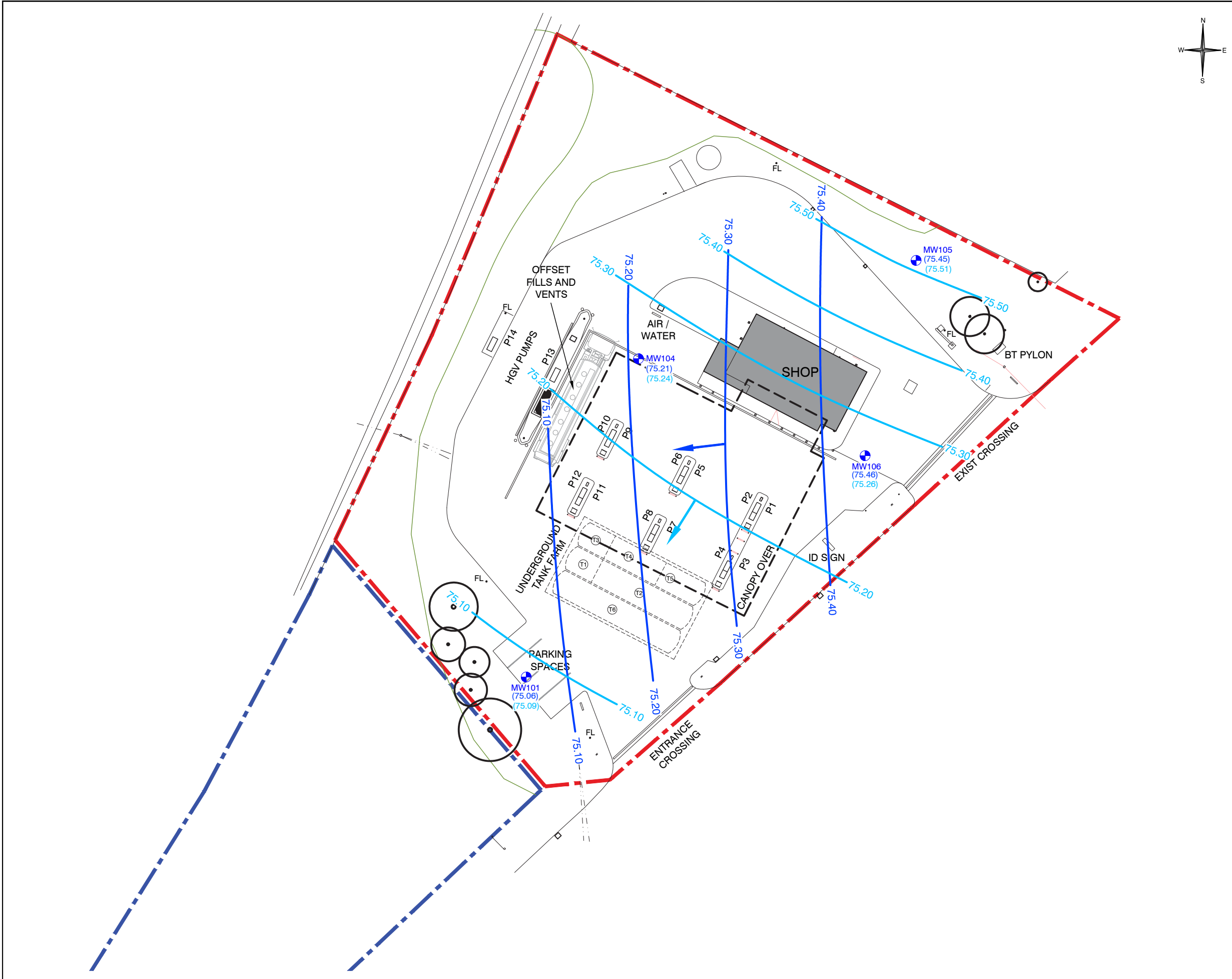
SITE:  
SHELL SUTTON ELMS

CLIENT:  
SHELL UK OIL PRODUCTS LIMITED

PROJECT: 10044284      FIGURE 2

DATE: 13/02/22    DRAWN: MS    REV: 01

DRG.No.: 10044284-AUK-SHSE-XX-DR-ZZ-0647-P1    PRINT: A3

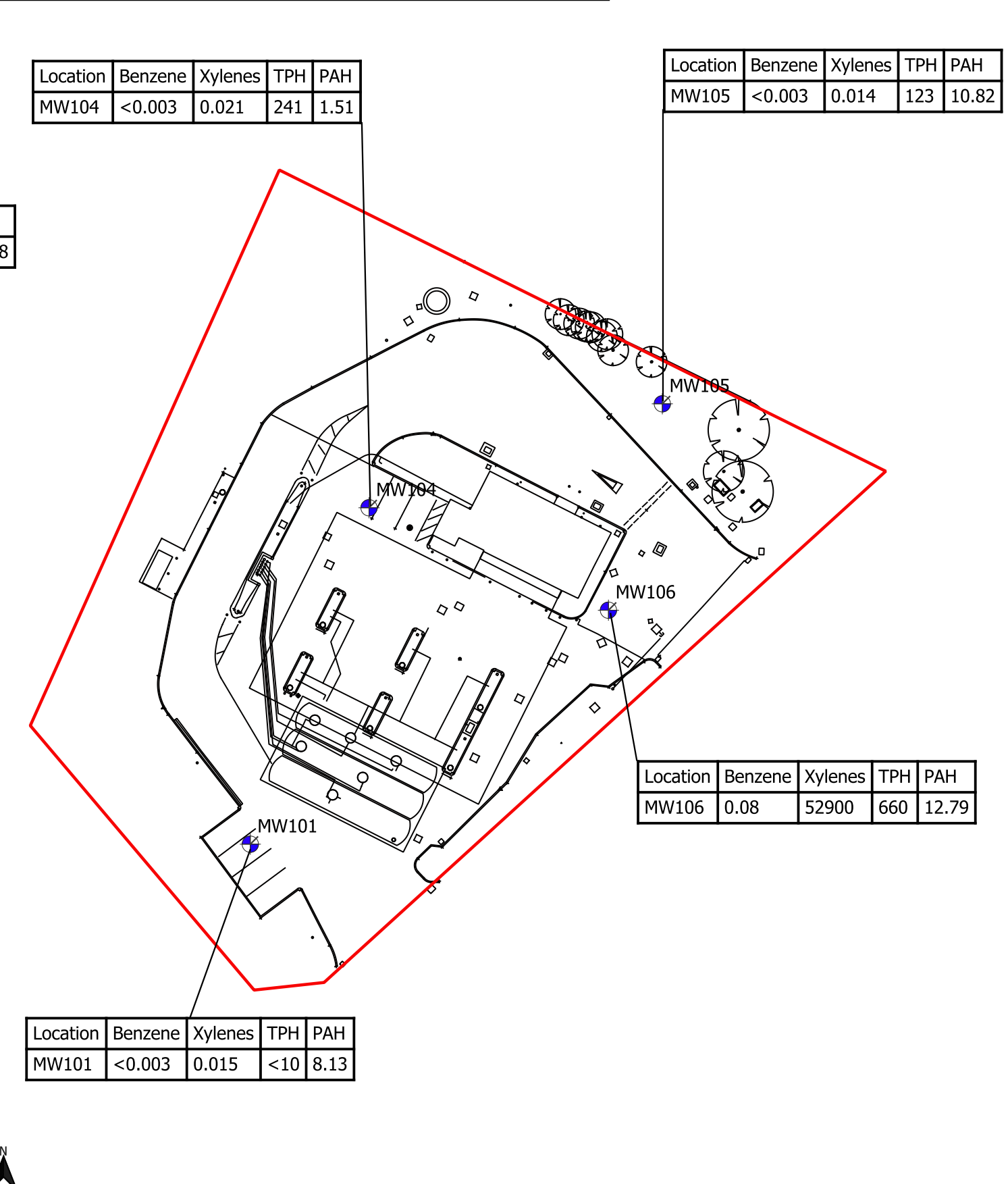
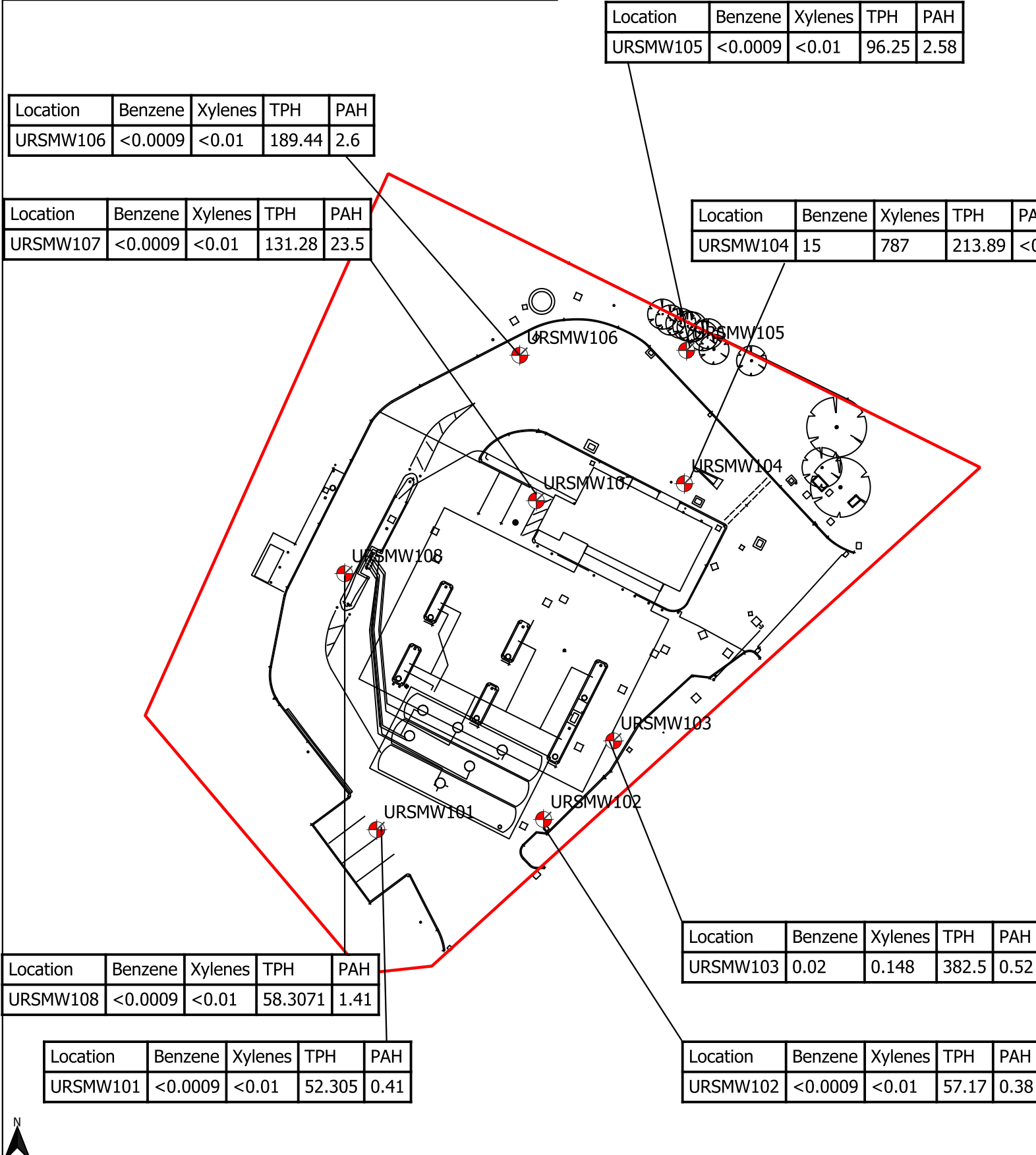


NOTE: ALL ENTITIES SHOWN ON THIS DRAWING ARE TO BE REGARDED AS APPROXIMATE AND ARE INDICATIVE ONLY. NO MEASUREMENTS TAKEN FROM THIS DRAWING SHOULD BE USED FOR THE LOCATION OF INTRUSIVE INVESTIGATION WORKS ON SITE. SYMBOLS FOR BOREHOLES, TRIAL PITS AND OTHER SPECIFIC FEATURES ARE REPRESENTATIONS OF LOCATION ONLY AND UNLESS OTHERWISE SPECIFIED, DO NOT REPRESENT THE TRUE SIZE OF THE FEATURE. - CONTACT ARCADIS UK IN CASE OF ANY QUERY



Contaminant Distribution in Soil Plot - August 2011 URS Works

Contaminant Distribution in Soil Plot - January 2023 Arcadis Works



Scale: 1:499.999611

0 10 20 30 m

REV	Date	Description	Drawn	Check	Approved
1	25/06/2023	Figure 4B	SK	SB	PH

**Legend**

- Indicative Site Boundary
- Groundwater Monitoring Well Installed in 2011
- Groundwater Monitoring Well Installed in 2023

**NOTES:**

Total Xylenes - Total concentration of m,p,oXylenes

Total TPH - Total Petroleum Hydrocarbon (C5 -C35 Aromatics)

Total PAH - Poly Aromatic Hydrocarbons (addition of 16 PAH)

[Maximum Concentration at each Well Location is selected as representative Sample]

All CoPC's are measured in mg/Kg

**CLIENT:**

SHELL UK OIL PRODUCTS LIMITED

**PROJECT:**

SHELL SUTTON ELMS

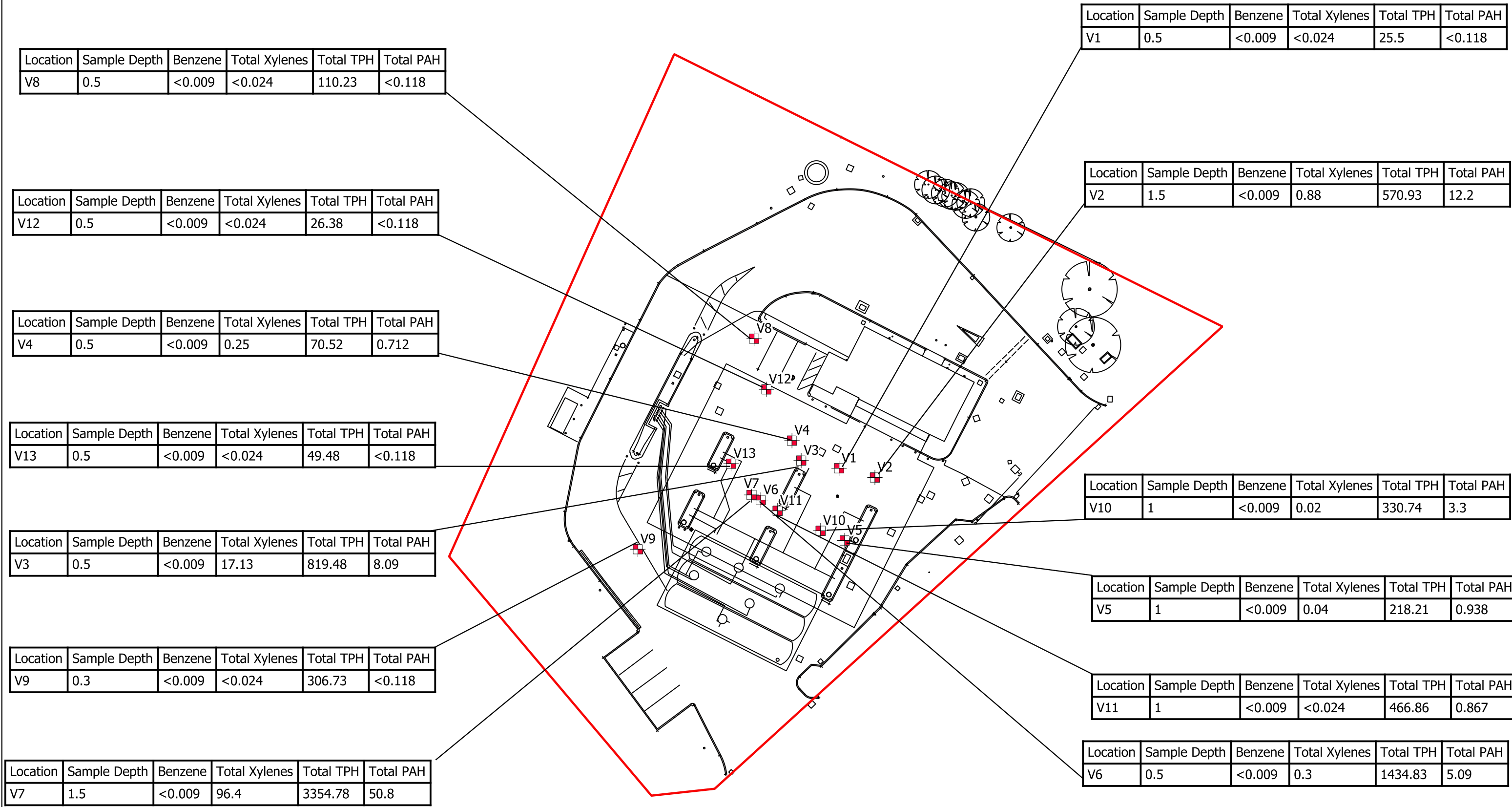
**TITLE:**

Figure 4A: Contaminant Distribution in Soil Boring Locations

Registered office: Arcadis House, 34 York Way, London N1 9AB

Co-Ordinating office: 62-68 Hills Road, Cambridge, CB2 1LA

Drawing Number: 10044284-AUK-SHSE-XX-DR-ZZ-0784-P1



Scale: 1:400

0 10 20 30 m

0	Figure 4B				
REV	Date	Description	Drawn	Check	Approved

**Legend**

- Indicative Site Boundary
- + Soil Validation Sample Locations

NOTES:

Total Xylenes - Total concentration of m,p,oXylenes

Total TPH - Total Petroleum Hydrocarbon (C5 -C35 Aromatics)

Total PAH - Poly Aromatic Hydrocarbons (addition of 16 PAH)

CLIENT:

SHELL UK OIL PRODUCTS LIMITED

PROJECT:

SHELL SUTTON ELMS

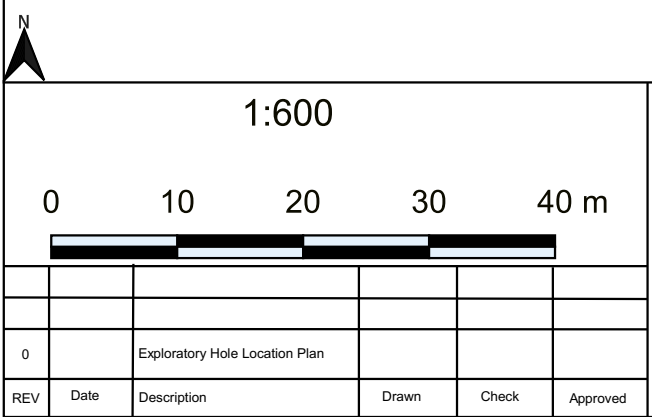
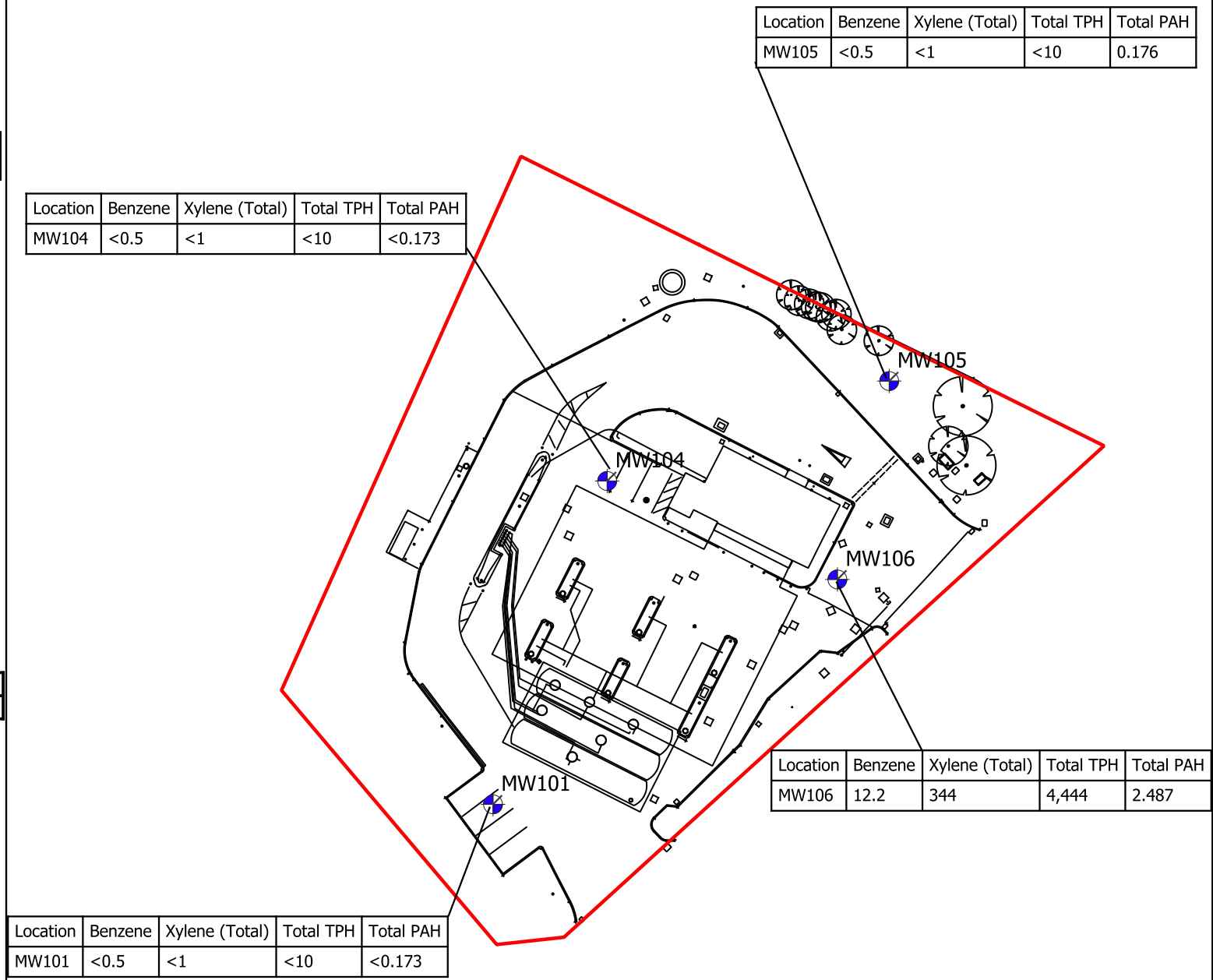
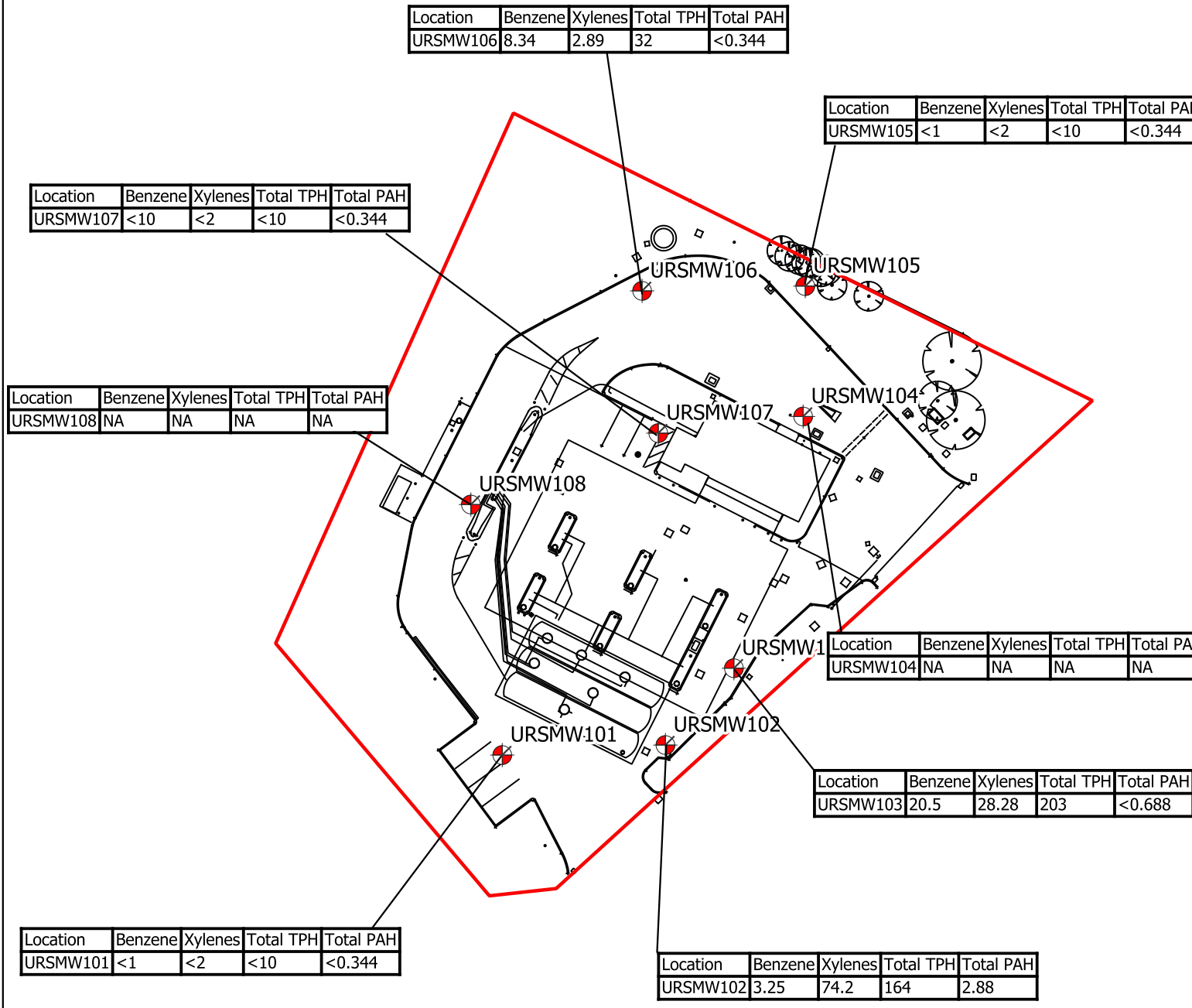
TITLE:

Figure 4B: Contaminant Distribution in Soil Validation Samples

Registered office: Arcadis House, 34 York Way, London N1 9AB

Co-Ordinating office: 62-68 Hills Road, Cambridge, CB2 1LA

Drawing Number: 10044284-AUK-SHSE-XX-DR-ZZ-0736-P1



- Legend**
- Indicative Site Boundary
  - Groundwater Monitoring Well Installed in 2011
  - Groundwater Monitoring Well Installed in 2023

NOTES:

Total Xylenes - Total concentration of m,p&oXylenes

Total TPH - Total Petroleum Hydrocarbon (C5 -C35 Aromatics)

Total PAH - Poly Aromatic Hydrocarbons (addition of 16 PAH)

All CoPC's are measured in µg/L

CLIENT:

SHELL UK OIL PRODUCTS LIMITED

PROJECT:

SHELL SUTTON ELMS

TITLE:

Figure 5: Contaminant Distribution in Groundwater Plot

Registered office: Arcadis House, 34 York Way, London N1 9AB

Co-Ordinating office: 62-68 Hills Road, Cambridge, CB2 1LA

Drawing Number: 10044284-AUK-SHSE-XX-DR-ZZ-0736-P1

# APPENDIX B

## Study Limitations

## Arcadis' Study Limitations

**IMPORTANT.** This appendix should be read before reliance is placed on any of the information, opinions, advice, recommendations or conclusions contained in this report.

1. This report has been prepared by Arcadis Ltd. (Arcadis), with all reasonable skill, care and diligence within the terms of the Appointment and with the resources and manpower agreed with Shell UK Oil Products Limited (the 'Client'). Arcadis does not accept responsibility for any matters outside the agreed scope.
2. This report has been prepared for the sole benefit of the Client unless agreed otherwise in writing. The contents of this report may not be used or relied upon by any person other than this party without the express written consent and authorisation of Arcadis.
3. Unless stated otherwise, no consultations with authorities or funders or other interested third parties have been carried out. Arcadis is unable to give categorical assurance that the findings will be accepted by these third parties as such bodies may have unpublished, more stringent objectives. Further work may be required by these parties.
4. All work carried out in preparing this report has used, and is based on, Arcadis' professional knowledge and understanding of current relevant legislation. Changes in legislation or regulatory guidance may cause the opinion or advice contained in this report to become inappropriate or incorrect. In giving opinions and advice, pending changes in legislation, of which Arcadis is aware, have been considered. Following delivery of the report, Arcadis has no obligation to advise the Client or any other party of such changes or their repercussions.
5. This report is only valid when used in its entirety. Any information or advice included in the report should not be relied upon until considered in the context of the whole report.
6. Whilst this report and the opinions made are correct to the best of Arcadis' belief, Arcadis cannot guarantee the accuracy or completeness of any information provided by third parties. provided by third parties. Arcadis has taken reasonable steps to ensure that the information sources used for this assessment provided accurate information and has therefore assumed this to be the case.
7. This report has been prepared based on the information reasonably available during the project programme. All information relevant to the scope may not have been received.
8. This report refers, within the limitations stated, to the condition of the Site at the time of the inspection. No warranty is given as to the possibility of changes in the condition of the Site since the time of the investigation.
9. The content of this report represents the professional opinion of experienced environmental consultants. Arcadis does not provide specialist legal or other professional advice. The advice of other professionals may be required.
10. Where intrusive investigation techniques have been employed they have been designed to provide a reasonable level of assurance on the conditions. Given the discrete nature of sampling, no investigation technique is capable of identifying all conditions present in all areas. In some cases the investigation is further limited by Site operations, underground obstructions and above ground structures. Unless otherwise stated, areas beyond the boundary of the Site have not been investigated.
11. If below ground intrusive investigations have been conducted as part of the scope, safe location of exploratory holes has been carried out with reference to the Arcadis ground disturbances procedure. No guarantee can be given that all services have been identified. Additional services, structures or other below ground obstructions, not indicated on the drawing, may be present on Site.
12. Unless otherwise stated the report provides no comment on the nature of building materials, operational integrity of the facility or on any regulatory compliance issues.
13. Unless otherwise stated, an inspection of the Site has not been undertaken and there may be conditions present at the Site which have not been identified within the scope of this assessment.
14. Unless otherwise stated, samples from the Site (soil, groundwater, building fabric or other samples) have not been obtained.
15. Arcadis has relied upon the accuracy of documents, oral information and other material and information provided by the Client and others, and Arcadis assumes no liability for the accuracy of such data, although in the event of apparent conflicts in information, Arcadis would highlight this and seek to resolve.
16. Unless otherwise stated, the scope of works has not included an environmental compliance review, health and safety compliance review, hazardous building materials assessment, interviews or contacting Local Authority, requests for information to the petroleum officer, sampling or analyses of soil, ground water, surface water, air or hazardous building materials or a chain of title review.
17. Unless otherwise stated, this assessment has considered the ongoing use of the Site and has not been prepared for the purposes of redevelopment which may act as a trigger for Site investigation and remediation works not needed for ongoing use.

## **APPENDIX C**

### **Borehole Logs**





Project  
**Shell Sutton Elms**  
 Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
 Easting (OS mE)

Ground Level (mAOD)  
**0.00**  
 Northing (OS mN)

Start Date  
**15/11/2022**  
 End Date  
**15/11/2022**

Scale  
**1:15**  
 Sheet 1 of 1

Progress Date / Time Casing / DTW	Samples Type - Depth (m)	Tests and Measurements			Strata		Depth (Thickness)	Level	Install/ Backfill
		Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description	Legend			
2022/11/15 11:30 - / -		PID 0.21m <1ppm			MADE GROUND: CONCRETE		(0.21)		
					MADE GROUND: SUB BASE MATERIAL.		0.21	-0.21	
2022/11/15 12:30 - / -					MADE GROUND: CONCRETE		0.30	-0.30	

DRILLING TECHNIQUE			HOLE / CASING DIAMETER				CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS				WATER ADDED				
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres	
0.00	0.30	Inspection Pit	300	0.30	300	0.30																	

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS															
Name	Type	m AGL	Well Name	From	To	Dia.	Refused on concrete slab															



Project  
**Shell Sutton Elms**  
 Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
 Easting (OS mE)

Ground Level (mAOD)  
**0.00**  
 Northing (OS mN)

Start Date  
**15/11/2022**  
 End Date  
**15/11/2022**

Scale  
**1:15**  
**Sheet 1 of 1**

Progress Date / Time Casing / DTW	Samples Type - Depth (m)	Tests and Measurements			Strata		Depth (Thickness)	Level	Install/ Backfill
		Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description	Legend			
2022/11/15 12:50 - / -		PID 0.20m <1ppm			MADE GROUND: CONCRETE		(0.20)		
					MADE GROUND: SUB BASE MATERIAL.		0.20 (0.11)	-0.20	
2022/11/15 13:30 - / -					MADE GROUND: CONCRETE .		0.31	-0.31	

DRILLING TECHNIQUE			HOLE / CASING DIAMETER				CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS				WATER ADDED			
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres
0.00	0.31	Inspection Pit	300	0.30																		

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS															
Name	Type	m AGL	Well Name	From	To	Dia.	Refused on concrete slab															

Project  
**Shell Sutton Elms**  
Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
Easting (OS mE)  
**450804.79**

Ground Level (mAOD)  
**76.54**  
Northing (OS mN)  
**293728.24**

Start Date  
**15/11/2022**  
End Date  
**24/11/2022**

Scale  
**1:50**  
Sheet 1 of 1

Progress	Samples	Tests and Measurements				Strata		Depth (Thickness)	Level	Install/ Backfill
		Type - Depth (m)	Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description	Legend			
2022/11/15 14:20 - / -	(1) 0.20	PID 0.20m	<1ppm			MADE GROUND: CONCRETE with rebar and plastic membrane.	[Cross-hatch pattern]	0.19	76.35	[Diagram]
		PID 0.50m	<1ppm			MADE GROUND: SUB BASE MATERIAL - Grey sandy gravel. Gravel is fine to coarse subangular of granite.		0.46		
	(2) 1.00							0.65	75.89	
		PID 1.00m	<1ppm			Soft mottled orangish brown and brown sandy CLAY.		0.76		
		PID 1.20m	<1ppm							
		PID 1.50m	<1ppm			Soft light brown mottled grey speckled white sandy gravelly CLAY. Gravel is fine to coarse subangular of flint chalk and sandstone.		1.41	75.13	
		PID 2.00m	<1ppm					0.96		
		SPT() 2.00m	N>50 (0 for 0mm/0 for 0mm)							
	(ES3) 4.20-4.50	PID 2.50m	<1ppm			Soft to Firm mottled brown and grey speckled white sandy CLAY with occasional fine gravel of chalk.		2.37	74.17	
		PID 3.00m	<1ppm							
		SPT() 3.00m	N>50 (0 for 0mm/0 for 0mm)							
		PID 3.50m	<1ppm							
		PID 4.00m	<1ppm			Brown speckled cream clayey gravelly SAND. Sand is fine to coarse. Gravel is fine to coarse subrounded of flint and chalk.		4.08	72.46	
		PID 4.20m	<1ppm					0.51		
2022/11/24 11:18 - / -	PID 4.50m	<1ppm			Brown slightly clayey gravelly SAND. Gravel is fine to medium subangular to subrounded of flint and chalk.		4.59	71.95		
							0.45			
	PID 5.00m	<1ppm			Mottled cream and brown sandy gravel. Gravel is fine to coarse subangular to subrounded of flint, chalk and sandstone. 4.67-4.7m bgl		5.04	71.50		
					Mottled cream and brown sandy gravel. Gravel is fine to coarse subangular to subrounded of flint, chalk and sandstone. 4.77-4.81m bgl		5.12	71.42		
	PID 5.50m	<1ppm			Dark brown mottled black sandy GRAVEL. Gravel is fine to coarse subrounded of flint, chalk and black rock.		5.70	70.84		

DRILLING TECHNIQUE			HOLE / CASING DIAMETER				CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS			WATER ADDED					
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres	
0.00	1.23	Inspection Pit	300	1.23						15/11/2022 15:00	1.20	1.14											
1.23	5.70	Dynamic Sample								24/11/2022 09:38	1.56												

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS										
Name	Type	m AGL	Well Name	From	To	Dia.											
MW101	Standpipe	0.000	MW101	0.50	5.50	50											

Project  
**Shell Sutton Elms**  
Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
Easting (OS mE)  
**450816.42**

Ground Level (mAOD)  
**76.38**  
Northing (OS mN)  
**293761.17**

Start Date  
**16/11/2022**  
End Date  
**25/11/2022**

Scale  
**1:50**  
Sheet 1 of 1

Progress Date / Time Casing / DTW	Samples Type - Depth (m)	Tests and Measurements			Strata		Depth (Thickness)	Level	Install/ Backfill
		Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description	Legend			
2022/11/16 09:00 - / -	(ES1) 0.50	PID 0.50m <1ppm			MADE GROUND: CONCRETE. <i>Rebar 0.08m bgl</i>		0.16 0.16	76.22	
	(ES2) 1.00	PID 1.00m <1ppm PID 1.20m <1ppm PID 1.50m <1ppm			MADE GROUND: SUB BASE MATERIAL - Brown sandy GRAVEL. Gravel is fine to coarse subangular of granite. MADE GROUND: Soft mottled greenish grey and light brown sandy gravelly CLAY. Gravel is medium to coarse subangular of granite and red brick. Soft greenish grey mottled brown sandy slightly gravelly CLAY. Gravel is medium subrounded of flint.		0.61 0.14 0.75	75.77 75.63	
	(ES3) 3.80-4.20	PID 2.00m <1ppm SPT() 2.00m N>50 (0 for 0mm/0 for 0mm) PID 2.50m <1ppm PID 3.00m <1ppm PID 3.50m <1ppm SPT() 3.50m N>50 (0 for 0mm/0 for 0mm) PID 4.00m <1ppm PID 4.50m <1ppm PID 5.00m <1ppm PID 5.50m <1ppm PID 6.00m <1ppm PID 6.30m <1ppm			Soft mottled brown and grey sandy gravelly CLAY. Gravel is fine to coarse subrounded of chalk. Reddish brown slightly clayey SAND with rare flint gravel. Soft mottled grey and brown sandy slightly gravelly CLAY. Gravel is fine to coarse subangular to subrounded of flint and chalk. Soft brownish speckled white grey sandy CLAY. Brown mottled cream clayey sandy GRAVEL. Gravel is subangular to subrounded of chalk and flint. Brown speckled white slightly clayey slightly gravelly SAND. Gravel is fine to coarse subangular of flint and chalk. <i>Becomes gravelly 4.6-4.7m bgl</i> <i>Becomes gravelly 4.8-4.85m bgl</i> Brown clayey SAND with rare chalk and flint fine gravel and black banding. Soft greyish brown sandy CLAY.		1.45 (0.25) 1.70 (0.30) 2.00 (1.09) 3.09 (0.72) 3.81 (0.44) 4.25 (0.60) 4.85 (1.06) 5.91 (0.39) 6.30	74.93 74.68 74.38 73.29 72.57 72.13 71.53 70.47 70.08	

DRILLING TECHNIQUE			HOLE / CASING DIAMETER			CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS			WATER ADDED						
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres	
0.00	1.20	Inspection Pit Dynamic Sample	300	1.20						25/11/2022 08:09	1.20			5.00									

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS															
Name	Type	m AGL	Well Name	From	To	Dia.																
MW104	Standpipe	0.000	MW104	0.50	5.50	50																

Project  
**Shell Sutton Elms**  
 Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
 Easting (OS mE)

Ground Level (mAOD)  
**0.00**  
 Northing (OS mN)

Start Date  
**16/11/2022**  
 End Date  
**18/11/2022**

Scale  
**1:15**  
 Sheet 1 of 1

Progress		Samples		Tests and Measurements				Strata				Depth (Thickness)	Level	Install/Backfill	
Date / Time Casing / DTW	Type - Depth (m)	Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description			Legend							
2022/11/16 14:10 - / -															
		PID 0.50m <1ppm										(0.60)			
2022/11/16 14:30 - / -												0.60	-0.60	-0.60	

DRILLING TECHNIQUE			HOLE / CASING DIAMETER			CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS			WATER ADDED						
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres	
0.00	0.60	Inspection Pit																					

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS														
Name	Type	m AGL	Well Name	From	To	Dia.															
							Refused on concrete slab														




Project  
**Shell Sutton Elms**  
 Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
 Easting (OS mE)  
**450839.66**

Ground Level (mAOD)  
**76.17**  
 Northing (OS mN)  
**293751.28**

Start Date  
**16/11/2022**  
 End Date  
**16/11/2022**

Scale  
**1:15**  
 Sheet 1 of 1

Progress Date / Time Casing / DTW	Samples Type - Depth (m)	Tests and Measurements			Strata		Depth (Thickness)	Level	Install/ Backfill
		Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description	Legend			
2022/11/16 11:15 - / -					MADE GROUND: ASPHALT.		0.15	76.02	
					MADE GROUND: SUB BASE MATERIAL.		0.15		
					MADE GROUND: CONCRETE.		0.12		
							0.27	75.90	75.90

DRILLING TECHNIQUE			HOLE / CASING DIAMETER				CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS				WATER ADDED				
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres	

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS															
Name	Type	m AGL	Well Name	From	To	Dia.	Refused on concrete															

Project  
**Shell Sutton Elms**  
Client  
**Shell UK Oil Products Ltd.**

Project No.  
**10044284**  
Easting (OS mE)  
**450839.88**

Ground Level (mAOD)  
**76.14**  
Northing (OS mN)  
**293751.14**

Start Date  
**16/11/2022**  
End Date  
**22/11/2022**

Scale  
**1:50**  
Sheet 1 of 1

Progress Date / Time Casing / DTW	Samples Type - Depth (m)	Tests and Measurements			Strata		Depth (Thickness)	Level	Install/ Backfill
		Type - Depth (m) - Result	Fracture Details	TCR SCR RGD	Description	Legend			
2022/11/16 11:15 - / -					MADE GROUND: ASPHALT.		(0.15) 0.15	75.99	
	(ES1) 1.00	PID 0.50m <1ppm			MADE GROUND: Dark grey to dark brown clayey gravelly SAND with frequent cobbles of brick and red brick. Gravel is fine to coarse subangular of brick, bituminous material and granite. Hydrocarbon odour noted.		(1.21)		
		PID 1.00m 61.3ppm							
		PID 1.30m 216.3ppm							
	(ES2) 1.50-1.80	PID 1.50m Over 5000ppm			Brown clayey gravelly SAND. Gravel is fine to coarse subrounded of flint. Hydrocarbon odour noted.		1.36	74.78	
		PID 1.70m Over 5000ppm			<i>Dark grey to black staining. Sheen noted 1.59-1.79m bgl</i>		(0.48)		
		PID 2.00m 223.9ppm SPT() 2.00m N>50 (0 for 0mm/0 for 0mm)			Soft mottled grey and brown speckled white sandy gravelly CLAY. Gravel is fine to medium subrounded of chalk. Frequent roots and rootlets		1.84	74.30	
	(ES3) 2.30-2.50	PID 2.50m 1.6ppm					(0.72)		
		PID 3.00m <1ppm			Soft brownish grey to greyish brown sandy CLAY.		2.56	73.58	
		PID 3.50m <1ppm SPT() 3.50m N>50 (0 for 0mm/0 for 0mm)							
		PID 4.00m 1.2ppm							
		PID 4.50m <1ppm					(3.94)		
		PID 5.00m 1.9ppm							
		PID 5.50m <1ppm							
		PID 6.00m 1.0ppm							
		PID 6.40m <1ppm							
							6.50	69.64	

DRILLING TECHNIQUE		HOLE / CASING DIAMETER			CHISELLING			WATER OBSERVATIONS					FLUSH DETAILS			WATER ADDED							
From	To	Type	Hole Dia.	Depth	Casing Dia.	Depth	From	To	Duration	Date/Time	Strike	Rest	Mins	Casing	Sealed	From	To	Rtn%	Type	From	To	Litres	
0.00	1.20	Inspection Pit	300	1.20						22/11/2022 14:23	1.57			2.20									
1.20	6.50	Dynamic Sample								22/11/2022 14:54	2.59			2.10									
										22/11/2022 15:48	4.81			3.81									

INSTRUMENTS			WELL SCREEN DESIGN				REMARKS										
Name	Type	m AGL	Well Name	From	To	Dia.											
MW106	Standpipe	-	MW106	0.50	5.50	50											



**APPENDIX D**

**Arcadis Laboratory QA/QC Policy**

## Appendix D

Arcadis is committed to providing our clients and regulators with robust investigative or monitoring results within the confines of the project. We recognise that a report is only as good as the data that is used to draw conclusions and thus it is important that the consultant and the client be able to have full confidence in data provided by laboratories that we use for analysis.

The first step in assuring said confidence is to ensure that our consultants on Site are using appropriate sampling methodologies and are storing collected samples in the appropriate sample containers and under correct conditions. Laboratories are contacted prior to Site works commencing and required analysis discussed, so that the laboratory can provide the necessary sample containers appropriate for sample storage and testing, as well as any preservatives that may be required. On delivery receipt the Site consultant will visually check the containers to make sure the correct number have been delivered and verify that their condition is appropriate for use.

Once collected, samples are shipped to the laboratory in sealed cold boxes/containers provided by the laboratory with cooling aids and a Chain of Custody attached. The Chain of Custody identifies Arcadis as the client, the Arcadis Project Number, the Consultant/Project Manager, the type of sample e.g. groundwater, soil etc., the parameters to be tested and turnaround required for the analysis. Samples boxes are either hand delivered to the laboratory, picked up directly by the laboratory or picked up by a courier sent by the laboratory.

### **QA/QC of Laboratories**

Arcadis has a preferred supplier program, and contract laboratories are expected to have analytical test methods UKAS accredited and to use the MCertS standard as far as possible. The MCertS accreditation was initially developed for the analysis of soils but is also now applied to some water types (e.g. effluent water), but is not available on groundwater analysis. The Environment Agency (EA) requires MCertS accredited data for Sites that are within the regulatory process i.e. Part 2A designated contaminated land Sites. For Sites in which work is being undertaken voluntarily or through Planning it is recommended that the analysis be conducted following the MCertS standard wherever possible.

Data quality control is extremely important to Arcadis because we must be able to rely on the data provided in order to make our interpretations and recommendations. Data provided by the laboratory are provided digital formats to minimise potential for transcription errors during reporting. The data and laboratory QA results submitted by the laboratory are reviewed by the Arcadis Project Manager who has support from the Arcadis Analytical Chemistry Technical Lead. As part of the project execution plan the Project Manager will determine if QA/QC samples are required which could include:

- Duplicate samples (recommended for groundwater sampling only as soil samples are heterogeneous)
- Trip Blank Samples
- Field Blank Samples
- Equipment Rinse Blanks
- Certified Reference Materials submitted as samples.

Arcadis monitor laboratory performance as part of our Integrated Observation (IO) management process. Project teams are encouraged to submit an IO if they experience positive or negative performance during project implementation, the IO's are then reviewed on a monthly basis and if repeat issues are identified with one or more laboratory suppliers a meeting will be convened with the supplier to understand the root cause of the issues experienced.

# APPENDIX E

## Report Tables

Table 1: Comparison of Measured Concentrations of Contaminants in Soil (mg/kg) to Arcadis GAC for Continued Petroleum Use

Table 2: Groundwater Monitoring Installation Details and Elevation Survey

Table 3: Stabilised Hydrogeochemical Parameters in Groundwater

Table 4: Comparison of Measured Concentrations of Contaminants in Groundwater ( $\mu\text{g/l}$ ) to Arcadis GAC for Continued Petroleum Use

Project: 10044284  
 Site Name: Shell Sutton Elms

Table 1 Comparison of Measured Concentrations of Contaminants in Soil (mg/kg) to Arcadis GAC for Continued Petroleum Use										MW101	MW101	MW101	MW104	MW104	MW104	MW104(DUPSO)			
Analyte Group	Location Code	Analyte	Unit	MDL	Arcadis GAC - Human Health - Continued Petroleum Use	Arcadis GAC - Water Resources - Aquifers - England & Wales	Arcadis GAC - Water Resources - Surface Water - England & Wales	15-11-2022		16-11-2022		24-11-2022		24-11-2022					
								0.2 - 0.5	1.0	4.2 - 4.5	0.5	1.0	3.0 - 4.2	3.0 - 4.2					
TPH CWG	NA	Mineral Oil (C10-C40)	mg/kg	30				8.20				1.51							
		TPH(T) Total	mg/kg	0.54															
		Dry Matter Content Ratio 105C	percent	0.1															
		<C5-C6 Aliphatics	mg/kg	0.1	261	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
		<C6-C8 Aliphatics	mg/kg	0.1	291 (SAT) <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
		<C9-C10 Aliphatics	mg/kg	0.1	433 (SAT) <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
		<C10-C12 Aliphatics	mg/kg	0.2	178 (SAT) <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
		<C12-C16 Aliphatics	mg/kg	4	812 (SAT) <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<4	<4	<4	22	<4	<4	<4	<4	<4	<4	<4	
		<C16-C21 Aliphatics	mg/kg	7	NR <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<7	<7	<7	103	<7	<7	<7	<7	<7	<7	<7	
		<C21-C35 Aliphatics	mg/kg	7	NR <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<7	<7	<7	71	<7	<7	<7	<7	<7	<7	<7	
		Total <C5-C35 Aliphatics	mg/kg	19				<19	<19	<19	186	<19	<19	<19	<19	<19	<19	<19	
		<EC5-EC7 Aromatics	mg/kg	0.1	1.5	0.0019	0.019	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
		<EC7-EC8 Aromatics	mg/kg	0.1	2.750 (SAT) <sup>#</sup>	2.3	0.24	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
		<EC8-EC10 Aromatics	mg/kg	0.1	62.8	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<0.1	<0.1	<0.1	<10	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	
		<EC10-EC12 Aromatics	mg/kg	0.2	330 (SAT) <sup>#</sup>	50	50	<0.2	50 <sup>#</sup>	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2	
<EC12-EC15 Aromatics	mg/kg	4	1,660 (SAT) <sup>#</sup>			<4	<4	<4	<4	<4	<4	<4	<4	<4	<4	<4			
<EC15-EC21 Aromatics	mg/kg	7	NR <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<7	<7	<7	31	<7	<7	<7	<7	<7	<7	<7			
<EC21-EC35 Aromatics	mg/kg	7	NR <sup>#</sup>	See TPH <sup>#</sup>	See TPH <sup>#</sup>	<7	<7	<7	14	<7	<7	<7	<7	<7	<7	<7			
Total <EC5-EC35 Aromatics	mg/kg	19				<19	<19	<19	45	<19	<19	<19	<19	<19	<19	<19			
TPH <C5-C35 Aliphatics/Aromatics	mg/kg	38	na <sup>#</sup>			<38	<38	<38	241	<38	<38	<38	<38	<38	<38	<38			
BTEX		Benzene	mg/kg	0.003	1.5	0.0019		<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003		
		Toluene	mg/kg	0.003	2.750 (SAT) <sup>#</sup>	2.3	0.24	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003		
		Ethylbenzene	mg/kg	0.003	221 (SAT) <sup>#</sup>	1.7	0.11	<0.003	<0.003	0.004	<0.003	<0.003	0.008	0.003	0.003	0.003	0.003		
		Styrene (v)	mg/kg	0.003				<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	<0.003	
		p,m-Xylene	mg/kg	0.005				<0.005	<0.005	0.015	<0.005	<0.005	0.021	0.009	0.009	0.009	0.009		
		Total Xylenes	mg/kg		236	2.9	0.17	<0.005	<0.005	0.015	<0.005	<0.005	0.021	0.009	0.009	0.009	0.009		
Fuel oxygenates		Dioisopropyl ether	mg/kg	0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
		Ethanol	mg/kg	0.1				<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
		Ethyl tertiary butyl ether	mg/kg	0.005	15.8	0.07	0.07	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
		DiTBE	mg/kg	0.002	360	0.016	0.016	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
		tert-Butyl methyl ether	mg/kg	0.005				<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005	<0.005		
TPH		tert-Butyl alcohol	mg/kg	0.1	3.700	0.014	0.014	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1		
		EPH <C3-C40	mg/kg	30				258	<30	<30	436	<30	<30	<30	<30	<30			
		GRD <C4-C12 #	mg/kg	0.1				<0.1	<0.1	<0.1	0.314	<0.1	<0.1	<0.1	<0.1	<0.1			
PAH		GRD <C4-C8 #	mg/kg	0.1				<0.1	<0.1	<0.1	0.314	<0.1	<0.1	<0.1	<0.1	<0.1			
		GRD <C8-C12 #	mg/kg	0.1				<0.1	<0.1	<0.1	0.314	<0.1	<0.1	<0.1	<0.1	<0.1			
		Coronene	mg/kg	0.04				0.07	<0.04		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04			
PAH 16		Naphthalene	mg/kg	0.04	69.7 (SAT) <sup>#</sup>	0.015	0.015	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		Acenaphthene	mg/kg	0.05	21,800 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	0.13	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
		Acenaphthylene	mg/kg	0.03	34,500 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>		<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		
		Fluoranthene	mg/kg	0.03	247,000 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	2.02	<0.03	<0.03	0.12	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		
		Anthracene	mg/kg	0.04	1,430,000 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	0.23	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		Phenanthrene	mg/kg	0.03	5,120 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	0.68	<0.03	<0.03	<0.13	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		
		Fluorene	mg/kg	0.04	43,000 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		Chrysenes	mg/kg	0.02	1,970 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	0.80	<0.02	<0.02	0.21	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
		Pyrene	mg/kg	0.03	579,000 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	1.49	<0.03	<0.03	0.38	<0.03	<0.03	<0.03	<0.03	<0.03	<0.03		
		Benzo(a)anthracene	mg/kg	0.06	223 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	0.75	<0.06	<0.06	0.27	<0.06	<0.06	<0.06	<0.06	<0.06	<0.06		
		Benzo(b)fluoranthene	mg/kg	0.05	911 (SAT) <sup>#</sup>	0.026	0.026	0.86	<0.05	<0.05	0.23	<0.05	<0.05	<0.05	<0.05	<0.05	<0.05		
		Benzo(k)fluoranthene	mg/kg	0.02	23,800 (SAT) <sup>#</sup>	0.037	0.037	0.34	<0.02	<0.02	0.09	<0.02	<0.02	<0.02	<0.02	<0.02	<0.02		
		Benzo(a)pyrene	mg/kg	0.04	632 (SAT) <sup>#</sup>	0.013	0.0002		<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		Dibenz(a,h)anthracene	mg/kg	0.04	40.8 (SAT) <sup>#</sup>	- <sup>#</sup>	- <sup>#</sup>	0.09	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		Benzo(a,h)perylene	mg/kg	0.04	136,000 (SAT) <sup>#</sup>	0.105	0.105	0.32	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		Indeno(1,2,3-c,d)pyrene	mg/kg	0.04	5,940 (SAT) <sup>#</sup>	0.022	0.022	0.42	<0.04	<0.04	0.12	<0.04	<0.04	<0.04	<0.04	<0.04	<0.04		
		TPH 16 total	mg/kg	0.5															
		Benzo(i)fluoranthene	mg/kg	0.07				1.20	<0.07	<0.07	0.32	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	<0.07	
		Metals	#8 No UK DWS for total	Antimony (filtered)	µg/L	0.02													
				Arsenic (filtered)	µg/L	0.025		10	50										
Barium (filtered)	µg/L			0.03		700	700												
Cadmium (filtered)	µg/L			0.005		5	0.08-0.25												
Chromium (hexavalent)	mg/kg			0.3	NVP <sup>#</sup>														
Chromium (filtered)	µg/L			0.015		50	3.4 <sup>#</sup>												
Copper (filtered)	µg/L			0.07		2,000	1												
Lead (filtered)	µg/L			0.05		10	1.2												
Mercury (filtered)	µg/L			0.01		1	0.07												
Nickel (filtered)	µg/L			0.02		70	70												
Nickel (filtered)	µg/L			0.02		20	4												
Selenium (filtered)	µg/L			0.03		10	10												
Zinc (filtered)	µg/L			0.03		3,000	12.1												
Asbestos				Asbestos Containing Material	Detect				NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	
				Asbestos type	None				NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	
VOC				Asbestos fibres	Detect				NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	NAD	
		Hexane	mg/kg	0.05				<0.05	<0.05										



Project: 10044284  
 Site Name: Shell Sutton Elms

Table 2 Groundwater Monitoring Installation Details and Elevation Survey														
Monitoring Well	Installation Type	Date Installed	Dip Point Elevation (m AOD)	Dip Point Description	Response Zone (m bgl)	Response Zone (m AOD)	Depth to Well Base on Install (m bgl)	Depth to NAPL (m bgl)	Depth to Water (m bgl)	Depth to Well Base (m bgl)	NAPL Thickness	Groundwater Elevation (m AOD)	Head of Water Above Base (m)	Difference from Installed Depth/ Silt Thickness (m)
<b>Groundwater Elevation Survey Conducted on 18 January 2023</b>														
MW101	50mm ID HDPE Standpipe	18-11-2022	76.55	Ground level	0.5 to 5.5	76.05 to 71.05	5.50	NMP	1.49	4.05	0.00	75.06	2.56	-1.45
MW104	50mm ID HDPE Standpipe	25-11-2022	76.39	Ground level	0.5 to 5.5	75.89 to 70.89	5.50	NMP	1.18	3.95	0.00	75.21	2.77	-1.55
MW105	50mm ID HDPE Standpipe	18-11-2022	76.06	Ground level	0.5 to 5.5	78.56 to 70.56	5.50	NMP	0.61	5.52	0.00	75.45	4.91	0.02
MW106	50mm ID HDPE Standpipe	22-11-2022	76.14	Ground level	0.5 to 5.5	75.64 to 70.64	5.50	NMP	0.68	5.16	0.00	75.46	4.48	-0.34
<b>Groundwater Elevation Survey Conducted on 15 March 2023</b>														
MW101	50mm ID HDPE Standpipe	18-11-2022	76.55	Ground level	0.5 to 5.5	76.05 to 71.05	5.50	NMP	1.46	4.05	0.00	75.09	2.59	-1.45
MW104	50mm ID HDPE Standpipe	25-11-2022	76.39	Ground level	0.5 to 5.5	75.89 to 70.89	5.50	NMP	1.14	1.50	0.00	75.24	0.36	-4.00
MW105	50mm ID HDPE Standpipe	18-11-2022	76.06	Ground level	0.5 to 5.5	78.56 to 70.56	5.50	NMP	0.55	2.55	0.00	75.51	1.99	-2.95
MW106	50mm ID HDPE Standpipe	22-11-2022	76.14	Ground level	0.5 to 5.5	75.64 to 70.64	5.50	NMP	0.88	4.88	0.00	75.26	4.00	-0.62

- Notes:**
- m AOD Meters Above Ordnance Datum
  - m bgl Meters Below Ground Level
  - NAPL Non-Aqueous Phase Liquid
  - NA Not Applicable
  - HDPE High-Density Polyethylene
  - NMP No Measurable Product thickness recorded

Project: 10044284  
 Site Name: Shell Sutton Elms

Table 3 Stabilised Hydrogeochemical Parameters in Groundwater												
Monitoring Well	Date	Sampled Time	Sampling Method	Sample Depth (m bgl)	Temperature (°C)	Dissolved Oxygen (%)	Dissolved Oxygen (mg/l)	Specific Conductivity (µS/cm)	Conductivity (µS/cm)	pH	ORP (mV)	Sample Comments
MW101	18-01-2023	10:07 AM	Multiprobe / Peristaltic	2.50	7.20	49.70	6.03	1033.00	683.00	7.31	77.40	Cloudy and odourless sample was obtained
MW104	18-01-2023	11:15 AM	Multiprobe / Peristaltic	2.50	6.70	17.80	2.16	1050.00	684.00	7.40	54.80	Cloudy and odourless sample was obtained
MW105	18-01-2023	12:15 PM	Multiprobe / Bladder	2.50	7.30	6.10	0.75	678.20	448.30	7.01	-16.70	Cloudy and odourless sample was obtained
MW106	18-01-2023	01:15 AM	Multiprobe / Bladder	2.50	8.50	25.40	2.95	1810.00	1241.00	7.35	43.20	Cloudy and odourless sample was obtained

**Notes:**  
 mg/l milligrammes per litre  
 mV millivolts  
 µS/cm micro-Siemens per centimeter  
 m bgl meters below ground level  
 ORP Oxidation-Reduction Potential  
 - Not applicable  
 NS Parameters not stabilised after 30 minutes

Project: 10044264  
 Site Name: Shell Sutton Elms

Location ID				Arcadis GAC - Human Health - Continued Petroleum Use	Arcadis GAC - Water Resources - Aquifers - England & Wales	Arcadis GAC - Water Resources - Surface Water - England & Wales	Shell RBSL	UK Drinking Water Standards	MW101	MW104	MW105	MW106	
Date				Use	Aquifers	Surface Water	RBSL	Standards	18-01-2023	18-01-2023	18-01-2023	18-01-2023	
Depth (Meters Below Ground Level)									2.50	2.50	2.50	2.50	
Analyte Group	Analyte	Unit	MDL										
TPH CWG	>C5-C6 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	146	
	>C8-C8 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	215	
	>C8-C10 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	173	
	>C10-C12 Aliphatics	µg/L	5	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<5	<5	<5	<5	
	>C12-C16 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	<10	
	>C16-C21 Aliphatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	<10	
	>C21-C35 Aliphatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	<10	
	Total >C5-C35 Aliphatics	µg/L	10					See TPH	<10	<10	<10	534	
	>EC5-EC7 Aromatics	µg/L	10	12,000		1	10		See TPH	<10	<10	<10	<10
	>EC7-EC8 Aromatics	µg/L	10	>SOL <sup>#1</sup>	700	74	74		See TPH	<10	<10	<10	56
	>EC8-EC10 Aromatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	353
	>EC10-EC12 Aromatics	µg/L	5	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<5	<5	<5	3,501
	>EC12-EC16 Aromatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	<10
	>EC16-EC21 Aromatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	<10
	>EC21-EC35 Aromatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	<10	<10	<10
	Total >EC5-EC35 Aromatics	µg/L	10						See TPH	<10	<10	<10	3,910
	TPH >C5-C35 Aliphatics/Aromatics	µg/L	10	na <sup>#3</sup>	50	50	50	50 <sup>#8</sup>	See TPH	<10	<10	<10	4,444
BTEX	Benzene	µg/L	0.5	12,000	1	10		1 <sup>#9</sup>	<0.5	<0.5	<0.5	12.2	
	Toluene	µg/L	5	>SOL <sup>#1</sup>	700	74		700 <sup>#10</sup>	<5	<5	<5	63	
	Ethylbenzene	µg/L	1	>SOL <sup>#1</sup>	300	20		300 <sup>#10</sup>	<1	<1	<1	22	
	Xylene (o)	µg/L	1	>SOL <sup>#1</sup>	250 <sup>#5</sup>	15 <sup>#5</sup>		250 <sup>#11</sup>	<1	<1	<1	80	
	p,m-Xylene	µg/L	2						<2	<2	<2	264	
	Xylene (Total)	µg/L	1	>SOL <sup>#1</sup>	500 <sup>#5</sup>	30 <sup>#5</sup>		93,000 <sup>#7</sup>	500 <sup>#11</sup>	<1	<1	<1	344
Fuel oxygenates	Diisopropyl ether	µg/L	1						<1	<1	<1	<1	
	Ethanol	µg/L	100						<100	<100	<100	<100	
	Ethyl tertiary butyl ether	µg/L	1	460,000	47	47		47 <sup>#12</sup>	<1	<1	<1	<1	
	MTBE	µg/L	0.1	5,200,000	15	15		15 <sup>#13</sup>	<0.1	<0.1	<0.1	<0.1	
TPH	tert-Amyl methyl ether	µg/L	1						<1	<1	<1	<1	
	tert-Butyl alcohol	µg/L	100	20,000,000	12	12		12 <sup>#14</sup>	<100	<100	<100	<100	
	EPH >C8-C40	µg/L	10						<10	520	1,860	3,010	
	GRO (>C4-C12) #	µg/L	10						<10	<10	33	1,209	
PAH 17	GRO (>C4-C28) #	µg/L	10						<10	<10	<10	437	
	GRO (>C8-C12) #	µg/L	10						<10	<10	33	772	
PAH 17	Naphthalene	µg/L	0.1	>SOL <sup>#1</sup>	2	2	15,000 <sup>#7</sup>		<0.1	<0.1	<0.1	2.4	
	Acenaphthene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	<0.005	0.005	0.017	
	Acenaphthylene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005	
	Fluoranthene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			0.005	0.015	0.029	<0.005	
	Anthracene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	0.008	0.013	0.006	
	Phenanthrene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	0.005	0.007	0.009	
	Fluorene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			0.005	0.005	<0.005	0.013	
	Chrysene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	0.011	0.017	0.008	
	Pyrene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			0.007	0.031	0.034	0.023	
	Benzo(a)anthracene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	0.016	0.018	0.011	
	Benzo(b)fluoranthene	µg/L	0.008	>SOL <sup>#1</sup>	0.025	<0.025		0.025 <sup>#15</sup>	<0.008	<0.008	0.017	<0.008	
	Benzo(k)fluoranthene	µg/L	0.008	>SOL <sup>#1</sup>	0.025	<0.025		0.025 <sup>#15</sup>	<0.008	<0.008	<0.008	<0.008	
	Benzo(e)pyrene	µg/L	0.005	>SOL <sup>#1</sup>	0.01	0.00017		0.01 <sup>#9</sup>	<0.005	<0.005	0.013	<0.005	
	Dibenz(a,h)anthracene	µg/L	0.005	>SOL <sup>#1</sup>	<0.005	<0.005			<0.005	<0.005	<0.005	<0.005	
	Benzo(g,h,i)perylene	µg/L	0.005	>SOL <sup>#1</sup>	0.025	<0.025		0.025 <sup>#15</sup>	<0.005	<0.005	0.007	<0.005	
	Indeno(1,2,3-c,d)pyrene	µg/L	0.005	>SOL <sup>#1</sup>	0.025	<0.025		0.025 <sup>#15</sup>	<0.005	<0.005	0.009	<0.005	
	PAH 16 Total	µg/L	0.173						<0.173	<0.173	0.176	2.487	
Benzo(b+k)fluoranthene	µg/L	0.008						<0.008	0.008	0.024	<0.008		
VOC	Hexane	µg/L	50						<50	<50	<50	<50	
	2-methylnaphthalene	µg/L	1						<1	<1	<1	<1	

**Comments:**

- #1 >SOL - Target acceptable risk not exceeded at theoretical solubility concentration
- #2 NR - No appropriate inhalation reference dose identified during review of toxicological data
- #3 na - Comprises multiple contaminants - no GAC derived
- #4 No GAC for individual TPH fractions given that the compliance criteria is for sum TPH
- #5 Criteria derived for sum xylenes split between isomers. Requires summation of m,p & o isomers to use sum xylenes criteria.
- #6 No water quality standard identified as suitable for deriving generic assessment criteria
- #7 Universal Human Health Risk-Based Screening Levels (RBSL) Tables for Shell Downstream. SR.14.13826 Rev 2. March 2021
- #8 No UK DWS for total petroleum hydrocarbons (TPH), or speciated TPH fractions. A value of 50 µg/l is adopted for sum TPH based on the rescinded Private Water Supply Regulations, 1991.
- #9 Water Supply (Water Quality) Regulations 2016.
- #10 Guidelines for Drinking-water Quality, 4th Edition. WHO, 2011
- #11 Guidelines for Drinking-water Quality, 4th Edition. WHO, 2011. Value of 500µg/l for sum xylenes split between isomers. Requires summation of m,p & o isomers to use 500µg/l value.
- #12 The taste and odour threshold of 47µg/l is commonly adopted as a guide.
- #13 The taste and odour threshold of 15µg/l is commonly adopted as a guide.
- #14 The taste and odour threshold of 12µg/l is commonly adopted as a guide.
- #15 Water Supply (Water Quality) Regulations 2016. Value of 0.1µg/l for PAH split between four individual PAH. Requires summation of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene and indeno(123cd)pyrene to use 0.1µg/l value.

**Notes:**

MDL	Method Detection Limit
NA	Data not applicable
m bgl	Meters Below Ground Level
---	Analysis not scheduled/ not applicable
<0.123	Result less than Effective Quantification Limit
0.123	Result above Effective Quantification Limit
EB	Equipment Blank Sample
DUP	Duplicate Sample
0.123	Concentration exceeds Arcadis GAC - Human Health - Continued Petroleum Use
0.123	Concentration exceeds Arcadis GAC - Water Resources - Aquifers - Continued Petroleum Use
0.123	Concentration exceeds Arcadis GAC - Water Resources - Surface Water - Continued Petroleum Use
0.123	Concentration exceeds Shell RBSLs
0.123	Concentration exceeds UK Drinking Water Standards
0.123	Concentration exceeds Arcadis GAC - Water Resources - Aquifers/Surface Water and UK Drinking Water Standards



Project: 10044264  
 Site Name: Shell Sutton Elms

Table 4 Comparison of Measured Concentrations of Contaminants in Groundwater (µg/l) to Arcadis GAC for Continued Petroleum Use											
Location ID				Arcadis GAC - Human Health - Continued Petroleum Use	Arcadis GAC - Water Resources - Aquifers - England & Wales	Arcadis GAC - Water Resources - Surface Water - England & Wales	Shell RBSL	UK Drinking Water Standards	MW106 [Dup]		EB
Date									18-01-2023	18-01-2023	
Depth (Meters Below Ground Level)									2.50	NA	
Analyte Group	Analyte	Unit	MDL								
TPH CWG	>C5-C6 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	147	---	
	>C6-C8 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	217	---	
	>C8-C10 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	171	---	
	>C10-C12 Aliphatics	µg/L	5	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<5	---	
	>C12-C16 Aliphatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	---	
	>C16-C21 Aliphatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	---	
	>C21-C35 Aliphatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	---	
	Total >C5-C35 Aliphatics	µg/L	10					See TPH	535	---	
	>EC5-EC7 Aromatics	µg/L	10	12,000	1	10		See TPH	<10	---	
	>EC7-EC8 Aromatics	µg/L	10	>SOL <sup>#1</sup>	700	74		See TPH	56	---	
	>EC8-EC10 Aromatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	348	---	
	>EC10-EC12 Aromatics	µg/L	5	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	3,516	---	
	>EC12-EC16 Aromatics	µg/L	10	>SOL <sup>#1</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	---	
	>EC16-EC21 Aromatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	---	
	>EC21-EC35 Aromatics	µg/L	10	NR <sup>#2</sup>	See TPH <sup>#4</sup>	See TPH <sup>#4</sup>		See TPH	<10	---	
	Total >EC5-EC35 Aromatics	µg/L	10					See TPH	3,920	---	
	TPH >C5-C35 Aliphatics/Aromatics	µg/L	10	na <sup>#3</sup>	50	50		50 <sup>#8</sup>	4,455	---	
	BTX	Benzene	µg/L	0.5	12,000	1	10		1 <sup>#9</sup>	12.4	<0.5
		Toluene	µg/L	5	>SOL <sup>#1</sup>	700	74		700 <sup>#10</sup>	64	<5
		Ethylbenzene	µg/L	1	>SOL <sup>#1</sup>	300	20		300 <sup>#10</sup>	24	<1
Xylene (o)		µg/L	1	>SOL <sup>#1</sup>	250 <sup>#5</sup>	15 <sup>#5</sup>		250 <sup>#11</sup>	80	<1	
p,m-Xylene		µg/L	2						286	<2	
Xylene (Total)		µg/L	1	>SOL <sup>#1</sup>	500 <sup>#5</sup>	30 <sup>#5</sup>	93,000 <sup>#7</sup>	500 <sup>#11</sup>	346	<1	
Diisopropyl ether		µg/L	1						<1	<1	
Fuel oxygenates	Ethanol	µg/L	100						<100	<100	
	Ethyl tertiary butyl ether	µg/L	1	460,000	47	47		47 <sup>#12</sup>	<1	<1	
	MTBE	µg/L	0.1	5,200,000	15	15		15 <sup>#13</sup>	<0.1	<0.1	
	tert-Amyl methyl ether	µg/L	1						<1	<1	
	tert-Butyl alcohol	µg/L	100	20,000,000	12	12		12 <sup>#14</sup>	<100	<100	
TPH	EPH >C8-C40	µg/L	10						2,440	<10	
	GRO >C4-C12 #	µg/L	10						1,201	<10	
	GRO >C4-C26 #	µg/L	10						440	<10	
	GRO >C8-C12 #	µg/L	10						761	<10	
PAH 17	Naphthalene	µg/L	0.1	>SOL <sup>#1</sup>	2	2	15,000 <sup>#7</sup>		2.2	<0.1	
	Acenaphthene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			0.018	<0.005	
	Acenaphthylene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			<0.005	<0.005	
	Fluoranthene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			<0.005	<0.005	
	Anthracene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			0.010	<0.005	
	Phenanthrene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			0.011	0.006	
	Fluorene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			0.014	0.007	
	Chrysene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			0.014	<0.005	
	Pyrene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			<0.005	<0.005	
	Benzo(a)anthracene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			0.018	<0.005	
	Benzo(b)fluoranthene	µg/L	0.008	>SOL <sup>#1</sup>	0.025	- <sup>#6</sup>		0.025 <sup>#15</sup>	0.012	<0.008	
	Benzo(k)fluoranthene	µg/L	0.008	>SOL <sup>#1</sup>	0.025	- <sup>#6</sup>		0.025 <sup>#15</sup>	<0.008	<0.008	
	Benzo(e)pyrene	µg/L	0.005	>SOL <sup>#1</sup>	0.01	0.00017		0.01 <sup>#9</sup>	<0.005	<0.005	
	Dibenz(a,h)anthracene	µg/L	0.005	>SOL <sup>#1</sup>	- <sup>#6</sup>	- <sup>#6</sup>			<0.005	<0.005	
	Benzo(g,h,i)perylene	µg/L	0.005	>SOL <sup>#1</sup>	0.025	- <sup>#6</sup>		0.025 <sup>#15</sup>	0.005	<0.005	
	Indeno(1,2,3-c,d)pyrene	µg/L	0.005	>SOL <sup>#1</sup>	0.025	- <sup>#6</sup>		0.025 <sup>#15</sup>	0.005	<0.005	
	PAH 16 Total	µg/L	0.173						2,311	<0.173	
	Benzo(b+k)fluoranthene	µg/L	0.008						0.016	<0.008	
	VOC	Hexane	µg/L	50						<50	---
		2-methylnaphthalene	µg/L	1						<1	<1

**Comments:**

- #1 >SOL - Target acceptable risk not exceeded at theoretical solubility concentration
- #2 NR - No appropriate inhalation reference dose identified during review of toxicological data
- #3 na - Comprises multiple contaminants - no GAC derived
- #4 No GAC for individual TPH fractions given that the compliance criteria is for sum TPH
- #5 Criteria derived for sum xylenes split between isomers. Requires summation of m,p & o isomers to use sum xylenes criteria.
- #6 No water quality standard identified as suitable for deriving generic assessment criteria
- #7 Universal Human Health Risk-Based Screening Levels (RBSL) Tables for Shell Downstream. SR.14.13826 Rev 2. March 2021
- #8 No UK DWS for total petroleum hydrocarbons (TPH), or speciated TPH fractions. A value of 50 µg/l is adopted for sum TPH based on the rescinded Private Water Supply Regulations, 1991.
- #9 Water Supply (Water Quality) Regulations 2016.
- #10 Guidelines for Drinking-water Quality, 4th Edition. WHO, 2011
- #11 Guidelines for Drinking-water Quality, 4th Edition. WHO, 2011. Value of 500µg/l for sum xylenes split between isomers. Requires summation of m,p & o isomers to use 500µg/l value.
- #12 The taste and odour threshold of 47µg/l is commonly adopted as a guide.
- #13 The taste and odour threshold of 15µg/l is commonly adopted as a guide.
- #14 The taste and odour threshold of 12µg/l is commonly adopted as a guide.
- #15 Water Supply (Water Quality) Regulations 2016. Value of 0.1µg/l for PAH split between four individual PAH. Requires summation of benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(g,h,i)perylene and indeno(123cd)pyrene to use 0.1µg/l value.

**Notes:**

- MDL Method Detection Limit
- NA Data not applicable
- m bgl Meters Below Ground Level
- Analysis not scheduled/ not applicable
- <0.123 Result less than Effective Quantification Limit
- 0.123 Result above Effective Quantification Limit
- EB Equipment Blank Sample
- DUP Duplicate Sample
- 0.123 Concentration exceeds Arcadis GAC - Human Health - Continued Petroleum Use
- 0.123 Concentration exceeds Arcadis GAC - Water Resources - Aquifers - Continued Petroleum Use
- 0.123 Concentration exceeds Arcadis GAC - Water Resources - Surface Water - Continued Petroleum Use
- 0.123 Concentration exceeds Shell RBSLs
- 0.123 Concentration exceeds UK Drinking Water Standards
- 0.123 Concentration exceeds Arcadis GAC - Water Resources - Aquifers/Surface Water and UK Drinking Water Standards

# **APPENDIX F**

## **Laboratory Certificates of Analysis for Soil and Groundwater Samples**

Arcadis  
Part 3rd Floor  
Charter House  
62-68 Hills Road  
Cambridge  
Cambridgeshire  
CB2 1LA



**Attention :** Shanth Belagodu  
**Date :** 30th November, 2022  
**Your reference :** 10044284  
**Our reference :** Test Report 22/18969 Batch 1  
**Location :** Shell Sutton Elms  
**Date samples received :** 18th November, 2022  
**Status :** Final Report  
**Issue :** 1

Six samples were received for analysis on 18th November, 2022 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**



**Simon Gomery BSc**

Project Manager

Please include all sections of this report if it is reproduced





**Client Name:** Arcadis  
**Reference:** 10044284  
**Location:** Shell Sutton Elms  
**Contact:** Shanth Belagodu

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Asbestos sub-samples are retained for not less than 6 months from the date of analysis unless specifically requested.

The LOQ of the Asbestos Quantification is 0.001% dry fibre of dry mass of sample.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Where trace asbestos is reported the amount of asbestos will be <0.1%.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analyst Name	Date Of Analysis	Analysis	Result
22/18969	1	01MW101151122SO0.2	0.20-0.50	4	Charlotte Taylor	23/11/2022	<b>General Description (Bulk Analysis)</b>	brown soil/stones
					Charlotte Taylor	23/11/2022	<b>Asbestos Fibres</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos ACM</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos Type</b>	NAD
22/18969	1	02MW101151122SO1.0	1.00	8	Charlotte Taylor	23/11/2022	<b>General Description (Bulk Analysis)</b>	brown soil/stones
					Charlotte Taylor	23/11/2022	<b>Asbestos Fibres</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos ACM</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos Type</b>	NAD
22/18969	1	03MW105151122SO1.0-1.2	1.00-1.20	12	Charlotte Taylor	23/11/2022	<b>General Description (Bulk Analysis)</b>	brown soil/stones
					Charlotte Taylor	23/11/2022	<b>Asbestos Fibres</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos ACM</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos Type</b>	NAD
22/18969	1	04MW106161122SO1.0	1.00	16	Charlotte Taylor	23/11/2022	<b>General Description (Bulk Analysis)</b>	brown soil/stones
					Charlotte Taylor	23/11/2022	<b>Asbestos Fibres</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos ACM</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos Type</b>	NAD
22/18969	1	05MW104161122SO0.5	0.50	20	Charlotte Taylor	23/11/2022	<b>General Description (Bulk Analysis)</b>	brown soil/stones
					Charlotte Taylor	23/11/2022	<b>Asbestos Fibres</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos ACM</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos Type</b>	NAD
22/18969	1	06MW104161122SO1.0	1.00	24	Charlotte Taylor	23/11/2022	<b>General Description (Bulk Analysis)</b>	brown soil/stones
					Charlotte Taylor	23/11/2022	<b>Asbestos Fibres</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos ACM</b>	NAD
					Charlotte Taylor	23/11/2022	<b>Asbestos Type</b>	NAD



# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/18969

## SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

## WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

## STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

## DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

## SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

## DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

## BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.



**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**Customer Provided Information**

Sample ID and depth is information provided by the customer.

**ABBREVIATIONS and ACRONYMS USED**

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

## HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/18969

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes

EMT Job No: 22/18969

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248 Second edition (2021)	PM42	Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM83	Modified USEPA method 8260B v2:1996. Determination of Alcohols, Acetates, Acetone, Fuel Oxygenates, THF and Cyclohexane by Headspace GC-MS	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes

Arcadis  
Part 3rd Floor  
Charter House  
62-68 Hills Road  
Cambridge  
Cambridgeshire  
CB2 1LA



**Attention :** Shanth Belagodu  
**Date :** 5th December, 2022  
**Your reference :** 10044284  
**Our reference :** Test Report 22/19428 Batch 1  
**Location :** Shell Sutton Elms  
**Date samples received :** 25th November, 2022  
**Status :** Final Report  
**Issue :** 1

Five samples were received for analysis on 25th November, 2022 of which five were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**



**Paul Boden BSc**  
Senior Project Manager

Please include all sections of this report if it is reproduced







**Client Name:** Arcadis  
**Reference:** 10044284  
**Location:** Shell Sutton Elms  
**Contact:** Shanth Belagodu

**Note:**  
 Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Asbestos sub-samples are retained for not less than 6 months from the date of analysis unless specifically requested.

The LOQ of the Asbestos Quantification is 0.001% dry fibre of dry mass of sample.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Where trace asbestos is reported the amount of asbestos will be <0.1%.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analyst Name	Date Of Analysis	Analysis	Result
22/19428	1	01MW105221122SO1.8-2.0	1.8-2.0	4	Catherine Coles	30/11/2022	<b>General Description (Bulk Analysis)</b>	red sand/stone
					Catherine Coles	30/11/2022	<b>Asbestos Fibres</b>	NAD
					Catherine Coles	30/11/2022	<b>Asbestos ACM</b>	NAD
					Catherine Coles	30/11/2022	<b>Asbestos Type</b>	NAD
22/19428	1	02MW105221122SO2.5-2.7	2.5-2.7	8	Catherine Coles	30/11/2022	<b>General Description (Bulk Analysis)</b>	soil/clay
					Catherine Coles	30/11/2022	<b>Asbestos Fibres</b>	NAD
					Catherine Coles	30/11/2022	<b>Asbestos ACM</b>	NAD
					Catherine Coles	30/11/2022	<b>Asbestos Type</b>	NAD
22/19428	1	03MW106221122SO1.5-1.8	1.5-1.8	12	Anthony Carman	30/11/2022	<b>General Description (Bulk Analysis)</b>	Brown Soil/Stones
					Anthony Carman	30/11/2022	<b>Asbestos Fibres</b>	NAD
					Anthony Carman	30/11/2022	<b>Asbestos ACM</b>	NAD
					Anthony Carman	30/11/2022	<b>Asbestos Type</b>	NAD
22/19428	1	04MW106221122SO2.3-2.5	2.3-2.5	16	Anthony Carman	30/11/2022	<b>General Description (Bulk Analysis)</b>	Brown Soil/Stones
					Anthony Carman	30/11/2022	<b>Asbestos Fibres</b>	NAD
					Anthony Carman	30/11/2022	<b>Asbestos ACM</b>	NAD
					Anthony Carman	30/11/2022	<b>Asbestos Type</b>	NAD
22/19428	1	05MW101241122SO4.2-4.5	4.2-4.5	20	Catherine Coles	30/11/2022	<b>General Description (Bulk Analysis)</b>	redsoil
					Catherine Coles	30/11/2022	<b>Asbestos Fibres</b>	NAD
					Catherine Coles	30/11/2022	<b>Asbestos ACM</b>	NAD
					Catherine Coles	30/11/2022	<b>Asbestos Type</b>	NAD



# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/19428

## SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

## WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

## STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

## DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

## SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

## DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

## BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**Customer Provided Information**

Sample ID and depth is information provided by the customer.

**ABBREVIATIONS and ACRONYMS USED**

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range
AA	x10 Dilution

## HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/19428

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes

EMT Job No: 22/19428

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248 Second edition (2021)	PM42	Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM83	Modified USEPA method 8260B v2:1996. Determination of Alcohols, Acetates, Acetone, Fuel Oxygenates, THF and Cyclohexane by Headspace GC-MS	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes



Arcadis  
Part 3rd Floor  
Charter House  
62-68 Hills Road  
Cambridge  
Cambridgeshire  
CB2 1LA



**Attention :** Shanth Belagodu  
**Date :** 9th December, 2022  
**Your reference :** 10044284  
**Our reference :** Test Report 22/19728 Batch 1  
**Location :** Shell Sutton Elms  
**Date samples received :** 30th November, 2022  
**Status :** Final Report  
**Issue :** 1

Three samples were received for analysis on 30th November, 2022 of which three were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**



**Simon Gomery BSc**

Project Manager

Please include all sections of this report if it is reproduced







Mass of sample taken (kg)	-	Moisture Content Ratio (%) =	20.9		
Mass of dry sample (kg) =	0.09	Dry Matter Content Ratio (%) =	82.7		
Particle Size <4mm =	>95%				
<b>EMT Job No</b>	<b>22/19728</b>		<b>Landfill Waste Acceptance Criteria Limits</b>		
<b>Sample No</b>	<b>12</b>		<b>Inert Waste Landfill</b>	<b>Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill</b>	<b>Hazardous Waste Landfill</b>
<b>Client Sample No</b>	<b>03SKIP251122SO</b>				
<b>Depth/Other</b>					
<b>Sample Date</b>	<b>25/11/2022</b>				
<b>Batch No</b>	<b>1</b>				
<b>Solid Waste Analysis</b>					
Total Organic Carbon (%)	0.40		3	5	6
Loss on Ignition (%)	3.0		-	-	10
Sum of BTEX (mg/kg)	0.543		6	-	-
Sum of 7 PCBs (mg/kg)	<0.035		1	-	-
Mineral Oil (mg/kg) (EH_CU_1D_AL)	<30		500	-	-
PAH Sum of 17(mg/kg)	<0.64		100	-	-
pH (pH Units)	9.50		-	>6	-
ANC to pH 7 (mol/kg)	0.07		-	to be evaluated	to be evaluated
ANC to pH 4 (mol/kg)	0.49		-	to be evaluated	to be evaluated
<b>Eluate Analysis</b>	<b>10:1 conc<sup>n</sup> leached</b>		<b>Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg</b>		
	<b>C<sub>10</sub></b>	<b>A<sub>10</sub></b>	<b>mg/kg</b>		
	<b>mg/l</b>	<b>mg/kg</b>			
Arsenic	0.0069	0.069	0.5	2	25
Barium	0.009	0.09	20	100	300
Cadmium	<0.0005	<0.005	0.04	1	5
Chromium	0.0019	0.019	0.5	10	70
Copper	<0.007	<0.07	2	50	100
Mercury	<0.001	<0.01	0.01	0.2	2
Molybdenum	0.004	0.04	0.5	10	30
Nickel	<0.002	<0.02	0.4	10	40
Lead	<0.005	<0.05	0.5	10	50
Antimony	<0.002	<0.02	0.06	0.7	5
Selenium	0.003	<0.03	0.1	0.5	7
Zinc	<0.003	<0.03	4	50	200
Chloride	7.6	76	800	15000	25000
Fluoride	0.3	<3	10	150	500
Sulphate as SO4	12.8	128	1000	20000	50000
Total Dissolved Solids	89	890	4000	60000	100000
Phenol	<0.01	<0.1	1	-	-
Dissolved Organic Carbon	2	<20	500	800	1000

**Client Name:** Arcadis  
**Reference:** 10044284  
**Location:** Shell Sutton Elms  
**Contact:** Shanth Belagodu

**Note:**

Asbestos Screen analysis is carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Detailed Gravimetric Quantification and PCOM Fibre Analysis is carried out in accordance with our documented in-house methods PM042 and TM131 and HSG 248 using Stereo and Polarised Light Microscopy and Phase Contrast Optical Microscopy (PCOM). Asbestos sub-samples are retained for not less than 6 months from the date of analysis unless specifically requested.

The LOQ of the Asbestos Quantification is 0.001% dry fibre of dry mass of sample.

Where the sample is not taken by a Element Materials Technology consultant, Element Materials Technology cannot be responsible for inaccurate or unrepresentative sampling.

Where trace asbestos is reported the amount of asbestos will be <0.1%.

EMT Job No.	Batch	Sample ID	Depth	EMT Sample No.	Analyst Name	Date Of Analysis	Analysis	Result
22/19728	1	01MW104241122S03.8-4.2	3.80-4.20	4	Catherine Coles	02/12/2022	<b>General Description (Bulk Analysis)</b>	soil,stone
					Catherine Coles	02/12/2022	<b>Asbestos Fibres</b>	NAD
					Catherine Coles	02/12/2022	<b>Asbestos ACM</b>	NAD
					Catherine Coles	02/12/2022	<b>Asbestos Type</b>	NAD
22/19728	1	02DUPSO		8	Catherine Coles	02/12/2022	<b>General Description (Bulk Analysis)</b>	soil,stone
					Catherine Coles	02/12/2022	<b>Asbestos Fibres</b>	NAD
					Catherine Coles	02/12/2022	<b>Asbestos ACM</b>	NAD
					Catherine Coles	02/12/2022	<b>Asbestos Type</b>	NAD
22/19728	1	03SKIP251122SO		13	Simon Postlewhite	01/12/2022	<b>General Description (Bulk Analysis)</b>	Brown soil/stones
					Simon Postlewhite	01/12/2022	<b>Asbestos Fibres</b>	NAD
					Simon Postlewhite	01/12/2022	<b>Asbestos ACM</b>	NAD
					Simon Postlewhite	01/12/2022	<b>Asbestos Type</b>	NAD



# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 22/19728

## SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

## WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

## STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

## DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

## SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

## DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

## BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

Please include all sections of this report if it is reproduced

All solid results are expressed on a dry weight basis unless stated otherwise.



**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**Customer Provided Information**

Sample ID and depth is information provided by the customer.

**ABBREVIATIONS and ACRONYMS USED**

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

## HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 22/19728

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM8/PM16	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required/Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details			AR	Yes
TM5/TM36	please refer to TM5 and TM36 for method details	PM8/PM12/PM16	please refer to PM8/PM16 and PM12 for method details	Yes		AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes

EMT Job No: 22/19728

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM17	Modified US EPA method 8270D v5:2014. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified BS 1377-3:1990/USEPA 160.1/3 (TDS/TS: 1971) Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.			AR	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.			AD	Yes
TM21	Modified BS 7755-3:1995, ISO10694:1995 Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection. Organic Matter (SOM) calculated as per EA MCERTS Chemical Testing of Soil, March 2012 v4.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM22	Modified BS1377-3:1990 Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (35C-440C). On request modified ASTM D2974-00 LOI (105C-440C)	PM0	No preparation is required.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM0	No preparation is required.	Yes		AR	Yes

EMT Job No: 22/19728

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using Discrete Analyser. Modified US EPA methods: Chloride 325.2 (1978), Sulphate 375.4 (Rev.2 1993), o-Phosphate 365.2 (Rev.2 1993), TON 353.1 (Rev.2 1993), Nitrite 354.1 (1971), Hex Cr 7196A (1992), NH4+ 350.1 (Rev.2 1993) – All anions comparable to BS ISO 15923-1: 2013	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AR	Yes
TM60	TC/TOC analysis of Waters by High Temperature Combustion followed by NDIR detection. Based on the following modified standard methods: USEPA 9060A (2002), APHA SMEWW 5310B:1999 22nd Edition, ASTM D 7573, and USEPA 415.1.	PM0	No preparation is required.			AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248 Second edition (2021)	PM42	Modified SCA Blue Book V.12 draft 2017 and WM3 1st Edition v1.1:2018. Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 (1982) and 9045D Rev. 4 - 2004) and BS1377-3:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM77	Modified DDCEN/TS method 15364:2006. Determination of Acid Neutralization Capacity by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	No
TM83	Modified USEPA method 8260B v2:1996. Determination of Alcohols, Acetates, Acetone, Fuel Oxygenates, THF and Cyclohexane by Headspace GC-MS	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM170	Determination of Trace Metals by ICP-MS (Inductively Coupled Plasma – Mass Spectrometry): Modified USEPA Method 200.8, Rev. 5.4, 1994; Modified EPA Method 6020A, Rev.1, Feb 2007; Modified BS EN ISO 17294-2:2016	PM14	Preparation of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for Dissolved metals, and remain unfiltered for Total metals then acidified	Yes		AR	Yes
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 9214 - 340.2 (EPA 1998)	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465:1993(E) and BS1377-2:1990.			AR	

Arcadis Consulting (UK) Limited  
10 Medawar Road  
Surrey Research Park  
Guildford  
GU2 7AR



**Attention :** Jon Raven  
**Date :** 24th January, 2023  
**Your reference :** 10052912  
**Our reference :** Test Report 23/751 Batch 1  
**Location :** Shell Sutton Elms  
**Date samples received :** 19th January, 2023  
**Status :** Final Report  
**Issue :** 1

Six samples were received for analysis on 19th January, 2023 of which six were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.

All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

**Authorised By:**



**Paul Boden BSc**  
Senior Project Manager

Please include all sections of this report if it is reproduced









# NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

EMT Job No.: 23/751

## SOILS and ASH

Please note we are only MCERTS accredited (UK soils only) for sand, loam and clay and any other matrix is outside our scope of accreditation.

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation has been performed on clay, sand and loam, only samples that are predominantly these matrices, or combinations of them will be within our MCERTS scope. If samples are not one of a combination of the above matrices they will not be marked as MCERTS accredited.

It is assumed that you have taken representative samples on site and require analysis on a representative subsample. Stones will generally be included unless we are requested to remove them.

All samples will be discarded one month after the date of reporting, unless we are instructed to the contrary. Asbestos samples are retained for 6 months.

If you have not already done so, please send us a purchase order if this is required by your company.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

All analysis is reported on a dry weight basis unless stated otherwise. Limits of detection for analyses carried out on as received samples are not moisture content corrected. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C. Ash samples are dried at 37°C ±5°C.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

Where a CEN 10:1 ZERO Headspace VOC test has been carried out, a 10:1 ratio of water to wet (as received) soil has been used.

% Asbestos in Asbestos Containing Materials (ACMs) is determined by reference to HSG 264 The Survey Guide - Appendix 2 : ACMs in buildings listed in order of ease of fibre release.

Sufficient amount of sample must be received to carry out the testing specified. Where an insufficient amount of sample has been received the testing may not meet the requirements of our accredited methods, as such accreditation may be removed.

Negative Neutralization Potential (NP) values are obtained when the volume of NaOH (0.1N) titrated (pH 8.3) is greater than the volume of HCl (1N) to reduce the pH of the sample to 2.0 - 2.5. Any negative NP values are corrected to 0.

The calculation of Pyrite content assumes that all oxidisable sulphides present in the sample are pyrite. This may not be the case. The calculation may be an overestimate when other sulphides such as Barite (Barium Sulphate) are present.

## WATERS

Please note we are not a UK Drinking Water Inspectorate (DWI) Approved Laboratory .

ISO17025 accreditation applies to surface water and groundwater and usually one other matrix which is analysis specific, any other liquids are outside our scope of accreditation.

As surface waters require different sample preparation to groundwaters the laboratory must be informed of the water type when submitting samples.

Where Mineral Oil or Fats, Oils and Grease is quoted, this refers to Total Aliphatics C10-C40.

## STACK EMISSIONS

Where an MCERTS report has been requested, you will be notified within 48 hours of any samples that have been identified as being outside our MCERTS scope. As validation for Dioxins and Furans and Dioxin like PCBs has been performed on XAD-2 Resin, only samples which use this resin will be within our MCERTS scope.

Where appropriate please make sure that our detection limits are suitable for your needs, if they are not, please notify us immediately.

## DEVIATING SAMPLES

All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. The temperature of sample receipt is recorded on the confirmation schedules in order that the client can make an informed decision as to whether testing should still be undertaken.

## SURROGATES

Surrogate compounds are added during the preparation process to monitor recovery of analytes. However low recovery in soils is often due to peat, clay or other organic rich matrices. For waters this can be due to oxidants, surfactants, organic rich sediments or remediation fluids. Acceptable limits for most organic methods are 70 - 130% and for VOCs are 50 - 150%. When surrogate recoveries are outside the performance criteria but the associated AQC passes this is assumed to be due to matrix effect. Results are not surrogate corrected.

## DILUTIONS

A dilution suffix indicates a dilution has been performed and the reported result takes this into account. No further calculation is required.

## BLANKS

Where analytes have been found in the blank, the sample will be treated in accordance with our laboratory procedure for dealing with contaminated blanks.

**NOTE**

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.

Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

Laboratory records are kept for a period of no less than 6 years.

**REPORTS FROM THE SOUTH AFRICA LABORATORY**

Any method number not prefixed with SA has been undertaken in our UK laboratory unless reported as subcontracted.

**Measurement Uncertainty**

Measurement uncertainty defines the range of values that could reasonably be attributed to the measured quantity. This range of values has not been included within the reported results. Uncertainty expressed as a percentage can be provided upon request.

**Customer Provided Information**

Sample ID and depth is information provided by the customer.

**ABBREVIATIONS and ACRONYMS USED**

#	ISO17025 (UKAS Ref No. 4225) accredited - UK.
SA	ISO17025 (SANAS Ref No.T0729) accredited - South Africa
B	Indicates analyte found in associated method blank.
DR	Dilution required.
M	MCERTS accredited.
NA	Not applicable
NAD	No Asbestos Detected.
ND	None Detected (usually refers to VOC and/SVOC TICs).
NDP	No Determination Possible
SS	Calibrated against a single substance
SV	Surrogate recovery outside performance criteria. This may be due to a matrix effect.
W	Results expressed on as received basis.
+	AQC failure, accreditation has been removed from this result, if appropriate, see 'Note' on previous page.
>>	Results above calibration range, the result should be considered the minimum value. The actual result could be significantly higher.
*	Analysis subcontracted to an Element Materials Technology approved laboratory.
AD	Samples are dried at 35°C ±5°C
CO	Suspected carry over
LOD/LOR	Limit of Detection (Limit of Reporting) in line with ISO 17025 and MCERTS
ME	Matrix Effect
NFD	No Fibres Detected
BS	AQC Sample
LB	Blank Sample
N	Client Sample
TB	Trip Blank Sample
OC	Outside Calibration Range

## HWOL ACRONYMS AND OPERATORS USED

HS	Headspace Analysis.
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent.
CU	Clean-up - e.g. by florisil, silica gel.
1D	GC - Single coil gas chromatography.
Total	Aliphatics & Aromatics.
AL	Aliphatics only.
AR	Aromatics only.
2D	GC-GC - Double coil gas chromatography.
#1	EH_Total but with humics mathematically subtracted
#2	EU_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +).
+	Operator to indicate cumulative e.g. EH+HS_Total or EH_CU+HS_Total
MS	Mass Spectrometry.

EMT Job No: 23/751

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/S ANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM4	Modified USEPA 8270D v5:2014 method for the solvent extraction and determination of PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM16/PM30	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE/Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5	Modified 8015B v2:1996 method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) within the range C8-C40 by GCFID. For waters the solvent extracts dissolved phase plus a sheen if present.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	please refer to TM5 and TM36 for method details	PM12/PM16/PM30	please refer to PM16/PM30 and PM12 for method details	Yes			
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.				
TM15	Modified USEPA 8260B v2:1996. Quantitative Determination of Volatile Organic Compounds (VOCs) by Headspace GC-MS.	PM10	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM16	Modified USEPA 8270D v5:2014. Quantitative determination of Semi-Volatile Organic compounds (SVOCs) by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM36	Modified US EPA method 8015B v2:1996. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID. MTBE by GCFID co-elutes with 3-methylpentane if present and therefore can give a false positive. Positive MTBE results will be re-run using GC-MS to double check, when requested.	PM12	Modified US EPA method 5021A v2:2014. Preparation of solid and liquid samples for GC headspace analysis.	Yes			





**APPENDIX G**

**Arcadis GAC Derivation**

## SUMMARY

The purpose of this document is to describe the general principles adopted in the derivation of the Arcadis' Generic Assessment Criteria (GAC). The document and associated GAC underpins the generic quantitative risk assessments Arcadis undertakes for its clients and is not intended for any other use or use by others. Guidance has been provided by the EA to aid development of GAC which are appropriate for a typical England or Wales site, incorporating conservatism where warranted. Arcadis has used the EA guidance to develop in-house GAC to aid assessment of land contamination sites, and in particular to assess risks to human health receptors from chronic health effects and risks to water resource receptors. The GAC do not consider potential risks to ecological receptors, which may need to be assessed on specific sites. The following non-statutory technical guidance has been referred to in deriving the GAC.

- EA Science Reports SC050021/SR2, SC050021/SR3 and SC050021/SR7.
- Related Toxicity and Soil Guideline Value reports
- EA Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination
- EA. Groundwater Protection and Water Quality, March 2017 (accessible online <https://www.gov.uk/government/collections/groundwater-protection>)
- SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination

The GAC used within this report have been derived for "continued petroleum end use". Based on the typical use and design of these sites, with buildings and/or hard standing present across the majority of the site, direct exposure to shallow soils is not considered active. A building typical of a petrol filling station shop (represented by the size of a bungalow) is adopted in the derivation of the GAC. A neighbouring resident is assumed present, comprising a small terraced house without basement.

Arcadis has undertaken environmental works on hundreds of potentially contaminated sites across the UK. The typical shallow geology encountered comprises granular soils or made ground, with a low organic matter content. As such, Arcadis has taken the decision to derive in-house GAC for a *sand* rather than sandy loam soil-type used by the EA to derive Soil Guideline Values, with an organic matter content of 0.34% (fraction of organic carbon content 0.002, typical of many sites).

Development of GAC\_March 2022

To derive Human Health GAC (HH-GAC), the following exposure pathways are considered active for potential soil, groundwater or soil gas exposures:

Site End-Use	On-Site Pathways
Continued petroleum use	<ul style="list-style-type: none"> <li>• Inhalation of vapours outside from a soil or groundwater source</li> <li>• Inhalation of vapours inside from a soil, groundwater or soil gas source</li> </ul>
Neighbouring resident	<ul style="list-style-type: none"> <li>• Inhalation of vapours inside from a soil gas source (assumed that the neighbouring residential property directly overlies the soil gas source); and, Migration of impacted groundwater beneath neighbouring property, and subsequently: <ul style="list-style-type: none"> <li>• Inhalation of indoor air in an off-site property (originating from an on-site soil or groundwater source)</li> <li>• Inhalation of outdoor air in an off-site garden (originating from an on-site soil or groundwater source)</li> </ul> </li> </ul>

Two levels of water quality standard have been considered to enable Water Resource GAC (WR-GAC) to be developed depending on the environmental setting of a site. The WR-GAC have been derived based on adopted Environmental Quality Standards and Drinking Water Standards. No attenuation with transport off-site is assumed.

The following modelling tools have been utilised in the derivation of the GAC:

HH-GAC (on-site):	CLEA 1.07 and RBCA Toolkit v2.6
HH-GAC (off-site):	CLEA 1.07, RBCA Toolkit v2.6 and Remedial Targets Worksheet v3.2
WR-GAC:	Remedial Targets Worksheet v3.2

Selected model inputs and outputs are presented in the following tables.

	Air-water partition co-efficient		Diffusion co-efficient in air		Diffusion co-efficient in water		Relative molecular mass		Vapour pressure		Water solubility		Koc	Notes
	cm <sup>3</sup> cm <sup>3</sup>	Notes	m <sup>2</sup> s <sup>-1</sup>	Notes	m <sup>2</sup> s <sup>-1</sup>	Notes	g mol <sup>-1</sup>	Notes	Pa	Notes	mg L <sup>-1</sup>	Notes	Log (dimension)	
Benzene	1.16E-01	Science Report – SC050021/SR7	8.77E-06	Science Report – SC050021/SR7	6.64E-10	Science Report – SC050021/SR7	78.11	Science Report – SC050021/SR7	6.24E+03	Science Report – SC050021/SR7	1.78E+03	Science Report – SC050021/SR7	1.83E+00	Science Report – SC050021/SR7
Toluene	1.15E-01	Science Report – SC050021/SR7	7.78E-06	Science Report – SC050021/SR7	5.88E-10	Science Report – SC050021/SR7	92.14	Science Report – SC050021/SR7	1.73E+03	Science Report – SC050021/SR7	5.90E+02	Science Report – SC050021/SR7	2.31E+00	Science Report – SC050021/SR7
Ethylbenzene	1.39E-01	Science Report – SC050021/SR7	7.04E-06	Science Report – SC050021/SR7	5.31E-10	Science Report – SC050021/SR7	106.17	Science Report – SC050021/SR7	5.53E+02	Science Report – SC050021/SR7	1.80E+02	Science Report – SC050021/SR7	2.65E+00	Science Report – SC050021/SR7
Sum xylenes	1.04E-01	Average for three xylenes	7.03E-06	Average for three xylenes	5.3E-10	Average for three xylenes	106.17	Average for three xylenes	4.52E+02	Average for three xylenes	1.91E+02	Average for three xylenes	2.66E+00	Average for three xylenes
MTBE	2.04E-02	Literature review	7.10E-06	Literature review	9.00E-10	Literature review	88.17	Literature review	3.45E+04	Literature review	4.80E+04	Literature review	1.08E+00	Literature review
Aliphatic >C5-6	3.40E+01	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	81	Literature review	3.60E+04	Literature review	3.60E+01	Literature review	2.90E+00	Literature review
Aliphatic >C6-8	5.10E+01	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	100	Literature review	6.40E+03	Literature review	5.40E+00	Literature review	3.60E+00	Literature review
Aliphatic >C8-10	8.20E+01	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	130	Literature review	6.40E+02	Literature review	4.30E-01	Literature review	4.51E+00	Literature review
Aliphatic >C10-12	1.30E+02	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	160	Literature review	6.50E+01	Literature review	3.40E-02	Literature review	5.40E+00	Literature review
Aliphatic >C12-16	5.40E+02	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	200	Literature review	4.80E+00	Literature review	7.60E-04	Literature review	6.70E+00	Literature review
Aliphatic >C16-35	6.40E+03	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	270	Literature review	7.70E-01	Literature review	1.30E-06	Literature review	9.00E+00	Literature review
Aromatic >C8-10	4.90E-01	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	120	Literature review	6.40E+02	Literature review	6.50E+01	Literature review	3.20E+00	Literature review
Aromatic >C10-12	1.40E-01	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	130	Literature review	6.40E+01	Literature review	2.50E+01	Literature review	3.40E+00	Literature review
Aromatic >C12-16	5.40E-02	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	150	Literature review	4.80E+00	Literature review	5.80E+00	Literature review	3.70E+00	Literature review
Aromatic >C16-21	1.30E-02	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	190	Literature review	7.70E-01	Literature review	5.10E-01	Literature review	4.20E+00	Literature review
Aromatic >C21-35	6.80E-04	TPHCWG	1.00E-05	Literature review	0.000000001	Literature review	240	Literature review	4.40E-04	Literature review	6.60E-03	Literature review	5.11E+00	Literature review

Chemical Name	Chemical Type	Oral HCV						Inhalation HCV						Combine oral and Inhalation AC	Oral MDI for adults		Inhalation MDI for adults	
		Type	µg kg <sup>-1</sup> BW day <sup>-1</sup>	Notes	Oral exposure	Dermal exposure	Inhalation exposure	Type	µg kg <sup>-1</sup> BW day <sup>-1</sup>	Notes	Oral exposure	Dermal exposure	Inhalation exposure		µg kg <sup>-1</sup> BW day <sup>-1</sup>	Notes	µg kg <sup>-1</sup> BW day <sup>-1</sup>	Notes
Benzene	organic	ID	2.90E-01	UK TOX (March 2009)	Yes	Yes	No	ID	1.40E+00	UK TOX (March 2009)	No	No	Yes	Yes	NR	NA	NR	NA
Toluene	organic	TDI	2.23E+02	UK TOX (March 2009)	Yes	Yes	No	TDI	1.40E+03	UK TOX (March 2009)	No	No	Yes	Yes	1.00E+01	UK TOX (March 2009)	5.20E+02	UK TOX (March 2009)
Ethylbenzene	organic	TDI	1.00E+02	UK TOX (March 2009)	Yes	Yes	No	TDI	7.43E+01	Literature review	No	No	Yes	Yes	5.00E+00	UK TOX (March 2009)	1.30E+02	UK TOX (March 2009)
Sum xylenes	organic	TDI	1.80E+02	UK TOX (March 2009)	Yes	Yes	No	TDI	6.00E+01	UK TOX (March 2009)	No	No	Yes	Yes	1.10E+01	UK TOX (March 2009)	1.40E+02	UK TOX (March 2009)
MTBE	organic	TDI	8.60E+02	Literature review	Yes	Yes	No	TDI	8.60E+02	Literature review	No	No	Yes	Yes	3.00E+01	EU Risk Assessment Report	1.89E+02	EU Risk Assessment Report
Aliphatic >C5-6	organic	TDI	5.00E+03	TPHCWG	Yes	Yes	No	TDI	5.26E+03	TPHCWG	No	No	Yes	Yes	3.50E+05	TDI x 70kg (MDI unknown)	3.68E+05	TDI x 70kg (MDI unknown)
Aliphatic >C6-8	organic	TDI	5.00E+03	TPHCWG	Yes	Yes	No	TDI	5.26E+03	TPHCWG	No	No	Yes	Yes	3.50E+05	TDI x 70kg (MDI unknown)	3.68E+05	TDI x 70kg (MDI unknown)
Aliphatic >C8-10	organic	TDI	1.00E+02	TPHCWG	Yes	Yes	No	TDI	2.70E+02	TPHCWG	No	No	Yes	Yes	7.00E+03	TDI x 70kg (MDI unknown)	1.89E+04	TDI x 70kg (MDI unknown)
Aliphatic >C10-12	organic	TDI	1.00E+02	TPHCWG	Yes	Yes	No	TDI	2.70E+02	TPHCWG	No	No	Yes	Yes	7.00E+03	TDI x 70kg (MDI unknown)	1.89E+04	TDI x 70kg (MDI unknown)
Aliphatic >C12-16	organic	TDI	1.00E+02	TPHCWG	Yes	Yes	No	TDI	2.70E+02	TPHCWG	No	No	Yes	Yes	7.00E+03	TDI x 70kg (MDI unknown)	1.89E+04	TDI x 70kg (MDI unknown)
Aliphatic >C16-35	organic	TDI	2.00E+03	TPHCWG	Yes	Yes	No	NR			NR	NR	NR	NR	1.40E+05	TDI x 70kg (MDI unknown)		
Aromatic >C8-10	organic	TDI	4.00E+01	TPHCWG	Yes	Yes	No	TDI	5.50E+01	TPHCWG	No	No	Yes	Yes	2.80E+03	TDI x 70kg (MDI unknown)	3.85E+03	TDI x 70kg (MDI unknown)
Aromatic >C10-12	organic	TDI	4.00E+01	TPHCWG	Yes	Yes	No	TDI	5.50E+01	TPHCWG	No	No	Yes	Yes	2.80E+03	TDI x 70kg (MDI unknown)	3.85E+03	TDI x 70kg (MDI unknown)
Aromatic >C12-16	organic	TDI	4.00E+01	TPHCWG	Yes	Yes	No	TDI	5.50E+01	TPHCWG	No	No	Yes	Yes	2.80E+03	TDI x 70kg (MDI unknown)	3.85E+03	TDI x 70kg (MDI unknown)
Aromatic >C16-21	organic	TDI	3.00E+01	TPHCWG	Yes	Yes	No	NR			NR	NR	NR	NR	2.10E+03	TDI x 70kg (MDI unknown)		
Aromatic >C21-35	organic	TDI	3.00E+01	TPHCWG	Yes	Yes	No	NR			NR	NR	NR	NR	2.10E+03	TDI x 70kg (MDI unknown)		

**PHYSICAL PROPERTIES**

		<b>Commercial Land Use</b>	<b>Source</b>
<b>Soil type</b>	na	Sand	Professional experience
<b>Porosity (total)</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.54	SC050021/SR3
<b>Porosity (air-filled)*</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.30	SC050021/SR3
<b>Porosity (water-filled)*</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.24	SC050021/SR3
<b>Capillary fringe porosity (air-filled)</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.01	Literature value
<b>Capillary fringe porosity (water-filled)</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.53	Literature value
<b>Thickness of capillary fringe</b>	m	0.1	Literature value
<b>Residual soil water content</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.07	SC050021/SR3
<b>Saturated hydraulic conductivity</b>	cm s <sup>-1</sup>	7.36E-03	SC050021/SR3
<b>van Genuchten shape parameter</b>	dimensionless	3.51E-01	SC050021/SR3
<b>Bulk density</b>	g cm <sup>-3</sup>	1.18	SC050021/SR3
<b>Soil organic matter content</b>	%	0.34	Professional experience
<b>Threshold value of wind speed at 10m</b>	m s <sup>-1</sup>	7.20	SC050021/SR3
<b>Ambient soil temperature</b>	K	283	SC050021/SR3
<b>Mean annual windspeed (10m)</b>	m s <sup>-1</sup>	5.00	SC050021/SR3
<b>Fraction of site with hard or vegetative cover</b>	m <sup>2</sup> m <sup>-2</sup>	1.00	Conceptual Site Model
<b>Depth to groundwater (RBCA)</b>	m	1	Assumption
<b>Infiltration rate in vadose zone</b>	m day <sup>-1</sup>	6.80E-04	Likely worst-case
<b>Aquifer type**</b>	na	Sand	Assumption
<b>Source width</b>	m	40	Likely worst-case
<b>Source length</b>	m	40	Likely worst-case
<b>Saturated aquifer thickness</b>	m	10	Assumption
<b>Mixing zone depth</b>	m	5.5	Calculated in RTW
<b>Hydraulic conductivity</b>	m day <sup>-1</sup>	20	Literature value
<b>Hydraulic gradient</b>	m m <sup>-1</sup>	0.001	Typical value for sand
<b>Aquifer soil organic matter content</b>	%	0.34	Professional experience
<b>Effective Porosity (total)**</b>	cm <sup>3</sup> cm <sup>-3</sup>	0.3	Literature value
<b>Aquifer bulk density**</b>	g cm <sup>-3</sup>	1.18	SC050021/SR3
<b>Distance to neighbouring resident**</b>	m	5	Likely worst-case

Notes:

\* Assumed to be present in foundation cracks when modelling in RBCA Toolkit

\*\* Only used to generate GAC for neighbouring residents through off-site migration of impact in groundwater

For the purpose of assessing the risk to on-Site commercial workers from impacts in soil it is assumed that the soil source is present 50cm below the grounds surface (based on the typical minimum depth of petroleum infrastructure beneath the ground). For soil gas it is assumed that the source is present 20cm beneath the grounds surface (in relation to both on-Site commercial worker and off-Site residents).

## BUILDING PROPERTIES

		Age Class							
		Residents						Commercial Worker	
Age class	-	1	2	3	4	5	6	17	
Building footprint	m2	2.80E+01						7.80E+01	SC050021/SR3
Living space air exchange rate	hr-1	0.50						1.00	SC050021/SR3
Living space height (above ground)	m	4.8						2.4	SC050021/SR3
Living space height (below ground)	m	0.0						0.0	SC050021/SR3
Pressure difference	Pa	3.1						2.6	SC050021/SR3
Foundation thickness	m	1.50E-01						1.50E-01	SC050021/SR3
Floor crack area	cm2	4.23E+02						7.07E+02	SC050021/SR3

Notes:

Petrol filling station shop modelled as a bungalow, with increased ventilation

## CLEA 1.07 EXPOSURE DATA

		Neighbouring Residential			Continued Petroleum Use			Source
		Residents						Commercial Worker
Age class	-	1	2	3	4	5	6	17
Frequency of inhalation (dust and vapour indoors)	days yr-1	365	365	365	365	365	365	230
Frequency of inhalation (dust and vapour outdoors)	days yr-1	365	365	365	365	365	365	170
Occupancy period (indoors)	hr day-1	23	23	23	23	19	19	8.3
Occupancy period (outdoors)	hr day-1	1	1	1	1	1	1	0.7
Body weight	kg	5.6	9.8	12.7	15.1	16.9	19.7	70
Body height	m	0.7	0.8	0.9	0.9	1	1.1	1.6
Inhalation rate*	m3 day-1	5.4	8	8.9	10.1	10.1	10.1	15.7

\* Inhalation rate adopted from Category 4 Screening Levels

RBCA Toolkit EXPOSURE DATA		Age Class	
		0-6	17
<b>Averaging time</b>	yrs	6	49
<b>Body weight</b>	kg	13.3	70
<b>Exposure duration</b>	yrs	6	49
<b>Averaging time (vapour flux)</b>	yrs	6	49
<b>Exposure frequency (indoors)*</b>	days yr-1	365	29.9
<b>Exposure frequency (outdoors)*</b>	days yr-1	16.8	1.87

Notes:

Time-weighted average used for 0-6 year old female child

\* RBCA Toolkit compares an acceptable air concentration to a predicted air concentration. Only the exposure frequency can be modified (i.e. inhalation rate, time exposed cannot). As such, the TDSI (or ID) was converted to an acceptable indoor air concentration using the time-weighted properties for a 0-6 year old female child as defined within the Category 4 Screening Levels. The exposure frequency for other scenarios was modified to account for the differing exposure scenarios for the remaining pathways, to be equivalent to modifying the inhalation rate and time exposed.

AutoSave (On) | File Home Insert Page Layout Formulas Data Review View Add-ins Tell me what you want to do

Clipboard: Cut, Copy, Paste, Format Painter

Font: Arial, 10, Bold, Italic, Underline, Text Color, Background Color

Alignment: Wrap Text, Merge & Center

Number: General, Percentage, Currency, Accounting, Date, Time, Text, Fraction, Scientific

Styles: Normal, Bad, Good, Neutral, Calculation, Check Cell, Explainer..., Followed Hyperlink, Hyperlink, Input

F25 | NR

STEP 5: RESULTS																
		Find AC		Print Reports		Back to Guide										
Number	Chemical	Ratio of ADE to relevant Health Criteria Value			Soil Assessment Criteria			SAC Flag	Soil Saturation Limit	Pathway Contributions (%)						
		oral HCV	inhal HCV	Combined	oral HCV	inhal HCV	Combined	Current SAC used for determining pathway contributions	mg kg <sup>-1</sup>	direct soil ingestion	sum of consumption of homegrown produce and attached soil	dermal contact (indoor)	dermal contact (outdoor)	inhalation of dust (indoor)	inhalation of dust (outdoor)	inhalation of vapour (indoor)
		(dimensionless)	(dimensionless)	(dimensionless)	mg kg <sup>-1</sup>	mg kg <sup>-1</sup>	mg kg <sup>-1</sup>	(unitless)	mg kg <sup>-1</sup>	%	%	%	%	%	%	%
1	Benzene	0.00	1.00	1.00	NR	1.50E+00	1.50E+00	Combined	6.52E+02	0.00	0.00	0.00	0.00	0.00	0.00	99.96
2	Toluene	0.00	1.00	1.00	NR	2.75E+03	2.75E+03	Combined	3.74E+02	0.00	0.00	0.00	0.00	0.00	0.00	99.86
3	Ethylbenzene	0.00	1.00	1.00	NR	2.21E+02	2.21E+02	Combined	2.01E+02	0.00	0.00	0.00	0.00	0.00	0.00	99.59
4	Sum xylenes	0.00	1.00	1.00	NR	2.36E+02	2.36E+02	Combined	2.16E+02	0.00	0.00	0.00	0.00	0.00	0.00	97.46
5	MTBE	0.00	1.00	1.00	NR	3.60E+02	3.60E+02	Combined	1.11E+04	0.00	0.00	0.00	0.00	0.00	0.00	99.68
6	ETBE	0.00	1.00	1.00	NR	1.58E+01	1.58E+01	Combined	3.50E+03	0.00	0.00	0.00	0.00	0.00	0.00	100.00
7	TBA	0.00	1.00	1.00	NR	3.70E+03	3.70E+03	Combined	2.35E+05	0.00	0.00	0.00	0.00	0.00	0.00	99.92
8																
9	Aliphatic >C5-C6	0.00	1.00	1.00	NR	2.61E+02	2.61E+02	Combined	3.75E+02	0.00	0.00	0.00	0.00	0.00	0.00	49.99
10	Aliphatic >C6-C8	0.00	1.00	1.00	NR	3.51E+02	3.51E+02	Combined	1.12E+02	0.00	0.00	0.00	0.00	0.00	0.00	49.99
11	Aliphatic >C8-C10	0.00	1.00	1.00	NR	4.53E+01	4.53E+01	Combined	3.65E+01	0.00	0.00	0.00	0.00	0.00	0.00	49.99
12	Aliphatic >C10-C12	0.00	1.00	1.00	NR	1.78E+02	1.78E+02	Combined	1.80E+01	0.00	0.00	0.00	0.00	0.00	0.00	49.98
13	Aliphatic >C12-C16	0.00	1.00	1.00	NR	8.12E+02	8.12E+02	Combined	7.57E+00	0.00	0.00	0.00	0.00	0.00	0.00	49.96
14	Aliphatic >C16-C35	0.00	NR	NR	NR	NR	NR	NR	2.57E+00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
15	Aromatic >EC5-EC7	0.00	1.00	1.00	NR	3.24E+01	3.24E+01	Combined	7.53E+02	0.00	0.00	0.00	0.00	0.00	0.00	49.99
16	Aromatic >EC7-EC8	0.00	1.00	1.00	NR	5.07E+01	5.07E+01	Combined	3.99E+02	0.00	0.00	0.00	0.00	0.00	0.00	49.98
17	Aromatic >EC8-EC10	0.00	1.00	1.00	NR	6.29E+01	6.29E+01	Combined	2.24E+02	0.00	0.00	0.00	0.00	0.00	0.00	49.97
18	Aromatic >EC10-EC12	0.00	1.00	1.00	NR	3.30E+02	3.30E+02	Combined	1.30E+02	0.00	0.00	0.00	0.00	0.00	0.00	49.94
19	Aromatic >EC12-EC16	0.00	1.00	1.00	NR	1.66E+03	1.66E+03	Combined	5.72E+01	0.00	0.00	0.00	0.00	0.00	0.00	49.86
20	Aromatic >EC16-EC21	0.00	NR	NR	NR	NR	NR	NR	1.60E+01	0.00	0.00	0.00	0.00	0.00	0.00	0.00
21	Aromatic >EC21-EC35	0.00	NR	NR	NR	NR	NR	NR	1.68E+00	0.00	0.00	0.00	0.00	0.00	0.00	0.00
22																
23																
24																
25																
26																
27																
28																
29																
30																



**APPENDIX H**

**Arcadis GACs for CPU**

**ARCADIS GENERIC ASSESSMENT CRITERIA FOR GROUNDWATER**

- CONTINUED PETROLEUM USE -

Compound	Human Health - CPU		Water Resources	
	Petrol Filling Station Worker	Neighbouring Resident	Surface Waters	Aquifers
	µg/l	µg/l	µg/l	µg/l
Benzene	1.20E+04	1010	10	1
Toluene	>SOL	>SOL	74	700
Ethylbenzene	>SOL	5.87E+04	20	300
Xylenes	>SOL	4.99E+04	30	500
MTBE	5.20E+06	4.00E+05	15	15
ETBE	4.60E+05	3.80E+04	47	47
TBA	2.00E+07	1.38E+06	12	12
Aliphatic >C5-6	>SOL	>SOL	#	#
Aliphatic >C6-8	>SOL	>SOL	#	#
Aliphatic >C8-10	>SOL	>SOL	#	#
Aliphatic >C10-12	>SOL	>SOL	#	#
Aliphatic >C12-16	>SOL	>SOL	#	#
Aliphatic >C16-35	NR	NR	#	#
Aromatic >C5-C7 (as benzene)	1.20E+04	1010	10	1
Aromatic >C7-C8 (as toluene)	>SOL	>SOL	74	700
Aromatic >C8-10	>SOL	1.15E+04	#	#
Aromatic >C10-12	>SOL	9490	#	#
Aromatic >C12-16	>SOL	>SOL	#	#
Aromatic >C16-21	NR	NR	#	#
Aromatic >C21-35	NR	NR	#	#
TPH	na	na	10	10
Naphthalene	>SOL	4110	2	2
Acenaphthylene	>SOL	>SOL	-	-
Acenaphthene	>SOL	>SOL	-	-
Fluorene	>SOL	>SOL	-	-
Phenanthrene	>SOL	>SOL	-	-
Anthracene	>SOL	>SOL	-	-
Fluoranthene	>SOL	>SOL	-	-
Pyrene	>SOL	>SOL	-	-
Benzo(a)anthracene	>SOL	>SOL	-	-
Chrysene	>SOL	>SOL	-	-
Benzo(b)fluoranthene	>SOL	>SOL	-	0.025
Benzo(k)fluoranthene	>SOL	>SOL	-	0.025
Benzo(a)pyrene	>SOL	>SOL	0.00017	0.01
Indeno(123cd)pyrene	>SOL	>SOL	-	0.025
Dibenzo(ah)anthracene	>SOL	>SOL	-	-
Benzo(ghi)perylene	>SOL	>SOL	-	0.025
Dichloroethane (1,1)	3.70E+05	3.33E+04	2.7	2.7
Dichloroethane (1,2)	820	69.8	10	3
Trichloroethane (111)	>SOL	2.97E+05	100	2000
Dichloroethene (1,1)	1.70E+05	1.42E+04	7	140
Dichloroethene (cis 1,2)	2.70E+04	2240	25 <sup>3</sup>	25 <sup>3</sup>
Dichloroethene (trans 1,2)	9.50E+04	7220	25 <sup>3</sup>	25 <sup>3</sup>
Trichloroethene	3200	274	5 <sup>3</sup>	5 <sup>3</sup>
Tetrachloroethene	3.30E+04	2840	5 <sup>3</sup>	5 <sup>3</sup>
Chloroform (Trichloromethane)	1.90E+05	1.54E+04	2.5	100 <sup>4</sup>
Vinyl Chloride (chloroethene)	1200	108	0.5	0.5
Chlorobenzene	2.90E+04	2850	100	100
Phenol	2.50E+07	1.42E+06	7.7	7.7
Arsenic (inorganic)	NVP	NVP	50	10
Barium	NVP	NVP	700	700
Boron	NVP	NVP	2000	1000
Cadmium	NVP	NVP	0.08 - 0.25	5
Chromium (as VI)	NVP	NVP	3.4	50
Chromium (as III)	NVP	NVP	4.7	
Copper	NVP	NVP	1 <sup>1</sup>	2000
Lead	NVP	NVP	1.2 <sup>1</sup>	10
Mercury (inorganic)	NVP	NVP		
Mercury (elemental)	>SOL	9.7	0.07	1
Mercury (methylated)	>SOL	1.90E+04		
Molybdenum	NVP	NVP	70	70
Nickel	NVP	NVP	4 <sup>1</sup>	20
Selenium	NVP	NVP	10	10
Zinc	NVP	NVP	12.1 <sup>1,2</sup>	3000

Notes:

>SOL

NR

#

na

-

-

NVP

1

2

3

4

Target acceptable risk not exceeded at theoretical solubility concentration

No appropriate inhalation reference dose identified during review of toxicological data

No GAC for individual TPH fractions given that the compliance criteria is for sum TPH

Comprises multiple contaminants - no GAC derived

No water quality standard identified as suitable for deriving generic assessment criteria

Contaminant has only a low vapour pressure in groundwater

Bioavailable fraction. The fraction of the dissolved concentration likely to

result in toxic effects as determined using the UKTAG Metal Bioavailability Assessment Tool

(also

Adjusted to account for background concentrations

Based on values of 10µg/l combined for TCE and PCE and 50µg/l combined for cis-DCE and

trans-DCE

Total value for trihalomethanes (chloroform, bromoform, dibromochloromethane and

bromodichloromethane).

**ARCADIS GENERIC ASSESSMENT CRITERIA FOR SOILS**

- CONTINUED PETROLEUM USE -

Compound	Theoretical Soil Saturation Limit	Human Health - CPU		Water Resources	
		Petrol Filling Station Worker - Inhalation	Neighbouring Resident	Surface Waters	Aquifers
		mg/kg	mg/kg	mg/kg	mg/kg
Benzene	652	1.5	1.84	0.019	0.0019
Toluene	374	2750	ND	0.24	2.3
Ethylbenzene	201	221	ND	0.11	1.7
Xylenes	216	236	ND	0.17	2.9
MTBE	1.11E+04	360	467	0.018	0.018
ETBE	3500	15.8	55.9	0.07	0.07
TBA	2.35E+05	3700	1600	0.014	0.014
Aliphatic >C5-6	375	261	ND	#	#
Aliphatic >C6-8	112	351	ND	#	#
Aliphatic >C8-10	36.5	45.3	ND	#	#
Aliphatic >C10-12	18	178	ND	#	#
Aliphatic >C12-16	7.57	812	ND	#	#
Aliphatic >C16-35	2.57	NR	NR	#	#
Aromatic >C5-C7 (as benzene)	652	1.5	1.84	0.019	0.0019
Aromatic >C7-C8 (as toluene)	374	2750	ND	0.24	2.3
Aromatic >C8-10	224	62.8	ND	#	#
Aromatic >C10-12	130	330	ND	#	#
Aromatic >C12-16	57.2	1660	ND	#	#
Aromatic >C16-21	16	NR	NR	#	#
Aromatic >C21-35	1.68	NR	NR	#	#
TPH	na	na	na	see Soil Assessment footnote	
Naphthalene	28.1	69.7	ND	0.015	0.015
Acenaphthylene	72.7	3.45E+04	ND	-	-
Acenaphthene	15.6	2.16E+04	ND	-	-
Fluorene	12	4.30E+04	ND	-	-
Phenanthrene	4.83	6120	ND	-	-
Anthracene	0.706	1.43E+06	ND	-	-
Fluoranthene	6.46	2.47E+05	ND	-	-
Pyrene	0.75	5.79E+05	ND	-	-
Benzo(a)anthracene	0.582	223	ND	-	-
Chrysene	0.15	1970	ND	-	-
Benzo(b)fluoranthene	0.413	611	ND	-	0.026
Benzo(k)fluoranthene	0.234	2.38E+04	ND	-	0.037
Benzo(a)pyrene	0.31	632	ND	0.0002	0.013
Indeno(123cd)pyrene	0.0209	5940	ND	-	0.022
Dibenzo(ah)anthracene	0.00134	40.8	ND	-	-
Benzo(ghi)perylene	0.00634	1.36E+05	ND	-	0.105
Dichloroethane (1,1)	1580	9.02	50.6	0.0042	0.0042
Dichloroethane (1,2)	2160	0.0429	0.0861	0.013	0.0038
Trichloroethane (111)	721	32.7	ND	0.28	5.64
Dichloroethene (1,1)	1310	1.28	37.7	0.02	0.372
Dichloroethene (cis 1,2)	1120	0.682	3.62	0.041	0.041
Dichloroethene (trans 1,2)	2040	10.1	11.9	0.041	0.041
Trichloroethene	724	0.057	0.73	0.013	0.013
Tetrachloroethene	183	0.775	11.7	0.021	0.0207
Chloroform (Trichloromethane)	2880	5.55	25	0.0041	0.16
Vinyl Chloride (chloroethene)	1180	0.00536	0.227	0.0011	0.0011
Chlorobenzene	279	2.24	10.1	0.37	0.37
Phenol	2.02E+04	9870	2570	0.014	0.014
Arsenic (inorganic)	NVP	NVP	NVP		
Barium	NVP	NVP	NVP		
Boron	NVP	NVP	NVP		
Cadmium	NVP	NVP	NVP		
Chromium (as VI)	NVP	NVP	NVP		
Chromium (as III)	NVP	NVP	NVP		
Copper	NVP	NVP	NVP		
Lead	NVP	NVP	NVP		
Mercury (inorganic)	NVP	NVP	NVP		
Mercury (elemental)	1.47	0.567	1.43		
Mercury (methylated)	36	165	34.7		
Molybdenum	NVP	NVP	NVP		
Nickel	NVP	NVP	NVP		
Selenium	NVP	NVP	NVP		
Zinc	NVP	NVP	NVP		

Notes:

For benzo(ghi)perylene, calculated GAC is 1.4E+08 mg/kg. The theoretical maximum concentration of 1.0E+06 mg/kg presented as GAC *italics* Target exceeds theoretical soil saturation limit. Concentrations above the soil saturation limit may indicate the presence of separate phase in soil, but does not necessarily present a significant risk

NR No appropriate inhalation reference dose identified during review of toxicological data

# No GAC for individual TPH fractions given that the compliance criteria is for sum TPH

na Comprises multiple contaminants - no GAC derived

- No water quality standard identified as suitable for deriving generic assessment criteria

NVP Contaminant has only a low vapour pressure in soil

ND Results of modelling indicates pathway not considered to present a significant risk

No GAC as potential for leaching commonly linked to the soil pH/cannot be readily modelled

Soil Assessment: Potential risk to water resources Where supported by the CSM, the risk to water resource receptors is generally best assessed via groundwater, or alternatively leachate. However, in the absence of suitable groundwater or leachate data, soil data is used. For TPH in soil no criteria are present for water resources (see #), TPH concentrations measured above the laboratory MDL indicate the need for further consideration and could present a potential risk to water resource receptors.

# APPENDIX I

## Waste Transfer Notes

The Hazardous Waste Regulations 2005:  
**CONSIGNMENT NOTE**

**Acumen**  
 Waste Services

Job no. CONS/22304

Booking Ref L2212094

**PRODUCER'S/HOLDER'S/CONSIGNOR'S/CARRIER'S/CONSIGNEE'S COPY** (Please delete as appropriate)

**PART A Notification Details**

1. Consignment Note Code ARCADI/22304
2. The waste described below is to be removed from (name, address, postcode, telephone, e-mail, facsimile)  
ARCADIS LLP  
Shell Sutton Elms  
Coventry Road  
Leicester  
Broughton Astley LE9 6QD
3. Premises Code (Where applicable) ARCADI
4. The waste will be taken to (name, address and postcode)  
Augean  
East Northants Resource Management Facility  
Stamford Road  
Kings Cliffe  
Peterborough  
PE8 6XX
5. The waste producer was (if different from A2)(name, address, postcode, telephone, e-mail, facsimile)  
As A2

**PART B Description of the waste**

If continuation sheet used, tick here:

1. The process giving rise to the waste(s) was: Demolition
2. SIC for process: 43.11
3. WASTE DETAILS (where more than one waste type is collected all of the information given below must be completed for each EWC identified)

Description of waste	Components / Concentrations (%)	Weight (kg)	Quantity	Container size	Physical form	Hazardous properties	EWC	ID
Subsoils with possible Heavy Metals contamination	n/a	4000	1	4yrd Skip	Solid	HP10, HP14	17 05 03*	Collect

The information given below is to be completed for each EWC identified

EWC Code	UN No.	Proper Shipping Name	Class	PG	Tunnel Code	EAC
17 05 03*	n/a	WASTE NON DANGEROUS FOR ROAD CARRIAGE	n/a	n/a	n/a	n/a

**PART C Carriers Certificate**

**PART D Consignor's certificate**

If a schedule of carriers is attached tick here

I certify that I today collected the consignment and that the details in A2, A4 and B3 are correct and I have been advised of any specific handling requirements

1. Carrier's name PAUL B. BSB  
Southwell

On behalf of (name, address, postcode, telephone, e-mail, fax)  
T WATTS WASTE LIMITED  
Barkby Road  
Leicester  
Leicestershire  
LE4 9LG

2. Carrier registration no./reason for exemption  
CBDU212098

3. Vehicle registration no. (or mode of transport, if not road)  
YK15W00

Signature: [Signature]

Date: 19/12/02 Time: 12:30

I certify that the information in A, B and C is correct, that the carrier is registered or exempt and was advised of the appropriate precautionary measures. All of the waste is packaged and labelled correctly and the carrier has been advised of any special handling requirements.

I confirm that I have fulfilled my duty to apply the waste hierarchy as required by Regulation 12 of the Waste (England and Wales) Regulations 2011.

1. Consignor's name

On behalf of (name, address, postcode, telephone, e-mail, fax)

ARCADIS LLP  
Shell Sutton Elms  
Coventry Road  
Leicester  
Broughton Astley LE9 6QD

Signature:

Date: 19/12/02 Time:

**PART E Consignee's Certificate**

EWC code(s) received	Qty of each EWC received (kg)	Accepted/Rejected	Waste Management operation (R or D code)
17 05 03*	<u>1960</u>		

1. I received this waste at the address given in A4 on Date: 19.12.2012 Time: 12:32  
 Name: [Signature]
2. Vehicle registration no. (or mode of transport if not road)  
YK15W00
3. Where the waste is rejected please provide details

On behalf of (name, address, postcode, telephone, e-mail, fax)  
Augean  
East Northants Resource Management Facility  
Stamford Road  
Kings Cliffe  
Peterborough  
PE8 6XX

Signature: [Signature]  
 Date: 19/12/02 Time: 12:32

I certify that waste management licence/permit/authorised exemption no(s)

Y9JWXB

authorises the management of the waste described in B at the address given in A4



East Northants Resource Management Facility  
Stamford Road, Kings Cliffe PE8 6XX

tel. 01780 444900 fax. 01780 444901

WASTE/WASTE TRANSFER NOTE TICKET NO: 394946 Permit : EPR/YP3138XB/V005

<b>CUSTOMER:</b> LIMPIA Acumen Waste Services Limited Acumen House Headlands Lane Knottingley West Yorkshire WF11 0LA <b>ORDER NO:</b> CONS/22304 <b>SOURCE:</b> 526 London	<b>HAULIER:</b> LIMPIA Acumen Waste Services Limited Acumen House Headlands Lane Knottingley <b>VEH. TYPE:</b> SKIP Skip Lorry <b>VEH. REG NO:</b> YK15WDD <b>CARRIER NO:</b> CBDU233934 <b>TRANSFER NO:</b> ARCADI22304
---	--

**WASTE TYPE:**

**WASTE CATEGORY:** L170503 - Contaminated Soils

**CONTAINER:** GRID REF: PAD - 350 Job No. : L221209400001

ROSS	WEIGHT KG'S	SEQ. NO	DATE	TIME
		7680	147553	19/12/2022
WRE	5720	147567	19/12/2022	13:17
ET	1960			

MEASURE 1.96 Tonne

**PRINT NAME:** KCWEIGHBRIDGE

**SIGNATURE ON BEHALF OF CUSTOMER:**

**SIGNATURE FOR AUGEAN:**

**Arcadis UK**

62-68 Hills Road,  
Cambridge, CB2 1LA  
T: +44 (0)1223 935011

[arcadis.com](http://arcadis.com)