

SITE INVESTIGATION REPORT

Afan Way

Project name	Afan Way
Date	20 th June 2008
Report number	R070022#1
Prepared by	Matt Rees
Reviewed by	
Distribution	
List of appended items	Site Photos 4 No.

1. Investigative Works

Investigative works on the site were designed to focus around the location of the former underground fuel storage tank (UST) compound at the north eastern section of the site. A series of trial pits were to be advanced to a depth of 3 – 4M or to the groundwater table anticipated to be at or near this depth. In addition an investigative trench was to be excavated across the UST compound to establish the condition of ground localised to the tanks and associated pipe work. Investigation of the previously installed boreholes was to be carried out provided the well installations were still intact.

2. Trial Pit Findings

LEE Remediation excavated the following trial pits:

LEE Pit 1: Location – North West of UST compound.

0.0 – 0.8M – Made Ground;

0.8 – 2.0M – Orange /Grey soft, sandy CLAY;

2.0 – 2.6M – Grey / Orange firm, gleyed CLAY.

Sample of (CLAY) material from 1.2M.

LEE Pit 2: Location – North East of UST compound.

0.0 – 0.7M – Made Ground;

0.7 – 2.2M - Orange /Grey soft, sandy CLAY;

2.2 – 3.1M – Grey / Black firm CLAY.

Free product ingress at NW corner of pit at 2.3M, Sample (impacted CLAY) from 2.6M.

Headspace reading with PID = 652ppm.

LEE Pit 3: Location – West of UST compound.

0.0 – 0.9M – Made Ground;

0.9 – 2.0M – Orange, V soft, V sandy CLAY with lenses of black ash;

2.0 – 3.5M – Grey / Black firm continuous CLAY.

Sample (black sandy ASH) fill from 1.8M. Brick structure in eastern wall of pit.

LEE Pit 4: Location – South West of UST compound.

0.0 – 1.2M – Made Ground with lens of black ash;

1.2 – 2.3M – Orange / Grey, firm CLAY;

2.3 – 3.6M – Grey, V firm CLAY.

Samples (ASH) from 0.9M and 1.4M (CLAY).

LEE Pit 5: Location – South East of UST compound.

0.0 – 1.1M – Made Ground;

1.1 – 2.3M – Loose possibly reworked, Grey mottled CLAY;

2.3 – 3.6M – Grey, firm CLAY with cobbles and water recorded at 3.6M.

LEE Pit 6: Location – East of UST compound.

0.0 – 1.6M – Made Ground;

1.6 – 1.8M – Horizon of Orange, soft, sandy, CLAY;

1.8 – 3.4M – Grey / Orange firm, continuous CLAY;

3.4 – 3.6M - Grey / Orange firm, continuous CLAY with frequent cobbles of rounded gravel.

Sample (CLAY with Gravel) from 3.5M.

LEE Pit 7: Location – Adjacent to Borehole E4

0.0 – 1.2M – Made Ground;

1.2 – 3.6M – Grey, firm, continuous CLAY.

Ingress of free phase product at 3.3M depth. Sample (CLAY) from 2.1M.

3. Trial Trench Findings

The trial trench was excavated from the central point of the former UST compound firstly to the south and latterly to the north. The excavation was characteristic in the greater depth of made ground present almost entirely composed of site generated crushed materials. The trenching contained concrete infrastructure at 1.7 – 2.0M depth, potentially from the former UST compound although no staining or visual contamination was present. Perched water was encountered at approximately 1.8m within the southern section of the trench adjacent to the residual concrete structure. No samples were collected from the treatment trench.

4. Groundwater Findings

The only remaining borehole located by LEE Remediation at site not lost or damaged during previous phases of work was borehole E4. This was located to the south east of the former UST compound area.

A product baler was dropped into the borehole and returned full of phase separated product with a strong petroleum odour. This was repeated with no water being recorded in the baler until the sixth repetition. Approximately 10 litres of the product was subsequently recovered reducing the recorded column of phase separated product to 185mm within the baler. The borehole was then left to recharge for a period of 1 hour whereupon the baler was recorded as having recharged to 670mm of phase separated product with no water present.



Photo 1 – Trial trench through former compound area.



Photo 2 – Ingress of free phase product into LEE pit 2.



Photo 3 – Ingress of free phase product into LEE pit 7.



Photo 4 – Free phase Product from Borehole E4.



APPENDIX B

Mr Rees
Lee Remediation Ltd
Innovation Centre
Longbridge Technology Park
1 Devon Way B31 2TS
Birmingham

26 June 2008

Test Report: COV/525201/2008

Dear Mr Rees

Analysis of your sample(s) submitted on 20 June 2008 is now complete and we have pleasure in enclosing the appropriate test report(s).

An invoice for the analysis carried out will be sent under separate cover.

Should you have any queries regarding this report(s) or any part of our service, please contact Customer Services on +44 (0)24 7642 1213 who will be happy to discuss your requirements.

If you would like to arrange any further analysis, please contact Customer Services. To arrange container delivery or sample collection, please call the Couriers Department directly on 024 7685 6562.

Thank you for using STL and we look forward to receiving your next samples.

Yours Sincerely,

Signed: 

Name: G. Smith

Title: Inorg and License Chem Manager

STL Coventry

STL Business Centre, Torrington Avenue,
Coventry, CV4 9GU

Tel: +44 (0)24 7642 1213

Fax: +44 (0)24 7685 6575

www.stl-ltd.com

Severn Trent Laboratories Limited

Registered in England & Wales Registration No. 2148934 Registered Office: 2297 Coventry Road, Birmingham B26



1314
0897
1229
1510



Cert. No. 10269
Environmental Management Systems



Certificate No. FS67435



Report Summary

Mr Matt Rees
Lee Remediation Ltd
Innovation Centre
Longbridge Technology Park
1 Devon Way
Birmingham
B31 2TS



Date of Issue: 26 June 2008

Report Number: COV/525201/2008 Issue 1

Number of Samples
included in this report 8
Number of Test Results
included in this report 123

Site Name: Afan Way
Job Received: 20 June 2008
Analysis Commenced: 20 June 2008
Order No: 0082/R070022/MR

Signed:

Name: G. Smith

Date: 26 June 2008

Title: Inorg and License Chem Manager

STL was not responsible for sampling unless otherwise stated. Sampling is not covered by our UKAS accreditation. Information on the methods of analysis and performance characteristics are available on request. Opinions and interpretations expressed herein are outside the scope of UKAS accreditation. Tests marked 'Not UKAS Accredited' in this Report/Certificate are not included in the UKAS Accreditation Schedule for our laboratory.

Severn Trent Laboratories Ltd.

STL Business Centre, Torrington Avenue, Coventry, CV4 9GU Tel:+44 (0)24 7642 1213 Fax:+44 (0)24 7685 6575



1314
0897
1229
1510

Report Number: COV/525201/2008

Issue 1

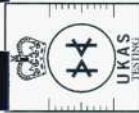
Site Name: Afan Way

Group	Determinand	Unit	Method/ Accreditation	Soil									
				10633229	10633230	10633231	10633232	10633233	10633234	10633235	10633236		
Inorganics	TOC by Ignition in Oxygen	%	27	1.5	1.3	-	-	-	1.2	-	-		
Phenols	MTBE	mg/kg	304	-	-	<0.010	<0.010	<0.010	-	0.11	<0.010		
TPH	Benzene	mg/kg	304	-	-	<0.010	<0.010	0.010	-	0.23	0.61		
	Toluene	mg/kg	304	-	-	<0.010	<0.010	0.025	-	0.69	1.0		
	Ethyl Benzene	mg/kg	304	-	-	<0.010	<0.010	<0.010	-	1.1	7.2		
	m,p-xylene	mg/kg	304	-	-	0.30	<0.010	0.014	-	4.0	20		
	o-xylene	mg/kg	304	-	-	0.19	<0.010	<0.010	-	2.2	<0.010		
	>C5 to C6 Aliphatics	mg/kg	304	-	-	<0.10	<0.10	<0.10	-	1.8	0.89		
	>C6 to C8 Aliphatics	mg/kg	304	-	-	13	<0.10	<0.10	-	10	4.0		
	>C8 to C10 Aliphatics	mg/kg	304	-	-	520	0.10	0.13	-	15	<0.10		
	>C10 to C12 Aliphatics	mg/kg	317EPH	-	-	1200	<1.0	<1.0	-	39	72		
	>C12 to C16 Aliphatics	mg/kg	317EPH	-	-	3900	<1.0	<1.0	-	<1.0	95		
	>C16 to C35 Aliphatics	mg/kg	317EPH	-	-	3200	<1.0	<1.0	-	18	70		
	>C35 to C44 Aliphatics	mg/kg	317EPH	-	-	160	<1.0	<1.0	-	<1.0	<1.0		
	Total Aliphatics (>C5 to C44)	mg/kg	304/317EPH	-	-	9000	<5.0	<5.0	-	84	240		
	>C5 to C7 Aromatics	mg/kg	304	-	-	<0.010	<0.010	0.010	-	0.23	0.61		
	>C7 to C8 Aromatics	mg/kg	304	-	-	<0.010	<0.010	0.025	-	0.69	1.0		
	>C8 to C10 Aromatics	mg/kg	304	-	-	4.5	<0.10	<0.10	-	12	73		
	>C10 to C12 Aromatics	mg/kg	317EPH	-	-	83	<1.0	<1.0	-	9.7	35		
	>C12 to C16 Aromatics	mg/kg	317EPH	-	-	550	<1.0	<1.0	-	10	26		
	>C16 to C21 Aromatics	mg/kg	317EPH	-	-	430	<1.0	<1.0	-	8.8	16		
	>C21 to C35 Aromatics	mg/kg	317EPH	-	-	160	<1.0	<1.0	-	<1.0	6.2		
	>C35 to C44 Aromatics	mg/kg	317EPH	-	-	210	<1.0	<1.0	-	<1.0	<1.0		
	Total Aromatics (>C5 to C44)	mg/kg	304/317EPH	-	-	1400	<5.0	<5.0	-	41	160		

Accreditation Codes: Y = UKAS Accredited, N = Not UKAS Accredited, M = MCERTS, S = Sub-contracted.
Analysed at: Bri = STL Bridgend, Cov = STL Coventry, Mid = STL Midlands, Rea = STL Reading, Run = STL Runcom.
For Microbiological determinands 0 or ND=Not Detected, For Legionella ND=Not Detected in volume of sample filtered, /S=Insufficient sample

Severn Trent Laboratories Ltd.

STL Business Centre, Torrington Avenue, Coventry, CV4 9GU Tel: +44 (0)24 7642 1213 Fax: +44 (0)24 7685 6575



ANALYST COMMENTS FOR REPORT

COV/525201/2008

Issue 1

Date of Issue: 26 June 2008

Sample No	Analyst Comments
10633229	
10633230	
10633231	
10633232	
10633233	
10633234	
10633235	
10633236	

Signed: 

Name: G. Smith

Title: Inorg and License Chem Manager

Date: 26 June 2008

DETERMINAND COMMENTS FOR REPORT COV/525201/2008

ISSUE 1

Date of Issue : 26 June 2008

Sample No	Description	Determinand	Comments
-----------	-------------	-------------	----------

Signed: 

Name: G. Smith

Title: Inorg and License Chem Manager

Date: 26 June 2008



APPENDIX C



APPENDIX D

APPENDIX J

Coal Authority Mining Report

Issued by:

The Coal Authority, Property Search Services, 200 Lichfield Lane, Berry Hill, Mansfield, Nottinghamshire, NG18 4RG
Website: www.groundstability.com Phone: 0345 762 6848 DX 716176 MANSFIELD 5

**GROUNDSURE LIMITED
SOVEREIGN HOUSE
CHURCH STREET
BRIGHTON
BN1 3UJ**

Our reference: **51000896384001**
Your reference: **ESP-2129828; PO:**
Date of your enquiry: **01 June 2015**
Date we received your enquiry: **01 June 2015**
Date of issue: **01 June 2015**

This report is for the property described in the address below and the attached plan.

Non-Residential Coal Authority Mining Report

275966, 189794, NEATH PORT TALBOT,

This report is based on and limited to the records held by, the Coal Authority, and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Coal mining	See comments below
Brine Compensation District	No

Information from the Coal Authority

Underground coal mining

Past

According to the records in our possession, the property is not within the zone of likely physical influence on the surface from past underground workings.

Present

The property is not in the likely zone of influence of any present underground coal workings.

Future

The property is not in an area for which the Coal Authority is determining whether to grant a licence to remove coal using underground methods.

The property is not in an area for which a licence has been granted to remove or otherwise work coal using underground methods.

The property is not in an area that is likely to be affected at the surface from any planned future workings.

However, reserves of coal exist in the local area which could be worked at some time in the future.

No notice of the risk of the land being affected by subsidence has been given under section 46 of the Coal Mining Subsidence Act 1991.

Mine entries

There are no known coal mine entries within, or within 20 metres of, the boundary of the property.

Coal mining geology

The Authority is not aware of any evidence of damage arising due to geological faults or other lines of weakness that have been affected by coal mining.

Opencast coal mining

Past

The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.

Present

The property does not lie within 200 metres of the boundary of an opencast site from which coal is being removed by opencast methods.

Future

The property is not within 800 metres of the boundary of an opencast site for which the Coal Authority is determining whether to grant a licence to remove coal by opencast methods.

The property is not within 800 metres of the boundary of an opencast site for which a licence to remove coal by opencast methods has been granted.

Coal mining subsidence

The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres, since 31st October 1994.

There is no current Stop Notice delaying the start of remedial works or repairs to the property.

The Authority is not aware of any request having been made to carry out preventive works before coal is worked under section 33 of the Coal Mining Subsidence Act 1991.

Mine gas

There is no record of a mine gas emission requiring action by the Coal Authority within the boundary of the property.

Hazards related to coal mining

The property has not been subject to remedial works, by or on behalf of the Authority, under its Emergency Surface Hazard Call Out procedures.

Withdrawal of support

The property is not in an area for which a notice of entitlement to withdraw support has been published.

The property is not in an area for which a notice has been given under section 41 of the Coal Industry Act 1994, revoking the entitlement to withdraw support.

Working facilities orders

The property is not in an area for which an Order has been made under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

Payments to owners of former copyhold land

The property is not in an area for which a relevant notice has been published under the Coal Industry Act 1975/Coal Industry Act 1994.

Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Additional Remarks

Information provided by the Coal Authority in this report is compiled in response to the Law Society's Con29M Coal Mining and Brine Subsidence Claim enquiries. The said enquiries are protected by copyright owned by the Law Society of 113 Chancery Lane, London WC2A 1PL. Please note that Brine Subsidence Claim enquiries are only relevant for England and Wales. This report is prepared in accordance with the Law Society's Guidance Notes 2006, the User Guide 2006 and the Coal Authority and Cheshire Brine Board's Terms and Conditions applicable at the time the report was produced.

The Coal Authority owns the copyright in this report. The information we have used to write this report is protected by our database right. All rights are reserved and unauthorised use is prohibited. If we provide a report for you, this does not mean that copyright and any other rights will pass to you. However, you can use the report for your own purposes.

Location map



Approximate position of property

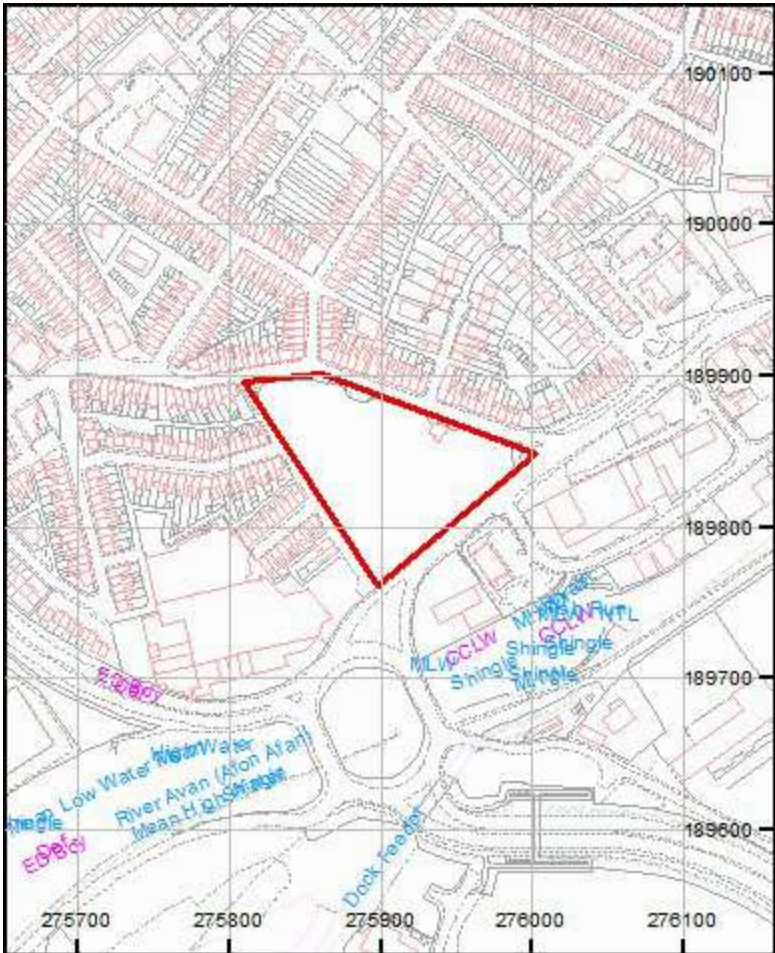


Enquiry boundary

Reproduced by permission of Ordnance Survey on behalf of HMSO. © Crown copyright and database right 2015. All rights reserved. Ordnance Survey Licence number: 100020315

Key

Approximate position of enquiry boundary shown





APPENDIX 6 - Arcadis Investigation Report

BUROWS YARD

Ground Investigation Report

April 2018



CONTACTS

GEORGE FLOWER
Technical Director Geoscience

t +44 (0) 117 372 1200
m +44 (0) 7764 368421
e george.flower@arcadis.com

Arcadis.
2 Glass Wharf
Temple Quay
Bristol
BS2 0FR
United Kingdom

Burows Yard

Ground Investigation Report

AUTHORISED SIGNATURES

Author Sian Carter



Checker Jonny Aykroyd



Approver George Flower

Report No 10013618-AFS-GLR-G001

Date April 2018

Version control

Version	Date	Author	Changes
00	April 2018	Sian Carter	[Original Issue]

This report dated April 2018 has been prepared for Neath Port Talbot County Borough Council (the "Client") in accordance with the terms and conditions of appointment dated December 2017 (the "Appointment") between the Client and **Arcadis Consulting (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

1	INTRODUCTION	1
1.1	Limitations.....	1
1.2	Proposed Development.....	1
1.3	Pre-Existing Information.....	1
2	SITE DETAILS.....	2
2.1	Site Location and Description	2
2.2	Geology.....	3
2.3	Hydrogeology and Hydrology	3
3	FIELDWORK	4
3.1	General.....	4
3.2	Exploratory Holes	4
3.2.1	Exploratory Hole Locations.....	4
3.2.2	Investigation Methodology	4
3.2.3	Cable Percussive Boring	7
3.2.4	Trial Pitting/Trial Trenches.....	7
3.3	Visual & Olfactory Evidence of Contamination	8
3.4	In-situ Testing	8
3.4.1	Laser Induced Fluorescence Testing	8
3.4.2	VOC Head Space Screening.....	10
3.5	Installations and Post-Fieldwork Monitoring.....	10
3.5.1	Post-fieldwork Monitoring	11
4	LABORATORY TESTING	12
4.1	General.....	12
4.2	Geotechnical Laboratory Testing	12
4.3	Geo-Environmental Laboratory Testing.....	12
5	REFERENCES	14

FIGURES

Figure 2-1 Site Location.....	2
-------------------------------	---

Figure 2-2: Geological Setting 3

TABLES

Table 3-1 Initial ground investigation scope 4

Table 3-2 Summary of completed exploratory holes..... 5

Table 3-3 Summary of LIF Responses and Basic Iterpretation of Response Signature..... 9

Table 3-4 Summary exploratory hole installations 10

Table 4-1 Summary of geotechnical test data 12

Table 4-2 Summary of Soil Chemical Tests 12

Table 4-3 Summary of Groundwater Chemica,Tests 13

APPENDICES

APPENDIX A

DRAWINGS

Drawing 10013618-GLR-EHP-0001: Exploratory Hole Location Plan

Drawing 10013618-ARC-XX-XX-DR-YY-0002-Z1-PDF: Potential Sources of Contamination & Exploratory Hole/Test Locations

APPENDIX B

STANDARD PROCEDURES

APPENDIX C

EXPLORATORY HOLE LOGS & PHOTOGRAPHIC RECORDS

APPENDIX D

MONITORING DATA

APPENDIX E

GEOTECHNICAL LABORATORY TEST DATA

APPENDIX F

GEO-ENVIRONMENTAL LABORATORY TEST DATA

1 INTRODUCTION

Neath Port Talbot County Borough Council propose to undertake a residential and commercial development at Burrows Yard, Port Talbot in the county of Neath Port Talbot. This ground investigation was commissioned by Neath Port Talbot County Borough Council, ‘the Client’, to supplement the pre-existing ground investigation data and assessments, fully characterise the soil and groundwater conditions at the site and thereby inform the Remediation Strategy for the development.

The scope of the supplementary ground investigation was determined by Arcadis Consulting (UK) Ltd, and the work was instructed in December 2017.

This report provides a factual account of the fieldwork undertaken including engineering descriptions of the various strata encountered, the geotechnical and geo-environmental laboratory testing undertaken on samples obtained, and subsequent groundwater monitoring.

1.1 Limitations

This report has been prepared for the Client in accordance with the terms and conditions of appointment. Arcadis cannot accept any responsibility for any use of or reliance on the contents of this report by any third party. The copyright of this document, including the electronic format and any AGS data, shall remain the property of Arcadis.

Arcadis do not accept liability for any use of the information presented in this report unless it is signed by the author, checker and approver and marked as final.

It should be noted that ground conditions between exploratory holes may vary from those identified during this ground investigation; any design should take this into consideration. It should also be noted that groundwater levels may be subject to diurnal, tidal, seasonal, climatic variations and those recorded in this report are solely dependent on the time the ground investigation was carried out and the weather before and during the investigation.

1.2 Proposed Development

The proposed development at the site comprises a mixed use commercial and residential development.

1.3 Pre-Existing Information

The following information relating to the site and the ground conditions was made available to Arcadis prior to mobilisation to the site:

- a. Burrows Yard Ground Investigation, Supplementary Phase 2 Ground Investigation – Interpretative Report, G762/IR [1]; source Quantum Geotechnical
- b. Ground investigation Scope and Specification [2]; source Arcadis Consulting (UK) Ltd.

2 SITE DETAILS

2.1 Site Location and Description

The site is situated approximately 0.5 km southwest of Port Talbot city centre in Neath, South Wales, at an approximate National Grid Reference (NGR) of SS 759 898. Figure 2-1 shows the site location.

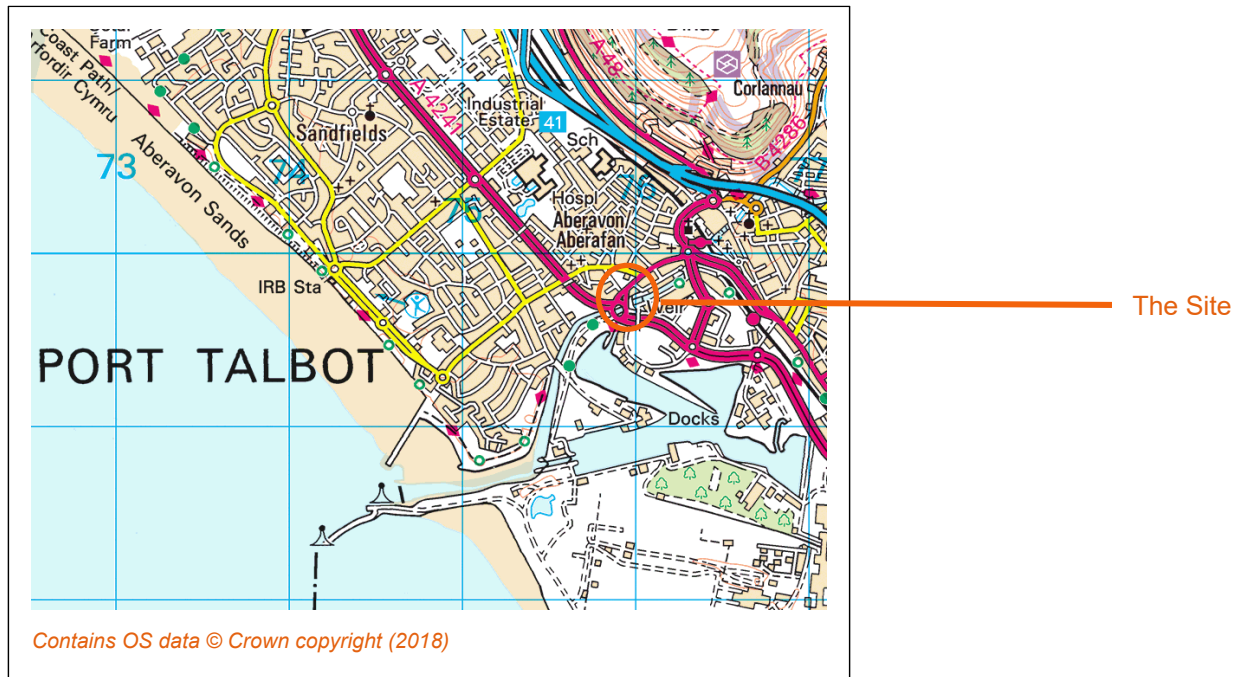


Figure 2-1 Site Location

The site is roughly triangular in shape and bordered by Water Street to the north, Isaacs place to the southwest and Afan Way to the southeast. The site is relatively flat with occasional hummocky surfacing. The site level dips slightly from west to east across site. The site sits at approximately 5 mAOD.

The site is predominantly surrounded by terraced residential properties, with commercial properties to the southeast. The River Afan (Afon Afan) is approximately 80m to the southeast, trending northeast to southwest.

The site contains two abandoned steel frame structures on the western edge and a number of large stockpiles of soil and construction debris in the central and eastern areas of site.

The Port Talbot Docks are within 0.50 km southeast of site.

2.2 Geology

The published 1:50 000 scale British Geological Survey (BGS) map of the area incorporating the site, Sheet 247 [3], and the BGS online GeoIndex [17] indicate the site is underlain by Estuarine Alluvial superficial deposits, and the South Wales Middle Coal Measures Formation.

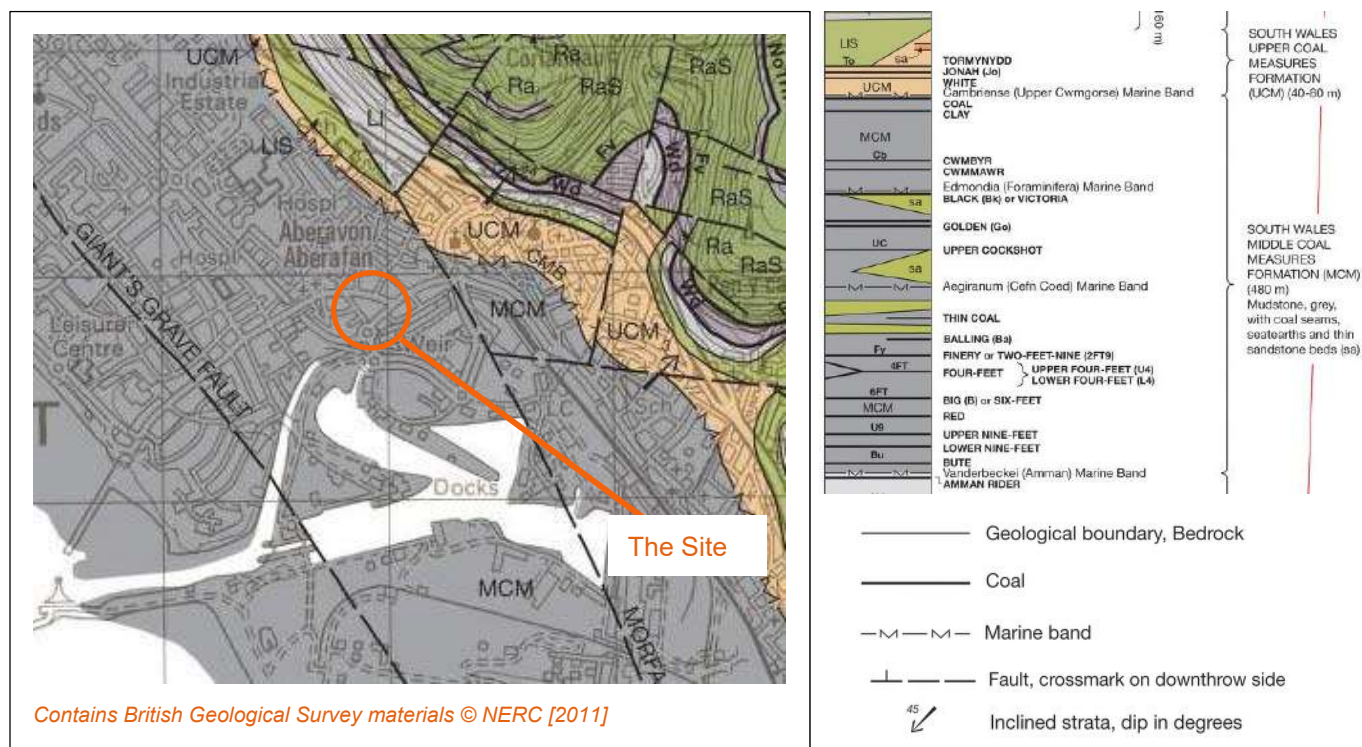


Figure 2-2: Geological Setting

The area surrounding site is recorded as artificially modified ground or landscaped ground. The site itself is known to have been built up, and Made Ground is present.

The superficial deposits underlying the site are recorded as estuarine alluvial deposits, normally consisting of a consolidated soft silty clay, with layers of sand, gravel and peat.

The bedrock geology is recorded as the South Wales Middle Coal Measures Formation, which is identified as grey coal-bearing mudstones and siltstones, with seat earths and minor sandstones [17].

The nearest linear feature is the inferred Morfa Fault which has an unknown displacement and is approximately 350 m east of site.

The Cambriense (Upper Cwmgorse) Marine Band is present approximately 350 m northeast of site separating the South Wales Middle Coal Measures Formation and the South Wales Upper Coal Measures Formation [3].

2.3 Hydrogeology and Hydrology

The hydrogeological rock unit beneath site is recorded as the South Wales Upper Coal Measures Formation. This rock unit is described as a regional, cyclic multi-layered aquifer with moderate yields from sandstones and many springs.

The site is approximately 90m northwest of the River Afan. Natural Resources Wales identifies the site having a low risk of flooding from rivers and sea, with a chance of flooding between 1 in 1000 (0.1%) and 1 in 100 (1%) [18]. The edges of site have a low to medium risk of surface water flooding, identifying as a risk between 0.1% - 1 % and 1% - 3.3% per year. A small area of central site is also recorded to have between a low and medium risk of flooding by surface water [18].

3 FIELDWORK

3.1 General

Intrusive investigations were carried out in a single phase of works between 4th December and 12th December 2017. The scope of the ground investigation, including the location, target depths and types of exploratory holes undertaken was designed and planned by Arcadis Consulting (UK) Ltd and is summarised in Table 3-1.

The ground investigation methods were undertaken in general accordance with the principles set out in BS EN 1997-2:2005 [7] and with the general practice described in BS5930:2015 [8]. The geo-environmental aspects of the ground investigation complied with the general requirements of BS 10175:2011 [9].

Table 3-1 Initial ground investigation scope

Location ID	Hole Type	Target Depth (m bgl)	Requirements
BH01-BH04	CP	10.0	Boreholes to be drilled using 'clean drilling' methodologies including formation of an environmental seal upon the first main water strike. On completion boreholes to be installed with 50mm dia HDPE groundwater monitoring standpipes.
M01-M06	TP	3.0	Machine excavated trial pits with regular sampling, within each existing waste material/soil mound (M1-M4)
TP01-TP12	TP	3.0	Machine excavated trial pits with regular sampling. Determine depth of natural strata.
LIF01-LIF20	IP + LIF	1.20	Undertake inspection pits at the location of each LIF test to clear for underground services

Notes:

TP = trial pitting | CP = cable percussive boring | IP = inspection pit | LIF = laser induced fluorescence

The investigation works were carried out under the supervision of a suitably experienced ground engineer who undertook the logging and reporting of the exploratory holes and in situ testing.

3.2 Exploratory Holes

3.2.1 Exploratory Hole Locations

The exploratory hole locations were set out using fixed points of reference on site by the Arcadis supervising engineer and the co-ordinates and elevations then established using existing topographical information and GPS.

Drawing 10013618-GLR-EHP-0001 presented in Appendix A displays the as-constructed exploratory hole locations while the co-ordinates and elevation of the ground surface at each exploratory hole location are given on the individual logs.

3.2.2 Investigation Methodology

The following methods and techniques were undertaken to construct the exploratory holes at the site. The completed scope of investigation is summarised in Table 3-2 below.

Details of the methods of investigation and associated standards adopted are presented in Appendix B; the exploratory hole records are presented in Appendix C, a key to the notation and symbols used on the logs is presented in Appendix B.

Table 3-2 Summary of completed exploratory holes

Location ID	Hole Type	Start Date	End Date	Final depth (m bgl)	Comment	Termination Reason
ABH01	CP	04 Dec 2017	05 Dec 2017	10.00	Installed with dual monitoring well standpipe	Target depth
ABH02	CP	06 Dec 2017	07 Dec 2017	9.00	Installed with dual monitoring well standpipe	Terminated due to slow progression in very dense sand and gravel
ABH03	CP	07 Dec 2017	08 Dec 2017	9.30	Installed with dual monitoring well standpipe	Terminated due to slow progression in very dense sand and gravel
ABH04	CP	08 Dec 2017	12 Dec 2017	6.20	Installed with single monitoring well standpipe	Terminated due to slow progression in very dense sand and gravel
ATP01	TP	06 Dec 2017	06 Dec 2017	0.50	-	Unmarked service located at 0.50 mbgl
ATP01a	TP	06 Dec 2017	06 Dec 2017	0.70	-	Obstruction - Curved concrete base found. Possible foundation
ATP03	TP	06 Dec 2017	06 Dec 2017	1.90	-	Unstable pit sides
ATP04	TP	06 Dec 2017	06 Dec 2017	2.50	-	Excavator limited due to surrounding building frame structure
ATP05	TP	06 Dec 2017	06 Dec 2017	1.90	-	Obstruction – Concrete in base of pit. Possible foundation
ATP06	TP	05 Dec 2017	05 Dec 2017	2.10	-	Obstruction - potential buried structure
ATP07	TP	05 Dec 2017	05 Dec 2017	1.00	-	Metal obstruction and unmarked buried service
ATP08	TP	07 Dec 2017	07 Dec 2017	0.40	-	Unmarked service (water pipe)
ATP08a	TP	07 Dec 2017	07 Dec 2017	2.20	-	Obstruction – possible concrete slab
ATP09	TP	06 Dec 2017	06 Dec 2017	2.80	-	Unstable pit sides
ATP10	TP	06 Dec 2017	06 Dec 2017	2.60	-	Natural strata encountered

Burows Yard – Supplementary Ground Investigation Factual Report

Location ID	Hole Type	Start Date	End Date	Final depth (m bgl)	Comment	Termination Reason
ATP11	TP	05 Dec 2017	05 Dec 2017	2.20	-	Natural strata encountered
ATP12	TP	05 Dec 2017	05 Dec 2017	2.50	-	Natural strata encountered
LIF01	IP	04 Dec 2017	04 Dec 2017	0.60	IP terminate at 0.60 mbgl, position move to LIF01a	Obstruction
LIF01a	IP + LIF	04 Dec 2017	07 Dec 2017	5.02	-	Target depth
LIF02	IP	04 Dec 2017	04 Dec 2017	0.45	IP terminate at 0.45 mbgl, position move to LIF02a	Obstruction
LIF02a	IP + LIF	04 Dec 2017	07 Dec 2017	5.00	-	Target depth
LIF03	IP	04 Dec 2017	04 Dec 2017	0.80	IP terminate at 0.80 mbgl, position move to LIF03a	Obstruction
LIF03a	IP + LIF	04 Dec 2017	04 Dec 2017	2.47	-	
LIF04	IP	05 Dec 2017	05 Dec 2017	0.50	IP terminate at 0.50 mbgl, position move to LIF04a	Obstruction
LIF04a	IP	05 Dec 2017	05 Dec 2017	0.80	IP terminate at 0.80 mbgl. Position cancelled	Obstruction
LIF05	IP + LIF	05 Dec 2017	05 Dec 2017	5.01	-	Target depth
LIF06	IP + LIF	05 Dec 2017	05 Dec 2017	5.04	-	Target depth
LIF07	IP	05 Dec 2017	05 Dec 2017	0.30	IP terminate at 0.30 mbgl, position move to LIF07a	Obstruction
LIF07a	IP + LIF	05 Dec 2017	05 Dec 2017	5.02	-	Target depth
LIF08	IP + LIF	07 Dec 2017	07 Dec 2017	5.07	-	Target depth
LIF09	IP + LIF	07 Dec 2017	07 Dec 2017	5.00	-	Target depth
LIF10	IP + LIF	06 Dec 2017	06 Dec 2017	5.03	-	Target depth
LIF12	IP + LIF	05 Dec 2017	06 Dec 2017	5.10	-	Target depth
LIF13	IP + LIF	06 Dec 2017	06 Dec 2017	5.01	-	Target depth

Location ID	Hole Type	Start Date	End Date	Final depth (m bgl)	Comment	Termination Reason
LIF14	IP + LIF	06 Dec 2017	06 Dec 2017	5.03	-	Target depth
LIF15	IP + LIF	06 Dec 2017	06 Dec 2017	5.01	-	Target depth
LIF16	IP + LIF	06 Dec 2017	06 Dec 2017	5.02	-	Target depth
M01a	TP	04 Dec 2017	04 Dec 2017	1.50	-	Trial pit within Mound 01
M02a	TP	04 Dec 2017	04 Dec 2017	1.00	-	Trial pit within southwest side of Mound 02
M02b	TP	04 Dec 2017	04 Dec 2017	1.00	-	Trial pit within eastern side of Mound 02
M02c	TP	04 Dec 2017	04 Dec 2017	2.00	-	Trial pit within north eastern side of Mound 02
M03a	TP	05 Dec 2017	05 Dec 2017	0.70	-	Within Mound 03
M03b	TP	05 Dec 2017	05 Dec 2017	1.50	-	Within Mound 03
M04a	TP	04 Dec 2017	04 Dec 2017	1.00	-	Within Mound 04
M05a	TP	05 Dec 2017	05 Dec 2017	1.20	-	Within Mound 05
M06	TP	07 Dec 2017	07 Dec 2017	1.40	-	Within Mound 06
M06a	TP	07 Dec 2017	07 Dec 2017	1.00	-	Within Mound 06

Notes

TP = trial pitting | CP = cable percussive boring | IP = inspection pit | LIF = laser induced fluorescence

3.2.3 Cable Percussive Boring

Cable percussive boring was completed using Dando D2000 drilling rig equipped with 200 mm and 150 mm casing and tools to undertake boreholes up to 10 m bgl.

Due to the potential for the bore to provide a contaminant pathway from the made ground in to the underlying strata, boring commenced using the 200 mm diameter casing through the made ground and a bentonite seal was formed between the two strata. Drilling then continued using the 150 mm diameter equipment.

Samples of the material recovered in borehole were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum and at 0.5 m intervals thereafter in clay soils; and bulk samples were taken at 1 m intervals where the sand and gravel content of the soil was significant.

3.2.4 Trial Pitting/Trial Trenches

Trial pits were undertaken using a mechanical excavator. Samples of the material recovered in the trial pits were taken to enable representative laboratory testing. Generally small disturbed samples were taken at each change in stratum.

Photographic records of the trial pit elevation and arisings were taken and are presented with the associated trial pit log.

3.3 Visual & Olfactory Evidence of Contamination

The following observations of palpable visual or olfactory evidence of contaminant were recorded during the field work:

- ABH04 2.3 m bgl: Strong hydrocarbon odour within the Made Ground.
- ATP06 2.0 – 2.10 m bgl: Strong hydrocarbon odour within the slightly silty sandy CLAY (Estuarine alluvium deposits)
- ATP08a 2.2 m bgl with groundwater seepage with hydrocarbon sheen within the Made Ground
- M04a 0.0 – 1.0: Slight organic odour within the Made Ground.
- M06 potential asbestos fragment encountered in the Made Ground between 0.1-1.4 m bgl.
- LIF01a: Potential asbestos identified in face of pit wall
- M05A Pocket of black granular material, possible degraded tarmac in the Made Ground at 0.5 m bgl

3.4 In-situ Testing

3.4.1 Laser Induced Fluorescence Testing

Objectives

Previous investigations (undertaken by others) had reported LNAPL in a number of investigation locations and some LNAPL was historically measured in pre-existing monitoring wells and trial pits. A number of potential LNAPL types including red diesel and weathered petrol had been identified from the historical landuse.

The LIF investigation locations were targeted to refine the extent of LNAPL that was potentially associated with historical sources and the locations where LNAPL had previously been reported. Drawing 10013618-ARC-XX-XX-DR-YY-0002-Z1-PDF in Appendix A shows the exploratory holes and LIF test positions in relation to potential sources of contamination, together with the previously recorded product thickness by Quantum.

The overall rationale for the LIF investigation was to provide additional data to identify areas where potentially recoverable LNAPL might be present that could reasonably be addressed as part of the overall remediation strategy; in simple terms to refine the extents of gross mobile NAPL contamination that could reasonably be expected to be targeted by LNAPL extraction remediation approaches.

Methodology

The LIF system is a rapid, dynamic screening tool which uses a high energy laser to induce fluorescence to assess hydrocarbon impacts in the subsurface. Irradiation by the laser causes the aromaticity of the hydrocarbon contamination to fluoresce. This fluorescence is collected, detected and analysed by the LIF system. The sample fluorescence is compared to the fluorescence of a standard reference emitter (RE) calibrated at the start of each drive and logged as a percentage of the standard response. The RE emits a signal response of 100%, although it should be noted that fluorescence of greater than 100% RE is possible as different hydrocarbon contaminants fluoresce with different intensities.

The LIF response signal, presented as a percentage of RE versus depth, is coloured to reflect the distribution of the four scanned wavelengths measured by the system. The colouration is performed by allocating the colours blue, green, orange and red to the four wavelengths namely 350nm, 400nm, 450nm and 500nm respectively. The colouring of the Signal versus Depth (SVD) plot is generated by applying the four colours proportionally to the area under the four wavelength peaks. Hence, changes in product type result in changes to the colouring of the data plots. Typical wavelength distribution plots at discrete depths (callouts) are shown on the SVD plots to provide examples of the type of products identified by the SVD colourisation.

Results

A summary of the LIF responses is presented in the following table together with a basic interpretation of their individual response signatures.

Table 3-3 Summary of LIF Responses and Basic Interpretation of Response Signature

LIF ID	Response	Colour	Basic Interpretation
LIF 01a	No significant responses	-	No discernible LNAPL likely to be present
LIF 02a	Very minor response over baseline (4% RE) between 2.6 and 3 m bgl	Orange/yellow	No discernible significant LNAPL likely to be present
LIF 03	Very minor response over baseline (4% RE) between 1.1 and 1.5 m bgl	Yellow/orange	No discernible significant LNAPL likely to be present
LIF 04	No data - refusal	N/A	No data - refusal
LIF 05	No significant response over baseline (<4% RE)	-	No discernible LNAPL likely to be present
LIF 06	Moderate response (maximum 36% RE) at approximately 2.8 to 3.3 m bgl	Orange	Evidence of residual LNAPL, unlikely to be fully saturated and have functional mobility or be recoverable. Signature suggests potential medium oils or very weathered diesel.
LIF 07a	Moderate response (maximum 36% RE) between 3 and 4 m bgl. Maximum response at approximately 3.8 m bgl	Yellow/Orange	Evidence of residual LNAPL, unlikely to be fully saturated and have functional mobility or be recoverable. Potential smear zone observed between 3.0 and 3.5m bgl. Signature suggests medium oils or weathered diesel.
LIF 08	No significant response over baseline (<4% RE)	-	No discernible LNAPL likely to be present
LIF 09	No significant response over baseline (<4% RE)	-	No discernible LNAPL likely to be present
LIF 10	No significant response over baseline (<4% RE)	Orange	No discernible LNAPL likely to be present
LIF 11	No data - refusal	N/A	No data - refusal
LIF 12	Very minor responses between 2.1 m and 4 m bgl (maximum of 8% RE)	Orange/yellow	Potential residual trace of weathered medium to heavy end hydrocarbon LNAPL. No mobile LNAPL likely to be present
LIF 13	No significant response over baseline (<4% RE)	Orange/yellow	No discernible LNAPL likely to be present
LIF 14	Very minor responses close to surface and at approximately 3.5 m bgl (maximum 6% at 0.4 m bgl RE)	Yellow/orange	Potential residual trace of weathered medium to heavy end hydrocarbon LNAPL. No mobile LNAPL

LIF ID	Response	Colour	Basic Interpretation
LIF 15	Moderate response (30% RE) at approximately 3.8 m bgl	Blue	Evidence of residual LNAPL, unlikely to be fully saturated and have functional mobility or be recoverable. Colour suggests potential gasoline source.
LIF 16	Very minor response at approximately 0.7 m bgl (8% RE)	Yellow	Potential residual trace of weathered medium to heavy end hydrocarbon LNAPL. No mobile LNAPL likely to be present

The colour denoted in the table above is indicative of the type of contaminant present, with green/blue colouration representative of light gasoline / unweathered diesel hydrocarbon products, yellow/oranges representative of weathered diesel oils, and orange/reds as heavier oils.

3.4.2 VOC Head Space Screening

The presence of Volatile Organic Compounds (VOC) within the ground was determined using a photoionization detector (PID) to detect the 'headspace' vapours emitted by the compounds. The method is applicable to a wide range of compounds that have sufficiently high volatility to be affected liberated from the soil or water matrix in normal temperature and pressure ranges.

The headspace test was undertaken on the freshly extracted soil sample by placing a small amount of material into a screw-top glass jar so that the jar was not more than half-full. The jar opening was covered with an aluminium foil sheet and the lid screwed on to form an air-tight seal. The sample and jar were then shaken for about 15 seconds to break-up and disperse the soil before resting the sample for about 5 minutes.

To assess the headspace vapour, the jar lid was removed and the PID probe was inserted through the foil into the headspace area. The PID reading recorded was the highest response observed in the first 10 seconds. The screening results are presented on the relevant exploratory holes logs within Appendix C.

The PID instrument was calibrated regularly throughout the day.

3.5 Installations and Post-Fieldwork Monitoring

Installations to enable long term monitoring of the site were made in those boreholes selected by Arcadis Consulting (UK) Ltd and the details are summarised in Table 3-4 and are also provided on the relevant borehole logs.

Table 3-4 Summary exploratory hole installations

Location ID	Installation Type	Response Zone Top (m bgl)	Response Zone Base (m bgl)
ABH01	SP50	3.50	5.50
	SP50	7.00	10.00
ABH02	SP50	4.50	6.00
	SP50	7.50	9.00
ABH03	SP50	4.50	6.00
	SP50	7.50	9.00

ABH04	SP50	5.00	6.00
-------	------	------	------

Notes: SP50 = 50 mm ID standpipe

3.5.1 Post-fieldwork Monitoring

Post-field work monitoring was undertaken on separate visits on 16th and 17th January, 13th and 14th February, and 12th and 13th March. In all, three visits to the site were made to record land gas emissions and groundwater levels. Groundwater monitoring and sampling was undertaken using low flow groundwater monitoring techniques. The well head parameters were monitored prior to sampling to ensure that stagnant water in the well casing was sufficiently purged and that fresh water was draw into the well prior to sampling. Further information is provided in the Addendum to the Remedial Strategy. The results of the groundwater monitoring are presented within Appendix D.

4 LABORATORY TESTING

4.1 General

Geotechnical and geo-environmental chemical testing was undertaken on selected samples obtained from the exploratory holes. The testing was scheduled by the geo-environmental engineer and the testing was undertaken by an Arcadis approved testing laboratory.

4.2 Geotechnical Laboratory Testing

The geotechnical tests detailed in Table 4-1 were carried out in accordance with either BS1377:1990: Parts 1 to 8 [14]; BS EN ISO 17892: Parts 1 to 12 [15]; BRE SD 1:2005 [5]; or other methods as listed in Table 4-1. The complete results of the geotechnical laboratory testing are presented in Appendix E.

Table 4-1 Summary of geotechnical test data

Test	Method	No of Determinations
Particle Size Distribution - Wet sieving	BS1377 Pt2-9.2	2

4.3 Geo-Environmental Laboratory Testing

Chemical tests were undertaken on soil and groundwater samples collected from the site. Testing was carried out for the contaminants detailed in Table 4-2 and Table 4-3. The results of the chemical laboratory testing are presented in Appendix F. Details of the test methodology is presented with the test results.

Table 4-2 Summary of Soil Chemical Tests

Test type	Method	No of Determinations
Metals and inorganics (Ar, B, Cd, Cr, Pb, Hg, Se, Cu, Ni, Zn)	Induced Coupled Plasma Optical Emission Spectroscopy (ICP-OES)	12
Hexavalent Chromium	ICP-OES	29
Trivalent Chromium		
Total Chromium		
Monoaromatics	ISO17025	16
Moisture Content	Gravimetric	34
Total Polycyclic Aromatic Hydrocarbon compounds (PAH)	Gas Chromatography –Mass Spectrometry (GC-MS)	16
Total Petroleum Hydrocarbons (TPH) Criteria Working Group (CWG) including BTEX (Benzene, Toluene, Ethylbenzene and xylenes)	Gas Chromatography – Flame Ionisation Detector (GC-FID)	16
Asbestos Identification	Stereobinocular Microscope	30

Asbestos Quantification		21
WAC		6

Table 4-3 Summary of Groundwater Chemicals, Tests

Test type	Method	No of Determinations
Metals and inorganics (As, B, Cr, Cd, Cu, Pb, Hg, Ni, Se, Zn), pH, Ferric iron, ferrous iron, total iron, dissolved iron, sulphate as SO ₄ , sulphide, dissolved organics carbon, total organic carbon, Nitrate as N, Nitrate as NO ₃ , Nitrate as NO ₂ , alkalinity, carbonate. Cyanide Free & Total	ICP-OES	21
Hexavalent chromium Trivalent chromium Total chromium	ICP-OES	7
Speciated Polycyclic Aromatic Hydrocarbon compounds (PAH)	GC-MS	21
TPH CWG (Aliphatic & Aromatic), BTEX	GC-FID	21
Monoaromatics	ISO17025	21
Methane	ISO17025	21
Dissolved gases (methane, carbon dioxide, oxygen)		21

5 REFERENCES

General References

1. Burrows Yard Ground Investigation, Supplementary Phase 2 Ground Investigation – Interpretative Report, G762/IR
2. Arcadis Consulting. 2017 Ground Investigation Scope Burrows Yard.
3. British Geological Survey. 2011. Swansea. England and Wales Sheet 247. Bedrock and Drift Deposits. 1:50 000. BGS Keyworth, Nottingham.
4. TRL. 2004. Dynamic cone penetrometer tests and analysis. TRL Technical Report PR IN 277-04. Transport Research Laboratory, Crowthorne, England.
5. Building Research Establishment. 2005. Concrete in aggressive ground. BRE Special Digest 1. 3rd Edition. BRE, Watford.

National Standards

6. BS EN 1997-1. 2004. Eurocode 7: Geotechnical Design. Part 1 General Rules. British Standards Institution, 2013 (revised text).
7. BS EN 1997-2. 2007. Eurocode 7: Geotechnical Design. Part 2 Ground Investigation and testing. British Standards Institution, 2010 (revised text).
8. BS 5930. 2015. Code of practice for ground investigations. British Standards Institution.
9. BS 10175. 2011. Investigation of potentially contaminated sites – Code of practice. British Standards Institution.
10. BS EN ISO 22282-1:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 1: General Rules. British Standards Institution.
11. BS EN ISO 22282-2:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 2: Water permeability tests in a borehole using open systems. British Standards Institution.
12. BS EN ISO 22282-5:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 5: Infiltrometer tests. British Standards Institution.
13. BS EN ISO 22282-6:2012. Geotechnical investigation and testing – Geohydraulic testing. Part 6: Water permeability tests in a borehole using closed systems. British Standards Institution.
14. BS 1377. 1990. Method of test for soils for civil engineering purposes. Published in 9 Parts. British Standards Institution,
15. BS EN ISO 17892-1: Geotechnical investigation and testing – Laboratory testing of soil – Determination of water content. British Standards Institution.
16. BS EN ISO 17892-2: Geotechnical investigation and testing – Laboratory testing of soil – Determination of bulk density. British Standards Institution.

Internet References

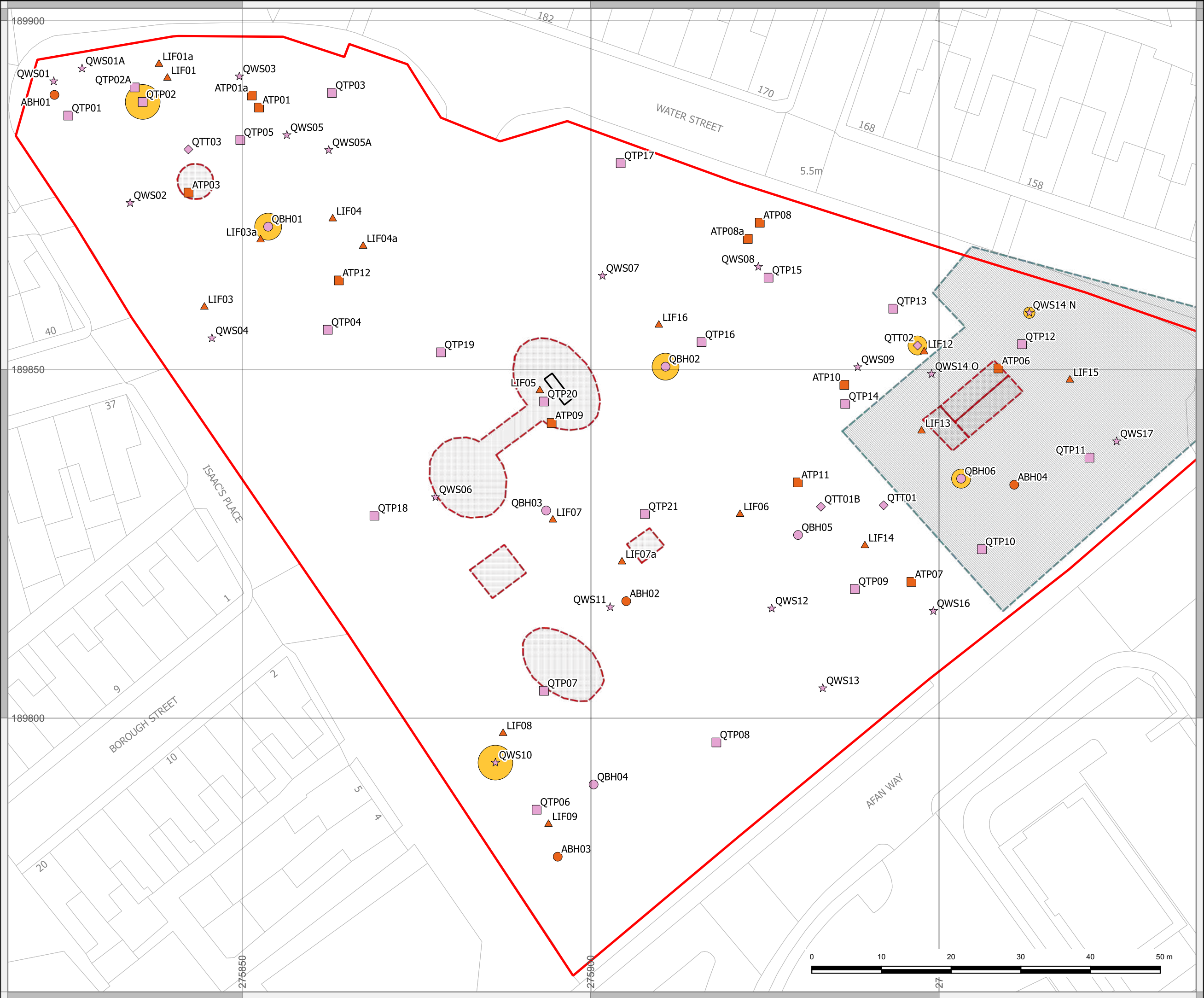
17. British Geological Survey: <http://www.bgs.ac.uk/data/mapViewers/home.html>. Accessed Feb 2018.
18. Natural Resources Wales: <https://naturalresources.wales/evidence-and-data/maps/long-term-flood-risk/?lang=en> Accessed Feb 2018

APPENDIX A

DRAWINGS

**Drawing 10013618-GLR-EHP-0001: Exploratory Hole
Location Plan**

**Drawing 10013618-ARC-XX-XX-DR-YY-0002-Z1-PDF:
Potential Sources of Contamination & Exploratory
Hole/Test Locations**



Legend

Potential Contamination Sources

- Filling Point
- Petrol Filling Station
- Tanks

Quantum SI

- CP
- TP
- TR
- WS

Quantum Product Thickness

- <1mm
- 1mm - <3mm
- 3mm - <5mm
- 5mm - <26mm
- 26mm - 50mm

Arcadis SI (2017)

- CP
- LIF
- TP

NOTES / DISCLAIMER:

Reproduced from the OS MasterMap by permission of Ordnance Survey® on behalf of The Controller of Her Majesty's Stationary Office. © Crown copyright OS 100023392

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.

Title:
POTENTIAL SOURCES OF CONTAMINATION &
EXPLORATORY HOLE/TEST LOCATIONS

Site:
BURROWS YARD

Client:
NEATH PORT TALBOT
COUNTY BOROUGH COUNCIL

Project: 10013618	10013618-ARC-XX-XX- DR-YY-0002-Z1-PDF
----------------------	--

Date: 06/04/2018
Drawn By: JLA
DRG No: 10013618-ARC-XX-XX-DR-YY-0002-Z1-PDF
Scale at A3 Page Size: 1:500

