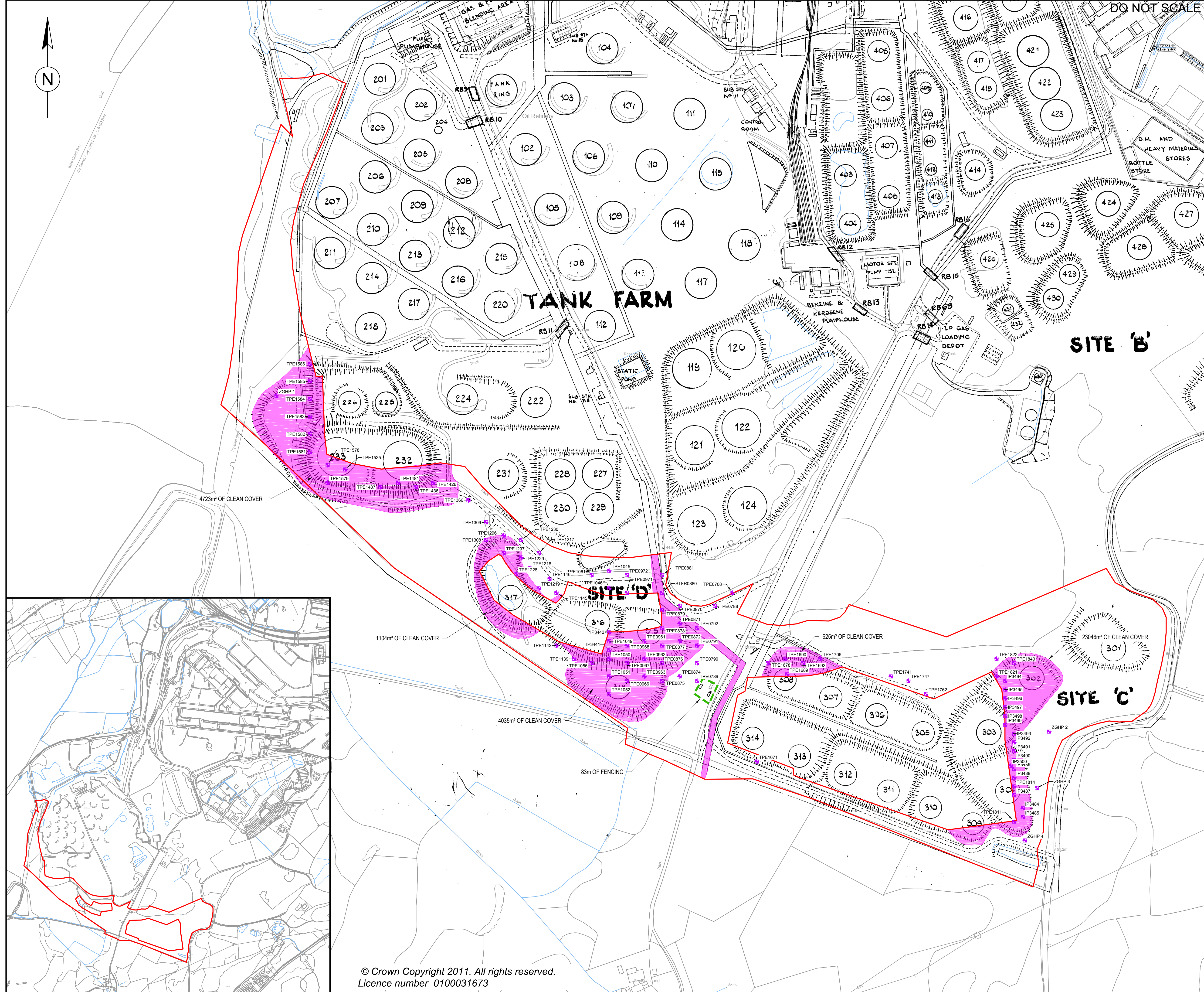




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Rev.	Date	Description	By	Chk'd	App'd
Drawing Status				Suitability	
FOR INFORMATION				S2	
			The Axis 10 Holliday Street Birmingham B1 1TF Tel: ☐44 (0)1214 835000 Fax: ☐44 (0)1214 835252 Copyright © Atkins Limited (2015) www.atkinsglobal.com		
Client					
					
Project Title					
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Drawing Title					
PUBLIC OPEN SPACES ZONE G LONG TERM RECEPTORS ACCESS AND LANDSCAPING PROPOSALS					
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5041216-ATK-REM-DWG-2020				P 1	

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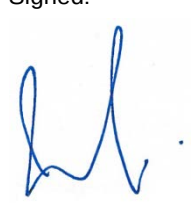
Contact
Rhys Mander
Associate
T +44 (0)29 2067 4600
E rhys.mander@aecom.com

1 Callaghan Square
Cardiff
CF10 5BT
United Kingdom

Coed arcy onitor hase i e RR CC

prepared for
Coed arcy Limited

prepared by
AECO Infrastructure Environment Limited

Rev	Date	Revision Details	Prepared by	Checked by	Approved by
1	August 2016	Original issue	Alice Court Graduate Environmental Consultant Signed:	Rhys Mander Associate Signed:	Geoff Jones Technical Director Signed:
					

AECOM Infrastructure & Environment UK Limited
1 Callaghan Square
Cardiff
CF10 5BT
United Kingdom

Telephone: +44(0)29 2067 4600

www.aecom.com

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I TRO CTIO

Scope

This Redevelopment Remediation Works Completion Certificate (RRWCC) has been prepared with reference to the following agreements:

- Section 106 Agreement dated 8 February 2008 between Neath Port Talbot Borough Council (NPTCBC), St Modwen Developments Limited (SMD), St Modwen Properties Plc (SMP), BP Oil Llandarcy Refinery Limited (BPLR) and Coed Darcy Limited (CDL); and
- Remediation and Maintenance Agreement dated 23 May 2008 (RMA) between SMD, SMP and CDL.

Unless advised otherwise, definitions used in this RRWCC can be found in the Section 106 Agreement and/or the RMA.

This RRWCC has been prepared for Phase 43 in response to the receipt of a written request from SMD pursuant to clause 4.3 of the RMA. The phase boundary and intended use on which this RRWCC is based have been notified to the Monitor by letter, a copy of which is provided in **Appendi A**.

The intended use for Phase 43 has been declared as public open space comprising playing fields. The phase boundary is the land edged red on drawing 5041216-REM-DWG-1666, a copy of which is provided in **Appendi A**. The approximate location of Phase 43 in relation to the Development Boundary is shown in **Figure** below. Phase 43 covers an area of approximately 75,800m².

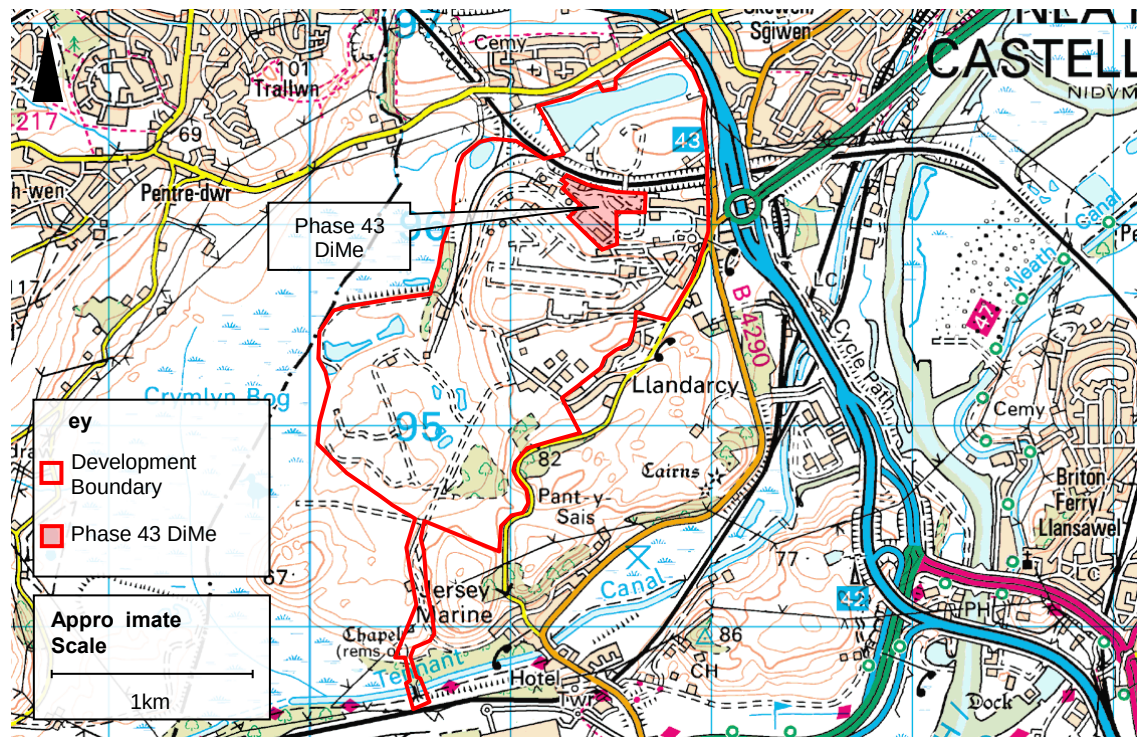


Figure Location plan

In accordance with the requirements of the Monitor's Deed of Appointment, this RRWCC shall:

- Describe the remedial action which in the Monitor's professional opinion has been carried out for the purposes of completing the Redevelopment Remediation Works in relation to Phase 43; and
- Certify that in the Monitor's professional opinion the Redevelopment Remediation Works have been satisfactorily completed for Phase 43 in accordance with the purpose, objectives and requirements of Schedule 8 of the Section 106 Agreement, having regard to the intended use.

A copy of Schedule 8 of the Section 106 Agreement is provided in **Appendix B**.

Background

Objectives of the Redevelopment Remediation Works

Part One of Schedule 8 of the Section 106 Agreement outlines the purpose and objectives of the Redevelopment Remediation Works as follows:

- The purpose and objectives of the Redevelopment Remediation Works are the carrying out of all such remedial action over and above that actually carried out as part of the RAP Works that is necessary in order to make each part of the Property suitable for its Intended Use. A part of the property will only be suitable for its Intended Use if and when the Phase Works Completion Date (PWCD) is declared in respect of that part of the Property.
- This objective will be deemed to be met for the purposes of the Section 106 Agreement and the RMA on the date specified in a notice from CDL declaring the PWCD for the Phase. The PWCD will be declared once CDL is satisfied that the remediation necessary for the specified Intended Use for the Phase has been completed.

Part Two of Schedule 8 of the Section 106 Agreement places a number of obligations on SMD as the Developer. The main obligations pertinent to this Phase are as follows:

- The Developer shall carry out or procure the carrying out of all Remedial Action necessary in order to achieve the purpose and objective as outlined in Part 1 of Schedule 8 of the Section 106 Agreement. The design and specification of any remediation shall take account of the principles and objectives and the design assumptions for the RAP Works and shall not prejudice the achievement and future sustainability of these principles and objectives.
- In order to determine the need for Remedial Action in the first place it is necessary to undertake an appropriate site assessment. This assessment needs to take account of the site history, potential and/or actual measured extent of contamination and the associated implied risk. Only by developing a thorough understanding of both potential and actual contamination will it be possible to confirm that all necessary Remedial Action likely to have been completed. This obligation should be satisfied through completion of an appropriate desk study and intrusive investigation.
- The Risk Based Screening Levels (RBSLs) set out in Tables 1 and 2 [in Schedule 8 of the Section 106 Agreement] and the aesthetic criteria, remediation quality and scope (including the depth below Final Finished Level (FFL) to which quality standards are achieved), as the same may be varied in accordance with this Schedule 8, shall be achieved for each part of the Property at the minimum validation frequencies set out in Clause 8 of Part 3 (as applicable depending upon whether such part of the Property is intended for use as residential, commercial or recreational land) as a minimum base level standard.

SMD has procured the services of Atkins Ltd. to assist in discharging the above obligations.

A proposed development layout for Phase 43 is shown on drawing 5041216-ENG-DWG-906 Revision A, a copy of which is provided in **Appendi A**. This drawing indicates the area being used as playing fields. It should be noted that the Section 106 Agreement does not specify remediation requirements for playing fields. Given this, bespoke remediation requirements have been developed by Atkins specifically for playing fields, details of which are provided in Atkins' report ref. 5041216- REM-RPT-1275 rev. 1 dated January 2015, a copy of which is included in the information sources presented in **Appendi C**. The Monitor and NPTCBC have confirmed their acceptance of these criteria, which therefore form the remediation requirements against which this certificate has been prepared.

It is noted that the development layout drawing indicates a proposed club house within Phase 43. Furthermore, with reference to the current masterplan drawing reference 1332/400/MP/SK/TERT Revision H, a copy of which is also provided in **Appendi A**, it is noted that part of Phase 43 was originally intended for residential and commercial end-uses and also part of a proposed school falls into Phase 43. Despite this, following discussion with the Developer, this certificate has been prepared on the assumption that the entire phase will be used for playing fields and that no occupiable spaces will be constructed within Phase 43. If however this should change, and occupiable spaces are proposed, then further remediation works will be necessary.

Tables 1, 2, 3 and 4 from Schedule 8 of the Section 106 Agreement are reproduced below for reference. It should be noted that Table 4 has been replaced with an updated table developed by Atkins specifically for schools and associated playing fields.

Table Summary of Soil RBSLs

<i>Contaminant</i>	<i>Land-Use Specific Soil RBSL Surface to 1m below FFL (mg/kg)¹</i>			<i>Land-Use Specific RBSL Soil below 1m depth (mg/kg)</i>		
	<i>Residential</i>	<i>Commercial</i>	<i>Recreational</i>	<i>Residential</i>	<i>Commercial</i>	<i>Recreational</i>
<u>METALS & METALLOIDS</u>						
Arsenic	64	500	64	-	-	-
Cadmium	2.6	1400	2.6	-	-	-
Chromium	130	5000	200	-	-	-
Mercury	1	480	1	-	-	-
Nickel	50	5000	75	-	-	-
Selenium	3	8000	3	-	-	-
Lead	337	750	337	-	-	-
Vanadium	416	16000	640	-	-	-
Copper	200	-	200	-	-	-
Zinc	478	-	478	-	-	-

<i>Contaminant</i>	<i>Land-Use Specific Soil RBSL Surface to 1m below FFL (mg/kg)¹</i>			<i>Land-Use Specific RBSL Soil below 1m depth (mg/kg)</i>		
	<i>Residential</i>	<i>Commercial</i>	<i>Recreational</i>	<i>Residential</i>	<i>Commercial</i>	<i>Recreational</i>
<u>ORGANIC SPECIES</u>						
Benzene	0.12	5	13	0.4	5	48
Benzo(a)pyrene ²	0.9	29	0.9	none	none	none
Toluene	36	1160	8110	52	389	none
Ethylbenzene	41	122000	4740	140	none	none
Xylenes	32	121000	7940	58	none	none
1,2-Dichloroethane	0.04	2	4.5	0.1	0.65	6
Dichloromethane	5	1650	241	84	665	6220
Tetrachloroethene	11	1050	641	34	368	1780
Trichloroethene	1	84	193	2	28	269
Vinyl Chloride	0.01	4	0.7	0.04	1.6	16
1,2 Dichloroethene	4	273	632	7	91	881
1,1,1-Trichloroethane	154	577000	27900	160	3250	none
TPH Aromatic EC>C7-C8	125	1840	21337	146	617	none
TPH Aromatic EC>C8-C10	94	913	4025	257	547	none
TPH Aromatic EC>C10-C12	118	26515	4589	1394	none	none
TPH Aromatic EC>C12-C16	131	64875	4799	none	none	none
TPH Aromatic EC>C16-C21	82	51449	3639	none	none	none
TPH Aromatic EC>C21-C35	1130	51449	3639	none	none	none
TPH Aliphatic EC>C6-C8	8335	8517587	606191	none	none	none
TPH Aliphatic EC>C8-C10	112	158890	12075	158	none	none
TPH Aliphatic EC>C10-C12	3204	163360	12094	none	none	none
TPH Aliphatic EC>C12-C16	4513	169032	12117	none	none	none
TPH Aliphatic EC>C16-C21	94174	3429944	242573	none	none	none
TPH Aliphatic EC>C21-C35	94820	3429944	242573	none	none	none
Total TPH (Phase 1) ³	1717	81413	9061	9182	81956	None

Contaminant	Land-Use Specific Soil RBSL Surface to 1m below FFL (mg/kg)¹			Land-Use Specific RBSL Soil below 1m depth (mg/kg)		
	Residential	Commercial	Recreational	Residential	Commercial	Recreational
Total TPH (Process Area) ³	2601	44344	10830	4098	35014	None
Total TPH (North Tank Farm) ³	1104	25875	9419	3802	13974	None
Total TPH (South Tank Farm) ²	1015	37230	6349	2792	34797	None
ASBESTOS						
Sum of all Types of ACM	200	300	200	200 ⁴	-	-

Notes

- “-” value not applicable to scenario
- “none” RBSL value exceeds soil saturation limits and free phase assessment appropriate
- 1 Lower value of human health RBSL or Soil Code value if higher than background LCL value (applicable to metals & metalloids only)
- 2 Benzo(a)pyrene RBSL to be compared against sum of 16 US EPA Priority List PAHs using Toxicity Equivalence approach
- 3 ‘Total’ TPH RBSL derived for an area of development, based on individual RBSLs provided and available mass fraction TPH data in soil at time of derivation, using the inverse weighted average approach
- 4 Refer to Section 106 Agreement for specification of relevant depth ranges

Table Summary of RBSLs for groundwater

Contaminant	Land-Use Specific RBSL (mg/l)		
	Residential	Commercial	Recreational
TPH Aliphatic EC>C6-C8	none	none	none
TPH Aliphatic EC>C8-C10	none	none	none
TPH Aliphatic EC>C10-C12	none	none	none
TPH Aliphatic EC>C12-C16	none	none	none
TPH Aliphatic EC>C16-C21	none	none	none
TPH Aliphatic EC>C21-C35	none	none	none
TPH Aromatic EC>C7-C8	20	97	none
TPH Aromatic EC>C8-C10	22	none	none
TPH Aromatic EC>C10-C12	none	none	none

Land-Use Specific RBSL (mg/l)

Contaminant	Residential	Commercial	Recreational
TPH Aromatic EC>C12-C16	none	none	none
TPH Aromatic EC>C16-C21	none	none	none
TPH Aromatic EC>C21-C35	none	none	none
Benzene	0.7	6	198
Benzo(a)pyrene	none	none	none
Toluene	47	229	none
Ethylbenzene	102	506	none
Xylenes	43	607	none
1,2-Dichloroethane	0.2	0.82	45
Dichloromethane	150	624	none
Tetrachloroethene	22	115	none
Trichloroethene	2.6	13	813
Vinyl Chloride	0.06	0.3	18
1,2-Dichloroethene	15	68	none
1,1,1-Trichloroethane	193	989	none

otes

“none” theoretical RBSL greater than solubility limit

Table Scale of Aesthetic Criteria

Class	Visual	Olfactory
0	No visible staining of soil, no visible suspect ACM	No detectable odour on soil
1	Occasional staining of soil, no visible suspect ACM	Faint odour on soil
2	Frequent staining of soil	Distinct but not strong odour on soil
3	Occasional heavy staining of soil	Strong odour on soil
4	Heavy staining of soil	Strong odour discernible in ambient air
5	Visible hydrocarbon product	Overwhelming Odour

otes

Visible suspect ACM refers to asbestos containing material visible to the naked eye which a reasonable and prudent person used to managing asbestos may suspect to be asbestos containing.

Table Minimum Validation Testing Frequencies

Testing for the Validation Suite at the following frequency:	Deeper Soils (Schools and Playing Fields >1m below FFL)
Imported soil from verified greenfield site	1 per 500m ³ ex situ, composite of 5 regular sub-samples
Imported soil from characterised brownfield site ¹	1 per 100m ³ ex situ, composite of 5 sub-samples
0.5-1m below FFL in-situ	Regular grid of 1 per 100m ² , sample over 1m depth
>1m below FFL in-situ in building areas	Regular grid of 1 per 200m ² , sample over 1m depth
>1m below FFL in-situ in open space areas	Regular grid of 1 per 400m ² , sample over 1m depth
Face of remedial excavations <1m deep	n/a
Face of remedial excavations >1m deep	1 per 10m ² , minimum of 1 per face, worst case VO sample
Along redundant service excavations	1 per 20m of trench, worst case VO sample
Stockpiled excavated site materials for re-use	1 per 100m ³ ex situ, composite of 5 sub-samples
Soil treated ex-situ and homogenised	1 per 200m ³ , composite of 5 regular sub-samples

Notes

- “1” Validation suite to reflect prior use of the originating brownfield site and the design and purpose of the relevant area of Coed Darcy.
- “VO” Visual/olfactory (i.e. aesthetic) observation

Risk Based Screening Levels (RBSLs) and Remediation Target Concentrations (RTCs)

It should be noted that in addition to the RBSLs specified in the Section 106 Agreement (as listed in **Tables 1 and 2** above), Atkins has also developed Remediation Target Concentrations (RTCs). The RTCs are intended to be health protective and it has been agreed previously with NPTCBC that where the RTCs are numerically lower than the RBSLs, the RTCs shall be used. A summary of the RBSLs and RTCs for schools and playing fields is presented Atkins' report ref. 5041216-REM-RPT-1275 revision 1, dated January 2015, a copy of which is included in the information sources presented in **Appendix C**.

Remediation Action Plan (RAP) Works

In addition to meeting the requirements of the Redevelopment Remediation Works, the Developer must also complete a series of statutory remedial works which are referred to as the RAP Works. The requirements for the RAP Works are outlined in Schedule 7 of the Section 106 Agreement.

It is intended that this report, which is the RRWCC, will be complemented by a RAP Works Completion Statement (RAPWCS) in order to provide the information required by CDL to enable the PWCD to be declared.

Details of the scope of works and associated validation completed to satisfy the RAP requirements pertinent to this Phase are reported separately in RAPWCS ref. 49310747/BRRP00022/Cert 43a.

Information Sources

A summary of the information sources that the Monitor has been provided with in relation to Phase 43 is provided in **Table** . Unless otherwise stated, the Monitor has relied solely on these information sources as the basis for issuing this RRWCC. Upon a review of the information sources, in the Monitor's reasonable professional opinion, such information and the manner in which it was obtained appears sufficiently up to date, reliable and robust to justify such reliance. No verification of the data has been completed by the Monitor unless noted in the following sections.

Electronic copies of the information sources are provided in **Appendi** .

Table Information Sources

<i>Ref</i>	<i>Document Reference</i>	<i>Format</i>	<i>Title</i>	<i>Author</i>	<i>Date Received</i>
1	39991-007/DR829	Report	Draft Summary Report Stage 1 Solvent Recovery Pilot Test DiMe Plant Area	Dames & Moore	November 1999
2	39991-016/6732/MC	Letter	Results of Di and Me Mineralisation Tests DiMe Plant, BP Llandarcy Refinery	URS	August 2002
3	39991-022/DR1096	Report	Information Supplement for DiMe Plant Area	URS	September 2002
4	39991-037-785/DR1144	Report	Draft Factual Report DiMe Area	URS	July 2003
5	39991-032-785/DR1161/LT/7205	Letter	Rail Cutting Inspection	URS	August 2003
6	39991-037/DR1158	Report	Outline Remedial Options Assessment	URS	July 2004
7	39991-044-785-FR1287	Report	Whole Site Investigation BP Llandarcy Refinery	URS	August 2005
8	44382742/BRRP0001	Report	BP Llandarcy Refinery Desk Study	URS	July 2007
9	49310747/BRRP0005	Report	DiMe Investigation Summary	URS	April 2009
10	5041216/ENG/239/OTH/JM/SPEC/0042	Report	Demolition Specification Issue 3	Atkins	April 2009
11	5041216-REM-RPT-000216	Report	Derivation of Remediation Target Criteria Revision 3	Atkins	January 2010
12	5041216-REM-RPT-000316	Report	Remediation Target Criteria for the DiMe Area (Revision 1)	Atkins	December 2010
13	5041216-REM-TN-000467	Technical Note	Detailed Ground Investigations	Atkins	December 2010

Ref	Document Reference	Format	Title	Author	Date Received
14	N/A	Response to RFI	Response to Monitor RFI no. 56 re. Atkins' Remediation Target Criteria for the DiMe Area	Atkins	December 2010
15	5041216-REM-RPT-476	Report	Derivation of Commercial Remediation Target Criteria	Atkins	January 2011
16	N/A	Response to RFI	Response to Monitor RFI no. 79 re. Atkins' Remediation Target Criteria for the DiMe Area	Atkins	January 2011
17	5041216-REM-TN-497	Technical Note	Response to Monitor RFI no. 80 re. DiMe Site Investigation Scope	Atkins	January 2011
18	N/A	Response to RFI	Response to Monitor RFI no. 78 re. Atkins' DiMe Controlled Waters QRA	Atkins	March 2011
19	5041216-REM-RPT-000372	Report	DiMe Area Controlled Waters Risk Assessment v2	Atkins	March 2011
20	5041216/REM/TN/552	Technical Note	Proposed re-use of Existing Stockpiled Materials	Atkins	April 2011
21	N/A	Response to RFI	Response to Monitor RFI no. 85 re. Atkins' DiMe Controlled Waters QRA	Atkins	May 2011
22	5014216/REM/RPT/616	Report	Geo-environmental Assessment & Outline Remediation Strategy	Atkins	August 2011
23	5014216/REM/RPT/372	Report	DiMe Area, Controlled Waters Risk Assessment	Atkins	November 2011
24	5041216-REM-RPT-1275	Report	Redevelopment Requirements: Proposed Schools (Revision 1)	Atkins	January 2015
25	5014216/PLOTS/RPT/1016	Report	Commercial Area Validation Report	Atkins	May 2015
26	5041216/PLOTS/RPT/001405	Report	Validation Report Monitor Phase 43	Atkins	October 2015

Requests for Information RFI Issued by the Monitor

The Monitor has raised eight RFIs in relation to Phase 43, as summarised in **Table 1**. Copies of the RFIs are provided in **Appendix E**. Copies of the responses received from Atkins are included in the information sources provided in **Appendix E**.

Table 1 RFIs

RFI Ref.	Title	Associated Atkins Document	Date Raised	Complete	Comments
56	DiMe RTC Report Review	Atkins report 'Remediation Target Criteria for the DiMe Area' (ref. 5041216/REM/RPT/00316)	April 2010	Yes	Further comments raised in RFI 79
65	Review of DiMe Controlled Waters Risk Assessment	Atkins report 'DiMe Controlled Waters Risk Assessment' (ref. 5041216-REM-RPT-000372)	August 2010	Yes	Further comments raised in RFI 78
78	Review of DiMe Controlled Waters Risk Assessment Rev01	Atkins report 'DiMe Controlled Waters Risk Assessment' (ref. 5041216-REM-RPT-000372)	January 2011	Yes	Further comments raised in RFI 85
79	DiMe RTC Report Review Rev01	Atkins report 'Remediation Target Criteria for the DiMe Area' (ref. 5041216/REM/RPT/000316)	January 2011	Yes	-
80	Review of DiMe Site Investigation Scope	Atkins report 'Detailed Ground Investigation' (ref. 5041216-REM-TN-000467)	January 2011	Yes	-
84	Re-Use of Existing Stockpiled Material on DiMe	Atkins Technical Note 552, 'Proposed re-use of Existing Stockpiled Materials'	April 2011	Yes	-
85	Review of DiMe Controlled Waters Risk Assessment Rev01	Atkins Report 'DiMe Area Controlled Waters Risk Assessment'	April 2011	Yes	-
156	Review of Atkins' Validation Report for Monitor Phase 43 (Former DiMe Plant and Proposed Sports Pitches)	Atkins' Validation Report for Phase 43 (ref. 5041216-PLOTS-RPT-1405)	September 2015	Yes	Updated validation report received in October 2015

DESCRIPTION OF REMEDIAL ACTION

The following section provides a description of the remedial action that has been carried out for the purposes of completing the Redevelopment Remediation Works in relation to Phase 43. This section of the report is structured as follows:

1. Site Assessment
2. Remediation Strategy
3. Redevelopment Remediation Works
4. Validation

Site Assessment

As discussed in Section 1.2.1 of this report, the Section 106 Agreement requires the Developer to undertake an appropriate site assessment which needs to take account of the site history, potential and/or actual measured extent of contamination and the associated implied risk. The Section 106 Agreement also states that only by developing a thorough understanding of both potential and actual contamination will it be possible to confirm that all necessary Remedial Action is likely to have been completed. This obligation should be satisfied through completion of an appropriate desk study and intrusive investigation.

Desk Study

From the information presented in Atkins' validation report (Information Source 26) it is evident that Atkins has reviewed the findings of previous site investigations and desk studies to develop an understanding of both potential and actual contamination within Phase 43. The following is of note.

Phase 43 covers an area of the former refinery referred to as the DiMe Plant which comprised one of the final stages in production of lubrication oils. Within the DiMe Plant, two chlorinated solvents (1,2 Dichloroethane ('Di') and Methylene Chloride ('Me')) were used to remove waxy components from the oils. URS' historical desk study report (Information Source 8) indicates evidence of losses and gradual leakages of solvents as well as occasional larger scale releases at the plant.

With reference to the historical maps presented in **Appendix E**, a number of buildings, including the Main Boiler House, were situated within Phase 43. Many of these buildings were demolished prior to acquisition of the site by St. Modwen in 2008. The Central Substation, Central Control Room and New Bath House were also situated within Phase 43 and it is reported that these buildings were demolished in 2009 to 2010, following the removal of asbestos from the buildings.

With regards geology, Atkins reports that the British Geological Survey Sheet for Swansea (Sheet 247) Drift Edition indicates that Phase 43 is underlain by Glacial Drift overlying Upper Pennant Sandstone Measures. Solid strata are suggested to dip towards the north. There are no recorded faults shown to cross beneath the area of the proposed playing fields.

With regards hydrogeology, Atkins reports that groundwater within Phase 43 is suggested to lie at shallow depth, rising beneath the southern part of the Phase, consistent with the general topography. The Upper Pennant measures underlying Phase 43 are classified as a Secondary A Aquifer, defined by the Environment Agency as 'permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers'.

With reference to the drawings presented in URS' site investigation report (Information Source 7) groundwater flow with Phase 43 is generally considered to be towards the northeast. The principal surface water receptors, as identified in Atkins' Controlled Waters Risk Assessment

(Information Source 19) are Crymlyn Bog (700m to the west) and the River Neath (1.5km to the east). It is noted that North Site Reservoir which is located to the north of Phase 43 is not considered to be in direct continuity with groundwater in the bedrock beneath Phase 43. However it is noted that storm water drainage runs which pass through Phase 43 discharge into North Site Reservoir.

Intrusive Investigations

URS carried out a number of site investigations on behalf of the operator of the former refinery, as reported in URS' site investigation report (Information Source 7) and summarised in Information Source 9. In addition to the site investigations undertaken by URS, Atkins undertook further site investigations as summarised below.

Ground Investigation (July 2009)

Preliminary investigations were undertaken by Atkins in the area of the former DiMe plant during July 2009. These works included the installation of new boreholes to replace those which had been damaged or destroyed during the removal of hard standing and earlier demolition works. In total, 13 cable percussive boreholes were installed to depths ranging from 4.5m below ground level (bgl) to 14.2m bgl and eight rotary (open) boreholes were installed to depths ranging from 4m bgl to 28m bgl.

A total of 32 soil samples, comprising made ground and natural soils, were collected for laboratory analysis. Atkins reports two exceedances of the DiMe RTCs for 1,2 Dichloroethane within natural soil samples at depths of 6.5m and 10m bgl. Strong odours were noted during drilling within shallow made ground and natural soils, generally within the northern part of the DiMe area.

Free Product Recovery (November 2009)

Atkins undertook a series of draw down tests on eight boreholes due to the presence of free product within the boreholes. The objective of the tests was to determine whether or not recorded product represented discrete bodies of trapped product within the well installations or was representative of a wider source beneath the former DiMe plant.

Results indicated product rebound within five wells after 30 minutes and within seven wells after 24 hours. Within three wells product thickness was in excess of that initially recorded after 24 hours.

Hardstanding Clearance and Shallow Drainage Removal (June 2010)

During June 2010 works were undertaken to remove below ground structures to a depth of 1m bgl and drainage infrastructure was removed from within the central part of the former DiMe Plant. A total of 200 litres of product was removed during these works. Following the works a series of shallow trenches were installed along the northern and southern boundaries of the former plant to allow shallow groundwater to be managed. Water samples were taken from these trenches and Atkins reports that contamination concentrations were noticeably higher than samples taken from the remaining storm water drains.

Ground Investigation (2011)

Atkins undertook a total of 74 machine excavated trial pits across the former DiMe Plant during 2011. The trial pits were excavated to depths ranging from 0.1m - 4m bgl. The aim of these works was to provide detail on shallow groundwater conditions across Phase 43, to confirm the extent and location of solvent impacted shallow groundwater and to confirm the extent of remaining free product.

Localised areas of heavy staining up to a visual/olfactory classification of 4, as defined in **Table** of this report, were recorded mainly within the Made Ground but also within the

deeper natural soils. One soil sample exceeded the RTC for 1,2 Dichloroethane within heavily impacted soils in the centre of Phase 43.

Free product was recorded in 18 locations, mostly within the northern and western parts of Phase 43. Groundwater samples from the vicinity of former solvent storage tanks exceeded adopted groundwater thresholds.

A series of product recovery trenches were installed across Phase 43 which indicated that free product was generally confined to isolated pockets and seepages. The largest volumes of free product were situated within the western part of Phase 43. Laboratory analysis on samples taken from the trenches indicated no exceedances of the adopted thresholds for groundwater.

Summary

In summary the Monitor is satisfied that an appropriate level of investigation has been completed in order to ascertain a sufficient understanding of contamination within Phase 43.

Remediation Strategy

Schedule 8 of the Section 106 Agreement sets out the minimum remedial action required depending on the intended use. However, as discussed in Section 1.1 of this report, the Section 106 Agreement does not specify remediation requirements for playing fields. Atkins has therefore developed remediation criteria specifically in relation to playing fields, details of which are provided in Atkins' report ref. 5041216- REM-RPT-1275 rev. 1 dated January 2015 (Information Source 24). The minimum requirements are as follows:

- All significant areas of oil-saturated soils and free product should be removed;
- All soils must be remediated so as to meet the adopted thresholds for residential (shallow) end use beneath the surface to 1m below FFL;
- Beneath proposed buildings, all soils must be remediated so as to meet the adopted thresholds for residential (deep) end use at depths >1m below FFL;
- Recreational (>1m below FFL) criteria will be adopted for soils at depth (>1m below FFL) within open space areas (including playing fields and proposed hardstanding etc). Where these lie immediately adjacent to proposed buildings, a suitable stand-off will be adopted utilising the residential criteria.
- The aesthetic quality of soils shall be Class 1 or better for at least the first metre below FFL.
- The aesthetic quality of soils shall be Class 2 or better at depths of between 1 – 2m below FFL and Class 4 or better at depths >2m beneath FFL.
- Where encountered near surface, groundwater will be assessed in line with the thresholds presented in Appendix E (of Atkins' report ref. 5041216- REM-RPT-1275) in line with the residential and recreational splits indicated above.
- All soil potentially containing dispersed asbestos fibres or visible ACM must be removed or remediated to meet in bulk, considering both dispersed fibres and pieces of ACM, the appropriate ACM RBSL, or the requirements of relevant Environmental Authorities, whichever is the more conservative, to a minimum depth of 2m below FFL.

In addition to the minimum remedial action requirements outlined above, Schedule 10 of the Section 106 Agreement states that:

- Irrespective of the Intended Use of each Phase or part thereof, all existing buried services at the Property shall be removed and the routes of those services shall be backfilled with material no more permeable than the general material in the vicinity. Where backfill to new underground services may become a pathway for residential Pre-Transfer Date Contamination, appropriate control measures such as land drainage or venting measures shall be installed so as to appropriately protect remediated and/or developed areas.
- Wherever there is a risk that following construction of the Urban Village groundwater or organic phase liquid may contaminate soils within the top one metre below FFL such that any of the relevant RBSLs and/or aesthetic criteria specified in Schedule 8 may be exceeded, the Developer shall ensure that all necessary steps are taken to mitigate these risks. Suitable measures may include, but not be limited to, the installation of land drains and/or the raising of the site ground levels such that groundwater will not be able to influence shallow soil quality.
- The final 0.5m of materials shall comprise quality controlled imported fill materials suitable for the use to which they are to be put and of better quality than all RBSLs for the relevant end-use and meeting aesthetic type 0 for residential use and type 1 or better for commercial use as specified in **Table** .

Based on the above requirements and the findings of the site assessment discussed in Section 2.1 of this report, Atkins considered that the following works were required in order to achieve the requirements of the Section 106 Agreement:

- Removal of existing structural remnants, including in-situ concrete, brickwork and other identified obstructions;
- Removal of identified free phase product;
- Removal and treatment of heavily impacted shallow groundwater;
- Removal of heavily impacted in-situ soils;
- Further investigation and the removal of identified hotspots of contamination; and
- Re-profiling and validation of in situ soils.

The Monitor considered the above approach to be appropriate in accordance with the requirements of the Section 106 Agreement.

Redevelopment Remediation or s

The redevelopment remediation works that have been completed for Phase 43 are described in Atkins' validation report (Information Source 26). The works undertaken are summarised below:

- Hardstanding removal and general clearance works (December 2009 to October 2010);
- Further site investigations followed by soil turnover and removal of heavily impacted soils and solvent impacted shallow groundwater (October 2011 to March 2012 – referred to as 'Phase 1');
- Backfill of excavations with suitable site-won materials and re-profiling of shallow soils (January to April 2012);
- Additional turnover of soils, including removal of relict infrastructure and heavily impacted soils (April to June 2013 – referred to as 'Phase 2')

- Turnover of remaining soils, including removal of relict infrastructure and heavily impacted soils (September to November 2014 – referred to as 'Phase 3')

As noted above, the remediation works were carried out in three phases. The extent of each phase is illustrated on drawing 5041216-ATK-REM-DWG-1962, a copy of which is provided in Atkins' validation report (Information Source 26). An extract from the drawing is presented below in **Figure** .

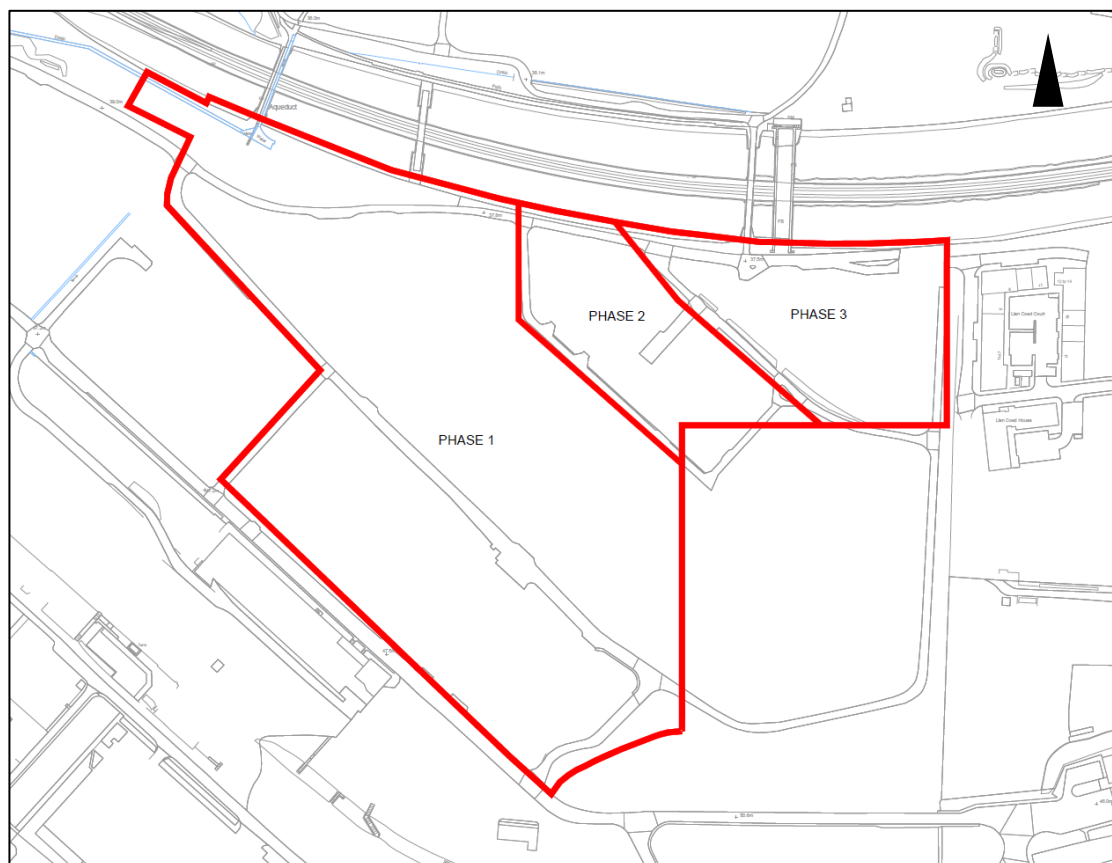


Figure **hasing of the Remediation or s**

A brief summary of the works undertaken during each phase is provided in the following sections. Reference should be made to Atkins' validation report (Information Source 26) for further detailed information.

Phase 1 (2011-2012)

Atkins reports that Phase 1 covers an area of approximately 53,844m². The remediation works comprised a large excavation across much of the area. Impacted soils were removed on the basis of a visual/olfactory assessment or based on the results from historical site investigations which had been used to identify hotspots of contamination. These soils were removed for treatment elsewhere on the refinery site. Atkins reports that the excavation was terminated on low permeability clay generally at depths greater than 5m bgl with no visual/olfactory evidence of hydrocarbon or solvent impact. This visual/olfactory evidence was further supported by the results of historical ground investigations which had indicated the underlying soils to be suitable for retention. Atkins also states that buried concrete and pipework were removed as part of these works. Atkins reports that approximately 38,000m³ of impacted soils were removed from the Phase 1 area.

Groundwater was encountered at shallow depth and Atkins also reports observations of suspected Dense Non Aqueous Phase Liquid (DNAPL). In order to manage shallow groundwater within the remediation excavation a series of trenches were installed and groundwater was pumped through a groundwater treatment plant comprising an oil/water separator, a carbon filter and a sand filter. Treated water was discharged into the site drainage network. Groundwater quality was monitored for the duration of the works, as discussed in section 2.4.4 of this report.

Following the completion of the remediation excavation, the area was re-profiled during October 2011 to April 2012. During these works Atkins reports that a further 6,000m³ of soils were removed, although these were reported to comprise non-contaminated made ground and natural soils.

Following these works approximately 34,000m³ of soils were placed within the Phase 1 area to create the finished ground profile. This is reported to have comprised 24,000m³ of suitable site-won materials from elsewhere across the refinery, 6,000m³ of suitable site won materials from within Phase 43 and 4,000m³ of treated soils returned to Phase 43 after bioremediation. The validation of these imported soils is discussed in section 2.4.3 of this report.

Phase 2 (2013)

Atkins reports that Phase 2 covers an area of approximately 9,430m². Historical borehole monitoring within this area had indicated the presence of free phase product and Atkins reports that approximately 20 litres of free phase product was removed from the wells between February and July 2012. Following this a series of machine excavated trial pits were undertaken within the vicinity of the boreholes which identified small volumes of free product within the soils. Atkins concluded that the thicknesses of product that had been observed within the boreholes comprised 'trapped' product within the borehole installations, rather a more widespread source of free product within the surrounding soils.

Following these investigations, a general turnover of soils was undertaken which comprised the excavation of soils, removal of heavily impacted soils based on a visual/olfactory assessment and removal of historical infrastructure such as buried concrete and redundant pipelines. Atkins reports that 14,000m³ of unacceptable soils were removed during these works which generally comprised heavily impacted Made Ground and very soft glacial sands. Atkins reports that the remediation excavation was terminated on natural soils which generally comprised silts and silty clays with minimal visual/olfactory evidence of hydrocarbon or solvent impact.

Atkins reports that the area was re-profiled in April to June 2013 during which a further 8,000m³ of impacted soils were removed. Following these works approximately 12,000m³ of soils were placed to create the finished ground profile. This is reported to have comprised 10,500m³ of suitable site-won materials and 1,500m³ of treated soils that had undergone bioremediation. The validation of these imported soils is discussed in section 2.4.3 of this report.

Phase 3 (2014)

Atkins reports that Phase 3 covers an area of approximately 11,780m². The remediation works comprised a general turnover of soils and a series of remediation excavations, during which Atkins reports that approximately 8,000m³ of unacceptable soils were removed based on a visual/olfactory assessment. A further 3,000m³ of non-contaminated Made Ground and natural soils were also removed. Atkins reports that the remediation excavations were terminated on underlying natural soils which were deemed to be suitable for retention based on a visual/olfactory assessment.

Following these works, Atkins reports that 10,000m³ of soils were placed to create the finished ground profile. This is reported to have comprised 9,500m³ of suitable site won materials and 500m³ of treated soils that had undergone bioremediation.

Monitor's Observations During the Works

The Monitor attended site to observe the works and was generally satisfied that they were being carried out appropriately and that the requirements of the Section 106 Agreement were likely to be achieved.

Validation

The following sections aim to demonstrate whether or not the minimum remediation requirements discussed in Section 2.2 of this report have been achieved. It should be noted that validation has been undertaken at various stages as summarised below:

1. Analysis of soil samples collected from trial pits during the initial site investigations;
2. Validation of the base of the remediation excavation via a series of trial pits;
3. Sampling of stockpiled soils prior to placement;
4. Validation of in situ soils via trial pits following the completion of the remediation works.

It should also be noted Atkins' validation report (Information Source 26) states that in the absence of a detailed layout for the proposed development and confirmed FFLs, it has been assumed that the ground levels following the completion of the redevelopment remediation works described above represents FFL minus 1m. A topographical record of the ground levels upon which this certificate is based are shown on drawing 5041216-ATK-REM-DWG-001844 a copy of which is provided in **Appendix F**.

Aesthetic Criteria

The remediation requirements for playing fields, as described in Section 2.2 of this report, requires that the aesthetic quality of soils shall be Class 1 or better for at least the first metre below FFL, Class 2 or better at depths between 1m and 2m below FFL and Class 4 or better at depths greater than 2m beneath FFL. The aesthetic criteria are defined in **Table** of this report.

Given that the ground levels upon which this certificate is based generally represent FFL minus 1m, and the top 1m of soils are yet to be placed, the aesthetic criteria that are applicable to the remaining soils are: soils within the top 1m bgl shall be Class 2 or better; and soils below 1m bgl shall be Class 4 or better.

Atkins' validation report (Information Source 26) states that the remediation excavations across Phase 43 were generally terminated in natural soils which indicated minimal visual/olfactory evidence of contamination. Atkins also reports that during the subsequent validation investigation, soils were logged in accordance with the specified aesthetic criteria. Soils achieving an aesthetic classification of greater than 2 at depths down to 1m bgl; or greater than 4 at depths below than 1m bgl were considered acceptable.

These validation trial pits, which were undertaken following the placement of imported fill material and the re-profiling of soils, confirmed that the soils remaining with Phase 43 were acceptable in accordance with the visual/olfactory criteria, with the exception of one location at DMV001. Here, Atkins describes localised pockets of free product at depths of between 0.7m and 1.2m bgl. Atkins also states that a heavy sheen with a visual/olfactory classification of 3/3 was observed in the underlying sands.

A visual/olfactory classification of 3/3 for the underlying sands is considered acceptable due to the depth being greater than 1m bgl, however the observation of free product at depths less than 1m bgl is not acceptable.

Atkins states that area will be subject to further investigation; however the Monitor has not received further correspondence in this respect. Given the shallow nature of the observed

free product it is suggested that this could be reinvestigated and if necessary remediated prior to the placement of the final 1m of soils. It should be noted that any subsequent remediation works following certification will need to be controlled by the Local Planning Authority as the Monitor will have no formal on-going role to control subsequent works once this RRWCC has been issued.

Notwithstanding the reported free product in trial pit DMV001, the Monitor is satisfied that the soils remaining within Phase 43 appear to be suitable for retention based on the specified aesthetic criteria.

Removal of Oil Saturated Soils and Soil Containing Free Product

The remediation requirements for playing fields, as described in Section 2.2 of this report, requires that all significant areas of oil saturated soils and soil containing free product shall be removed.

The remediation works described in Section 2.3 of this report targeted the removal of oil saturated soils and sources of free product. As described in Section 2.4.1 of this report, Atkins undertook a series of validation trial pits which confirmed an absence of oil saturated soils and free product, with the exception of trial pit DMV001 where localised pockets of free product were observed. It is noted in Atkins' validation report that this area will be subject to further investigation.

Notwithstanding this, given the observations described in Atkins' validation report and the works that have been undertaken, the Monitor is satisfied that significant areas of oil saturated soils and soils containing free product have been removed from Phase 43.

Soil Chemical Quality

The remediation requirements for playing fields, as described in Section 2.2 of this report, requires that all soils must meet the adopted thresholds for residential (shallow) end use to 1m below FFL. Beneath proposed buildings, all soils must be remediated so as to meet the adopted thresholds for residential (deep) end use at depths >1m below FFL. The recreational criteria (>1m below FFL) will be adopted for soils at depth (>1m below FFL) within open space areas (including playing fields and proposed hardstandings etc.). Where these lie immediately adjacent to proposed buildings, a suitable stand-off will be adopted utilising the residential criteria.

Given that the ground levels upon which this certificate are based generally represent FFL minus 1m and the intended use has been declared as playing fields, which it has been assumed does not include any buildings, the only criteria applicable to Phase 43 is that the soils must meet the recreational criteria for deep soils as defined in **Table** of this report. It should be noted that further consideration will need to be given if the FFLs should change, or if buildings, such as changing rooms for example, are proposed.

Atkins' validation report (Information Source 26) describes the validation works that have been undertaken, which have comprised the following:

- Analysis of soil samples collected during the initial site investigations undertaken by URS and Atkins;
- Analysis of soil samples collected from the base of the remediation excavations;
- Analysis of soil samples collected from stockpiles prior to re-use; and
- Trial pitting and analysis of in-situ soil samples following the completion of the remediation works.

Base of Excavation Validation

Atkins reports that following the completion of the remediation excavation described in Section 2.3 of this report, validation trial pits were excavated across the base of the remediation excavation in order to confirm the acceptability of the underlying soils. Atkins reports that with the exception of one base sample (DiMe Base 8) laboratory analysis of the soil samples confirmed contamination concentrations were below the RBSL/RTCs for a recreational end use at depths greater than 1m below FFL, as required.

Atkins reports that impacted soils in the vicinity of trial pit DiMe Base 8 were removed and the area was re-sampled. Atkins reports a marginal exceedance of the RBSL/RTC for 1,2 Dichloroethane (6050µg/kg against an RBSL/RTC of 6000µg/kg). The soils were considered acceptable for retention.

It is noted that Atkins reports that the remediation excavations covered an area of approximately 40,600m² whereas Phase 43 covers an area of 75,800m². Some of the areas that were not included in the remediation excavation had been shown to be acceptable during the initial site investigations and remediation works were not considered necessary. Other areas were inaccessible due to the presence of live utilities services which run along the northern part of Phase 43 parallel to the railway cutting. The remediation excavation did not extend into this part of Phase 43 to avoid damaging the buried services. The Monitor recognises that it is not practical to fully investigate this area, however it was noted during the works that the face of the remediation excavation was inspected and where necessary the remediation excavation was extended to chase out impacted soils. Nevertheless, it should be noted that it has not been possible to fully investigate this area and therefore the need for further remediation works, depending on the proposed end-use, cannot be discounted.

The Section 106 Agreement also requires that soils must be tested in accordance with minimum validation testing frequencies. As discussed above, given that there are no specific requirements in relation to playing fields, Atkins has developed bespoke criteria, including minimum testing frequencies, as set out in Atkins' report ref. 5041216- REM-RPT-1275 rev. 1 dated January 2015 (Information Source 24). This report states that in-situ soils greater than 1m below FFL within open space areas are to be tested at a minimum frequency of 1 per 400m², as summarised in **Table** presented in Section 1.2.1 of this report

As noted above, the remediation excavation is reported to have covered an area of approximately 40,600m². Atkins reports that 89 soil samples were collected from the base of the remediation excavations which equates to a testing frequency of 1 per 456m². Whilst this does not meet the specified testing frequency, it should be noted that the base of excavation sampling was supplemented with further validation as discussed further below.

Validation Trial Pits

Atkins reports that following the placement of soils to create the development platform, a series of validation trial pits were excavated from which soil samples were collected to ensure suitability. It is reported that 31 machine excavated trial pits were carried out across Monitor Phase 43.

As discussed previously in this report, localised pockets of free product were observed within trial pit DMV001 at depths of between 0.7m and 1.2m bgl. Atkins also states that a heavy sheen with a visual/olfactory classification of 3/3 was observed in the underlying sands at this location. In addition, Atkins also reports that heavy sheens were recorded in natural soils within trial pit DMV16 and a solvent odour was noted at depths of 2.2m to 3.2m bgl in DMV23. However, Atkins states that there was no evidence of free product or oily seepages at either of these locations.

Atkins reports that 56 soil samples were collected from these 31 trial pits and that laboratory analysis indicated all soils to be acceptable in accordance with the RBSL/RTC criteria.

In addition to these 31 trial pits, Atkins also reports that a series of trial pits were excavated within the southern part of the area referred to above as 'Phase 3' and that a total of 13 soil samples were collected for analysis. Again, all soil samples were found to be acceptable in accordance with the RBSL/RTC criteria.

Given the 44 trial pit locations from which soil samples were collected, and a site area of 75,800m², a testing frequency of 1 per 1,723m² has been achieved. Whilst this does not meet the specified minimum testing frequency, it should be noted that the validation trial pitting was undertaken in order to verify the data collected from the base of excavation samples, the stockpile validation samples and data from the original site investigation where soils had been shown to be acceptable and therefore remained in situ. The overall testing frequency that has been achieved is summarised below.

Testing Frequency

In summary, whereas the testing frequencies achieved for each phase of the validation exercise did not always meet the minimum testing frequency specified in the Section 106 Agreement, the Monitor is satisfied that a sufficient number of soil samples have been collected from Phase 43 in order to ascertain the suitability of the remaining soils. The overall testing frequency that has been achieved for the remaining soils across Phase 43 is summarised in **Table** .

Table Testing Frequencies

<i>Works</i>	<i>Area</i>	<i>Number of Sample Locations</i>	<i>Testing Frequency Achieved</i>	<i>Specified Testing Frequency</i>	<i>Comments</i>
URS site investigation on soils that have remained in situ ⁽¹⁾	35,200m ²	26	1,354m ²	400m ²	Non-compliant
Atkins site investigation on soils that have remained in situ ⁽¹⁾	35,200m ²	29	1,214m ²	400m ²	Non-compliant
Base of remediation excavation trial pits	40,600m ²	89	456m ²	400m ²	Non-compliant
Validation trial pits	75,800m ²	44	1,723m ²	400m ²	Non-compliant
Total	m		m	m	Acceptable

otes

1. For the original site investigations, only data from the areas outside the remediation excavation – i.e. soils which have remained in situ, have been considered.

It can be seen that an overall testing frequency of 1 per 403m² has been achieved which is broadly in line with the specified testing frequency of 1 per 400m².

Overall, Atkins reports that a total of 361 soil samples from the soils which remain within Phase 43 have been analysed and other than one minor exceedance for 1,2 Dichloroethane, all soil samples were found to be acceptable in accordance with the specified RBSL/RTC criteria.

Stockpile Validation

Atkins' validation report indicates that approximately 50,000m³ of stockpiled site-won materials were used as backfill across Phase 43. It is reported that these materials were tested to confirm their suitability prior to re-use, and that 124 soil samples were collected. Atkins reports that all samples were found to be acceptable in accordance with the specified RBSL/RTC criteria.

The analysis of 124 samples equates to a testing frequency of approximately 1 per 403m³. With reference to **Table** presented in Section 1.2.1 of this report, a minimum testing frequency of 1 per 100m³ is required for stockpiled excavated materials for re-use beneath playing fields. However Atkins notes this frequency is in accordance with the specified testing frequency for stockpiled materials for re-use in a commercial phases of 1 per 400m³ and that given the area was to be validated via trial pits following the placement of the soils, the reduced testing frequency was considered to be appropriate.

In addition to the above, Atkins reports that a further 6,000m³ of site won materials, which had undergone bioremediation, was used as backfill across Phase 43. Atkins reports that 79 soil samples were taken from the bioremediated material, which equates to a testing frequency of approximately 1 per 76m³. This frequency exceeds the specified testing frequency of 1 per 200m³ for soil treated ex-situ and homogenised as specified in **Table** in this report. Again, Atkins reports that all samples were found to be acceptable in accordance with the specified RBSL/RTC criteria.

Summary

In summary, the Monitor is satisfied that the soils within Phase 43 appear to meet the necessary chemical quality requirements and that the soils appear to have been validated at an appropriate testing frequency. It should be noted that if the development layout or proposed FFLs differ significantly from those assumed, or if the intended use should change, then further remediation works may be required.

Groundwater Quality

The remediation requirements for playing fields, as described in Section 2.2 of this report, requires that where groundwater is encountered near surface it is to be assessed in line with the defined thresholds.

Groundwater across Phase 43 is generally encountered at shallow depth. As described in section 2.3 of this report a groundwater treatment plant was installed to treat the groundwater that was encountered during the remediation excavations. Atkins reports that groundwater samples were collected from the inlet and discharge points on a weekly basis between November 2011 and February 2012 whilst the water treatment plant was operational. These water samples were analysed for the presence of solvent contamination, in particular 1,2 Dichloroethane and Dichloromethane.

Atkins reports a reduction in recorded concentrations at both sampling locations during the monitoring period. It is noted that the data presented in Atkins' validation report indicates that the solvent concentrations were variable, however the trend graph presented does appear to indicate a general fall in concentrations.

Analysis of the data indicates that the groundwater RBSL for 1,2 Dichloroethane was exceeded on one occasion, being the very first monitoring round. Whilst there is no

groundwater RBSL for Dichloromethane for a recreational end-use, it is noted that there were no exceedances against the residential and commercial RBSLs for groundwater.

In addition to the above, Atkins reports that water quality was monitored at the discharge point into North Site Reservoir which includes shallow groundwater and surface water run-off from the DiMe area. Atkins reports that the analysis of water samples collected between 2010 and 2015 indicate a reduction in concentrations for 1,2 Dichloroethane and Dichloromethane since 2012. In May 2014 Atkins submitted a report to NRW indicating that total petroleum hydrocarbons (TPH) and solvent levels within the water had been below the method detection limit during the previous 12 months.

Atkins has modelled the risks associated with chlorinated hydrocarbons, as reported in Atkins' DiMe Controlled Waters Risk Assessment (Information Source 23). This report concluded that the impact of 1,2-dichloroethane and dichloromethane on groundwater down gradient of the DiMe area is low. Specifically, the report states:

"The ongoing risks relating to the main contaminants of concern at the DiMe site, the ones that provide the name of the site; 1,2-dichloroethane and dichloromethane, have been found through investigation and risk assessment to be low. This is primarily due to the physical and chemical behaviour of 1,2-dichloroethane and dichloromethane. These are relatively low molecular weight chlorinated hydrocarbons which were discharged by spills and leaks from the DiMe plant in large quantities. The mixture of DiMe solvents is predicted to have behaved as a DNAPL by virtue of their high specific gravity, penetrating the Cohesive Drift and discharging to the groundwater in the bedrock relatively rapidly (c.4 years). The result of these discharges impacted the quality of the groundwater in the bedrock with 1,2-dichloroethane and dichloromethane, up to the time when the plant was closed and decommissioned. The concentrations of 1,2-dichloroethane and dichloromethane subsequently dropped after the site was closed indicating that the main pathway for the DiMe solvent through the Cohesive Drift was likely to be as DNAPL. The residual sources of 1,2-dichloroethane and dichloromethane at the DiMe site distributed through the Cohesive Drift do not appear to present a significant on-going risk to controlled waters."

Regarding the impact of other hydrocarbons, the report states:

"The risks relating to the other hydrocarbons have been represented using the fractions (Aromatic C10-C12 and C12-C16) which were considered the most likely to impact groundwater due to their high source concentration and physical and chemical properties. The risks of these to controlled waters were also found to be low but only on the assumption that the free phase Light Non-Aqueous Phase Liquid (LNAPL) was removed from the DiMe area."

As discussed in Section 2.4.2 of this report, free phase LNAPL, i.e. free phase product, appears to have been removed from Phase 43, with the exception of trial pit DMV001 where localised pockets of free product were observed.

Given the findings of the Controlled Waters Risk Assessment, coupled with the remediation works that have been undertaken across Phase 43, the Monitor is satisfied that the groundwater within Phase 43 appears to be generally acceptable in accordance with the specified criteria and that no further groundwater remediation works are required.

Asbestos

The remediation requirements for playing fields, as described in Section 2.2 of this report, requires that all soil potentially containing dispersed asbestos fibres or visible ACM must be removed or remediated to meet in bulk, considering both dispersed fibres and pieces of ACM, the appropriate ACM RBSL, or the requirements of relevant Environmental Authorities, whichever is the more conservative, to a minimum depth of 2m below FFL.

Atkins reports that 92 soil samples collected during the 2011 ground investigation described in Section 2.1.2 of this report were analysed for the presence of asbestos and that no asbestos was identified. Atkins reports that following the completion of the remediation works, 59 soil samples taken from the validation trial pits were analysed for the presence of asbestos. Suspected asbestos in the form of loose fibres was reported in five samples. Possible asbestos containing material was also reported in one soil sample.

No quantitative assessment was undertaken on these samples, so it is not possible to ascertain whether or not the soils are suitable for retention based on the RBSL/RTC thresholds. However, Atkins states that given the depth of the soil samples in relation to the proposed FFL and the proposed end-use as playing fields the risks associated with the proposed retention of these soils is considered to be low. The Monitor is satisfied that this is reasonable and that the soils within Phase 43 appear to meet the necessary requirements in relation to asbestos.

Removal of Buried Services

The Section 106 Agreement states that irrespective of the intended use, all existing buried services shall be removed and the routes of those services shall be backfilled with material no more permeable than the general material in the vicinity. Where backfill to new underground services may become a pathway for residential pre-transfer date contamination, appropriate control measures such as land drainage or venting measures shall be installed so as to appropriately protect remediated and/or developed areas.

As noted in section 2.4.3 of this report a number of utilities services are present within the northern part of Phase 43 adjacent to the railway cutting. These services remain live and Atkins notes that a 10m wide strip of land within this area is to be retained as a utilities corridor in the final development.

Elsewhere across Phase 43, redundant services have been removed where encountered. These generally comprised disused pipelines.

The Monitor is satisfied that as far as is practicable redundant services within Phase 43 have been dealt with appropriately.

Recontamination of Soils from Groundwater

The Section 106 Agreement states that wherever there is a risk that following construction of the Urban Village groundwater or organic phase liquid may contaminate soils within the top 1m below FFL such that any of the relevant RBSLs and/or aesthetic criteria may be exceeded, then all necessary steps should be taken to mitigate these risks. This may involve the installation of land drains and/or the raising of the site ground levels.

As discussed above, the top 1m of soils are yet to be placed, however albeit groundwater is relatively shallow across Phase 43, groundwater levels are sufficiently deep in relation to the proposed FLL such that it is not anticipated that groundwater would encroach into the top 1m of soils once they have been placed. Furthermore, as discussed in section 2.4.4 of this report, the chemical quality of groundwater within Phase 43 is generally considered to be acceptable. Therefore the recontamination of soils from groundwater is considered unlikely.

As such, the Monitor is satisfied that the installation of land drains and/or the further raising the ground levels is not necessary in relation to this phase.

Fill to Achieve FFL

The Section 106 Agreement requires that the build-up of the final elevation after completion of the redevelopment remediation works must comprise a minimum of 0.5m of quality controlled imported fill materials suitable for the use to which they are to be put and of better quality than all RBSLs for the relevant end-use and meeting aesthetic type 1 or better for recreational use.

Given that the ground levels upon which this certificate are based generally represent FFL minus 1m, the top 1m of soils, including the top 0.5m of quality controlled imported fill materials, are yet to be placed. As such this requirement is yet to be met for this phase.

It should be noted that any subsequent import of material and/or removal of material from the phase following certification will need to be controlled by the Local Planning Authority as the Monitor will have no formal on-going role to control subsequent works once this RRWCC has been issued.

Furthermore, if there is any significant change in the development proposals or the proposed FFLs then reconsideration of the information contained within this certificate may be necessary, albeit it is understood that the redevelopment remediation works that have been completed are aimed at being conservative to allow for minor alterations to the FFLs.

CERTIFICATIO

Redevelopment Remediation or s

The following section aims to confirm whether or not in the Monitor's professional opinion the Redevelopment Remediation Works have been satisfactorily completed in accordance with the purpose, objectives and requirements of Schedule 8 of the Section 106 Agreement, having regard to the intended use. **Table** provides a list of the minimum remedial action required for playing fields, as described in Section 2.2 of this report, and summarises whether or not each requirement has been satisfied.

Table Certificate Summary

<i>Requirement</i>	<i>Status</i>	<i>Comments</i>
The RBSLs and the aesthetic criteria, remediation quality and scope (including the depth below FFL to which quality standards are achieved) shall be achieved for each part of the property at the minimum validation frequencies set out in Clause 8 of Part 3 of the Section 106 Agreement (as applicable depending upon whether such part of the property is intended for use as residential, commercial or recreational land) as a minimum base level standard.	Complete	Refer to Section 2.4 of this report.
The aesthetic quality of soils shall be Class 1 or better for at least the first metre below FFL and that the aesthetic quality of soils shall be Class 2 or better at depths of between 1 – 2m below FFL and Class 4 or better at depths >2m beneath FFL.	Complete	Refer to Section 2.4.1 of this report.
All significant areas of oil saturated soils and soil containing free product shall be removed.	Complete	Refer to Section 2.4.2 of this report.

Requirement	Status	Comments
All soils must be remediated so as to meet the adopted thresholds for residential (shallow) end use beneath the surface to 1m below FFL. Beneath proposed buildings, all soils must be remediated so as to meet the adopted thresholds for residential (deep) end use at depths >1m below FFL. The recreational criteria (>1m below FFL) will be adopted for soils at depth (>1m below FFL) within open space areas (including playing fields and proposed hardstanding etc). Where these lie immediately adjacent to proposed buildings, a suitable stand-off will be adopted utilising the residential criteria.	Complete	Refer to Section 2.4.3 of this report.
Where encountered near surface, groundwater will be assessed in line with the defined thresholds.	Complete	Refer to Section 2.4.4 of this report.
All soil potentially containing dispersed asbestos fibres or visible ACM must be removed or remediated to meet in bulk, considering both dispersed fibres and pieces of ACM, the appropriate ACM RBSL, or the requirements of relevant Environmental Authorities, whichever is the more conservative, to a minimum depth of 2m below FFL.	Complete	Refer to Section 2.4.5 of this report.
Irrespective of the intended use of each phase or part thereof, all existing buried services at the property shall be removed and the routes of those services shall be backfilled with material no more permeable than the general material in the vicinity. Where backfill to new underground services may become a pathway for residential pre-transfer date contamination, appropriate control measures such as land drainage or venting measures shall be installed so as to appropriately protect remediated and/or developed areas.	Complete	Refer to Section 2.4.6 of this report.
Wherever there is a risk that following construction of the Urban Village groundwater or organic phase liquid may contaminate soils within the top one metre below FFL such that any of the relevant RBSLs and/or aesthetic criteria specified in Schedule 8 may be exceeded, the Developer shall ensure that all necessary steps are taken to mitigate these risks. Suitable measures may include, but not be limited to, the installation of land drains and/or the raising of the site ground levels such that groundwater will not be able to influence shallow soil quality.	Complete	Refer to Section 2.4.7 of this report.

Requirement	Status	Comments
To provide a minimum thickness of suitable garden soils in residential areas, soils for landscaping in public and commercial areas and sub-base for hardsurfaced areas, the Developer shall build up the final elevation after completion of the RAP and redevelopment remediation works with a minimum of 0.5m of quality controlled imported fill materials suitable for the use to which they are to be put and of better quality than all RBSLs for the relevant end-use and meeting aesthetic type 0 for residential use and type 1 or better for commercial use as specified in Schedule 8 of the Section 106 Agreement. For the avoidance of doubt, the minimum remediation standards set out above therefore assume that the first half metre below FFL will comprise such imported material in all circumstances of residential and commercial end-use.	Not applicable	The top 1m of soils is yet to be placed. Refer to Section 2.4.8 of this report.

Preventative Measures

In addition to preparing the RAPWCS and RRWCC, the Monitor is also obliged, if requested by CDL, to review any certificate or other documentation produced to CDL by or on behalf of the Developer purporting to confirm that Preventative Measures have been completed or are not required in relation to any Phase or part thereof providing CDL in writing of its professional opinion as to:

- whether the author is suitably qualified to issue the certificate; and
- whether the certificate contains or reflects any manifest error, omission or bias, etc. and certifies that the land is fit for its purpose.

The Monitor has not received any such documentation or requests in relation to Phase 43.

Ground Gas

The Section 106 Agreement states that a proprietary and appropriate ground gas resistant membrane and appropriate venting system shall be installed in all structures that will be entered by people and any structure where there is a potential for gas accumulation if ground gas is present.

No such structures are proposed within Phase 43 and therefore this requirement is not considered to be relevant to the Phase.

CONCLUSIONS

Redevelopment Remediation or s Completion Certificate RR CC

This RRWCC confirms that in the Monitor's professional opinion, and on the basis of the information provided within the information sources as well as observations made on site by the Monitor during the remediation works, the Monitor is satisfied that the Phase 43 redevelopment remediation works appear to have been completed in general accordance with the purpose, objectives and requirements of Schedule 8 of the Section 106 Agreement, having due regard to the specified intended use. The Monitor is satisfied that the purpose, objectives and requirements of Schedule 8 of the Section 106 Agreement are likely to continue to be met for the foreseeable future without the need for further remedial action in relation to or affecting the area within the Phase Boundary.

Phase 43 Completion Certificate

The PWCD will be declared by CDL once CDL is satisfied that the remediation necessary for the specified intended uses for the Phase has been completed. This report, which is the RRWCC, will be complemented by a RAPWCS in order to provide the information required by CDL to enable the PWCD to be declared.

Limitations

In the absence of a detailed layout for the proposed development and confirmed FFLs, it has been assumed that the ground levels following the completion of the redevelopment remediation works represents FFL minus 1m. A topographical record of the ground levels upon which this certificate is based are shown on drawing 5041216-ATK-REM-DWG-001844 a copy of which is provided in **Appendix F**. Should the proposed FFLs change then the findings of this report may need to be reconsidered.

This certificate has been prepared on the assumption that the entire phase will be used for playing fields and that no occupiable spaces will be constructed within Phase 43. If however this should change, and occupiable spaces are proposed, then further remediation works will be required.

Observations of free product within trial pit DMV001 will require further investigation and if necessary the impacted soils should be removed prior to the placement of the final 1m of soils. It should be noted that any subsequent remediation works following certification will need to be controlled by the Local Planning Authority as the Monitor will have no formal on-going role to control subsequent works once this RRWCC has been issued.

It should be noted that the northern part of Phase 43 adjacent to the railway cutting has not been fully investigated due to the presence of utilities services. It should be noted that given the lack of definitive information regarding the acceptability of the underlying soils in this area, the need for further remediation works, depending on the proposed end-use, cannot be discounted.

***A E I A ECLARATIO OF ASE
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SEA RO OSE
E ELO E TLA O T***



ST. MODWEN DEVELOPMENTS LIMITED - a ST. MODWEN company

Registration England 892832

Sir Stanley Clarke House, 7 Ridgeway, Quinton Business Park, Birmingham, B32 1AF

T: 0121 222 9400 **W:** www.stmodwen.co.uk

25th July 2014

Our ref:

Coed Darcy Limited
Dumfries House
Dumfries Place
Cardiff
CF10 3ZF

Dear Sirs

Coed Darcy
Phase 43 - DiMe
Request for Phase Works Completion Date

We hereby give our written request seeking the declaration of the Phase Works Completion Date for Phase 43 of Coed Darcy as required under Clause 4.6 of the Remediation Agreement made between Coed Darcy Limited, St. Modwen Developments Limited and St. Modwen Properties PLC dated 23rd May 2008.

The Phase 43 boundary is shown on the attached Drawing No. 5041216-DIME-DWG-1666.

The "Intended Use" for Phase 43 is presumed as that of Public Open Space comprising playing fields.

As required by the Remediation Agreement, we have copied this letter to the Monitor.

Yours faithfully

Neil Williams

For and on behalf of St. Modwen Developments Limited

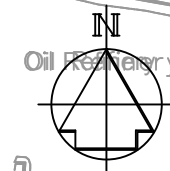
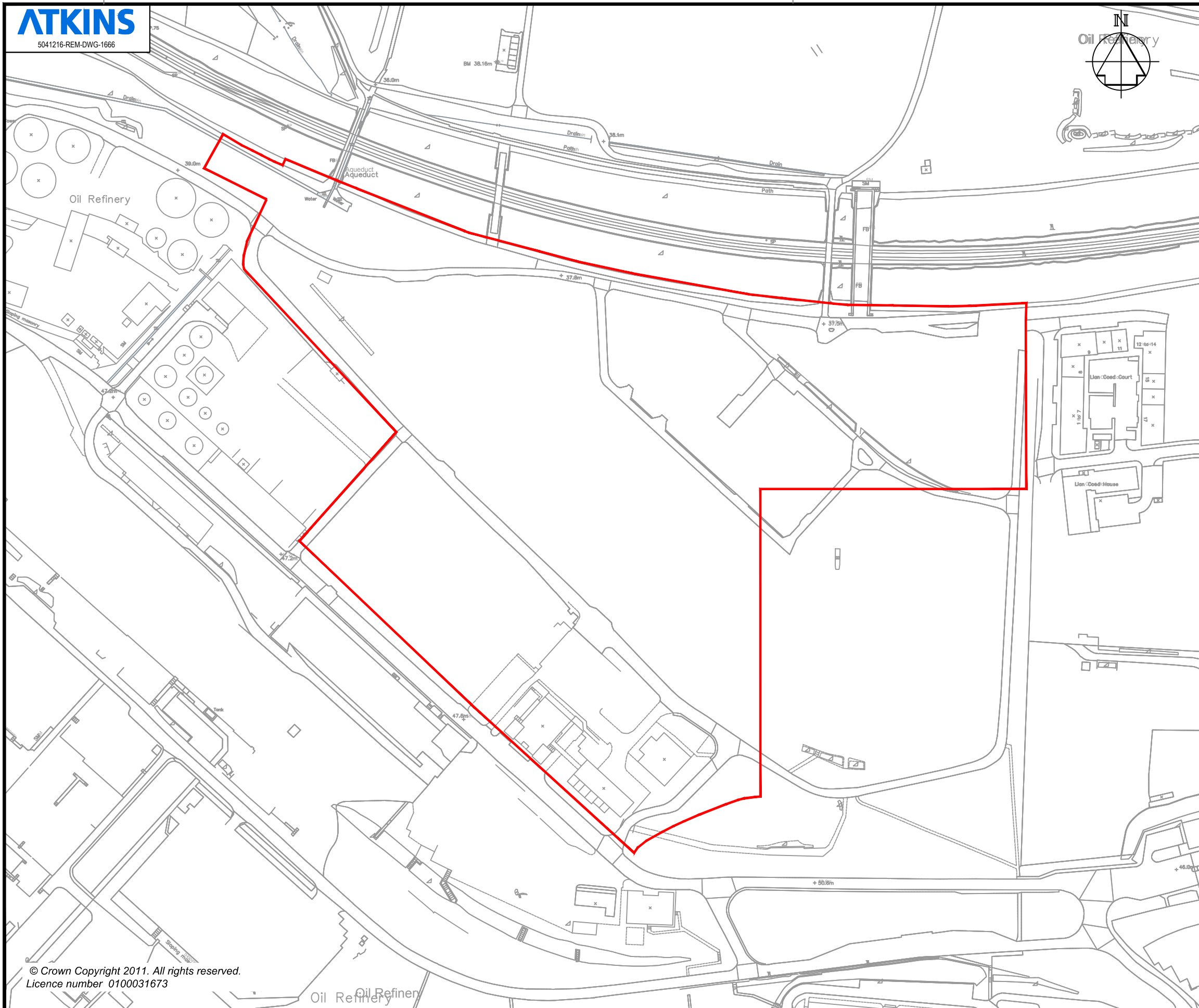
Cc Rhys Mander, Llancoed House, Coed Darcy, Neath, SA11 8AZ

St. Modwen Properties PLC

Head Office & Registered Office: Sir Stanley Clarke House, 7 Ridgeway, Quinton Business Park, Birmingham, B32 1AF

T: [0121] 222 9400 **W:** www.stmodwen.co.uk

Registration: England 349201



KEY

Monitor Phase 43 Boundary

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REVISIONS	Drawn By	Checked By	Date
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PURPOSE OF ISSUE	Rev.	Authorised for issue	Date
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Atkins Limited

Telford Office Cornerstone House Stafford Park 13 Telford TF3 3AZ Tel 01952 201234 Fax 01952 200981	©	Birmingham Office The Axis, 10 Holliday Street Birmingham West Midlands B1 1TF Tel 0121 483 5000 Fax 0121 483 5252
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THIS DRAWING IS NOT TO BE SCALED

CLIENT

ST.MODWEN

PROJECT

Coed Darcy

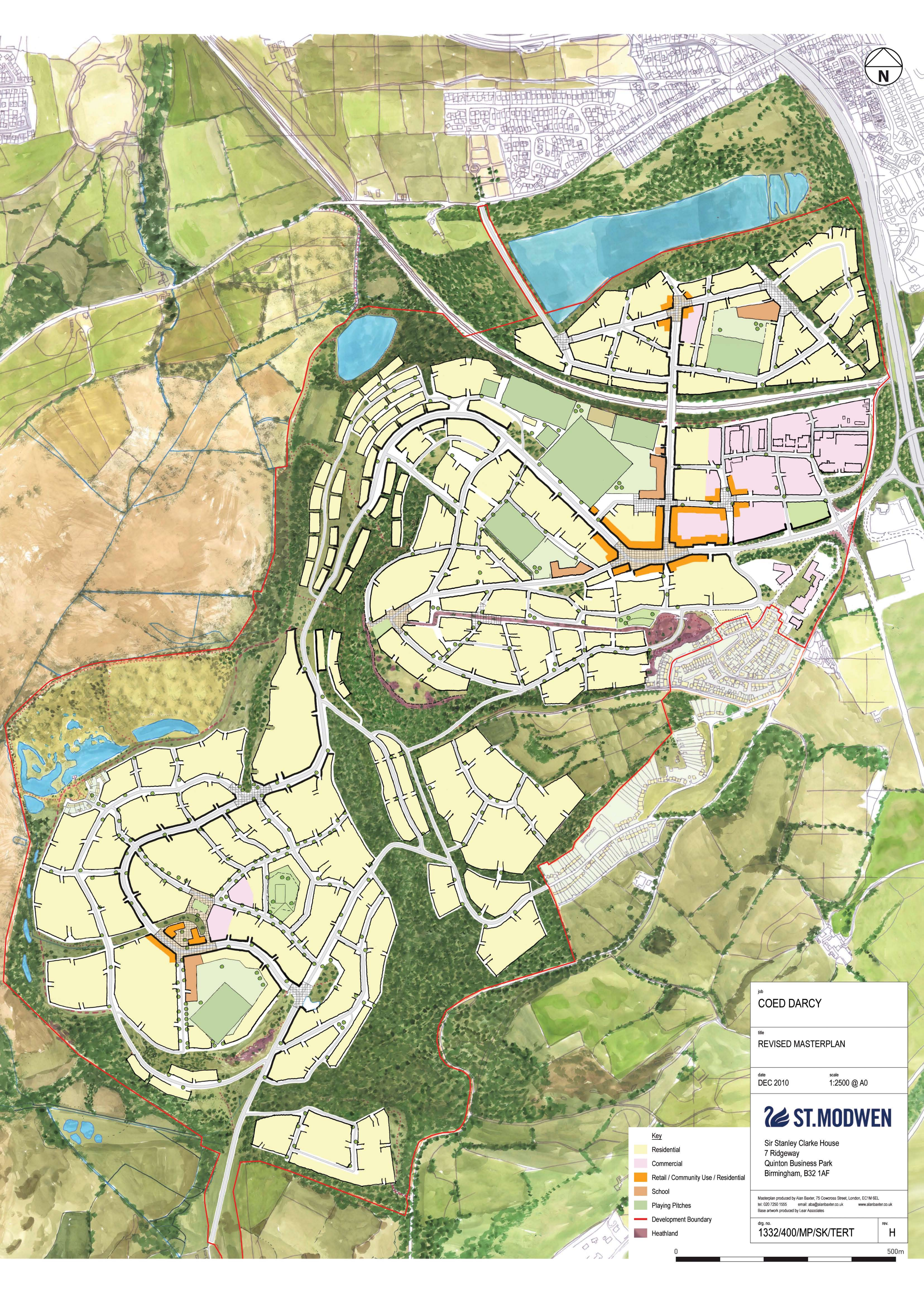
DRAWING TITLE

Proposed Phase Boundary
(Monitor Phase 43)

SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:2000	RS	MT	
	DATE	DATE	DATE
	14/01/14	14/01/14	

	SHEET	PLOT DATE
	A3	14.01.14

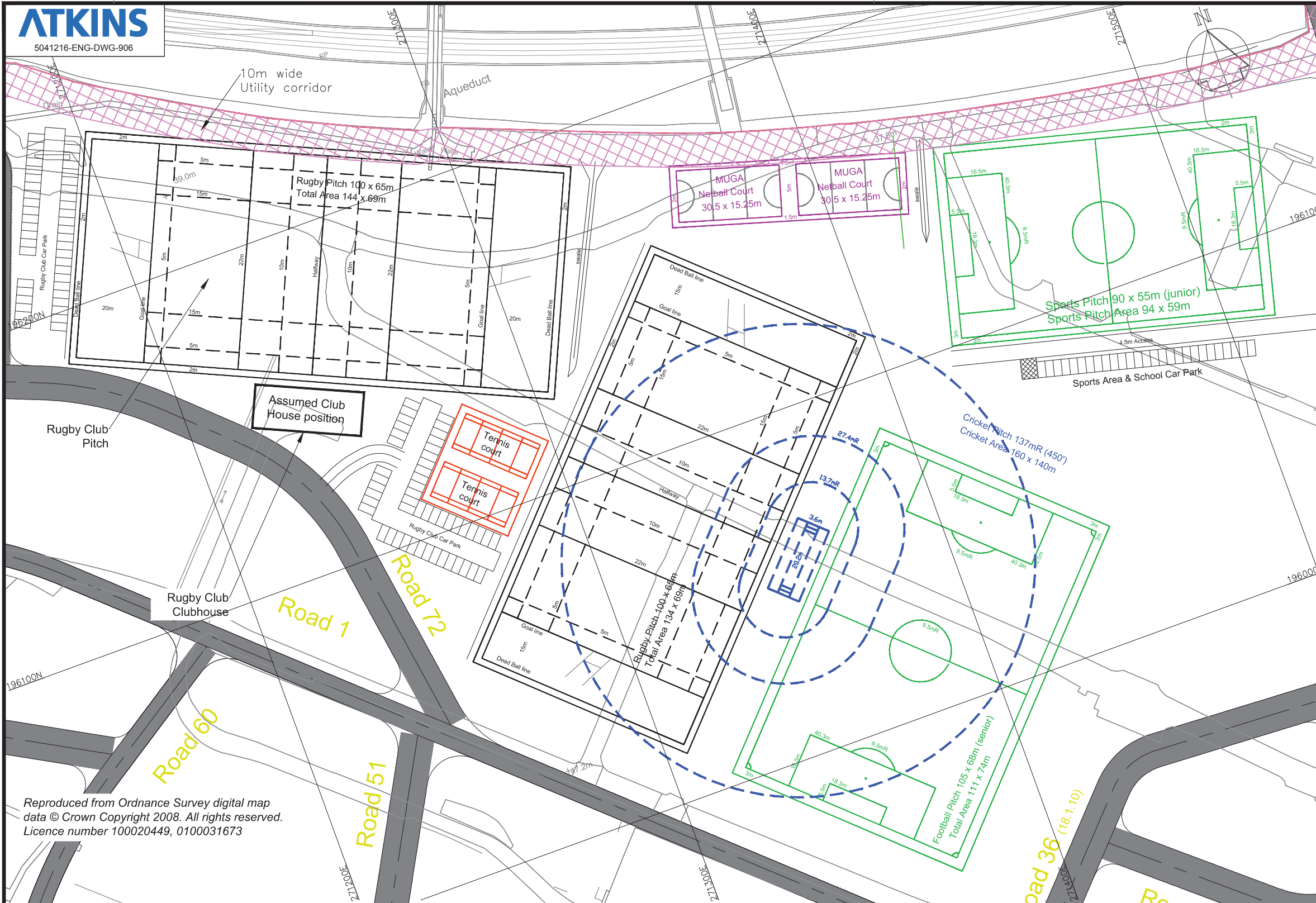
DRAWING NO	REV
5041216-REM-DWG-1666	-



- Key**
- Residential
 - Commercial
 - Retail / Community Use / Residential
 - School
 - Playing Pitches
 - Development Boundary
 - Heathland

job COED DARCY	
title REVISED MASTERPLAN	
date DEC 2010	scale 1:2500 @ A0
 ST.MODWEN	
Sir Stanley Clarke House 7 Ridgeway Quinton Business Park Birmingham, B32 1AF	
Masterplan produced by Alan Baxter, 75 Cowcross Street, London, EC1M 6EL tel: 020 7250 1555 email: aba@alanbaxter.co.uk www.alanbaxter.co.uk Base artwork produced by Lear Associates	
drp. no. 1332/400/MP/SK/TERT	rev. H





NOTES

This drawing is based upon the masterplan drawing by Alan Baxter Associates, drawing no. 1332/400/MP/SK/TERT Rev. H, dated April 2010.

Railway boundary fenceline is taken from Aerial Mapping produced in February 2010, boundary to be confirmed on site before construction work is commenced.

All sports facility area levels are extracted from Atkins validation masterplan, revision N.

Road layout based on Atkins model revision L.

This information is taken from a working live model and is subject to change.

All levels are for reference only and may change subject to final design.

THIS DRAWING IS TO BE USED FOR REFERENCE ONLY AND IS NOT PROVIDED FOR ANY CONSTRUCTION PURPOSES.

REVISIONS	Drawn By	Checked By	Date
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PURPOSE OF ISSUE	Rev.	Authorised for issue	Date
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Atkins Limited Telford Office Cornerstone House Stafford Park 13 Telford TF3 3AZ Tel 01952 201234 Fax 01952 200981			
Birmingham Office The Axis, 10 Holliday Street Birmingham West Midlands B1 1TF Tel 0121 483 5000 Fax 0121 483 5252			

THIS DRAWING IS NOT TO BE SCALED

CLIENT **ST.MODWEN**

PROJECT
Coed Darcy Urban Village

DRAWING TITLE
Proposed Sports Pitches Layout Plan

SCALES	DRAWN	CHECKED	CO-ORD CHECK
1:1250	B.S.	S.N.	
	DATE	DATE	DATE
	Mar. '11	Mar. '11	

0	SHEET A3	PLOT DATE 30.10.15
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DRAWING NO 5041216-ENG-DWG-906 REV A

***A E I B SC E LE OF T E
SECTION A REE E T***

SCHEDULE 8

Redevelopment Remediation Works

Purpose, objectives and requirements of the Redevelopment Remediation Works

Part 1

1. Purpose and objectives of the Redevelopment Remediation Works

- 1.1 The purpose and objectives of the Redevelopment Remediation Works are the carrying out of all such Remedial Action over and above that actually carried out as part of the RAP Works that is necessary in order to make each part of the Property suitable within the meaning of paragraph 1.2 below for its Intended Use or such other use as may be determined from time to time.
- 1.2 A part of the Property will only be suitable for its Intended Use or such other use as may be determined from time to time if and when the Phase Works Completion Date is declared in respect of that part of the Property.

Part 2

2. Developer's obligations regarding Redevelopment Remediation Works

- 2.1 The Developer shall carry out or procure the carrying out of all Remedial Action necessary in order to achieve the purpose and objectives set out in Part 1 of this Schedule.
- 2.2 The design and specification of the Redevelopment Remediation Works shall take appropriate account of the principles and objectives (as set out in sub-paragraph 1.3 (including 1.3.1-1.3.5 thereof) of Schedule 7 hereto) and the design assumptions of the RAP Works and shall not prejudice the achievement and future sustainability of these principles and objectives of the RAP Works or the RAP Works themselves.
- 2.3 The Redevelopment Remediation Works may reduce the reliance on the RAP Works to achieve the principles and objectives of the RAP Works set out in sub-paragraph 1.3 (including 1.3.1-1.3.5 thereof) of Schedule 7 hereto but must not increase that reliance.
- 2.4 The RBSLs set out in Tables 1 and 2 below and the aesthetic criteria, remediation quality and scope (including the depth below Final Finished Level to which quality standards are achieved) as also set out in Part 3 below, as the same may be varied in accordance with this Schedule 8, shall be achieved for each part of the Property at the minimum validation frequencies set out in clause 8 of Part 3 (as applicable depending upon whether such part of the Property is intended for use as residential, commercial or recreational land) as a minimum base level standard.
- 2.5 Without prejudice to the requirement to achieve the RBSLs set out in Tables 1 and 2 as a minimum base level standard, the Developer shall ensure that all necessary remediation targets are developed and used to determine the extent and quality of remediation appropriate to the development design and purpose of the Urban Village and the Pre-Transfer Date Contamination.
- 2.6 The Developer shall promptly notify CDL and the Monitor if at any time it or any person acting on its behalf identifies a substance present at, in, on or under the

Property, or has reasonable cause to suspect such presence, for which no RBSL is specified in Tables 1 or 2 of Part 3 below in which case the following procedure shall apply:

- 2.6.1 As soon as reasonably practicable after serving a notice under paragraph 2.6 above, the Developer shall prepare proposals for soil and groundwater RBSLs for the substance identified that are consistent with the purpose and objectives of the Redevelopment Remediation Works as set out in Part 1 of this Schedule and the standards of prevailing Environmental Law and shall provide a copy of such proposals to CDL the Monitor and the Authority. Any such proposal shall contain a detailed statement of the health risk assessment and general methodology from which the proposed RBSLs have been derived.
 - 2.6.2 Not earlier than 10 Working Days after submitting its proposals to CDL the Monitor and the Authority in accordance with sub-paragraph 2.6.1 above, the Developer shall submit a written request to the appropriate Environmental Authorities, copied at the same time to CDL the Monitor and the Authority, for approval of the use of the proposed RBSLs. The Developer shall provide to the appropriate Environmental Authorities with its request copies of the health risk assessment and general methodology referred to in sub-paragraph 2.6.1 above and a copy of this Agreement clearly drawing attention to the purpose, objectives and requirements of the Redevelopment Remediation Works set out therein and the proposed changes thereto.
 - 2.6.3 Each of the Developer, CDL and the Monitor shall be free at any time to make such submissions to the appropriate Environmental Authorities in relation to the Developer's proposals as they see fit, provided such submissions are made in writing and copied to each other and the Authority at the same time.
 - 2.6.4 The Developer shall ensure that the Redevelopment Remediation Works achieve compliance with any RBSLs approved in writing by the appropriate Environmental Authorities pursuant to this paragraph 2.6, as if they were also set out in Tables 1 and 2 of Part 3 of this Schedule.
- 2.7 The Developer may at any time propose variations to the requirements of clauses 3 to 8 inclusive of this Schedule 8 below to the appropriate Environmental Authorities and to the Authority pursuant and to the extent required to comply with the Planning Permission to take account of changes of circumstances since the date of this Agreement, provided no variation shall be proposed that is in any way prejudicial to the achievement of the purpose and objectives of the Redevelopment Remediation Works as set out in Part 1 above and, in particular, the achievement of the RBSLs set out in Tables 1 and 2 above (as previously amended in accordance with paragraph 2.6 above if applicable) and provided further that
- 2.7.1 Any such proposals shall be submitted in writing to CDL the Monitor and the Authority at least 10 Working Days before they are submitted to any Environmental Authority;
 - 2.7.2 Any such proposal submitted to any Environmental Authority shall be copied to CDL the Monitor and the Authority at the same time;
 - 2.7.3 The Developer shall enclose a copy of this Agreement with any such proposal made to any Environmental Authority clearly drawing attention to the

purpose, objectives and requirements of the Redevelopment Remediation Works set out therein and the proposed changes thereto;

- 2.7.4 Each of the Developer, CDL and the Monitor shall be free to make such submissions to the appropriate Environmental Authorities in relation to the Developer's proposals as they see fit, provided such submissions are made in writing and copied to each other and the Authority at the same time.
 - 2.7.5 Subject to paragraph 2.7.6 no such proposed variation shall be implemented unless, it has been approved in writing by the appropriate Environmental Authorities in accordance with the requirements of this clause 2.7.
 - 2.7.6 If the Developer has only oral approval (or non objection) to a proposed variation from the relevant Environmental Authorities, no such proposed variation shall be implemented unless the Developer notifies the relevant Environmental Authorities in writing (copied at the same time to CDL the Monitor and the Authority) that it proposes to proceed with the implementation of the proposed variation to the Redevelopment Remediation Works 10 Business Days after the date of such notice and no written objections of any relevant Environmental Authority are received within such 10 Business Day period in respect of the same.
 - 2.7.7 Any reference in this Agreement to the Redevelopment Remediation Works shall be to the Redevelopment Remediation Works as varied in accordance with this paragraph 2.
- 2.8 The Developer shall, and shall procure that any person acting on its behalf in relation to any aspect of the Redevelopment Remediation Works required by this Schedule 8 shall, at all times comply with the requirements of Schedule 10 (General Remediation Requirements).

Part 3

Table 1 – Summary of Soil RBSLs

Contaminant	Land-Use Specific Soil RBSL Surface to 1m below FFL (mg/kg) ¹			Land-Use Specific RBSL Soil below 1m depth (mg/kg)		
	Residential	Commercial	Recreational	Residential	Commercial	Recreational
METALS & METALLOIDS						
Arsenic	64	500	64	-	-	-
Cadmium	2.6	1400	2.6	-	-	-
Chromium	130	5000	200	-	-	-
Mercury	1	480	1	-	-	-
Nickel	50	5000	75	-	-	-
Selenium	3	8000	3	-	-	-
Lead	337	750	337	-	-	-
Vanadium	416	16000	640	-	-	-
Copper	478	-	478	-	-	-
Zinc	200	-	200	-	-	-
ORGANIC SPECIES						
Benzene	0.12	5	13	0.4	5	48
Benzo(a)pyrene ²	0.9	29	0.9	none	none	none
Toluene	36	1160	8110	52	389	none
Ethylbenzene	41	122000	4740	140	none	none
Xylenes	32	121000	7940	58	none	none
1,2-Dichloroethane	0.04	2	4.5	0.1	0.65	6
Dichloromethane	5	1650	241	84	665	6220
Tetrachloroethene	11	1050	641	34	368	1780
Trichloroethene	1	84	193	2	28	269
Vinyl Chloride	0.01	4	0.7	0.04	1.6	16
1,2 Dichloroethene	4	273	632	7	91	881
1,1,1-Trichloroethane	154	577000	27900	160	3250	none
TPH Aromatic EC>C7-C8	125	1840	21337	146	617	none
TPH Aromatic EC>C8-C10	94	913	4025	257	547	none
TPH Aromatic EC>C10-C12	118	26515	4589	1394	none	none
TPH Aromatic EC>C12-C16	131	64875	4799	none	none	none
TPH Aromatic EC>C16-C21	82	51449	3639	none	none	none
TPH Aromatic EC>C21-C35	1130	51449	3639	none	none	none

TPH Aliphatic EC>C6-C8	8335	8517587	606191	none	none	none
TPH Aliphatic EC>C8-C10	112	158890	12075	158	none	none
TPH Aliphatic EC>C10-C12	3204	163360	12094	none	none	none
TPH Aliphatic EC>C12-C16	4513	169032	12117	none	none	none
TPH Aliphatic EC>C16-C21	94174	3429944	242573	none	none	none
TPH Aliphatic EC>C21-C35	94820	3429944	242573	none	none	none
Total TPH (Phase 1) ³	1717	81413	9061	9182	81956	none
Total TPH (Process Area) ³	2601	44344	10830	4098	35014	none
Total TPH (North Tank Farm) ³	1104	25875	9419	3802	13974	none
Total TPH (South Tank Farm) ²	1015	37230	6349	2792	34797	none
ASBESTOS						
Sum of all Types of ACM	200	300	200	200 ⁴	-	-

“-“ value not applicable to scenario

“none” RSBL value exceeds soil saturation limits and free phase assessment appropriate

¹ Lower value of human health RBSL or Soil Code value if higher than background LCL value (applicable to metals & metalloids only)

² Benzo(a)pyrene RBSL to be compared against sum of 16 US EPA Priority List PAHs using Toxicity Equivalence approach

³ ‘Total’ TPH RBSL derived for an area of development, based on individual RBSLs provided and available mass fraction TPH data in soil at time of derivation, using the inverse weighted average approach.

⁴ See text below for specification of relevant depth ranges

Table 2 – Summary of RBSLs for Groundwater

Contaminant	Land-Use Specific RBSL (mg/l)		
	Residential	Commercial	Recreational
TPH Aliphatic EC>C6-C8	none	none	none
TPH Aliphatic EC>C8-C10	none	none	none
TPH Aliphatic EC>C10-C12	none	none	none
TPH Aliphatic EC>C12-C16	none	none	none
TPH Aliphatic EC>C16-C21	none	none	none
TPH Aliphatic EC>C21-C35	none	none	none
TPH Aromatic EC>C7-C8	20	97	none
TPH Aromatic EC>C8-C10	22	none	none
TPH Aromatic EC>C10-C12	none	none	none
TPH Aromatic EC>C12-C16	none	none	none
TPH Aromatic EC>C16-C21	none	none	none
TPH Aromatic EC>C21-C35	none	none	none
Benzene	0.7	6	198
Benzo(a)pyrene	none	none	none
Toluene	47	229	none
Ethylbenzene	102	506	none
Xylenes	43	607	none
1,2-Dichloroethane	0.2	0.82	45
Dichloromethane	150	624	none
Tetrachloroethene	22	115	none
Trichloroethene	2.6	13	813
Vinyl Chloride	0.06	0.3	18
1,2-Dichloroethene	15	68	none
1,1,1-Trichloroethane	193	989	none

“none”= theoretical RBSL greater than solubility limit

3. Scale of aesthetic criteria

Table 3 – Scale of aesthetic criteria

Class	Visual	Olfactory
0	No visible staining of soil, no visible suspect ACM	No detectable odour on soil
1	Occasional staining of soil, no visible suspect ACM	Faint odour on soil
2	Frequent staining of soil	Distinct but not strong odour on soil
3	Occasional heavy staining of soil	Strong odour on soil
4	Heavy staining of soil	Strong odour discernable in ambient air
5	Visible hydrocarbon product	Overwhelming Odour

3.1 Visible suspect ACM refers to asbestos containing material visible to the naked eye which a reasonable and prudent person used to managing asbestos may suspect to be asbestos containing.

3.2 All references in Table 1 above to depths to which minimum RBSLs are to be achieved are expressed below, relative to FFL following completion of construction of the intended Urban Village.

4. Residential End-Use where Groundwater is Primarily in Rock

4.1 This remediation scenario is intended to refer to residential end-use in areas where there is limited soil material over bedrock, little perched groundwater is present in that soil, and the water table is normally first encountered in bedrock. Areas of the Property with these characteristics include the more elevated parts of the former process area and of the southern tank farm. The minimum Remedial Action required in this scenario is as follows:

4.2 All oil saturated soil should be removed.

4.3 All soils must be remediated so as to meet the RBSLs for TPH, BTEX and PAHs at the relevant depth relative to FFL and the aesthetic criteria Class 2 or better at greater than 1m below FFL.

4.4 The aesthetic quality of soils shall be Class 1 or better for at least the first metre below FFL.

4.5 Soils where there is visible ash and clinker, or metal concentrations above RBSLs, are to be removed so that none is retained within the first metre below FFL in garden areas.

4.6 Where it is not practicable to address groundwater contamination within bedrock this must be controlled, e.g. where seeps, sheens and iron staining discharge from the bedrock. Acceptable methodologies for remediation may include, but are not limited to, the use of land drainage via interceptors. Control measures should result in no visible discharge at surface and little or no odour observable.

4.7 All soil potentially containing dispersed asbestos fibres or visible ACM must be removed or remediated to meet in bulk, considering both dispersed fibres and pieces

of ACM, the appropriate ACM RBSL, or to meet the requirements of relevant Environmental Authorities, whichever is the more conservative.

5. Residential End-Use where Groundwater is in soil

- 5.1 This remediation scenario is intended to refer to residential end-use in areas where there is sufficient soil material over bedrock to commonly contain perched groundwater such that the water table is normally first encountered in soil. Areas of the Property with these characteristics include the lower parts of the former process area and of the southern tank farm and the north site tank farm. The minimum Remedial Action required in this scenario is as follows.
- 5.2 All oil saturated soils and free product shall be removed.
- 5.3 Soils must be remediated so as to meet the RBSLs for TPH, BTEX and PAHs to a minimum depth of 0.5m below the likely seasonal minimum groundwater depth following development of the intended Urban Village. This depth is to be established by consideration of all available groundwater level monitoring data relevant for each area. All soil must meet aesthetic criteria Class 2 or better to the same depth.
- 5.4 All soil must meet aesthetic criteria Class 1 or better to at least 1m below FFL.
- 5.5 Soils where there is visible ash and clinker or metal concentrations above RBSLs to be replaced to at least 1m below FFL.
- 5.6 All soil potentially containing dispersed asbestos fibres or visible ACM must be removed or remediated to meet in bulk, considering both dispersed fibres and pieces of ACM, the appropriate ACM RBSL, or the requirements of relevant Environmental Authorities, whichever is the more conservative, to a minimum depth of 2m below FFL.
- 5.7 Where there is a risk of the migration in ground of hazardous gas or vapour or contaminated liquid into remediated areas, the Developer shall take all necessary measures appropriate to prevent this occurring, including monitoring whatever measures are put in place after their installation to continue to demonstrate their effectiveness. Such measures could include the installation of interception trenches and management of discharge from these.
- 5.8 Where necessary, seeps, sheens and iron rich discharges from the bedrock must be permanently controlled such that there is no visible discharge at surface and little or no odour detectable. Acceptable methodologies for remediation may include, but are not limited to the use of land drainage via interceptors.

6. Commercial End-Use where Groundwater is in soil

- 6.1 This remediation scenario is intended to refer to commercial end-use in areas where there is sufficient soil material over bedrock to commonly contain perched groundwater such that the water table is normally first encountered in soil. The area identified for commercial development in the Masterplan is the lower part of the former process area, which in general terms has these characteristics. Based on the Masterplan, no commercial developments are currently envisaged where groundwater is primarily encountered only in rock; in the event such development is proposed, Remedial Action consistent with the standards specified below would be required, adapted as necessary to local conditions.

- 6.2 All oil saturated soils and soil containing free product other than minor sheens shall be removed to a minimum depth of 2 m FFL or 0.5 m below the likely lowest seasonal groundwater elevation following development of the intended Urban Village, whichever is the deeper. This depth is to be established by consideration of all available groundwater level monitoring data.
- 6.3 All soils must meet the RBSL for TPH to at least 1m below FFL.
- 6.4 All soils must meet in bulk, considering both dispersed fibres and pieces of ACM”, the RBSL for ACM to at least 1m below FFL and any visible ACM encountered during construction in the first 1m below FFL is to be removed.
- 6.5 Where there is a risk of the migration in ground of hazardous gas or contaminated liquid into remediated areas, the Developer shall take all appropriate measures to prevent this occurring. Such measures could include the installation of interception trenches and management of discharge from those. The Developer shall monitor whatever measures are put in place after their installation to continue to demonstrate their effectiveness.
- 6.6 Where necessary, seeps, sheens and iron rich discharges from the bedrock must be controlled such that there is no visible discharge at surface and little or no odour. Acceptable methodologies for remediation may include, but are not limited to the use of land drainage via interceptors.

7. Public Open Space

- 7.1 The Developer shall remediate areas of the Property which will not be developed for residential or commercial end-uses based on those areas falling into one of the following three broad categories of land-use:
- 7.1.1 Well managed parks and public gardens;
- 7.1.2 More lightly managed areas where public access is encouraged;
- 7.1.3 Areas to which access is discouraged but occasional access and/or trespassing is possible.
- 7.2 The degree of protection that will need to be afforded to people will be largely dependent upon how the access to these areas is encouraged/discouraged and managed. For guidance only, access may be discouraged by physical barriers such as fencing, or vegetation, or actively managed by the provision of walkways along which controlled access is encouraged. The topography of the site may encourage children to use bikes, potentially causing rutting of the ground surface and exposing soils at depth. Detailed designs in this regard will be prepared by the Developer approved by CDL and agreed with the Environmental Authorities to (i) protect human health considering the reasonably anticipatable use of the land (ii) achieve the relevant RBSLs (recreational RBSLs being provided in Table 1 above) to an appropriate depth and (iii) include an appropriate scheme of validation testing.

8. Validation

- 8.1 As a minimum validation of RBSL's will be required to include:
- 8.1.1 Determining the necessary extent of remedial excavations: this will be the responsibility of the Developer;

- 8.1.2 Quality assurance of imported materials, including testing of imported materials for contamination if it is intended to use reclaimed aggregates, top soil, etc: this will be the responsibility of the Developer, however, CDL may elect to validate such materials in-situ, once they are finally placed for construction;
- 8.1.3 Quality assurance of soils treated on the site for re-use: this will be the responsibility of the Developer, however, CDL will validate such materials in-situ, once they are finally placed for construction, and;
- 8.1.4 Quality assurance of soils for which no remedial works are identified: this will be the responsibility of the Developer, however, CDL will validate such materials.

8.2 As a minimum, sampling at the following frequencies should be undertaken.

Table 4 - Minimum Validation Testing Frequencies.

Testing for the Validation Suite at the following frequency:	Shallow Soils (Residential <1m FFL)	Deeper Soils (Residential >1m below FFL)	Soils (Commercial all relevant depths)
Imported quarried material	1 per 500m ³ ex situ, composite of 5 regular sub-samples	1 per 1000m ³ ex situ, composite of 5 regular sub-samples	1 per 1000m ³ ex situ, composite of 5 regular sub-samples
Imported soil from verified greenfield site	1 per 250m ³ ex situ, composite of 5 regular sub-samples	1 per 500m ³ ex situ, composite of 5 regular sub-samples	1 per 500m ³ ex situ, composite of 5 regular sub-samples
Imported soil from characterised brownfield site ¹	1 per 25m ³ ex situ, composite of 5 sub-samples	1 per 50m ³ ex situ, composite of 5 sub-samples	1 per 100m ³ ex situ, composite of 5 sub-samples
0.5-1m below FFL in-situ	Regular grid of 1 per 50m ² , sample over 0.5m depth	n/a	Regular grid of 1 per 400m ² , sample over 0.5m depth
>1m below FFL in-situ	n/a	Regular grid of 1 per 100m ² , sample over 1m depth	Regular grid of 1 per 400m ² , sample over 0.5m depth
Stockpiled excavated site materials for re-use	1 per 50m ³ ex situ, composite of 5 sub-samples	1 per 100m ³ ex situ, composite of 5 sub-samples	1 per 400m ³ ex situ, composite of 5 sub-samples
Face of remedial excavations <1m deep	1 per 10m, minimum of 1 per face, worst case VO sample	n/a	1 per 15m, minimum of 1 per face, worst case VO sample
Face of remedial excavations >1m deep	n/a	1 per 10m ² , minimum of 1 per face, worst case VO sample	1 per 15m ² , minimum of 1 per face, worst case VO sample
Along redundant service excavations	1 per 20m of trench, worst case VO sample	1 per 20m of trench, worst case VO sample	1 per 20m of trench, worst case VO sample
Soil treated ex-situ and homogenised	1 per 200m ³ , composite of 5 regular sub-samples	1 per 200m ³ , composite of 5 regular sub-samples	1 per 500m ³ , composite of 5 regular sub-samples

¹ Validation suite to reflect prior use of the originating brownfield site and the design and purpose of the relevant area of Coed Darcy.

VO = visual / olfactory (ie aesthetic) observation

- 8.3 The quality of all material placed as fill and/or remaining in-situ post-construction of the Urban Village must as a minimum meet the relevant RBSLs and aesthetic standards at the frequencies set out above (in either case as the same may be amended in accordance with this Schedule).
- 8.4 In all circumstances, CDL and/or the Monitor may at its discretion take additional samples if it has reason to suspect that material may not meet the relevant RBSLs and

aesthetic standards (in either case as the same may be amended in accordance with this Schedule).

- 8.5 All validation samples obtained by CDL and/or the Monitor whether according to the above frequencies or on a discretionary basis must on analysis be of the same or better quality than the relevant RBSLs and meet or exceed the relevant aesthetic criteria (in either case as the same may be amended in accordance with this Schedule).

A E I C I FOR ATIO SO RCES

***A E I RE ESTS FOR
I FOR ATIO RFI***



Request for Information

Contract Name: Coed D'Arcy **O** ITOR

RFI No:

Contract Number: GNP/NJR/13773-2

Date Raised:

29/04/2010

Subject: DiMe RTC Report Review

To: Hannah White

Atkins

From: Simon Gibbons

URS

Response Required Within:

1 Day

3 Days

5 Days

10 Days

X

Comments

The following comments have been prepared in response to Atkins report ' Remediation Target Criteria for the DiMe Area', dated April 2009, ref.5041216/REM//RPT/000316.

Pages 6 and 8 contain footnotes relating to PCB and dioxins. This element is not discussed in the text in any detail and its inclusion may be potentially misleading. Atkins dismisses PCBs due to there being no substations present. However there is repeated inclusion of 'dioxins' along with PCBs in the text. There could well be other sources of dioxins at the site, for example as the result of power station operations and which is totally separate to substation-related PCB containing oils. It is not clear therefore whether Atkins is mooting that dioxins might be an issue, or whether dioxins are being tagged along with PCBs on the basis that there is no plausible source on the DiMe area. The SGV report referenced in the RTC report deals only with dioxin-like PCBs and is therefore only part of the process required to be followed when assessing potential risks from PCB containing oils from substations. It is recommended that in the introduction to the report the CSM is more fully presented and the potential sources of contamination associated with this part of the site are discussed. By introducing the concept of PCBs/dioxins etc and dismissing it without further explanation may result in queries being raised about the appropriateness of the assessment that has been completed. If there is no identified plausible source then there is no need to make further reference to the HH guidance.

The report dismisses the recreational RBSLs as being irrelevant before establishing whether or not the Atkins conceptual model says otherwise. In order to demonstrate that the potentially lower risk recreational end-uses assessed by URS are not significant it may be appropriate to carry these RBSLs through the process as being the minimum required standard for that generic end-use. Arguments as to why they should not be used should then be raised at the end of the process if any potential issues are identified.

On page 9 of the report Atkins makes a critical assumption in the recreational CSM that children will use other green spaces for ad hoc outdoor activity. This is only relevant if the playing fields don't represent the closest, most convenient open space for a given area of housing. If access to the fields is totally un-fenced, unrestricted, it would be plausible for children living close to the fields to use them for ad hoc activity, rather than walking/biking to a green space further away within the development. This assumption requires further justification and/or explanation about the effect this may have on the RTCs that are generated.

Can Atkins provide a date when the asbestos QRA will be available for review and comment? Is Atkins still proposing to use the residential RBSL for asbestos of 200ppm? Given the demolition activities and former land use it is plausible that asbestos could be present in the shallow made ground soils. The RBSL for asbestos is not depth specific.

It is unclear why metals are not being considered yet Atkins is including other contaminants not expected to be present within the soils. Why include additional contaminants and not metals if there may be a need to screen imported material and which presumably could end up in the top 1m of the soil profile? It should be made clear that the RTCs are only applicable for deep soils and that alternative criteria may need to be developed for shallow soils. Is it practical at this stage to assess recreational quality for imported soils to be used at depths shallower than 1m?

The DiMe area is referenced in a few places and there are several parts of the report which indicate no substations to be present. Can Atkins provide a figure showing which area the assessment relates to? Has a Phase been declared for this area? Given the presence of the power station and large areas of processing plant it seems unlikely that there would be no substations on the DiMe area. The report also refers separately to the site, DiMe and DiMe exclusion area. Can these be defined and the report made clear about which area the RTCs relate to.

The discussion on sources does not seem very specific. It is not clear where the impacts from chlorinated hydrocarbons in particular are located - what the magnitude of observed concentrations is and how this relates to the historic use of this part of the site. This may have been discussed in another site investigation report but as a minimum reference to this information source should be provided.

It is not clear what SOM data is being referenced - site-wide or DiMe specific? Does this vary with geology/depth? How many samples have been collected and used in the selection process? Are the soils a combination of natural and made ground? The selection process described for this parameter seems brief given that this is a stand-alone QRA report and that no data is appended for reference.

The discussion on soil type is brief. A reference to more detailed information would be desirable. A simple clarification that a sand soil is considered conservative might aid in this section since from recollection only the granular made ground would likely be considered a sand and the deeper (perhaps <0.5m below made ground) material is much finer grained. Does vertical stratification of the soils play a role in the modelling and RTC development? Has any consideration been made to the pitch drainage layer and the potential introduction of preferential pathways? Would a gravel sub base create a higher risk since the risk assessment needs to be based on what will be imported not just on what current soil conditions are like.

There is discussion presented on groundwater flow direction, location of school and assertion that concentrations below the school are lower than the RTCs for residential use. This needs greater clarification and discussion. Atkins should indicate that residential RTC are conservative for a school and a drawing with location of the wells used, school position, exclusion zone, etc are required to validate this point. How many wells have been used to confirm this? What does the shallow and bedrock data set actually show? Some discussion on actual concentrations and RTCs would help the reader to understand the assessment that has been completed. What does the time series data show for that particular area of the site? What does the hydrogeological assessment suggest in terms of contaminant depth etc? This element seems to be too simply dismissed with limited back-up with real data.

More explanation on the reason why the longer age-group class used for the female teacher is not significant should be provided rather than simply dismissed.

Is there any national or international guidance on child recreational activity? As noted above what consideration has been given to children using the playing fields more regularly if they live close to them (eg school holidays, other public holidays, evening use, etc)? The assumption of exposure may be appropriate but a clearer breakdown of the thought process used in making the assumptions would be useful.

On page 13 Atkins do not present hazard indices where the RTC is indicated to be > saturation/solubility. Not presenting HI at saturation, therefore leads to uninformed decisions on the degree of risk posed at saturation/solubility limit and the significance for the remedial strategy.

TPH additivity should be discussed so that the risks from all fractions at solubility limit can be considered.

What is the rationale for considering exposure from the school and surrounding grounds to be negligible?

A sensitivity analysis on the exposure frequency for the school child would help provide confidence in the selection of the critical receptor – especially as additional exposure does not appear to have been considered when the child is not on the sports fields?

In the groundwater assessment could you clarify how the exposure frequency is calculated since numerically it appears much lower and inconsistent with the soil model value.

There are inconsistencies between tabulated parameter values and the relevant text in the report.

Signed:  Date: 29/04/2010

Reply

Signed: _____ Date: _____

istribution

To	cc	Name	Company	Fax No
X		Hannah White	Atkins	
	X	Mike Poland	Atkins	

Request for Information

Contract Name: Coed D'Arcy **O** ITOR RFI No:
 Contract Number: GNP/NJR/13773-2 Date Raised: 31/08/2010
 Subject: Review of DiMe Controlled Waters Risk Assessment
 To: Howel Morris Atkins
 From: Simon Gibbons URS

Response Required Within:	1 Day		3 Days		5 Days	X	10 Days	
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Comments

The following comments are provided in response to Atkins report 'DiMe Area Controlled Waters Risk Assessment', dated 11th August 2010, ref 5041216-REM-RPT-000372.

geology

Atkins has changed the previous classification system for the geology preferring to split the site into granular and cohesive drift units rather than the previously described Units 'A', 'B' and 'C'. The previous descriptions of the site geology suggest that unit B is a drift deposit which tends to fine downwards and contains what appear to be discontinuous horizons of more permeable material. It is unclear how the Atkins revised assessment deviates significantly from this description. A simplification of the geology – particularly where this will result in a conservative risk assessment may be appropriate but it is not clear if this is why the stratification into more clearly defined granular and cohesive drift deposits has been made.

The report suggests that there is a lack of evidence of groundwater seepage into the railway cutting. This lack of seepage is then used to justify the assumption that the granular units within the sequence are laterally discontinuous (i.e. the main focus for the assessment being vertical migration into the bedrock unit). It is not clear how this conclusion regarding the railway cutting has been formed. From URS' investigation of the railway cutting in 2003 the following observations were made¹;

'The reconnaissance walkover inspection provided a general overview of conditions within the rail cutting. No evidence of severe contamination egress was observed. However, closer inspection and soil boring identified a few locations where contamination was present. The observations are summarised in Table 1. Many water seepages with ochreous precipitates were observed at the base of the cutting, either from soil or bedrock. These seepages were generally observed along the south side of the rail cutting and were often observed to have associated hydrocarbon and/or microbial films.

Soil samples taken from RCSS001 and RCSS002 (approximately 1.5m above the base of the south side of the cutting and 10cm depth) and RCSS008 (approximately 2.0m above the base of the south side of the cutting and 10cm depth) were observed to have black staining and strong hydrocarbon odours. These locations corresponded with ochre rich seepages and hydrocarbon sheens at the base of the cutting. Many soil borings, including samples not contaminated with hydrocarbons, indicated the presence of ashy fill material. It was reported by BP during the inspection, that a lube-oil spill had occurred onto the embankment around location RCSS003, from overhead oil pipes. Vegetative dieback in the immediate area was observed, together with hydrocarbon staining, sheens and odours, further confirming the presence of contamination in this area. However, the extent of soil affected by the spill appeared to be limited to the area beneath and immediately surrounding the overhead pipes on the south side of the cutting.

The Wernandrew separator was observed to collect water from an un-named stream and drainage from the railway cutting. It appeared, although could not be confirmed on site, that separate drainage channels exist for the north side and south side of the cutting. The south side drainage channel is collected into the separator and the north side joins the stream immediately downstream of the separator. Water samples were collected from each of the drainage channels, the upgradient stream and the down gradient stream. No sheens or odours were observed in any of the water samples collected.'

¹ Rail Cutting Inspection, BP Llandarcy Refinery, ref 39991-032-785/DR1161/LT/7205, dated 6th August 2003

A copy of the report is attached for information. On the basis of previous observations of seepages in the railway cutting it is considered that this may indicate a plausible pathway for contamination to migrate off-site. Further consideration of this pathway should therefore be presented in the assessment.

The geological description of the bedrock unit does not appear to present any discussion on the significance of either the dip or bedding control on groundwater movement.

The exclusion of the term boulder clay from the geological succession description is not considered appropriate. The term is a widely used and understood geological term and is considered to be an accurate description of the material encountered beneath the DiMe plant. It is recognised, however that this type of formation may be difficult to model, in which case it may be more appropriate to recognise areas where simplifications have been made (i.e. the distinction between granular and cohesive drift).

hydrogeology

The hydrogeology section reports that groundwater flow is towards the railway cutting but subsequently infers groundwater flow only to the River Neath. Is this considered a reasonable reflection of the data? Is it inferred that groundwater in the bedrock flowing north underpasses the railway cutting and is inferred to ultimately discharge to the River Neath?

It should be noted that the extent of groundwater data used in previous assessments for the site cover a much larger area than the groundwater contouring completed by Atkins. This more comprehensive data set suggests a groundwater catchment divide at or close to the DiMe plant. Its exclusion by Atkins does not appear to be well justified. It may ultimately be appropriate to exclude the Crymlyn Bog catchment on the basis of the position of any divide (eg the bulk of the contamination lies to the east) but it should perhaps not be dismissed so quickly without consideration of the wider groundwater flow regime at the site. Can further justification be provided for consideration of westerly contamination migration only at the DiMe plant?

The brief discussion on recharge to the bedrock should be supported by some form of calculation. Can Atkins demonstrate that recharge alone over the bedrock outcrop at the site is sufficient to supply enough water to maintain the observed gradients across DiMe using the permeability/porosity assumptions used in the model? If not then consideration of vertical recharge through the drift to can be assumed and may help to estimate the relative significance of lateral migration in the drift itself. One of the fundamental parts of the assessment that was discussed at the outset was the provision of a water balance for this area of the site so that the real site data can be used to calibrate the whole assessment. Without this water balance there is likely to be a lack of confidence in the risk assessment results and in particular the likely groundwater residence time and transport velocities to the various receptors.

A large range in water levels is reported in some wells in the DiMe area. Would the large variations in some locations provide supporting evidence for the likely low storage and potentially poor connectivity in the main bedrock unit? This type of evidence needs to be extracted more clearly from the data set and related to the CSM for the site.

With regard to free product, further assessment of its location relative to potential sources, its significance with regard shallow groundwater migration, particularly towards the railway cutting, would be beneficial given the ultimate conclusion presented in the report. A sentinel well monitoring programme is in place specifically to monitor for product migration towards the railway cutting yet this element of the CSM appears to have been dismissed completely in the assessment presented. A plot of product thickness variation with time in key wells would be useful to help assess its potential significance.

The discussion on depressed water levels in the cohesive drift is confusing. Does the initial part of the discussion relate purely to the measured depth to water before consideration of overlying product or is it implying an error in the data set? An entire page dedicated to discussing corrections for the presence of product in wells appears inconsistent with the level of detail presented for the other aspects of the hydrogeology at the site.

For the cohesive drift hydrogeology URS would note that seepages have been observed in the railway cutting and therefore the suggestion that lack of seepage supports the assumption that the water is 'perched' does not appear to be reliable. Notwithstanding this, the conclusion that the majority of groundwater movement in the drift is likely to be vertical appears to be a reasonable assumption. As with the recharge element discussed above, some form of calculation to demonstrate this is considered appropriate (eg what is the groundwater flow laterally given the permeability, gradient, etc versus the calculated vertical flux given the larger area, observed vertical gradients, assumption of homogeneous permeability, etc). Are the various assumptions reasonable? This would likely provide some justification that vertical migration is likely to be the most important element of the CSM (eg the simple calculation may show that 90-95% of the groundwater flow through the drift is vertical (to support the estimated recharge into the bedrock unit) rather than laterally towards the railway cutting). This may also enable certain receptors to be ruled out as being significant although further inspection of seepages and water quality in the railway cutting may ultimately be required to complete this element.

In the made ground/granular drift hydrogeology there does not appear to be any discussion on the effects of the drainage network on groundwater levels? There is no presentation of water level data or assessment of the distribution of free product which has historically been observed in a large number of wells screened in the made ground in the DiMe plant itself. Could the drainage system be a route for discharge of shallow groundwater? It is known that the drainage system has contributed significantly to the transfer of chlorinated hydrocarbon contamination from the DiMe plant into the North Site Reservoir. Therefore a pollutant linkage between shallow ground contamination and drainage must exist. If contaminated shallow groundwater is not considered to be part of the source then further evidence should be presented to rule out this particular pathway (eg are shallow groundwater levels consistently below the invert levels of the drainage system? Can additional data be supplied to support any of the conclusions that are reached? Consideration of removal of the drainage network may help assist future predictive modelling but consideration of the historic influence is still considered appropriate.

The hydraulic conductivity section reports on tests completed across the entire Llandarcy refinery site (as distinct from the DiMe Site?) Whilst a range of values are recorded there is no discussion on the geology type at each of the test locations? How comparable are these results considered to be to the DiMe area? Would it be possible to collect data specifically from DiMe wells and those immediately down hydraulic gradient? It is not apparent that any of this data has been used in the assessment (see below – the report suggests literature values for the cohesive drift have been used).

Whilst the comment on well screens intercepting more productive strata is likely to be correct it is not clear if the comment about the bulk hydraulic conductivity of the cohesive drift is relevant. Whilst the bulk transmissivity of the cohesive drift may be lower than indicated by the slug test data the permeability of the more sandy units in the drift through which contamination is likely to migrate is likely to reasonably well reflected in the test data. Given that migration is likely to occur through the more permeable units it is considered appropriate to consider the use of this permeability value in the assessment itself.

product

It is noted by Atkins that the monitoring well network is likely to be insufficient to assess the potential for LNAPL migration. Atkins do not, however, present their conclusion following this remark? How does it affect the CSM? If product migration was occurring would the assessment be completed differently? The sentinel well monitoring programme has indicated that there is the potential for product migration to occur. Would the sentinel well data assist in assessing the potential for migration of product across DiMe? If free product migration is considered possible what does that suggest about the heterogeneity of the shallow and/or deep drift?

The LNAPL analysis would likely benefit from presentation of pie charts to show the relative proportions of each TPH/BTEX fraction from each sample location. The most recent data clearly shows a significantly different composition to the LNAPL analysed on 21/1/2009? No borehole references are provided however to help the reader understand the location of the various samples? It is not clear if Atkins is implying a change in product composition at the same/similar locations or simply that there are two different types of product in the DiMe plant area. More details on geographic extent would be helpful.

It is not clear what Atkins mean by 'conventional' hydrocarbons. The TPHCWG analysis is based on effective carbon numbers/carbon bonds and therefore could include a wide variety of different aliphatic and aromatic compounds. In order to understand what the 'conventional' hydrocarbon comment means would require a more detailed VOC analysis to rule out certain contaminants and/or would require a more refined assessment of the likely source of the LNAPL. It is not clear if DiMe analysis was included for the product samples?

The potential risk from product to controlled waters does not appear to have been assessed in the risk assessment process.

Contamination Assessment

The discussion on solubility and volume of groundwater appears to be a little abstract. Would it be possible to provide further information on rates of dissolution of the chlorinated hydrocarbons given the site setting? How much water is passing through the aquifer, how much DNAPL might reasonably be expected based on historic concentration data? Taking into account Raoult's Law what solubility might be expected for each determinand in the mixture? Are the observations on site supported by the theory (using calculations to demonstrate Atkins understanding) and/or are there potential data gaps on site that need filling before a conclusion on this aspect can be made.

In the contaminant properties Table 4.6, a selection of half lives are presented for the two key chlorinated contaminants. These rates are likely to be critical in establishing the extent of any contamination plume migrating from the DiMe plant. It is not clear, however, how these rates have been incorporated into the assessment.

There is a brief discussion on anaerobic vs aerobic degradation however no site specific assessment appears to have been completed (it is assumed by Atkins that groundwater will only be anaerobic on site). Use of DO/Redox data etc should help confirm whether conditions are likely to be reducing in the DiMe plant area. It is noted that dissolved methane analysis has been completed recently and this is discussed in more detail later in the report.

The discussion on historical contamination appears relatively brief. Has Atkins reviewed contaminant distribution data for themselves? Has the original risk assessment been reviewed? What sources are considered most likely to have caused the observed distribution of contamination? Is there a distinction between source and plume from the available data set?

It is noted that Atkins has completed more recent monitoring at the site. What is not clear, however, is how the locations of the new wells relate to the likely sources of contamination and whether they have been effective in replacing wells where high concentrations have been recorded historically but which may no longer exist. Can Atkins provide a figure showing which boreholes are included in the statistical analysis for 2009/2010? Have the wells with the highest historical Di and Me concentrations been resampled recently or replaced with appropriate monitoring points? (eg DSB007, DSB009s2, MSMW066d2, DSB008s1, etc).

Whilst the sporadic nature of sampling may lead to an overly pessimistic view of the contaminant distribution at the site it would at least provide a reasonable overview of where contamination has been identified at concentrations which may be considered to represent the main source area.

A specific comment is made on the concentrations in DSB023s2 in the report. It states that the current concentration of 21ug/l is significantly lower than historical data. Based on URS' records this location appears to have been sampled once in February 2002 and a concentration of 17.3ug/l was reported. Can Atkins confirm which data they are using?

For the cohesive drift discussion there is a general inference presented by Atkins that concentrations have decreased. It would be helpful to provide graphical evidence of this, making reference to the more contaminated wells which have not been resampled recently.

Has any assessment of depth of contamination in the cohesive drift been attempted? The potential presence of DNAPL or high dissolved phase concentrations towards the base of the cohesive drift will reduce the vertical distance for attenuation in any vertical migration model.

The conclusions about lack of a DNAPL source in the bedrock appears reasonable based on the bedrock monitoring data.

The significance of potential data gaps requires clarification in each of the contamination distribution sub-sections.

No comments are provided in relation to the distribution/magnitude of shallow groundwater contamination and no discussion is presented on PID data or soil results to help infer where releases to ground may have occurred.

The presence of chloride in the cohesive drift deposits is discussed by Atkins. The report states that chloride is 'preferentially' transported. It would be more accurate to suggest that chloride is relatively little retarded during transport and does not undergo degradation. It is therefore a good tracer to help understand the distribution and longevity of a source of contamination.

The inference that 500mg/l of chloride in the cohesive drift is from dechlorination appears to be reasonable. The correlation data for methane appears to support the earlier supposition that conditions in the groundwater are generally reducing. There does appear to be reasonable evidence to support the conclusion that biodegradation of the DiMe solvents is occurring in the cohesive drift deposits. Is any similar data available for bedrock and/or granular drift wells?

Whilst a detailed discussion on the presence of chloride is presented the significance to the CSM and the risk assessment is not clearly stated. Can this data be used to estimate the potential lateral extent of dissolved phase plumes in each unit?

The calculations for assessing the relative conductivity for Di and Me appear reasonable although further discussion on how/why this calculation is necessary would aid the non-specialist (i.e. the intrinsic permeability is a function of the porous media while the fluid conductivity will be dependent on the dynamic viscosity and density of the fluid). For low viscosity, high density fluids the rate of migration will be higher than the hydraulic conductivity (i.e. the pure phase contaminant will migrate more rapidly than would groundwater alone).

The conclusion presented by Atkins that there is likely to be relatively little residual DNAPL is presumably based on the assumption that the formation is relatively homogeneous vertically and that wells are installed in appropriate locations across the site.

The velocity calculations suggest that a 5m thick cohesive drift unit should be penetrated in 1-10 years allowing for some variation in local permeability. This appears to be a reasonable assumption.

Coal Measures contain a naturally occurring source of chloride. Consideration should be given to the background chloride content in the bedrock across the site (i.e. away from potentially chlorinated solvent contaminated areas) to understand the natural background. A brief review of available site wide chloride data for deep wells suggests a background concentration in the range 25-50mg/l. This suggests that results between 50-300mg/l may be indicative of some dechlorination of chlorinated solvent contamination and as suggested by Atkins may be diluted from the cohesive drift as a result of mixing in the deeper groundwater.

CS Summary

It is not clear why an assessment of all of the TPH fractions has not been undertaken and in particular aromatic C8-C10 which has been reported at up to 18.72% in one sample analysed from 23/01/2009. Based on mass fraction/solubility (i.e. Raoult's Law) even the relatively low proportions of BTEX contaminants could also potentially present a risk but do not appear to have been considered.

For the pathways element it appears as though the DNAPL migration directly to the bedrock is no longer considered by Atkins to be plausible. This is backed-up by evidence from site and calculations presented in the report which indicate declining concentrations and calculated velocities which suggest DNAPL would most likely have reached bedrock and there is no on-going source from site operations which ceased more than 10 years ago. It is not clear, however, if Atkins are satisfied that there is sufficient current monitoring well coverage to be confident in this conclusion. If not what difference would be made by considering the presence of DNAPL in the bedrock as part of the assessment? How would down gradient monitoring data and lateral velocity calculations help support the conclusions regarding potential for on-going sources in the bedrock?

The selection of a compliance point at the eastern site boundary appears reasonable. Consideration should, however, be given to the railway cutting as a potential receptor.

The extent of source areas is not described in the CSM summary. The location of potential sources in the different aquifer units is also not discussed and the relationship between source and pathway is not clearly described.

Understanding of Assessment

The objectives indicate that the controlled waters assessment was to be completed on the basis of the CSM described in Section 4 of Atkins' report. From the information provided in the report it is not clear, however, exactly what S-P-R linkage has been simulated and how the two models relate to one another. The description at the start of Section 5 is confusing. It has been assumed that the following assessments have been completed;

1. Predictive Model – Used to calibrate the risk assessment model to attempt to replicate observed conditions. It is assumed this calibration is completed on a trial and error basis. No details of the calibration method/data are provided. Can you confirm which data points / wells are used for calibration? Can the source/pathway/receptor be described more clearly for this model.
2. Impact Model – Using a revised model following the calibration process to estimate the potential risk at the selected compliance point from the contaminants of concern. Two assessments using a constant and declining source have been completed. It is not clear if this model assumes vertical and then lateral migration using cohesive drift input concentrations or not?

The methodology then states that the deep groundwater concentrations have been ignored? It does not state what data has actually been used. Irrespective of the source of dissolved phase contamination in the bedrock it is not clear why it is considered that the reported deep contamination won't migrate laterally in the dissolved phase towards the receptor. Further clarification of what sources have been considered is required.

The models might be aided by clearly stating the objectives for each assessment;

1. What concentrations do the soil contaminants leach at into the granular drift?
2. What attenuation via dilution is simulated in the shallow groundwater unit?
3. How do these concentrations compare to the observed dissolved phase concentrations in both the granular and cohesive drift groundwater units?
4. What mechanisms are active vertically through the granular/cohesive drift units in order to create the pollutant linkage into the bedrock aquifer?
5. What attenuation factor is calculated for this migration process?
6. What additional dilution may be expected in the bedrock aquifer?
7. How do the vertical model simulated concentrations into the bedrock compare with observed concentrations?
8. What concentrations are simulated laterally to the 360m compliance point assuming current observed deep groundwater concentrations as the source concentration?
9. How does this differ from the results from the vertical model and what adjustments might need to be made to the vertical model to enable a closer match?
10. Given these adjustments how else might the vertical model be used to assess the significance of vertical migration of contamination within the DiMe area?
11. Can the lateral migration be calibrated using down gradient monitoring data?
12. Does the assessment of groundwater velocities and contaminant migration rates mean that down gradient data can be inferred as being in steady state?
13. Would concentrations be expected to increase in the future at down gradient locations?
14. Given the potential for redevelopment of the site can simulated concentrations down gradient of the source be simulated at 50m intervals to aid the HH assessment?

The description of the stochastic nature of the two models is difficult to follow. Can this be stated more simply and clearly? Why is it considered appropriate to use different confidence levels in the two different assessments.

Atkins include the statement that the unsaturated vertical pathway has been incorporated as if it were a saturated pathway using appropriate values. Can these input values be provided and an indication of what processes the vertical 'unsaturated' pathway model in ConSim is trying to replicate. Has consideration of recharge limitation to vertical migration rates been considered (i.e. the rate of vertical migration through a saturated formation may be limited by the rate of recharge to it)? Has degradation been assumed through the vertical migration pathway? Has the DiMe fluid conductivity been incorporated (or adjusted for) when calculating the vertical velocity in the model?

It is not clear from the Parameterisation section whether soil and groundwater sources are being considered in the assessment. The source depth term for groundwater sources should be reflective of conditions described in the CSM so that vertical dispersion during lateral migration is limited or removed. Can the assumed or calculated groundwater source depth be provided.

Why has site specific foc data not been used?

Are the air filled porosity values presented for the unsaturated zone intended to reflect the vertical saturated pathway)?

Is 50% infiltration considered appropriate given the future use of the site? Given the long term presence of hardstanding and drainage systems at DiMe this degree of recharge may be on the high side but for soil leaching would likely be conservative. Does this degree of recharge work with the water balance for the site? How might having the whole DiMe area unsurfaced in the future affect gradients and water levels? Would this affect the output from the risk assessment?

Can a summary of the modelling components used for each of the assessments be provided (eg for soil – leaching, dilution in perched shallow groundwater, vertical migration through shallow saturated zone with biodegradation, dilution in deeper bedrock unit, lateral migration to compliance point, using max observed soil concentrations over whole DiMe source area, etc), together with a rationale for each element?

Why is site specific permeability data not being used for the cohesive drift as a maximum literature value of 0.01m/day seems to be on the low side given the recorded presence of sand and gravel within the drift unit. Whilst the bulk properties of the drift might more closely resemble clay would contamination not migrate preferentially through the more granular units and hence would a higher conductivity be appropriate? IF the sand/gravel lenses are not considered to be interlinked vertically then this should be clearly explained when presenting the rationale for the parameter selection. How would the separation of the cohesive drift into more and less permeable zones affect the incorporation of dispersion in the assessment? IS dispersion considered in the vertical migration model?

Is it assumed that the vertical conductivity is higher or lower than the lateral conductivity? No vertical hydraulic gradient is provided for the vertical pathway in the parameters summary?

The thickness of the bedrock unit appears to be very high and could potentially allow a large degree of vertical dispersion during migration (depending on source depth assumption and source length/width). The comments suggest that only the mixing zone thickness has been used in the assessment, in which case why is a 50m thick aquifer listed in the input parameters? Is the mixing zone thickness used to dilute soil contamination and limit the source thickness term for groundwater? Is the assumed effective porosity intended to reflect the weathered sandstone rather than the unweathered bedrock?

Does the model assume that the compliance point is located directly down hydraulic gradient of the source?

The Model Section does not provide any information on how the ConSim model has been setup and how the different pathways have been simulated.

If reported dissolved phase concentrations (or solubility limits) have been used to represent the source what is the basis for their selection and in which geological unit is the main source considered to reside?

It is indicated that the predictive model is under predicting concentrations compared to the site data and the inference is that degradation is slower than the literature values used in the model. This is one of several reasons why the results might be different. It is indicated that the degradation rate has been increased in order to match the site data to the 50%ile simulated concentration. No data is provided on what this degradation rate is or what the calibration point is taken to be? Without this information the relevance of this model in the whole process can not be evaluated.

Based on URS review of potential degradation rates for the key contaminants, 2 years and 1.5 years for 1,2-DCA and DCM respectively is considered potentially more appropriate.