

CONSULTING ENGINEERS

CIVIL • STRUCTURAL
GEOTECHNICAL • ENVIRONMENTAL

**REMEDIATION STRATEGY POLICY FOR
PROPOSED RESIDENTIAL DEVELOPMENT
WOODLANDS FARM, DODDS LANE
GWERSYLLT, WREXHAM**

**PREPARED FOR

ANWYL PARTNERSHIPS**

MAY 2022

**REMEDIATION STRATEGY
14155/REM/002**

ROBERT E FRY & ASSOCIATES LTD.
45, Bridgeman Terrace
Wigan, WN1 1TT

Telephone: 01942 826020
Fax: 01942 230816
Email: mail@refa.co.uk
Company Registration No. 2436911



DOCUMENT STATUS

Site Reference	Woodlands Farm, Dodds Lane, Gwersyllt, Wrexham
Title	Remediation Strategy
Client	Anwyl Partnerships
Project No.	14155/REM/001
Report Version	001
Date Issued	16 th May 2022
Issue Notes	Issue for comment and approval
Report Version	002
Date Issued	23 rd May 2022
Issue Notes	Updated development plans.

TABLE OF CONTENTS

- 1.0 INTRODUCTION**
- 2.0 SITE CONDITIONS**
- 3.0 CHEMICAL ANALYSIS**
- 4.0 PROPOSED REMEDIATION MEASURES**
- 5.0 VERIFICATION**
- 6.0 TIMESCALE**
- 7.0 REPORTING**

LIST OF DRAWINGS

Feasibility Site Plan – C861.03
Exploratory Hole Location Plan 14155/01
Remediation Plan 14155/06 – Rev A

REMEDIATION STRATEGY
PROPOSED RESIDENTIAL DEVELOPMENT
WOODLANDS FARM, DODDS LANE,
GWERSYLLT, WREXHAM

1.0 INTRODUCTION

- 1.1 R.E. Fry & Associates (REFA) have been commissioned by Anwyl Partnerships to prepare a remediation strategy scheme for the required site development works at the proposed residential development located at Woodlands Farm, Dodds Lane, Gwersyllt, Wrexham.
- 1.2 The site has been in agricultural usage for the whole of its recorded history. The farm buildings have been present since the earliest records, and a former fish pond was located in the north eastern corner. We have been provided with a feasibility Site Plan (C861.03) which shows the site to be developed into a series of semi-detached properties and apartment blocks with associated road access, private gardens, and landscaped areas. The site has previously been subject to a phase of ground investigations. In April 2015 REFA conducted works to investigate ground conditions on site, reference should be made to:-

- Geo-Environmental Investigation Report No. 14155 dated April 2015;

This Remediation Strategy has been developed in order to allow the safe development of the site.

- 1.3 This remediation strategy is intended to detail the minimum works which should be carried out within the development process to ensure that the ground conditions within the site do not represent a hazard to site operatives, residential end users or members of the general public.

2.0 SITE CONDITIONS

- 2.1 The site has been the subject to a programme of extensive investigation works undertaken by REFA. This previous investigation has identified the presence of an upper layer of topsoil varying in thickness of 0.10m – 0.40m. Within the previous investigation a localised area of made ground was identified within the localities TP07 – TP09, WS04 and WS05 which identified made ground comprising of silts, sands and gravels with brick, concrete and mudstone, extending to a depth in excess of 3.45m. It is believed the made ground identified is associated with the location of the former fish pond in the north eastern corner. The made ground within this area was seen to be underlain by a soft clay, possibility representing the “pond bottom”. In all other localities natural strata was identified to underlie the topsoil layer comprising of glaciofluvial deposits.
- 2.3 Following the initial phase of ground investigations, four gas wells were installed within windowless sample boreholes WS01 – WS04 and were later monitored by REFA to determine any extent of any potential hazards relating to ground gas.

Monitoring data chosen in an effort to assess the ground gas regime under differing barometric pressures in each borehole was monitoring in the presence of methane and carbon dioxide along with the concentrations of oxygen present. Following the completion of the monitoring works, all monitoring results were included in REFA report 14155 Phase II Geo-Environmental Investigation Report.

- 2.4 Following a review of the monitoring data, low concentrations of methane and carbon dioxide were identified with methane reaching maximum concentration of 0.0% v/v and carbon dioxide reaching a maximum concentration of 6.9% v/v in WS04.
- 2.5 The gas monitoring programme did not identify any flows of ground gases and in order to facilitate design and in accordance with CIRIA C665 "Assessing Risks Posed by Hazardous Ground Gases to Buildings" a default value of 0.1 l/hr has been used in the absence of any recorded flows from each of the monitoring wells. This has enabled a gas screening value for both carbon dioxide and methane to be generated.
- 2.6 Based upon the monitoring data, calculations confirm that the maximum gsv is 0.0069 l/hr relating to the maximum concentration of carbon dioxide recorded within WS04. Across the site, carbon dioxide levels have recorded a maximum concentration of 2.4% and calculations utilising these concentrations confirms a maximum gsv of 0.0024 l/hr. Both of the gsv's indicate characteristic situation 1 (NHBS Green). Consideration has been given to the general carbon dioxide levels within WS04 which have recorded concentrations generally over 5% and so there will be a requirement for the installation of characteristic situation 2 (NHBC Amber 1) for any properties within this area. Reference to the available development plans, shows that position WS04 is located within the amenity and wetland areas and therefore no residential development is proposed. If changes to the proposed development plans change and residential structures will be constructed within the vicinity of WS04, then consideration to CS2 (Amber 1) gas precautions will be required.
- 2.7 The desk study information has identified that the site is within a radon affected area where 10 – 30% of properties are subject to elevated radon emissions and therefore all properties will require FULL radon protective measures in accordance with publication BR211 'Protecting new buildings from Radon'.
- 2.8 During the site investigation, the site still contained a farmyard area which included an existing residential property and other dilapidated farm buildings. Investigations could not be conducted within the area at the time and upon demolition and removal of the hardstanding, if any visual or olfactory evidence of contamination is noted then further investigations including sampling and testing will be required to determine the strata's suitability for retention within a residential development.

3.0 CHEMICAL ANALYSIS

- 3.1 The previous programme of analysis has identified localised arsenic contamination within the locality TP08 at 1.20m within the made ground strata. Further chemical testing recorded no elevated metals, PAH compounds, Inorganics, Petroleum Hydrocarbons or Organochlorine Pesticides within any of the topsoil or remaining made ground samples. The single exceedance of arsenic has been noted to have a maximum concentration of 40mg/kg, with the assessment criteria at this site showing a maximum concentration of 37mg/kg and as such, the exceedance is believed to be mineral. When considered in conjunction with the remainder of the results, it is clear that the arsenic contamination does not represent a hazard within this material.

- 3.2 A programme of analysis of various PAH factions was carried out on twelve (12 No.) samples from across the site and did not identify any PAH concentrations above the detectable limit, therefore no remediation is required regarding PAH contamination.

4.0 PROPOSED REMEDIATION MEASURES

- 4.1 Remediation works at this site will extend to the following works:-

- Removal of existing buildings and hardstanding within the farmyard area.
- Provision of surface capping as required within the area of deep fill in the north eastern corner of the site.
- Unsuitable surface materials of concrete, tarmac brick should be removed from the soft landscaping areas surrounding the deep made ground deposits of the former fish pond.

- 4.2 The area of made ground within the north east of the site is likely to be largely capped and covered by the proposed amenity and wetland area. However, where made ground extends into the garden areas of associated properties, it is recommended that either:-

- All made ground is removed from the garden areas and disposed of accordingly, or
- A capping layer of at least 450mm thickness within the front garden areas and 600mm in rear gardens be provided.

Where capping is to be provided this must comprise of an upper layer of 150mm of topsoil underlain by clean inert subsoil material. The provision of capping areas or the removal of the made ground from the garden areas will require independent validation.

- 4.3 The contractor will maintain an accurate record of the materials excavated and removed from the site as part of any site preparation works including details of where the materials are disposed of. This information will be supplied to the engineer and will form part of the validation report.

- 4.4 The works are to be monitored by an independent engineer who will ensure that the following verification procedures are adopted:-

- Liaison with the appointed groundwork contractor, inspection and general monitoring of the works;
- Inspection of the materials to be retained within the site for construction purposes and recovery of any appropriate samples for chemical testing as specified. The presence of contaminative materials and the presence of physical hazards such as glass and metal etc. will need to be removed;
- Verify the source of surface topsoil imported to the site where necessary and commission a programme of chemical testing to determine the suitability of this material for use in a residential with plant uptake environment;
- The material to be used as topsoil for the proposed garden areas will be imported to the site and should comprise of inert topsoil material which satisfies the requirements of this land use as prescribed in tables 2 and 3 below;

- Verify the source of subsoil imported to the site where necessary and commission a programme of chemical testing to determine the suitability of this material for use in a residential with plant uptake environment;
- It is the contractor's responsibility to assess any materials proposed for importation to the site and ensure that they meet the criteria set out later in this document. This may include laboratory testing or the review of investigation data and laboratory testing carried out by others. Any laboratory testing shall clearly demonstrate that the soils tested are uncontaminated and suitable for use in residential garden areas as prescribed in tables 2 and 3 below;
- This data will be supplemented by field and laboratory testing undertaken by the engineer during the remediation works. All test data obtained will be collated by the engineer for inclusion in the validation report; and
- Where the site works identify any suspicious or unusual ground conditions these must be reported to the engineer for further inspection, sampling and assessment to determine their suitability for retention within the site area. Where unusual or suspicious ground conditions are encountered these will be referenced within the final validation report.

4.6 Where garden levels are to be raised, natural clean uncontaminated site arising material can be utilised for these purposes, or where unavailable, clean inert material may be imported to the site from a certified source. Where any materials are imported to site it will be necessary for these materials to be sampled and tested in accordance with the procedures detailed below to confirm their suitability for use within a residential environment.

4.7 A previous programme of ground gas monitoring was undertaken and consideration of the results suggests that the site is to be classified as Characteristic Situation 1 (NHBC Green), although the site is located within a radon affected area where 10 – 30% of properties are above the action level. Full radon protective measures are necessary.

4.8 A watching brief should be maintained throughout all groundworks and should be conducted by the client and the groundworker on site. If any unsuspected ground or contamination is identified, then the consulting engineer and the appropriate regulatory authorities should be notified so appropriate remediation measures can be put in place if required. Written confirmation will be required from the client and groundworker that no unforeseen contamination has been identified during the groundworks.

4.9 Details of the remediation measures are shown upon appended drawing number 14155/06 Rev A for reference.

5.0 VERIFICATION

5.1 The engineer will liaise with the appointed ground works contractor and inspect the site during the works and upon completion.

5.2 Topsoil where required will be placed at a minimum thickness of 150mm. Validation of the surface capping, if required, will be undertaken by trial hole excavation.

Trial holes will be required to ensure that suitable thickness of a clean capping is provided to a depth of 600 mm for rear gardens and 450 mm in front gardens. The thickness of topsoil/subsoil and presence of underlying natural strata should be validated in accordance with the requirements below.

- 5.3 Representative samples of the materials imported to the site and encountered during the validation assessment will be subject to sampling and chemical analyses based upon table 1 below.
- 5.4 Validation of the thickness of the capping material will be undertaken on the basis of one trial hole in each of the private gardens and one trial hole in every four front gardens. Validation will be required to prove a minimum 600mm thickness in all rear garden areas and a minimum of 450mm in all front gardens and landscaped areas.

Table 1: Site Generated Material Sampling Frequency and Analysis		
Material	Sampling Frequency	Analysis Suite
Recycled Aggregate (6F2)	1 sample per 1000m ³	A – B – C – D
Made Ground Fill Material	1 sample per 500m ³	A – B – C – D
Natural General Fill Material	1 sample per 1000m ³	A – B – C – D
Topsoil (capping material)	1 sample per 50m ³	A – B – C
Sub-soil (capping material)	1 sample per 250m ³	A – B – C
A – Heavy Metals and inorganics Suite B – Speciated PAH C – Asbestos Screen (quantification required if fibres are present) D – TPH (CWG) C5 – C44 bandings inc BTEX MTBE		

Table 2: Imported Material Sampling Frequency and Analysis		
Material	Sampling Frequency	Analysis Suite
Recycled Aggregate (6F2)	1 sample per 1000m ³	A – B – C – D
Made Ground Fill Material	1 sample per 500m ³	A – B – C – D
Natural General Fill Material	1 sample per 1000m ³	A – B – C – D

Brownfield Source Topsoil (capping Material)	1 sample per 50m ³ (minimum of 6)	A – B – C – D
Brownfield Source Sub-soil (capping Material)	1 sample per 100m ³ (minimum of 6)	A – B – C – D
Greenfield Source Topsoil (capping Material)	1 sample per 200m ³ (minimum of 3)	A – B – C
Greenfield Source Sub-soil (capping Material)	1 sample per 200m ³ (minimum of 3)	A – B – C
Virgin Quarried Material (Stone Only)	1 sample per 2000m ³	A
A – Heavy Metals and inorganics Suite B – Speciated PAH C – Asbestos Screen (quantification required if fibres are present) D – TPH (CWG) C5 – C44 bandings inc BTEX MTBE		

5.5 Samples recovered from the remediation works will be analysed by an appropriately certified laboratory using UKAS and MCERTS accredited testing procedures for selected chemical determinands based upon public guidance and the results of the ground investigation works. The range of determinands to be assessed and their assessment criteria are shown in table 3 below.

Table 3: Assessment Criteria Screening Values site generated and imported soils			
Determinand	Assessment Criteria for capping soils in gardens and landscaped areas (mg/kg)	Assessment Criteria for capping soils utilised in landscaped areas (mg/kg)	Assessment Criteria for capping soils utilised in POS (mg/kg)
Suite A			
Arsenic	37 ³	40 ³	79 ³
Cadmium	11.0 ³	85.0 ³	120 ³
Chromium (total)	910 ³	910 ³	1500 ³
Copper	2400 ³	7100 ³	12000 ³
Lead	200 ¹	310 ¹	630 ¹
Mercury	40 ³	40 ³	120 ³
Nickel	180 ³	180 ³	230 ³
Selenium	250 ³	430 ³	1100 ⁴
Zinc	3700 ³	40000 ³	81,000 ³
Total Cyanide	34.0 ²	34.0 ²	34.0 ²
Phenol	380 ³	440 ³	440 ³
Suite B			
Acenaphthene	1100 ³	6000 ³	15000 ³
Acenaphthylene	920 ³	6000 ³	15000 ³
Anthracene	11000 ³	37000 ³	74000 ³
Benzo[a]anthracene	13.0 ³	15.0 ³	29.0 ³
Benzo[a]pyrene	5.0 ¹	5.3 ¹	10.0 ²
Benzo[b]fluoranthene	3.7 ³	4.0 ³	7.2 ³
Benzo[ghi]perylene	350 ³	360 ³	640 ³
Benzo[k]fluoranthene	100 ³	110 ³	190 ³
Chrysene	27.0 ³	32.0 ³	57.0 ³
Dibenz[ah]anthracene	0.30 ³	0.32 ³	0.58 ³
Fluoranthene	890 ³	1600 ³	3100 ³
Fluorene	860 ³	4500 ³	9900 ³
Indeno[123-cd] pyrene	41.0 ³	46.0 ³	82.0 ³
Naphthalene	13.0 ³	13.0 ³	4900 ³

Table 3: Assessment Criteria Screening Values site generated and imported soils

Determinand	Assessment Criteria for capping soils in gardens and landscaped areas (mg/kg)	Assessment Criteria for capping soils utilised in landscaped areas (mg/kg)	Assessment Criteria for capping soils utilised in POS (mg/kg)
Phenanthrene	440 ³	1500 ³	1300 ³
Pyrene	2000 ³	3800 ³	7400 ³
Suite C			
Asbestos Screen	ND	ND	ND
Suite D			
Aliphatic EC 5-6	160 ³	160 ³	600000 ³
Aliphatic EC >6-8	530 ³	530 ³	620000 ³
Aliphatic EC >8-10	150 ³	150 ³	13000 ³
Aliphatic EC >10-12	760 ³	770 ³	13000 ³
Aliphatic EC >12-16	4300 ³	4400 ³	13000 ³
Aliphatic EC >16-35	11000 ³	11000 ³	250000 ³
Aliphatic EC >35-44	11000 ³	11000 ³	250000 ³
Aromatic EC 5-7	300 ³	1400 ³	56000 ³
Aliphatic EC >7-8	660 ³	3900 ³	56000 ³
Aromatic EC >8-10	190 ³	270 ³	5000 ³
Aromatic EC >10-12	380 ³	1200 ³	5000 ³
Aromatic EC >12-16	6603	2500 ³	5000 ³
Aromatic EC >16-21	930 ³	1900 ³	3800 ³
Aromatic EC >21-35	1700 ³	1900 ³	3800 ³
Aromatic EC >35-44	1700 ³	1900 ³	3800 ³
Benzene	0.37 ³	1.4 ³	73.0 ³
Toluene	660 ³	3900 ³	56000 ³
EthylBenzene	260 ³	440 ³	25000 ³
M/P Xylenes	320 ³	430 ³	43000 ³
O Xylene	330 ³	480 ³	43000 ³
Methyl tert-Butyl Ether	20 ²	20 ²	85500 ²
¹ DEFRA : SP1010 : Category 4 Screening Levels ² Atkins Atrisk SSV values ³ LQM and CIEH S4UL's for Human Health Risk Assessment (Registration No. S4UL 3265) ND – None Detected			

6.0 TIMESCALE

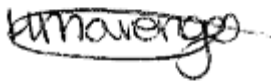
- 6.1 The implementation of the Remedial Strategy is subject to approval of the Local Authority and the implementation will be undertaken as soon as feasibly possible.

7.0 REPORTING

- 7.1 Upon completion of the works a full and final validation report will be prepared and submitted to the local authority and other regulatory authorities in order to satisfy them that the works have been completed successfully and to allow for any appropriate planning conditions to be discharged.
- 7.2 The validation report will also be submitted to the NHBC for approval in accordance with NHBC Handbook Chapter 4.1.
- 7.3 This report will include the following:-
- A description of all works undertaken;

- An accurate record of excavations and ground movements;
- Details of the disposal of any arisings from the site;
- The results of all chemical testing and contamination assessments;
- A photographic record confirming the removal of any potentially contaminated areas and the introduction of topsoil;
- Confirmation that the works have been completed in accordance with this remediation strategy.

Signed for and on behalf of
R E Fry & Associates Ltd

A handwritten signature in black ink, appearing to read "Hollie Marengo", enclosed within a hand-drawn oval.

Hollie Marengo BSc (Hons), MSc, FGS
Senior Geo-Environmental Manager

NOTES:
THIS DRAWING IS COPYRIGHT. DO NOT SCALE FROM THIS
DRAWING. WORK TO FIGURED DIMENSIONS ONLY. CHECK ALL
DIMENSIONS ON SITE. ANY DISCREPANCIES TO BE NOTIFIED
TO THE ARCHITECT.

- 4P2B WIDE
- 4P2B NARROW
- 5P3B WIDE
- 5P3B NARROW
- 6P4B HOUSE
- 3P2B WALK UP APARTMENTS

4P2B = 31
5P3B = 35
6P4B = 7
3P2B = 4
APARTMENTS
TOTAL = 77



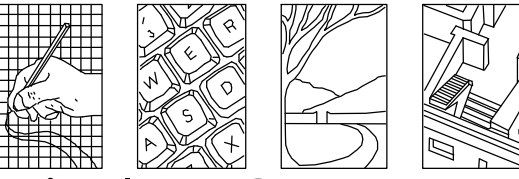
REV	DESCRIPTION	DATE BY (2020)
1	1	1

Job WOODLANDS FARM
GWERSYLLT for
WALES & WEST

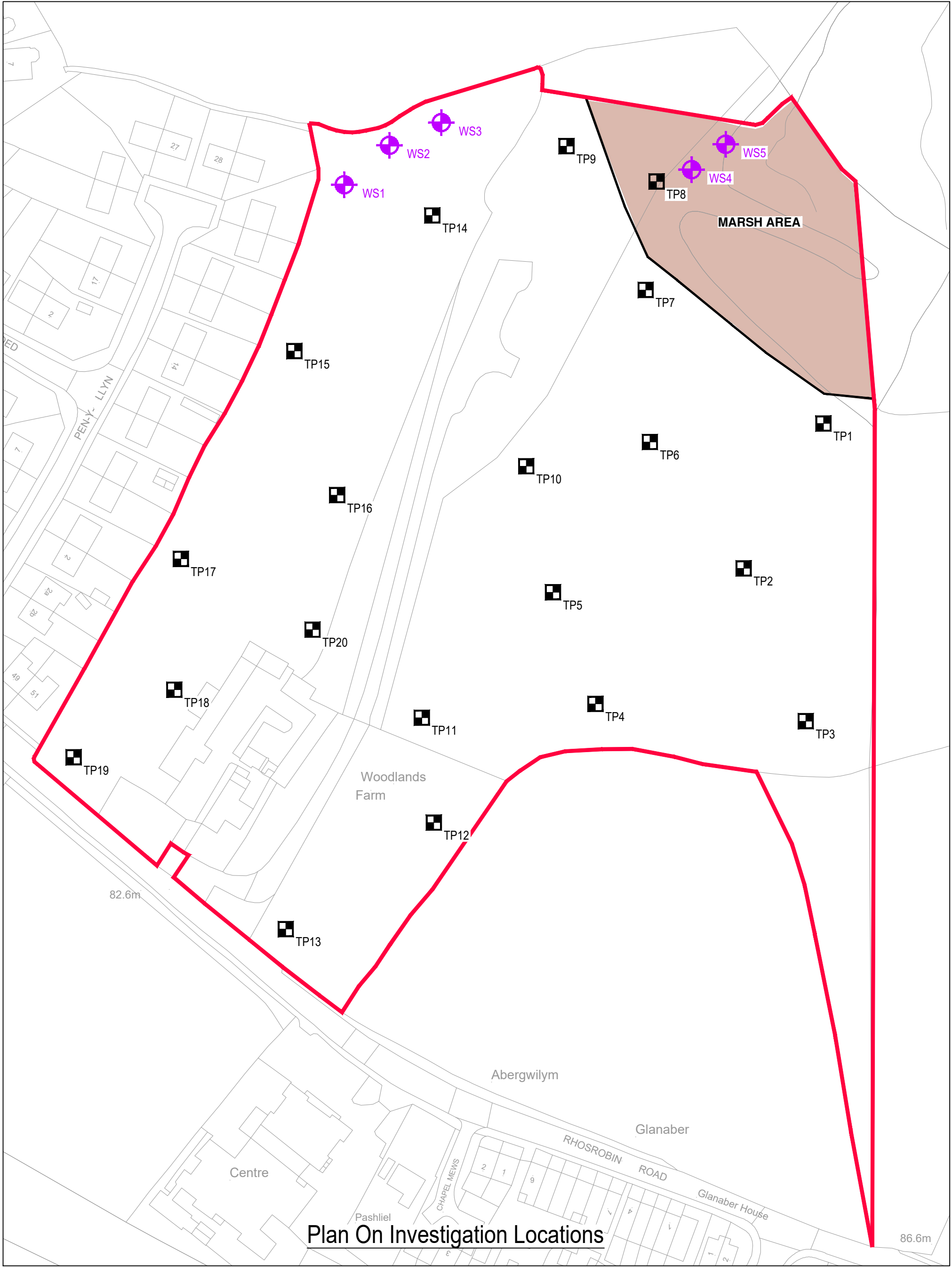
Drawing FEASIBILITY SITE
PLAN

Number C861.03

Scale 1:500 Date 06.02.15 Drawn DP (Checked) SV



Ainsley Common
architecture . urban design
THE OLD POLICE STATION, 15 CLYNNIE WAY, HAWARDEN CHS 3NS
Tel 01544 537100 Fax 01544 537167 info@ainsleycommonarchitects.co.uk
Registered Office: 2, Park Street, Hawarden Square, Bala, Gwynedd, LL23 7LN
www.ainsleycommonarchitects.co.uk



LEGEND:

Site Boundary

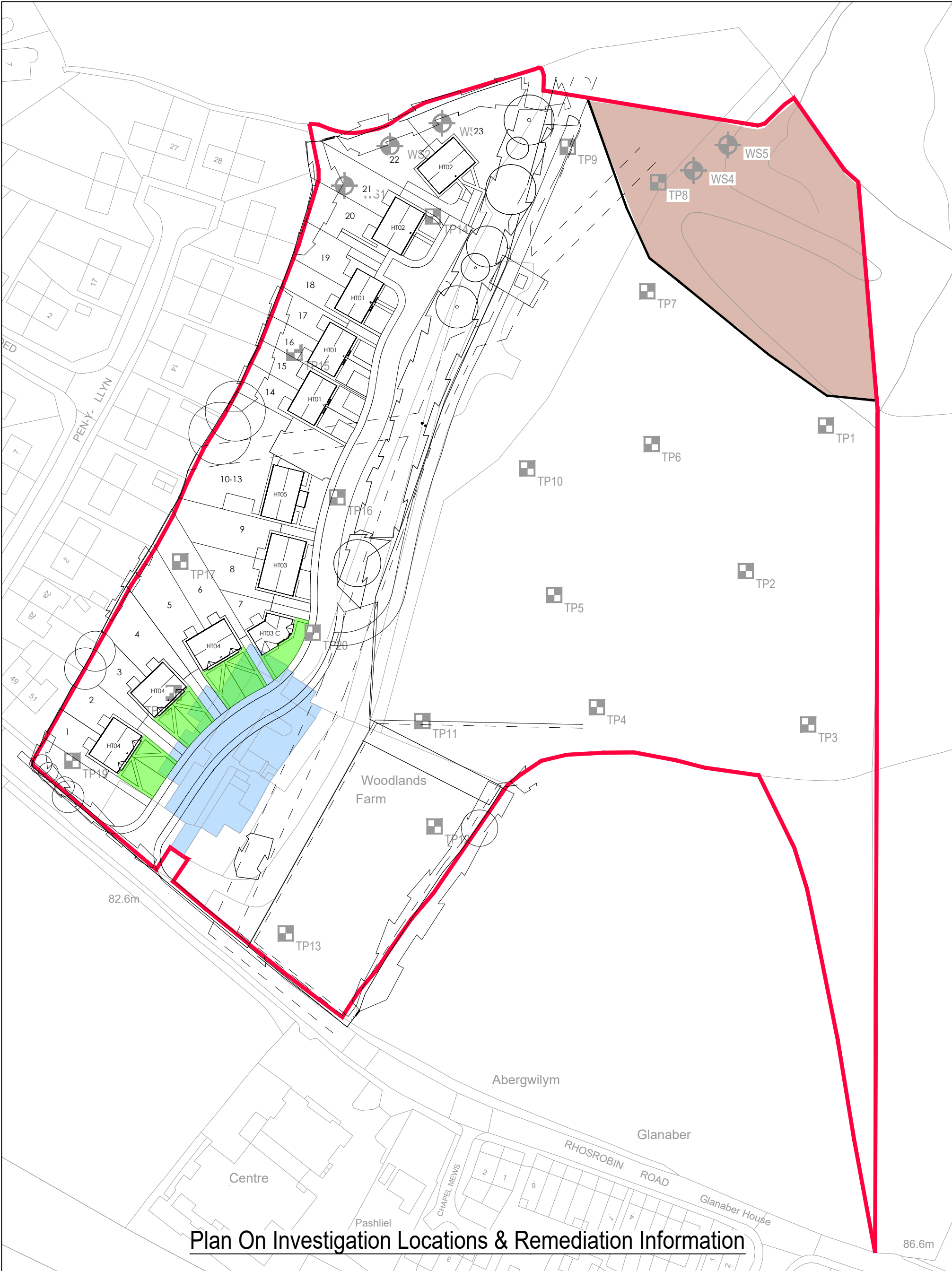
TP1

Trial Pit Locations

WS01

Window Sample Locations

	Revision Details		Date	
revision suffix				
smas worksafe consultant www.smasltd.com as recognised by SSIP SAFETY SCHEMES IN PROCUREMENT				
Drawing Stage		Drawing Status		
☐ Draft	☐ Comments	☒ Tender		
☒ Issued	☐ Information	☐ Construction		
☐ Preliminary	☐ Approval	☐ As Built		
This drawing is not authorised unless signed as checked & approved				
Client				
Wales & West Housing Ass.				
Job title				
Woodlands Farm				
Drawing title				
Exploratory Hole Location Plan				
REFA CONSULTING ENGINEERS CIVIL • STRUCTURAL GEOTECHNICAL • ENVIRONMENTAL 45 Bridgeman Terrace Wigan, Lancs WN1 1TT Tel: –(01942) 826020 Fax: –(01942) 230816				
Chkd	Appvd	date	scale	drawn
		18.12.14	1:1000	PT
DRAWING No		14155/01		rev
© This drawing is the property of REFA and should not be copied, used or its contents divulged without prior written consent				
Any discrepancies to this drawing discovered on site should be reported to REFA immediately. IF IN DOUBT ASK!				



Plan On Investigation Locations & Remediation Information

LEGEND:

Site Boundary

TP1

Trial Pit Locations

WS01

Window Sample Locations

Area of concrete & Tarmac
hardstanding requiring removal
prior to construction phase of works

Area of Made Ground - not suitable for
use within soft landscaping areas

Front garden areas requiring at least
450mm capping layer. Capping should
comprise of clean inert material which
should be confirmed by chemical analysis
in accordance with the remediation
strategy. The capping layer should
consist of at least 150mm of topsoil

Table 1: Site Generated Material Sampling Frequency and Analysis		
Material	Sampling Frequency	Analysis Suite
Recycled Aggregate (6F2)	1 sample per 1000m ³	A – B – C - D
Made Ground Fill Material	1 sample per 500m ³	A – B – C - D
Natural General Fill Material	1 sample per 1000m ³	A – B – C - D
Topsoil (capping material)	1 sample per 50m ³	A – B – C
Sub-soil (capping material)	1 sample per 250m ³	A – B – C
A – Heavy Metals and inorganics Suite B – Speciated PAH C – Asbestos Screen (quantification required if fibres are present) D – TPH (CWG) C5 – C44 bandings		

Table 2: Imported Material Sampling Frequency and Analysis		
Material	Sampling Frequency	Analysis Suite
Recycled Aggregate (6F2)	1 sample per 1000m ³	A – B – C - D
Made Ground Fill Material	1 sample per 500m ³	A – B – C - D
Natural General Fill Material	1 sample per 1000m ³	A – B – C - D
Brownfield Source Topsoil (capping Material)	1 sample per 50m ³	A – B – C - D
Brownfield Source Sub-soil (capping Material)	1 sample per 100m ³	A – B – C - D
Greenfield Source Topsoil (capping Material)	1 sample per 200m ³	A – B – C
Greenfield Source Sub-soil (capping Material)	1 sample per 200m ³	A – B – C
Virgin Quarried Material (Stone Only)	1 sample per 2000m ³	A
A – Heavy Metals and inorganics Suite B – Speciated PAH C – Asbestos Screen (quantification required if fibres are present) D – TPH (CWG) C5 – C44 bandings		

A

Additional remediation requirements added

23.05.22

revision
suffix

Revision Details

Date

worksafe
consultant

as recognised by

SSIP

SAFETY
SCHEMES IN
PROCUREMENT

www.smasltd.com

Drawing Stage

Drawing Status

Draft

Issued

Preliminary

Comments

Information

Approval

Tender

Construction

As Built

This drawing is not authorised unless signed as checked & approved

Client

Wales & West Housing Ass.

Job title

Woodlands Farm

Drawing title

Remediation Plan

REFA

CONSULTING ENGINEERS

CIVIL • STRUCTURAL

GEOTECHNICAL • ENVIRONMENTAL

45 Bridgeman Terrace
Wigan, Lancs
WN1 1TT
Tel: –(01942) 826020
Fax: –(01942) 230816

Chkd

Appvd

date

18.12.14

scale

1:1000

drawn

PT

DRAWING No

14155/06

rev

A

© This drawing is the property of REFA and should not be copied,
used or its contents divulged without prior written consent

Any discrepancies to this drawing discovered on site should be
reported to REFA immediately. IF IN DOUBT ASK!