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**PROPOSED RESIDENTIAL DEVELOPMENT
WOODLANDS FARM, DODDS LANE
GWERSYLLT, WREXHAM
FOR
WALES & WEST HOUSING ASSOCIATION**

FINAL ISSUE

APRIL 2015

**GEO-ENVIRONMENTAL INVESTIGATION REPORT
14155/GEIR**

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EXECUTIVE SUMMARY

Site	<i>The site is irregular in shape and extends to an area of approximately 4.1ha. It is located on the north eastern side of Rhosrobin Lane (Dodd's Lane) approximately 1.0km south east of Gwersyllt village centre.</i>
NGR	SJ 32333 53233
Site History	<i>The site has been in agricultural usage for the whole of its recorded history. The farm buildings have been present since the earliest records. A former fish pond was located in the north eastern corner.</i>
Investigations	<i>The investigations have extended to:-</i> <i>• Walkover survey</i> <i>• Desk study</i> <i>• Intrusive investigations by and trial pits</i> <i>• Gas monitoring by window sampler installations</i> <i>• Chemical analyses of soil samples</i> <i>• Plasticity index analyses of soil samples</i>
Ground Conditions	<i>Generally the site contains an upper layer of 0.3m or so of topsoil underlain predominantly by clayey, silty sand deposits (Glaciofluvial and Till deposits). Made ground and soft clays in north eastern corner (Alluvium)</i>
Environmental	<i>Assessment of these results suggests that the strata within this site is effectively uncontaminated.</i>
Trees	<i>The site contains trees, hedges and shrubs which may impact upon the proposed structures. Testing suggests that the strata has a LOW volume change potential but foundation precautions are likely to be necessary in some buildings in accordance with NHBC Handbook Chapter 4.2.</i>
Foundations	<i>Natural strata offers 100kN/m² at 0.9m or so below ground level. Traditional shallow strip footings will be appropriate for all traditional 2 & 3 storey residential structures. Larger apartment buildings etc. will require specific design. Nominal reinforcement to the foundations is required to protect against possible ground movements associated with the geological fault and previous deep coal mining activity. Development in the north eastern corner will require the provision of piled foundations – not currently proposed.</i>
Slabs	<i>It is recommended that all properties within this site should be provided with a suspended ground floor construction. The floors may be of a precast concrete beam and block arrangement or of a cast insitu reinforced concrete. In those areas which are affected by tree root issues, it is recommended that a beam and block type arrangement be adopted to provide an adequate under floor air void. FULL radon gas precautions are required within the ground floor construction.</i>
Remediation	<i>No specific remediation works are required at the site. Clearly it will be necessary for all concrete and tarmac hard standings to be removed from the proposed garden areas along with any potential physical hazards such as glass, metal etc. Demolition of existing buildings is required.</i>
Ground gases	<i>FULL radon precautions in all properties. Six rounds of gas monitoring have been completed and the site is classified as CS1 (Green) except in NE corner where CS2 (Amber 1) should be adopted.</i>
Further Works	<i>Further investigations after removal of farm buildings.</i> <i>Investigation of north eastern corner when access is available.</i> <i>Consultation with NRW regarding ditch.</i> <i>Possible soakaway testing</i>

This brief summary should not be assumed to represent a complete account of all the potential geo-environmental issues that may exist at the site. As such it is strongly recommended that the report be read in its entirety.

GEO-ENVIRONMENTAL INVESTIGATION WORKS

WOODLANDS FARM, DODDS LANE,

GWERSYLLT, WREXHAM

1.0 INTRODUCTION

1.1 Instructions

1.1.1 We are instructed by Wales & West Housing Association, Unit 2, Acorn Business Park, Aber Road, Flint CH6 5YN to undertake a program of ground investigation works at a site occupied by Woodlands Farm, Dodds Lane, Gwersyllt, Wrexham.

1.2 Object

1.2.1 The object of these investigations is as follows:

- To determine the engineering properties of the soils present within the site to form a basis upon which foundation and general infrastructure recommendations and design may be based;
- To enable sufficient information regarding ground conditions to be obtained from which risks to end users and the environment can be assessed;
- To utilise the information obtained from the investigations to provide recommendations for remediation measures where required.

1.3 Scope

1.3.1 The investigations considered within this report have comprised of the following elements:

- An environmental and engineering desk study based upon existing reports, services location information, geological, hydrogeology and hydrological information, a commercially available database and old Ordnance Survey maps;
- An initial walkover survey of the site to determine the presence of any visible hazards or features which may affect the design of the ground investigation works;
- Intrusive ground investigation works utilising window sampler drilling techniques by a specialist contractor and trial pit excavation supervised by a REFA engineer;
- Assessment of the presence, nature and extent of any soil and groundwater contamination at the site;
- Determination of the presence of any toxic or explosive gasses from areas of infilling within or adjacent to the site via a program of gas and groundwater monitoring.
- Appraisal of the engineering properties of the soils present within the site to form a basis upon which recommendations for foundations and infrastructure construction may be based;
- Identification of the potential requirements for any remedial action, where required.

1.4 Development Proposals

1.4.1 Prior to the desk study and ground investigations being carried out for this site our client had not supplied us with any proposed development layout drawings. Since publication of the draft report we have been supplied with a feasibility site plan drawing reference C861.03 which shows a residential development comprising of semi-detached housing with associated road access, private garden areas and landscaped areas. To the north there is a large wetland and amenity area. A copy of the feasibility plan is attached for reference but it is acknowledged that the development proposals may be amended during the formal planning process.

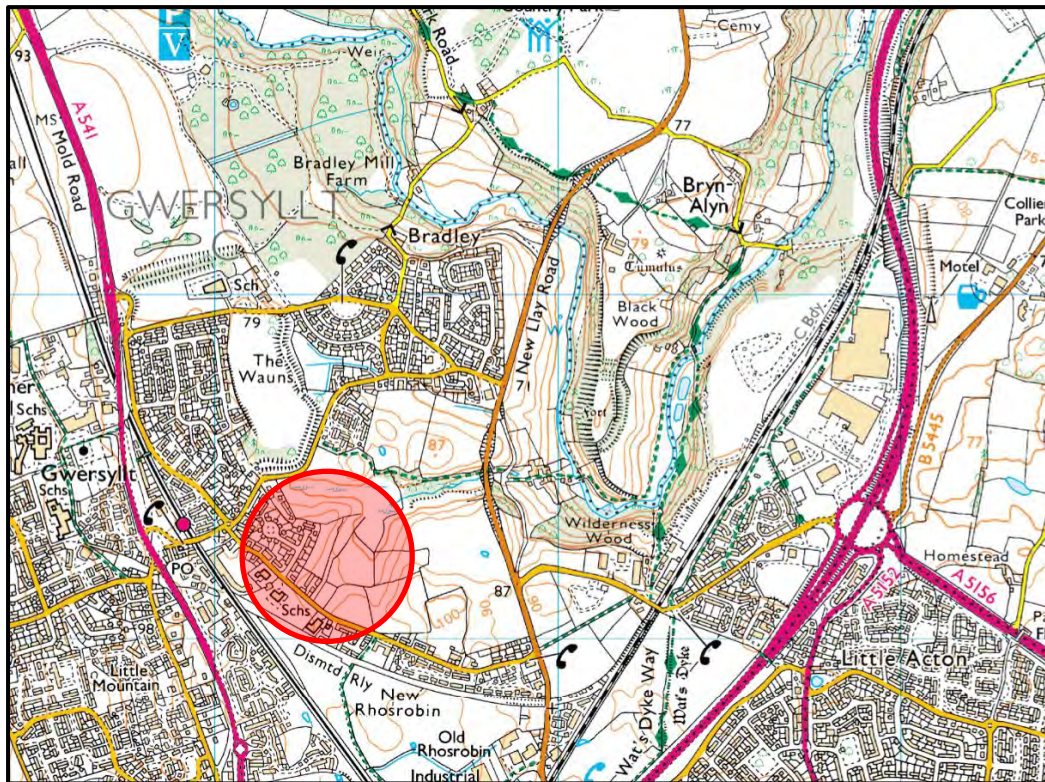
1.5 Services

1.5.1 Information regarding the presence of drainage services within the site have been provided by our client. These indicate the presence of a series of live public drains which pass through the central area of the site and which are connected to adjacent residential developments. No records regarding the presence of other services within the site have been made available. It is however recognised that the residential property and farmyard area are served by private services to which records are unavailable. Prior to undertaking intrusive works at each location a careful visual and electronic survey of the location was undertaken and all boreholes were preceded with a hand excavated trial pit.

2.0 THE SITE

2.1 Location

2.1.1 The site is irregular in shape and extends to an area of approximately 4.1 hectares. It is located upon the north eastern side of Rhosrobin Lane (Dodds Lane) approximately 1.0km to the south east of Gwersyllt village centre. The site is located at approximate National Grid Reference SJ 32333 53233 in an open semi-rural area, though with residential development within the immediate vicinity. Its approximate location is indicated in figure 1 overleaf.

Figure 1 - Site Location

2.2 Boundaries

- 2.2.1 The main boundaries to the site are formed by a series of mature hedges and dilapidated fences. To the west the adjoining land is occupied by existing residential properties on Pen-Y-Llyn. The remaining boundaries are formed predominately by mature hedges and trees with open agricultural land abutting these boundaries. To the south Dodds Lane marks the boundary.
- 2.2.2 Within the south eastern portion of the site there is an unusual narrow triangular peninsula parcel of land which we understand is included within this site. This area has not been subject to intrusive investigations due to heavy vegetation and inaccessibility at the time of these works. It is unlikely that the geometry of this area will allow any development without further land being made available.

2.3 Access

- 2.3.1 Access to the site is presently gained by means of a concrete and tarmac track extending from Rhosrobin Lane (Dodds Lane) at the southern boundary. This access point directly accesses the existing farm building development at Woodlands Farm but also gives access to a stone track which extends to the northern portion of the site. It is anticipated that permanent formal access to the proposed development of this site will be formed from approximately the location of the existing access way.

2.4 Topography

- 2.4.1 The site has a generally sloping topography with ground levels falling generally from the south and west towards the north eastern corner. Generally the gradients are relatively gentle but locally may be in the order of some 1 in 10.

It is considered possible that these gradients may impact upon the design and layout of the site in terms of the finished floor requirements of individual properties and their access highways etc.

2.4.2 At the time of these investigations the site represented effectively open land covered with grass and overgrown hedgerows etc. Within the southern portion of the site the existing buildings relating to Woodlands Farm were present and these areas have not been directly accessed for investigation so as to minimise disruption to the buildings and their immediately environment. Some of the farm buildings are in a very dilapidated condition and are considered unsafe.

2.4.3 The site also contains a long stone track which passes from the southern boundary into the northern portion of the site. This track is expected to contain drainage features referred to on the Welsh Water drainage plan but may also mark the route of a previous ditch.

2.5 Trees

2.5.1 The site contains a large number of mature and semi-mature hedgerows and trees, though these are predominately located at the main boundaries and adjacent to the access track passing through the central area of the site. It is considered likely that these trees and hedgerows will lie within potential influencing distance of any proposed structures and it is recommended that a detailed arboriculturist report should be undertaken upon all trees and hedges within the site along with those features situated outside the site but lying within influencing distance.

2.6 Walkover Survey

2.6.1 Prior to commencing the ground investigation works we have undertaken an initial walkover survey of the site to identify any areas which may impact upon the proposed site redevelopment works. These features are identified upon the appended walkover survey plan. However the main features of the site are as follows:-

- Presence of residential and agricultural buildings adjacent to the southern boundary and forming Woodlands Farm;*
- A number of agricultural buildings are in a very poor and precarious structural condition. They represent a clear health and safety hazard in their present condition;*
- Possible asbestos based products within the farmyard buildings;*
- Concrete and tarmac tracks giving access to the site and farmyard;*
- Mounds of tree and hedge cuttings and other materials adjacent to the western boundary;*
- The presence of manhole covers and a larger tank cover within the northern portion of the site;*
- A low lying marshy area at the north eastern corner;*
- General sloping topography towards the north eastern corner;*
- Locally steeply sloping areas;*
- Areas of standing water within the fields.*

3.0 DESK STUDY

3.0.1 As part of our environmental desk study we have commissioned an Enviro-Insight report by Groundsure which gives details of all recorded environmental features relating to the site and its immediately surrounding area. We have also obtained copies of all available old Ordnance Survey maps for the area and these give some historical guidance regarding the former usage of the site area and its immediate vicinity. A Geo-Insight report has also been commissioned which assesses the geological structures within the general area of the site.

3.1 Environmental Permits, Incidents & Registers

3.1.1 The Enviro-Insight report has identified up to five (5 No.) records of licensed discharge consents within 500m of the study site boundary. The closest of these records is located on site and relates to Gwersyllt Glan Llyn fish pond located adjacent to the north eastern corner of the site. The initial permit was revoked in 2005 and a new permit issued relating to land actually lying off the study site area. These licensed discharge consents are considered not to pose a potential hazard to the development of the site and its long term end users. The discharge appears to comprise of a storm overflow pipe from the public drainage route marked on the Welsh Water drainage plan.

3.1.2 There are records of up to four Environment Agency recorded pollution incidents also within a 500m buffer zone of the study site area. The closest of these is situated some 120m to the north of the site and relates to an incident in 2001 with the pollutant described as mixed/waste oils. The records indicate that there was no impact upon water, land or air as a result of this pollution incident. The incident is considered to be located sufficiently remotely from the site so as not to represent a potential hazard to the development works.

3.2 Landfill Sites

3.2.1 The Enviro-Insight report has confirmed the presence of an Environment Agency historic landfill site situated some 205m to the north of the site. The site is referred to as The Wauns, Gwersyllt and appears to have accepted waste types of inert, industrial, commercial, household and special. Assessment of the location of this landfill site in relation to the proposed development area suggests that there is a low possibility of landfill gas migration to the site area.

3.2.2 A series of other landfill sites are known to lie within the general area of the study site but these are located at distances in excess of 500m. Accordingly it is not anticipated that these more remote landfill sites are likely to pose any potential hazard in terms of landfill gas migration to the proposed development area.

3.3 Current Land Uses

3.3.1 The environmental report has identified up to seven (7 No.) records of potentially contaminative land uses within 250m of the study site boundary. Three of these features relate to electricity substations which are situated within the proximity of the site but which would not be anticipated to have any effect upon its future development. The remainder of the references relate to small scale commercial activity and the cursory examination of these premises suggests that they do not represent an environmental hazard to the proposed development.

- 3.3.2 *The environmental report did not identify any petrol and fuel sites or underground high pressure oil and gas pipelines within 500m of the study site.*

3.4 Hydrogeology & Hydrology

- 3.4.1 *The superficial deposits located beneath the site are designated as both Secondary (Undifferentiated) and Unproductive in terms of any potential aquifers. This Secondary (Undifferentiated) aquifer comprises layers that have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the material type. An Unproductive aquifer relates to drift deposits with low permeability that have negligible significance for water supply or river base flow.*
- 3.4.2 *The bedrock underlying this site is classified as Secondary (A) aquifer which comprises of permeable layers which may be capable of supporting water supplies at a local rather than strategic scale and which in some cases may form an important source of base flow to local rivers.*
- 3.4.3 *The Enviro-Insight report has not identified any water abstraction licenses within 2000 metres of the study site.*
- 3.4.4 *The Enviro-Insight report has identified the presence of various surface water features within 250m of the study site boundary. In effect these tertiary river features rise at the marshy low level area of ground situated to the north eastern corner of the study site. The watercourse from this location extends to the north and east and discharges into Afon Alyn river.*
- 3.4.5 *The proposed redevelopment of this site on a residential basis is not considered to represent a potential hazard to bedrock aquifer or other groundwater, however it is of course important that the appraisal of the current site should consider any possible effects to the underlying aquifer rocks. Subsequent remediation and development of the site should not allow any potential contaminants such as fuel oils etc., to be discharged into the aquifer below this site. Appropriate management techniques should be utilised at all times.*

3.5 Flooding

- 3.5.1 *The environmental report identifies that the study area is not located within an area which may be subject to Environment Agency zone 2 or zone 3 flooding events. Accordingly there is no requirement for any special precautions or defences against zone 2 or zone 3 flooding.*
- 3.5.2 *The environmental report has identified the site to be within a British Geological Survey groundwater flooding susceptibility area and relates to clear water flooding with a limited potential. A high confidence is given to this susceptibility. Where limited potential for groundwater flooding to occur is indicated, this means that although given that the geological conditions, there may be a groundwater flooding hazard unless other relevant information eg records of previous flooding suggests groundwater flooding has occurred before in this area, there is no need to take further action in relation to groundwater flooding hazards.*

3.6 Environmentally Sensitive Sites

- 3.6.1 *The Enviro-Insight report has identified up to six (6 No.) records of designated environmentally sensitive sites. Wilderness Wood which represents an ancient woodland is located some 460m to the east of the site and will not be impacted by the proposed site redevelopment. The remaining sites relate to areas of land which are in excess of 500m from the study site boundary and here again these sites are not considered to be at risk from the development proposals.*

3.7 Geology

- 3.7.1 *The superficial deposits underlying the study area are indicated to comprise of a combination of materials with the predominant deposits comprising of glaciofluvial sheet material and glacial till. Glaciofluvial deposits are likely to comprise of poorly sorted interspersed lenses and bands of sands, gravels and silts. These materials are indicated to lie at the higher levels of the site, whilst the central area is indicated to be underlain by glacial till. These deposits normally comprise predominately of sandy boulder clay material with interspersed lenses and bands of fine sand and silt. Alluvium deposits are indicated to be present within the north eastern corner and these clearly relate to the marshy ground indicated previously. These alluvium deposits are most likely to comprise of a combination of clay, silts, sands and gravels which would generally be anticipated to be of a very soft/loose consistency.*
- 3.7.2 *The solid geology underlying the site comprises of Pennine Lower Coal Measures Formation and Pennine Middle Coal Measures Formation. This strata is known to consist of alternating sequences of mudstones, shales, sandstone and occasional coal seams of economic merit. This strata represents the predominant bedrock material within this area.*
- 3.7.3 *Geological faulting is indicated to pass through the central area of the site in an approximate east west direction. Under normal circumstances it would not be anticipated that geological faulting would represent a potential long term stability hazard to any proposed development at this site. However, in areas where coal mining may have taken place it is possible that the extraction process can result in movements being concentrated within the faulted zone. Ground movements as a result of the presence of this faulting are considered to represent a remote possibility.*
- 3.7.4 *The site lies within an area where between 10 and 30% of properties are subject to elevated radon gas emissions. Accordingly full radon protective measures are necessary in all properties and extensions to properties at this site. Precautions should be in accordance with the recommendations laid down in publication BR211 by the Building Research Establishment.*
- 3.7.5 *The geological report has identified a series of ground working within the general vicinity of the site. Reference is made to the presence of ponds within the site area and these appear to be associated with the area of low lying land at the north eastern corner along with a very small area straddling the western boundary. The remaining areas relate to works which have been undertaken in historic times. The most significant of these relate to a brick field situated some 150m to the south west of the site but this area has now been fully developed and we anticipate that all necessary precautions have been adopted within the remediation process for this site.*

- 3.7.6 The site lies within an area where coal mining activity is known to have taken place. Certainly there are records of mining features within the general vicinity of the site, though none are indicated to lie within influencing distance. The Coal Authority have provided a report regarding the coal mining stability of the site and this is appended to this report for reference. The Authority have indicated that coal mine workings have taken place in six seams of coal lying at depths between 210 – 360m below ground level and with the last workings in 1949. They have also advised that any ground movement from these workings should have stopped by now. Accordingly there are no requirements for any specific investigations or precautions to be adopted in relation to previous coal mining activity.
- 3.7.7 The geological report also indicates that iron ore deposits are likely to be present within this area. It suggests that iron ore workings may have taken place at some period in the past, though the assessment of likelihood suggests that only rare and localised small scale mining may have occurred. It is considered that this site is at a very low risk of non-coal mining activity.
- 3.7.8 The geological report also presents an estimation of the background soil chemistry within the site area. Reference to the data presented suggests that the contaminants under consideration may be present at concentrations which are below current guideline criteria.

3.8 Site History

3.8.1 Table 1 – Review of Historical Maps

Date	Site	Adjacent Land
1874	The site is indicated to contain buildings which represent the current Woodlands Farm. Within the central area of the site there appears to be a ditch line passing from south to north. A small pond is indicated adjacent to the midpoint of the western boundary with a much larger area of water being present at the north eastern corner. A well is also indicated to be present within the north eastern corner.	All appears to be retained in agricultural usage, though the presence of a railway line is indicated to lie approximately 100m to the south of the site area. There is no evidence of any directly contaminative features located within close proximity to the site area.
1900	No significant changes.	The water area to the north east is now referred to as Fish Pond. Residential development has taken place upon the southern side of Rhosrobin Lane to the south of the site.
1912	The buildings within the site are now referred to as Woodlands Farm. The fish pond at the north east is now shown to be in a much reduced area with surrounding marshy ground.	No significant changes.
1939	No significant changes, though the fish pond to the north east has now effectively disappeared and is indicated to comprise of marshy land.	Further residential development has taken place to the south and west of the site along Rhosrobin Road.
1961	No significant changes.	Residential development has now taken place within the land immediately adjacent to the western boundary. Further development has also taken place to the south and east. The former railway is now shown to be dismantled.
1978	Further buildings appear to have been added to Woodlands Farm.	School buildings have now been constructed immediately to the south of the site upon the southern side of Rhosrobin Road.
1985	No significant changes.	No significant changes.
1990	No significant changes.	No significant changes.
2014	Present configuration.	No significant changes.

3.8.2 Careful appraisal of all available historical information has confirmed that the site has been occupied by Woodlands Farm and associated agricultural land since prior to the available OS maps. A large fish pond lake was originally situated at the north eastern corner of the site but this appears to have naturally silted up over a long period and is now retained as an area of marshy ground. To the south there is a disused railway track lying approximately 100m to the south of the site, though this is not anticipated to represent a potential hazard to the development on the basis that the immediately adjoining land has now been developed by residential properties and schools.

3.9 Anticipated Ground Conditions

3.9.1 Based upon the information obtained during the initial desk study phase the anticipated ground conditions are expected to comprise of strata as detailed in table 2 below.

Table 2 – Anticipated Ground Conditions

Ground Material	Anticipated Condition
Made Ground	May be present with track, farm yard and fish pond areas
Natural Strata	Combination of Fluvio-glacial deposits at the upper levels underlain by glacial till. Alluvium deposits located within the zone of the former fish pond
Bedrock	Pennine Lower and Middle Coal Measures Formations with alternating sequences of shales, mudstone, sandstones, siltstones and occasional coal seams.
Groundwater	Perched water likely to be present in the upper glaciofluvial material and the alluvium. Perched ground water may be present within the glacial till deposits. Natural standing ground water level anticipated to lie at depth below site ground level due to topography of the area.
Mine Workings	The hazards posed by mine workings are considered to be negligible at this site.

3.9.2 Based upon the data available within the Desk Study and tables 1 and 2 below, potential ground related issues associated with the proposed redevelopment of this site are likely to include the elements noted in table 3 below.

Table 3 – Potential Ground Related Issues

Type of Issue	Site Specific issue	Remarks (refer to walk over survey plan)
Potential on Site Contamination Sources	1. Access roads & track 2. Farm yard 3. Fish pond 4. Agricultural chemicals	1. Locations indicated. 2. Location indicated 3. Location indicated 4. Pesticides etc.
Potential off Site Contamination Sources	1. Migrating land fill gases 2. Former railway line 3. Agricultural chemicals	1. Nearby historic landfill site 2. Historic records 3. Pesticides etc.
Potential Geotechnical Hazards	1. Relict buried obstructions 2. Filled ditch 3. Services 4. Moderate slopes	1. Buried slabs, foundations 2. Refer to appended plans 3. Refer to appended plans 4. May impact final levels
Other Potential Constraints	1. Existing farm yard 2. Drainage services 3. Low lying north eastern corner	1. To be removed. 2. To be incorporated into proposed layout 3. Area may be difficult to develop

3.10 Preliminary Conceptual Model

3.10.1 The information presented within this Desk Study section of this report has been used to compile a preliminary conceptual model for the site. The identified potential contaminant and receptors have been considered along with any possible pathways that may link them. The resulting pollution linkages are considered in Table 4 below. The risk classification has been estimated in accordance with the terms and definitions based upon CIRIA C552 Contaminated Land Risk Assessment, A Guide to Good Practice.

Table 4 – Preliminary Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
Contaminated Soils	Site personnel during construction	Direct contact of soils Inhalation or ingestion of soil / dust	Lw	Md	Moderate/Low	Soil sampling during intrusive investigations. Laboratory analysis of samples
	Future site users	Direct contact of soils Inhalation or ingestion of soil / dust	Lw	Md	Moderate/Low	
	Surface water in the vicinity of the site	Leaching of contaminants through drainage system	Lw	Mi	Low	
	Ground water in aquifer	Leaching of contaminants to ground water	Ul	Sv	Moderate/Low	
	Future site users	Vapour migration from soils	Lw	Md	Moderate/Low	
	Proposed buildings and services	Direct contact with contaminated soils	Ul	Mi	Very Low	
	Plants in gardens and soft landscaping	Direct contact	Lw	Mi	Low	
Contaminated ground water	Site personnel during construction	Water entering excavations	Lw	Md	Moderate/Low	Sampling of ground water (where encountered)
	Future site Users	Retained surface water	Lw	Mi	Low	
Toxic and explosive gasses	Proposed buildings and occupiers	Ground gas migration into buildings	Lw	Md	Moderate / Low	Program of ground gas monitoring (where required)
Radon Gases	Proposed buildings and occupiers	Ground gas migration into buildings.	Lw	Md	Moderate	Full radon protective measures
Key: Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Hi = High, Li = Likely, Lw = Low Likelihood, Ul = Unlikely						

4.0 SITE WORKS

4.1 Intrusive Works

4.1.1 The ground conditions at this site were initially investigated by a program of trial pit excavations. A total of twenty (20 No.) trial pits were excavated using a JCB back acting type excavator in the presence of an experienced geotechnical engineer from REFA. Representative samples of the strata encountered have also been obtained from these trial pits and these have been retained for appropriate laboratory testing where required.

- 4.1.2 *A further program of window sampling drilling has also been undertaken adjacent to the northern boundary of the site and these boreholes have been utilised for the installation of ground gas monitoring probes. A total of five (5 No.) window sampling boreholes have been drilled and these works have been undertaken by Geo-Ventures (UK) Ltd., who are a specialist ground investigation contractor.*

4.2 Locations

- 4.2.1 *The locations of the trial pits and boreholes have been chosen by ourselves in conjunction with the accessible areas of the site and any potential surrounding hazards in an effort to identify the representative ground conditions present across the site area. The trial pits have been excavated across the site area to generally assess the site conditions. As indicated previously, unfortunately it has not been possible to gain safe access to the farmyard buildings and as such investigations have not taken place within this area of the site at this time. The track within the central area has also not been investigated due to major drainage services being present.*
- 4.2.2 *The window sampling boreholes have been positioned adjacent to the northern boundary of the site and have been intended to assess the potential for possible landfill gas migration to the site from the historic landfill site situated to the north west. Boreholes WS 4 and WS 5 have been positioned adjacent to the marshy area of ground which was formally occupied by the fish pond and where biodegradable materials may be present.*
- 4.2.3 *The locations of each trial pit and borehole are indicated upon the appended exploratory hole location plan number 14155/01. These locations are shown in relation to the principle features present at the site at the time of the investigations.*

4.3 Records

- 4.3.1 *During the investigation details of strata types, water entries, ground conditions and levels within each borehole and trial pit have been maintained. This information has been collated into a series of borehole and trial pit records which are appended to this report for reference. During these investigations representative samples of the strata encountered have been retained for laboratory testing has required.*

4.4 Targeting

- 4.4.1 *The desk study has confirmed the presence of an historic landfill site located some 200m to the north west of the study site area. A risk assessment of the probability of landfill gas migration from this landfill site to the study site suggests a low risk. However, the site also contains an area of marshy boggy land situated in the north eastern corner which may contain potentially biodegradable material which may be a generator of toxic or explosive gases. Accordingly a total of four (4 No.) window sampler boreholes have been utilised for the installation of ground gas monitoring standpipes to determine the presence of methane or carbon dioxide gases.*
- 4.4.2 *The trial pits were undertaken to identify the strata present over the whole of the proposed development area, though it should be acknowledged that ground conditions may vary between individual trial pit locations. Trial pits have not been excavated within the area of possible below ground drainage and within the proximity of the existing farmyard where the existing buildings are in a dilapidated condition.*

- 4.4.3 The investigation locations have been generally spread over the area of the site in accordance with the recommendations laid down in BS10175 : 2011 "Investigation of Potentially Contaminated Sites". The initial ground investigation strategy is detailed within table 5 below.

Table 5 - Initial Ground Investigation Strategy

Exploratory Hole No.	Target	Purpose
TP1 –TP20	General ground conditions	To determine the general nature of underlying soils and geology including: 1. Nature, distribution and thickness of made ground 2. Nature, degree and extent of potential contamination 3. Content of unacceptable material eg biodegradable matter and pond infill material 4. Suitability of the ground for the founding of structures 5. Engineering properties of the ground
WS1 – WS5	Install gas monitoring probes	Gas monitoring installations in WS1-WS4. WS5 omitted

5.0 GROUND CONDITIONS

5.1 Surface Strata

- 5.1.1 These investigation works have confirmed that the upper ground conditions comprise predominantly of topsoil varying in thickness between 0.1 – 0.4m. More generally the topsoil appears to be approximately 0.3m in thickness. The investigations have demonstrated that the topsoil is relatively heavy and contains clay and silt material. The topsoil may form an important resource for inclusion within the garden areas to the proposed development.
- 5.1.2 Surface made ground material has been identified within the area of the north eastern corner of the site. TP 7, TP 8 and TP 9 all encountered the presence of made ground comprising predominately of silt, sands, gravels with brick, concrete and mudstone. At TP 7 and TP 9 the made ground has been confirmed to have a maximum thickness of 1.0m (TP 9). However, at TP 8 the trial hole was excavated to a depth of 2.0m before being abandoned due to instability. The made ground was noted to extend beyond this 2.0m depth. WS 4 and WS 5 also confirmed the presence of made ground and in WS 4 the strata extended to a depth of 2.0m below ground level but was underlain by a layer of soft, brown/black peat to a depth of 2.5m below ground level. Within WS 5 the made ground was demonstrated to extend beyond the maximum accessible depth of 3.45m.
- 5.1.3 Clearly the made ground identified during these investigations is associated with the location of the former fish pond at the north eastern corner. The status of this former pond is unclear and it is therefore uncertain as to whether this area of the site will be subject to any redevelopment activities as part of these proposals. At the time of these investigations vehicular access to this particular area of the site was impossible, and as such, we have been unable to undertake further investigations utilising light cable drilling techniques to determine the full thickness of made ground present.

Where the development proposals are to extend into this area it will be necessary to undertake further investigations at a later date when vehicular access can be facilitated.

- 5.1.4 *Whilst the investigations over majority of the site have demonstrated the presence of topsoil lying at the surface, it is important to recognise that made ground materials are anticipated to be present within the area of the potential former ditch line passing through the central area of the site along with the existing farmyard and buildings area. As indicated previously, these areas have not been investigated due to the presence of services and health and safety limitations. Further works may need to be undertaken within these areas once improved and safe access is available.*

5.2 Natural Strata

- 5.2.1 *Underlying the topsoil and surface made ground the natural strata encountered comprises of a sequence of interbedded sands, silts and clays. The majority of this strata appears to represent the glaciofluvial deposits indicated within the desk study, though it is possible that glacial till materials have also been encountered. The interface between the upper glaciofluvial deposits and underlying glacial till materials cannot be easily determined, but generally the material properties should be considered to be similar.*
- 5.2.2 *Within the north eastern portion of the site a very soft clay material has been noted to be present below the deeper made ground materials. We anticipate that this soft clay represents "pond bottom" type material which has accumulated over the life of the former fish pond. This strata is also associated with a band of peat in WS 4 and may contain other vegetation deposits at other locations. As indicated previously, further investigations are required within this area once full vehicular access can be facilitated.*
- 5.2.3 *The visual appraisal of the superficial deposits over the majority of the site area indicates that they are capable of offering a safe bearing capacity of at least 100kN/m² at a minimum depth of 0.9m below existing ground level. Standard penetration testing carried out within the window sampling boreholes suggests that increased bearing capacities may be available within the deeper sand strata, though the results of this testing are variable. The natural strata present within this site would therefore be anticipated to provide a suitable bearing capacity for the adoption of shallow spread type foundations to traditional residential structures.*
- 5.2.4 *As indicated previously, clearly there are likely to be stability issues in relation to the materials encountered within the north eastern corner of the site and further works are required to positively identify the engineering properties of the strata present if this area is to be developed.*

5.3 Bedrock

- 5.3.1 *Within these investigations bedrock was not identified within any exploratory hole locations.*

5.4 Groundwater

- 5.4.1 *These investigations have identified no evidence of significant groundwater ingress, over the site area. Groundwater was encountered within TP 1 at a depth of 1.6m below ground level and this resulted in instability within the excavation. However this feature appears to relate to local groundwater which has become perched upon underlying impermeable layers. Groundwater was encountered within the north eastern corner of the site at the location of the former fish pond. In this area the water is anticipated to comprise of the residual water forming the original fish pond and which is perched upon underlying impermeable strata.*
- 5.4.2 *Whilst these investigations have not encountered any significant groundwater presence it is important to recognise that locally perched groundwater may be present. Where groundwater is encountered during excavations it is likely that "running sand" conditions will be generated and this may lead to significant difficulties in the stability of excavations and substructure construction.*
- 5.4.3 *It is likely that surface water may become perched within any excavations particularly during prolonged wet weather conditions. Water which is retained within excavations may however be removed by simple sump pumping operations. These water ingresses are not anticipated to represent a particular development hazard on the basis that appropriate management techniques are adopted.*

5.5 Contamination

- 5.5.1 *These investigations have not noted any presence of olfactory or visual evidence of contamination. The presence of anthropogenic materials within the made ground identified in the north eastern corner of the site may be indicative of possible contamination which may pose a potential hazard to the future development.*
- 5.5.2 *Within the majority of the site no evidence of any suspicious or unusual materials have been encountered. However further investigations will be required particularly in relation to the existing farmyard and associated farm buildings where potentially contaminative materials may be present. However, this will require further investigation at a later date.*

5.6 Sampling

- 5.6.1 *Based upon the initial site appraisal, in conjunction with the findings of the intrusive investigations, a series of representative samples of the strata encountered have been retained for chemical analyses. This analysis has been intended to determine the potential presence of any contamination which may represent a hazard to site operatives or end use of the site. This section of the work is considered in more detail in sections 7 and 8 of this report.*

5.7 Plasticity

- 5.7.1 *A total of eight (8 No.) samples of clay soil have been obtained during these investigations and returned to the laboratories of Testconsult Ltd. Index testing undertaken upon these samples has confirmed that the soils within the site have a plasticity index in the range of 9 – 29%. In fact only one sample TP 12 @ 1.5m recorded a plasticity index above 20% and after consideration of the remainder of the test results is considered to represent an outlier. Accordingly the clays within this site are considered to have a low shrinkage potential as defined by NHBC Handbook Chapter 4.2.*

5.8 SUDS

- 5.8.1 *Assessment of the ground conditions present within the study area in terms of sustainable urban drainage suggests that whilst majority of the strata encountered is predominantly of a sand material, it has been noted to contain a significant volume of clay and silt. Generally the sands are described as clayey and certainly contain regular clay bands. It is possible that the shallow superficial strata within this site may be permeable and this may allow the disposal of surface water drainage by a soakaway system.*
- 5.8.2 *It is our opinion based upon the results of these investigations that the shallow strata within this site may be conducive to the adoption of a soakaway or other ground infiltration system of drainage for surface water disposal. It is essential that an extensive program of testing in accordance with the recommendations laid down in BRE365 : 2007 "Soakaway Design" be undertaken. These tests will determine the soil infiltration characteristics of the materials present within the site and form a basis upon which an assessment of the suitability for soakaway disposal may be based. These tests will also determine the parameters for the soakaway design.*

6.0 GAS MONITORING

6.1 General

- 6.1.1 *The desk study undertaken by this practice has identified the presence of an Environment Agency historic landfill site situated some 205m to the north of the site area. This site is referred to as The Wauns and is indicated to have accepted inert, industrial, commercial, household and special wastes. The ground conditions generally within this area are anticipated to comprise of glaciofluvial materials which may allow for the migration of landfill gases over significant distances. Accordingly gas monitoring installations have been provided at WS 1 – WS 3 to consider any possible landfill gas migration. A further gas monitoring installation has been provided within the made ground and pond area at the north eastern corner of the site where peat is known to be present (WS 4).*

6.2 Installation

- 6.2.1 *To identify the presence of ground gases potentially migrating from the nearby landfill site three (3 No.) window sampling boreholes have been completed as permanent gas monitoring points (WS 1 – WS 3). A further borehole at WS 4 is intended to consider the possible generation of toxic and explosive gases at the north west eastern corner. In an effort to determine the presence of any gas migration or production the response zone has been created to the maximum depth in each borehole.*
- 6.2.2 *The installations have included for the insertion of high density polyethylene 50mm diameter plain and slotted standpipes. The annulus space around the standpipes has been filled with non-calcareous pea gravel in the range of 2mm – 5 mm. The upper 0.5m of the borehole has been sealed with bentonite clay and all positions have been finished with a gas tap and lockable steel cover. Full details of the installations are appended to this report for reference.*

6.3 Dates

- 6.3.1 *The gas monitoring points were installed on the 15th December 2014. Gas monitoring has been carried out between the 22nd December 2014 – 18th March 2015 comprising of a total of six (6 No.) monitoring visits.*

6.4 Procedure

6.4.1 The installation of the gas wells and gas monitoring procedures have been based upon the recommendations laid down in CIRIA C665 "Assessing Risks Posed by Hazardous Ground Gases to Buildings" along with NHBC publication No. 4 "Guidance on Evaluation of Development Proposals on Site where Methane and Carbon Dioxide are Present". In accordance with the documentation it is intended that the period of monitoring will be up to three months with at least six monitoring visits being undertaken during that period. This assessment is based upon Tables 5.5a and 5.5b of CIRIA C665 and relates to a residential development with a low potential source of gas.

6.5 Range

6.5.1 The installed gas wells are intended to be monitored for flammable gas calibrated to methane, carbon dioxide, oxygen and gas flow using a portable infrared gas analyser. The analyser is an LMS type G3Xi gas meter and has been calibrated with an annual period. Full details of the analysis program and assessments are presented within the appendix of this report.

6.6 Monitoring

6.6.1 The gas monitoring recommendations require that gas monitoring rounds should encompass various climatic conditions particularly in relation to atmospheric pressures. Ideally at least one round should be undertaken at an atmospheric pressure of less than 1000mb. Readings at falling pressures and after heavy rain are also considered to be desirable. Monitoring has been carried out using a LMS Type G3xi Gas Meter by an experienced engineer.

6.7 Results

6.7.1 The conceptual model suggests that the potential for landfill gas to this site is very low on the basis of the following factors:-

- Substantial interface distance between study site and historic landfill site;
- Predominately relatively impermeable strata to minimise gas migration;
- Very limited evidence of biodegradable strata within the site area.

6.7.2 The full gas monitoring results are presented within the appendix to this report. However a summary of the monitoring results are detailed in Table 6 below.

Table 6: Summary Of Gas Monitoring Results

Location	No Of Monitoring Occasions	Methane % _{v/v}	Carbon Dioxide % _{v/v}	Oxygen %	Flow l/hr	W.L. Depth	Base of Installation (m)	Atmospheric Pressure (mB)
WS 1	6	0.0	0.0 – 2.4	19.0 – 21.1	ND	Dry	3.0	1004 – 1035
WS 2	6	0.0	0.0 – 2.1	19.3 – 21.0	ND	Dry	3.0	1004 – 1035
WS 3	6	0.0	0.0 – 1.8	18.9 – 20.1	ND	Dry	4.45	1004 – 1035
WS 4	6	0.0	0.0 – 6.9	5.4 – 19.9	ND	1.70 – 1.75	3.0	1004 – 1035

Note ND - none detected

- 6.7.3 *The program of ground gas monitoring has not identified the presence of any significant methane gas in any borehole at any monitoring visit. Methane gas does not appear to be generated from the organic peat layer within locality WS4 or migrating from the historic landfill.*
- 6.7.4 *The majority of the boreholes have recorded the presence of carbon dioxide with a level generally below 2.5% although locality WS4 has recorded carbon dioxide levels generally above 5.0%. Locality WS4 identified a peat layer at 2.0 – 2.5m below ground level and it is considered that this localised peat layer is producing the localised elevated carbon dioxide concentrations recorded.*
- 6.7.5 *The monitoring has recorded no measurable flows and as such the calculation of the initial gas screening values (gsv) are based upon a flow rate of 0.1 l/hr. This value represents the limit of detection of an LMS Type G3xi Gas Meter.*
- 6.7.6 *Based upon the monitoring data, calculations confirm that the maximum gsv is 0.0069 l/hr. The gsv relates to the maximum concentration of carbon dioxide recorded within WS4. Across the rest of the site carbon dioxide levels have recorded a maximum concentration of 2.4%. Calculations utilising this maximum concentration confirm a maximum gsv of 0.0024 l/hr. Both gsv's indicate characteristic situation 1 (NHBC Green).*
- 6.7.7 *Consideration has been given to the general carbon dioxide levels within WS4 which have recorded concentrations generally over 5% and there will be a requirement for the installation of characteristic 2 (NHBC Amber 1) ground gas precautions within properties located within the vicinity of WS4. Reference to the feasibility plan shows that the position of WS4 is located within the amenity and wetland areas and therefore no residential development is proposed however if development does occur then in this area CS2 (NHBC Amber1) gas precautions will be required. However if the proposed development plans change and residential structures will be constructed within the vicinity of WS4 then consideration to CS2 (NHBC Amber 1) gas precautions will be required.*
- 6.7.8 *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'.*

7.0 CONTAMINATION ANALYSIS & ASSESSMENT CRITERIA

7.1 Sampling

- 7.1.1 *A total of fourteen (14 No.) samples of strata encountered during these investigations have been retained for chemical analyses. Ten of these samples relate to surface topsoil extending over the vast majority of the site area. A further four samples have been obtained from the made ground and ancillary materials encountered within TP 7 – TP 9. These samples are considered to be representative of the topsoil and made ground throughout the site and are suitable for assessment of their potential impact upon a residential development and environment.*

7.2 Laboratory

7.2.1 All samples selected for chemical analysis have been returned to Exova Laboratories who are an MCERTS and UKAS accredited laboratory facility. Each sample has been subject to a range of chemical analyses to determine the concentrations of a wide range of common contaminants applicable to the former use of this site and the materials present. Details of the analysis program are shown in table 7 below. Confirmation of the UKAS and MCERTS accreditations for each test is indicated within the results which are appended to this report.

7.3 Development Proposals

7.3.1 At the time of the production of the draft report for this development no proposed site layout was available. We have now been supplied with a feasibility site plan which shows that the site will be constructed in a series of residential properties with associated road layouts, garden areas and a large wetland and amenity area to the north. As such the conditions and assessment criteria adopted for the proposed development would be based upon the most stringent residential assessment criteria.

7.4 Analysis Range

7.4.1 The initial desk study and preliminary conceptual site model confirm that this site may have been affected by contamination associated with:-

- Naturally occurring contaminants;
- Made ground materials;
- Possible pesticides associated with former farmyard usage.

7.4.2 Table 7 below confirms the range of analyses undertaken upon the samples of soil obtained from this site.

Table 7 – Table of Chemical Testing

Analysis Suite	Determinands	No. of Samples	Sample References
REFA Series	Arsenic, Cadmium, Chromium (total), Copper, Lead, Mercury, Nickel, Selenium, Zinc PAH – USEPA 16 suite, Phenol	14	TP01-0.1m, TP03-0.1m, TP05-0.1m, TP06-0.1m, TP7-0.1m, TP08-0.1m, TP08-1.2m, TP09-0.5m, TP10-0.05m, TP13-0.2m, TP14-0.2m, TP15-0.2m, TP16-0.1m, TP18-0.05m
Inorganics	Cyanide, Soluble Sulphates, Sulphide, pH, Organic Matter	14	TP01-0.1m, TP03-0.1m, TP05-0.1m, TP06-0.1m, TP7-0.1m, TP08-0.1m, TP08-1.2m, TP09-0.5m, TP10-0.05m, TP13-0.2m, TP14-0.2m, TP15-0.2m, TP16-0.1m, TP18-0.05m
Petroleum Hydrocarbons	TPH (CWG) and BTEX	4	TP7-0.1m, TP08-0.1m, TP08-1.2m, TP09-0.5m,
Organochlorine Pesticides	O/C Suite	3	TP01-0.1m, TP13-0.2m, TP16-0.1m,

7.5 Results

- 7.5.1 *Full details of the chemical analyses results are appended to this report and should be read in conjunction with the comments and recommendations regarding risk assessments etc. Summaries of the test results are presented in conjunction with current assessment criteria in section 8 of this report.*

7.6 Approach

- 7.6.1 *The current UK approach to the consideration of contaminated land is based upon the principles of risk assessment. This in turn is founded upon the use of a source-pathway-target principle in order to establish the presence of a potential pollutant linkage. Our approach to the risk assessment is consistent with UK guidance and best practice. As advocated in the EA Policy Statement: Guidelines for Environmental Risk Assessment and Management a tiered approach has been adopted. This tiered approach is central to Part IIA of the Environmental Protection Act 1990 and the Town and Country Planning Act 1990.*

7.7 Site Classification

- 7.7.1 *Given the proposed development plans the site usage has been considered on the basis of an end use of residential as defined EA Science Report SC050021/SR3 2009 in relation to the most recent soil guideline values.*

7.8 Criteria

- 7.8.1 *The concentrations of contaminants within the ground have been compared to a range of generic soil guideline values that have been prepared by DEFRA and the Environment Agency. Where published, soil guideline values (sgv) have been utilised as intervention values for the purpose of an initial tier 1 assessment.*
- 7.8.2 *At the time of the preparation of this report soil guideline values were available only for a limited number of contaminants and the development of both the CLEA model and additional soil guideline values is on-going. Where published soil guideline values are available they have been utilised as intervention values for the purposes of an initial tier 1 assessment. A number of sgv's have recently been updated to reflect a modern approach to the protection of human health.*
- 7.8.3 *In March 2014 the Department for Environment Food & Rural Affairs published SP1010 : Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination Policy Companion Document. This document provides a series of Category 4 screening levels based upon differing land uses. Reference has been made to the values presented within this report in relation to the appropriate land usage.*
- 7.8.4 *Where soil guideline values were not published at the time of preparing this report, generic assessment criteria (GAC) published by Land Quality Management Ltd., in conjunction with the Chartered Institute Of Environmental Health have been adopted. The values published in the LQM/CIEH S4UL's for Human Health Risk Assessment" Registration No. S4UL3265.*
- 7.8.5 *Reference has also been made to published soil screening values presented by Atkins Ltd., under their Atrisk Subscription Service. The SSVs have been adopted where SGVs or GACs are not available. The remaining contaminants have been considered based upon information that was the best available at the time of the study.*

8.0 **RESULTS OF ANALYSIS & QUALITATIVE RISK ASSESSMENT**

8.1. **Model**

8.1.1 As discussed above, assessment of contaminated land is based upon a simple assessment of pollutant linkages referred to as the source-pathway-target model. This assessment considers the current or proposed usage of the site in terms of suitability for use. This implies the use of risk assessment in principle in order to evaluate the potential effects and concerns of contamination on a site-specific basis.

8.1.2 Initial assessment of the chemical analyses results has been undertaken to assess the concentrations of determinands in relation to tier 1 assessment criteria. The summary of these test results is detailed below.

8.2 **Results Summary**

8.2.1 The following tables 8 - 13 have been prepared as a summary of the laboratory analyses depending upon the class of analyses undertaken. The test results have been compared to the adopted assessment criteria, relating to a proposed residential land usage.

8.2.2 The materials encountered during these investigations have been considered separately with the topsoil material being considered within tables 8 and 9 and the made ground materials being considered within tables 10 – 13.

Table 8: Summary of Contamination Analysis: Metals & Inorganics (Topsoil)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	No. of Samples Failing	Locations
Arsenic	10	8 – 12	37 ¹	0	
Cadmium	10	<1	11 ⁴	0	
Chromium (total)	10	17 – 20	910 ⁴	0	
Copper	10	16 – 26	2400 ⁴	0	
Lead	10	46 – 70	200 ¹	0	
Mercury	10	<1	170 ²	0	
Nickel	10	14 – 18	130 ²	0	
Selenium	10	<1	350 ²	0	
Zinc	10	55 – 100	3700 ⁴	0	
Total Cyanide	10	<1	34 ³	0	
Phenol	10	<1	420 ⁴	0	
pH	10	5.74 – 7.24	-	-	
SOM (%)	10	2.73 – 6.07	-	-	
W/S Sulphate (2:1 Leachate Equivalent – g/l)	10	<0.01 – 0.04	0.5 ⁵	0	
Sulphide	10	<2	-	-	

¹ DEFRA : SP1010:Category 4 screening levels – Residential with home grown produce

² Revised SGV – SC050021 (values based upon “Residential” land use).

³ Atkins Atrisk SSV residential with consumption of home grown produce (2.5% SOM)

⁴ LQM and CIEH Generic Assessment Criteria S4UL’s (Registration No. 3265)

⁵ BRE Special Digest 1:2005 DS-1.

8.3 Metals & Inorganics (Topsoil)

8.3.1 Reference to table 8 above confirms that the range of contaminants considered within this series shows no exceedances of the determinands tested. The topsoil material is therefore considered to be free of any metals or inorganics at potentially hazardous concentrations.

Table 9: Summary of Contamination Analysis: Organics: PAH USEPA 16 Suite (Topsoil)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	No. of Samples Failing	Locations
Acenaphthene	10	<0.1	510	0	
Acenaphthylene	10	<0.1	420	0	
Anthracene	10	<0.1	5400	0	
Benzo[a]anthracene	10	<0.1 – 0.3	11	0	
Benzo[a]pyrene	10	<0.1 – 0.4	5 ²	0	
Benzo[b]fluoranthene	10	<0.1 – 0.4	3.3	0	
Benzo[ghi]perylene	10	<0.1 – 0.3	340	0	
Benzo[k]fluoranthene	10	<0.1 – 0.1	93	0	
Chrysene	10	<0.1 – 0.3	22	0	
Dibenz[ah]anthracene	10	<0.1	0.28	0	
Fluoranthene	10	<0.1 – 0.4	560	0	
Fluorene	10	<0.1	400	0	
Indeno[123-cd]pyrene	10	<0.1 – 0.3	36	0	
Naphthalene	10	<0.1	5.6	0	
Phenanthrene	10	<0.1 – 0.1	220	0	
Pyrene	10	<0.1 – 0.4	1200	0	

¹ LQM & CIEH Generic Assessment Criteria S4UL's (Reg. No. 3265) - Residential (2.5% SOM)

² DEFRA : SP1010 : Category 4 Screening Levels – Residential with home grown produce

8.4 Speciated PAH (Topsoil)

8.4.1 The soil samples retained from these investigations have been subject to a programme of analyses which have assessed the concentrations of the individual constituents of the polycyclic aromatic hydrocarbon series. A summary of these results is shown in table 9 above. The assessment criteria utilised are based upon the presence of 2.5% soil organic matter within the samples generally. Reference to the tests results does however show more variable soil organic matter content. Assessment of table 9 confirms no localised contamination by PAH constituents.

Table 10: Summary of Contamination Analysis: Metals & Inorganics (Made Ground)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	No. of Samples Failing	Locations
Arsenic	4	6 – 40	37 ¹	1	TP 08 -1.2m
Cadmium	4	<1 – 2	11 ⁴	0	
Chromium (total)	4	9 – 66	910 ⁴	0	
Copper	4	24 - 173	2400 ⁴	0	
Lead	4	30 – 110	200 ¹	0	
Mercury	4	<1	170 ²	0	
Nickel	4	18 – 51	130 ²	0	
Selenium	4	<1 – 2	350 ²	0	
Zinc	4	64 – 423	3750 ⁴	0	
Total Cyanide	4	<1	34 ³	0	
Phenol	4	<1	420 ⁴	0	
pH	4	5.79 – 8.41	-	-	
SOM (%)	4	3.68 – 12.20	-	-	
W/S Sulphate (2:1 Leachate Equivalent – g/l)	4	0.01 – 0.08	0.5 ⁵	0	
Sulphide	4	<2	-	-	

¹ DEFRA : SP1010:Category 4 screening levels – Residential with home grown produce

² Revised SGV – SC050021 (values based upon “Residential” land use).

³ Atkins Atrisk SSV residential with consumption of home grown produce (6% SOM)

⁴ LQM and CIEH Generic Assessment Criteria S4UL’s (Registration No. 3265)

⁵ BRE Special Digest 1:2005 DS-1.

8.5 Metals & Inorganics (Made Ground)

8.5.1 Reference to table 10 above confirms that generally the made ground materials should be considered to be free from any metals and inorganic contaminant. A single exceedance of arsenic has been noted within TP 8 at 1.2m with a maximum concentration of 40mg/kg. The assessment criteria adopted at this site is 37mg/kg and as such the exceedance is considered to be minimal. When considered in conjunction with the remainder of the results, it is clear that arsenic contamination does not represent a hazard within this material.

Table 11: Summary of Contamination Analysis: Organics: PAH USEPA 16 Suite (Made Ground)

	No. of Samples	Range of Values (mg/kg)	Assessment Criteria (mg/kg)	No. of Samples Failing	Locations
Acenaphthene	4	<0.1	1100	0	
Acenaphthylene	4	<0.1	920	0	
Anthracene	4	<0.1 – 0.2	11000	0	
Benzo[a]anthracene	4	<0.1 – 1.0	13	0	
Benzo[a]pyrene	4	<0.1 – 0.8	5 ²	0	
Benzo[b]fluoranthene	4	<0.1 – 1.0	3.7	0	
Benzo[ghi]perylene	4	<0.1 – 0.5	350	0	
Benzo[k]fluoranthene	4	<0.1 – 0.5	100	0	
Chrysene	4	<0.1 – 1.1	27	0	
Dibenz[ah]anthracene	4	<0.1	0.3	0	
Fluoranthene	4	<0.1 – 1.7	890	0	
Fluorene	4	<0.1	860	0	
Indeno[123-cd]pyrene	4	<0.1 – 0.5	41	0	
Naphthalene	4	<0.1 – 1.7	13	0	
Phenanthrene	4	<0.1 – 1.1	440	0	
Pyrene	4	<0.1 – 1.7	2000	0	

¹ LQM & CIEH Generic Assessment Criteria S4UL's (Reg. No. 3265) - Residential (6% SOM)

² DEFRA : SP1010 : Category 4 Screening Levels – Residential with home grown produce

8.6 Speciated PAH (Made Ground)

8.6.1 The made ground samples retained from these investigations have again been subject to a programme of analyses to assess the concentrations of the individual constituents of the polycyclic aromatic hydrocarbon series. A summary of these results is shown in table 11 above. The assessment criteria utilised are again based upon the presence of 2.5% soil organic matter within the samples generally. Reference to the tests results does however show more variable soil organic matter content. Assessment of table 11 also confirms no localised contamination by PAH constituents.

Table 12: Summary of Contamination Analysis: Organics: TPH (CWG) Suite (Made Ground)

	No. of Samples	Range of Values mg/kg	Assessment* Criteria mg/kg	No. of Samples Failing	Notes
Aliphatic EC> 5 - 6	4	<0.01	160	0	
Aliphatic EC> 6 - 8	4	<0.01	530	0	
Aliphatic EC> 8 - 10	4	<1.0 – 1.491	150	0	
Aliphatic EC> 10 - 12	4	<1.0 – 3.478	760	0	
Aliphatic EC> 12 - 16	4	<1.0 – 15.304	4300	0	
Aliphatic EC> 16- 35	4	2.408 – 7.426	110000	0	
Aliphatic EC> 35 - 44	4	<1.0	110000	0	
Aromatic EC> 5 – 7	4	<0.01	300	0	
Aromatic EC> 7 - 8	4	<0.01	660	0	
Aromatic EC> 8 - 10	4	<1.0	190	0	
Aromatic EC> 10 - 12	4	<1.0	380	0	
Aromatic EC> 12 - 16	4	<1.0 – 2.523	660	0	
Aromatic EC> 16 - 21	4	<1.0 – 4.600	930	0	
Aromatic EC> 21 - 35	4	1.856 – 16.586	1700	0	
Aromatic EC> 35 - 44	4	<1.0 – 1.695	1700	0	

* Criteria values based upon LQM & CIEH Generic Assessment Criteria S4UL's (Reg. No. 3265) - Residential (6% SOM)

8.7 Speciated TPH (CWG) (Made Ground)

- 8.7.1 Due to the presence of anthropogenic materials present within the made ground the possibility of the presence of petroleum hydrocarbons has been considered and a detailed analysis has been carried out on all samples of made ground to determine their possible presence. The results of this testing are summarised in table 12 above.
- 8.7.2 The summary clearly demonstrates that hydrocarbons are not present at elevated concentrations within all samples collected. Although concentrations are present they are generally all well below the current assessment criteria for a proposed residential development. Whilst specific remediation in relation to hydrocarbons is not required over the site as a whole, it is nevertheless important that where unusual or olfactory evidence of hydrocarbons is identified during the development works then further advice should be sought.

Table 13: Summary of Contamination Analysis: Organics: BTEX Suite

	No. of Samples	Range of Values mg/kg	Assessment* Criteria (mg/kg)	No. of Samples Failing	Notes
Benzene	4	<0.01	0.37	0	
Toluene	4	<0.01	660	0	
EthylBenzene	4	<0.01	260	0	
M/P Xylenes	4	<0.01	310	0	
O Xylene	4	<0.01	330	0	
Methyl tert-Butyl Ether	4	<0.01	23.4 ¹	0	

* Criteria values based upon soil guidelines values (2009) – Residential. (6% SOM)

¹ Atkins – At risk SSV. Residential without consumption of home grown produce (1% SOM)

8.8 BTEX

- 8.8.1 As part of the analysis for petroleum hydrocarbons the BTEX factions have also been assessed. Reference to table 13 above confirms no elevated concentrations of any of the BTEX factions.

8.9 Organochlorine Pesticide (Topsoil)

- 8.9.1 Representative samples of the topsoil material encountered over the site area have been tested to determine the presence of possible organochlorine pesticides. A total of three samples have been obtained from TP 1, TP 13 and TP 16. Reference to the chemical test results presented by Exova confirms that all organochlorine pesticides are present at concentrations which are below the limits of detection. Pesticide contamination is therefore not considered to represent a potential issue at this site, though further testing and analysis may be required within the vicinity of the former farmyard.

8.10 Sulphates

- 8.10.1 Within the program of laboratory testing each sample has been analysed to determine the concentration of water soluble sulphates within the ground. Reference to the laboratory results presented by Exova confirms that soluble sulphates present are at levels between 0.01 – 0.08g/l. Reference to BRE Special Publication 1 : 2005 “Concrete in Aggressive Ground” confirms that the design sulphate class for samples <0.5g/l is DS-1.

9.0 DISCUSSIONS

9.1 *General*

9.1.1 *The initial desk study of this site has identified a history of the site being in agricultural usage throughout the whole of its recorded history. The site contains an area of farmyard along with a ditch line along with areas of ponds and the former fish pond and stone track situated within the north eastern corner.*

9.1.2 *These investigations have extended to majority of the site area, though they have not included the area of the existing farmyard where further investigations will be required in the future once demolition has been completed. Further investigations may also be required within the north eastern corner of the site within the low lying area of ground where the full thickness of made ground has not been determined due to inaccessibility.*

9.2 *Topsoil*

9.2.1 *Chemical analyses undertaken upon representative samples of topsoil obtained from across the site area has identified no significant concentrations of determinands and the topsoil material is considered to be suitable for retention within a modern residential environment.*

9.3 *Made Ground*

9.3.1 *Made ground is limited to the north eastern corner of the site and is represented by the former fish pond which has become silted and filled. The fill materials generally comprise of reworked natural strata with brick rubble and other anthropogenic material. Here again chemical analyses undertaken upon representative samples of this strata has confirmed no evidence of any significantly elevated concentrations of contaminants based upon a residential assessment criteria. These made ground materials therefore are not considered to represent a potential hazard to the residential redevelopment of this area. However, it is important to recognise that made ground material may contain other physical hazards such as glass, metal and other materials which may be considered to be unsuitable for retention at the surface within garden areas.*

9.4 *Ground Gases*

9.4.1 *The initial desk study has identified the potential for migrating landfill gases from the nearby Waun landfill site and during the site investigation a localised peat deposit was identified within WS4 at 2.0 – 2.5m below ground level. The risk assessment for these potential sources suggests a low potential risk associated with methane and carbon dioxide.*

9.4.2 *Based upon the full data set generated a program of gas monitoring at this site a majority of this site is considered to be classified as Characteristic Situation 1 (NHBC Green). However, if the north east filled area of the site is to be included within the development proposals, then this area should be considered to be classified as Characteristic Situation 2 (NHBC Amber 1). It is also important to recognise that FULL radon gas precautions are required within all properties.*

9.5 Existing Buildings

9.5.1 Currently the site contains a farmyard area which includes an existing residential property and other dilapidated farm buildings. Investigations have not taken place within this area of the site but clearly such investigations should be undertaken once demolition of these existing buildings has been completed. The presence of possible pesticide and hydrocarbon contaminating the surface strata within this area should be considered to represent a potential hazard and appropriate sampling and testing will be required within the supplementary works.

9.5.2 Prior to any demolition works taking place at this site, it is important that all structures should be subject to an asbestos survey to determine the presence of any asbestos products which may be present within the structures so that an appropriate risk assessment may be completed prior to any works taking place. The asbestos report should be undertaken by a suitably experienced specialist asbestos contractor or consultant.

9.6 Former Ditch

9.6.1 Within the central area of the site there is a ditch which is substantially overgrown and inaccessible. It is uncertain as to whether this ditch line represents a surface water drainage course within the site and this may require further investigations. Certainly it is important to recognise that ditch features cannot be simply filled in as part of a development process. It is likely that Natural Resources Wales will need to be consulted regarding the status of this ditch and their requirements in terms of any works which may impact upon its presence. Certainly there will be a requirement for consent from NRW if development includes the filling of this feature.

9.7 Conceptual Site Model

9.7.1 As a result of these intrusive ground investigations and subsequent program of chemical analyses, it has been possible to revise the preliminary conceptual site model presented in section 3. The revised conceptual site model is now shown in table 14 below.

Table 14 – Revised Conceptual Site Model

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
Contaminated Soils	Site personnel during construction	Direct contact of soils Inhalation or ingestion of soil / dust	Li	Md	Low	No contamination issues identified
	Future site users	Direct contact of soils Inhalation or ingestion of soil / dust	Li	Md	Low	
	Surface water in the vicinity of the site	Leaching of contaminants through drainage system	Lw	Md	Low	Provision of surface water drainage system to transport water to discharge
	Ground water in aquifer	Leaching of contaminants to ground water	Lw	Sv	Low	
	Future site users	Vapour migration from soils	Lw	Md	Low	No vapours identified
	Proposed buildings and services	Direct contact with contaminated soils	Ul	Mi	Very Low	No elevated injurious materials identified

Potential Source	Potential Receptor	Possible Pathway	Probability	Consequence	Risk	Mitigation / Investigation
	Plants in gardens and soft landscaping	Direct contact	Lw	Mi	Low	No contamination issues identified
Contaminated ground water	Site personnel during construction	Water entering excavations	Lw	Mi	Low	Minimal ground water
	Future site Users	Retained surface water	Lw	Mi	Low	
Toxic and explosive gasses	Proposed buildings and occupiers	Ground gas migration into buildings	Lw	Md	Moderate/Low	No significant ground gases. Generally CS1 but CS2 in NE corner.
Radon Gas	Proposed buildings and occupiers	Ground gas migration into buildings	Lw	Md	Moderate	FULL radon precautions required
Key: Sv = Severe, Md = Medium, Mi = Mild, Mr = Minor Hi = High, Li = Likely, Lw = Low Likelihood, UI = Unlikely						

9.8 Preliminary Remediation Proposals

- 9.8.1 Based upon the information currently available to us we are of the opinion that there is no direct requirement for a specific program of remediation to the proposed garden areas. Nevertheless it is our opinion that the unsuitable surface materials of concrete, tarmac and materials which may contain hazards such as glass and metal should be removed from soft landscaped areas. The topsoil present within the site is considered to be suitable for retention and reuse within the open and private garden areas.
- 9.8.2 The site is located within an area where full radon gas precautions are required to all properties and extensions to properties. Accordingly it will be necessary for suitable radon protection measures to be included within the proposed structures as recommended in BRE Publication BR22 Radon : "Guidance on Protective Measures for New Buildings".
- 9.8.3 The majority of the site area is currently classified as Characteristic Situation 1 (NHBC Green) in relation to ground gases. However within the north eastern corner of the site at the former fishpond there is a requirement for an increased Characteristic situation 2 (NHBC Amber 1) due to the presence of elevated carbon dioxide levels. However it is likely that the necessary precautions relating to the presence of radon gases will provide suitable precautions against the presence of carbon dioxide.

9.9 Excavations

- 9.9.1 It is considered that excavations made within this site will not be capable of remaining open for a significant period without side support. It is however important to recognise that the sudden catastrophic collapse of any excavation made within this site represents a significant hazard. This is particularly important in relation to deeper excavations which may encounter perched groundwater resulting in "running sand" conditions.
- 9.9.2 It is essential that personnel should not be allowed to approach or enter any excavation made upon this site unless appropriate precautions have been adopted to ensure that hazardous side instability has been prevented. This is particularly important in relation to foundation and drainage construction where personnel may be specifically required to enter deeper excavations for essential construction purposes.

9.10 Foundations

9.10.1 The shallow ground conditions within this site are conducive to the adoption of a shallow spread type foundation. The investigations indicate that the natural strata present at a depth of 0.9m below existing ground level has been assessed to provide a safe bearing capacity in excess of 100kN/m² and this should allow for the construction of traditional strip type foundations to traditional residential properties. Where larger structures are intended, it will be necessary for specific foundation designs to be undertaken. Nominal reinforcement should be included within the foundations due to the presence of geological faulting through the site and deep coal mining activity.

9.10.2 Within the north eastern corner of the site significant thicknesses of made ground and generally relatively poor strata have been encountered. Where development of this area is to be undertaken it will be necessary for deep piled type foundations to be utilised. However to determine the likely lengths of piles required, it will be necessary for further investigations to be undertaken once access to this area is available.

9.11 Ground Floor Construction

9.11.1 It is recommended that the proposed building within this site should be provided with a suspended ground floor construction. This may be of a specialist manufactured precast concrete beam and block type, or of a designed cast insitu construction. It is recommended within the areas of potential tree root influences that a beam and block floor utilising an appropriate air void be adopted in accordance with the recommendations made by the NHBC. In all other areas it will be possible to utilise a cast insitu ground floor construction. Full radon gas precautions are required.

9.12 Precautions

9.12.1 Whilst these investigations have not located any evidence of any suspicious or unusual ground conditions, it is important to recognise that should such features become evident during the development process, they should be drawn to the attention of the appropriate authorities before proceeding. It is important that inspection, sampling and testing of any unusual materials encountered within the site is undertaken so as to ensure that these do not represent a hazard to site operatives or final end users.

10.0 CONCLUSIONS & RECOMMENDATIONS

10.1 Remediation

10.1.1 Extensive sampling and laboratory testing of representative samples of soil from this site has confirmed the absence of elevated levels of contaminants. Accordingly at this time we propose that the following preparation works are undertaken:-

- Demolition of existing buildings within the site area and removal of all unsuitable materials;
- Removal of all hard standings and existing roadways;
- Where any contaminated infrastructure is located, this must be removed by a competent and experienced contractor under the direct supervision of an experienced and qualified engineer;
- Full validation of all materials to be imported to the site should be undertaken and a final validation report produced for regulatory purposes;

- *Full radon gas precautions to all properties;*
- *Protection of the existing public drainage services within the site area;*
- *Arboriculturist report upon all trees within the site and within influencing distance of the site;*

These recommendations are intended only to represent a preliminary appraisal and it may be necessary to prepare a separate remediation strategy to determine the full scope of the necessary work, once the development proposals have been finalised.

10.2 Foundations

10.2.1 It is our opinion that traditional residential properties constructed within this site may utilise shallow strip foundations formed at a depth of 0.9m below ground level upon competent strata offering a safe bearing capacity of at least 100kN/m². Increased bearing capacities are available at greater depths but this will depend upon the types of structures utilised and the economic benefits of increasing the depths of excavations. Nominal reinforcement should be included within the foundations due to the presence of geological faulting through the site and deep coal mining activity.

10.2.2 Any development which takes place within the north eastern corner of the site will require the provision of piled foundations. Piles should extend through the surface made ground and soft clay strata into more competent strata below. Piles may be of a displacement driven type but will require the provision of a precast concrete ground beam arrangement to transmit the superstructure loads to the piles.

10.3 Ground Floor Construction

10.3.1 It is recommended that a suspended ground floor construction be adopted to all properties located within this site. These constructions may be of a precast concrete beam and block arrangement or of a suitably designed cast insitu reinforced concrete. In those areas where tree root influences are important, it is recommended that a precast concrete beam and block floor construction be utilised with an appropriate air void in accordance with the requirements of the NHBC.

10.3.2 Full radon gas precautions are required within the ground floor construction. Ground gas monitoring has now been completed and the site has been characterised upon completion. The majority of the main area of the site is considered to be Characteristic situation 1 (NHBC Green) with the north eastern former pond area classified as Characteristic Situation 2 (NHBC Amber 1). A review of the feasibility site plan shows that no residential development will take place within the vicinity of WS4 therefore it is considered unlikely that characteristic situation 2 ground gas precautions will be required however if the proposed development plans change and residential properties will be located within a close vicinity to WS4 then CS2 ground gas precautions will be required.

10.4 SUDS

10.4.1 The strata present within this site is predominately sand, though typically the sand deposits do contain silt and clay material. However it is possible that the shallow superficial strata may be permeable and allow the use of a soakaway system of surface water drainage. However it will be necessary to commission an extensive program of permeability testing undertaken in accordance with the recommendations laid down in BRE Publication 365 "Soakaway Design".

This program of testing will generate the soil infiltration characteristic of the site and determine its suitability for soakaway surface water disposal. These testing works should be undertaken at an early date to determine the parameters for the drainage design of the site.

10.5 Further Works

10.5.1 Within this program of ground investigation works we have been unable to access areas of the site for investigation and other elements will require consideration as they may impact upon the development. Accordingly the following further works are recommended to be undertaken prior to the commencement of development:-

- Asbestos survey to be carried out on all structures present within the property prior to the commencement of any demolition activities;*
- Demolition of the existing farmyard buildings and removal of hard standing followed by further investigations, sampling and testing of materials present within these areas;*
- Light cable drilling to investigate the full depth of made ground present within the north eastern corner of the site once vehicular access is possible to this area (if this area is to be developed);*
- Testing to determine the soil infiltration characteristics of the superficial strata present within the site to determine its suitability for soakaway disposal of surface water;*
- Full arboriculturist report undertaken upon all trees present within the site and within its influencing distance;*
- Consultation with NRW regarding the status of the existing ditch;*
- Consideration of variable ground levels within the proposed development layout.*

11.0 NOTES

- 11.1** *All reports are for advisory purposes only and all design decisions are the ultimate responsibility of others.*
- 11.2** *Unless stated otherwise the investigation has been undertaken in general accordance with the recommendations given in BS 5930 : 1999 "A Code of Practice for site Investigations" and the laboratory testing has been carried out in accordance with BS 1377 : 1990 "Methods of Test for Civil Engineering Purposes".*
- 11.3** *Soil and rock descriptions are generally based on the scales of strength and relative density within BS 5930 although it should be noted that in certain circumstances descriptions are based on site records or a qualitative assessment without the benefit of in-situ or laboratory test results.*
- 11.4** *The assessment of ground conditions given in this report is based on the results of the fieldwork and laboratory testing carried out and there may be other conditions at the site not encountered by these works, which have not been taken into account.*
- 11.5** *The scope of the investigation and information provided may not necessarily reflect all the geotechnical and environmental aspects related to the site, and the omission of certain items does not mean that the site is unaffected by such problems.*

- 11.6** *It should be noted that groundwater levels can vary and may at times be significantly different to those recorded during the investigation and attention is drawn to BS 5930 which indicates that measurements may be necessary over an extended period of time to investigate changes in groundwater pressures due to seasonal, tidal and other causes.*
- 11.7** *Any recommendations on construction methods within this report are for initial guidance only and all design proposals remain the responsibility of the appropriate contractor/consultant.*
- 11.8** *Further assessment, investigation, construction activities or time may reveal conditions that were not found during the period of investigation and, therefore, could not have been taken into account in the preparation of the report and where such information might impact upon the stated opinion R. E. Fry & Associates Ltd request the opportunity to review such information and modify the report if necessary.*
- 11.9** *Where information has been obtained from sources other than the direct findings of the investigation, R. E. Fry & Associates Ltd cannot and does not guarantee the authenticity or reliability of this information.*
- 11.10** *Where opinions expressed in this report are based on current available guidelines and legislation, no liability can be accepted by R. E. Fry & Associates Ltd for the effects of any future changes to such guidelines and legislation.*
- 11.11** *This report has been prepared on the instructions and to the requirements of the named client and any unauthorised party using this information for any purpose does so at his own risk and any duty of care to that party is excluded.*

Signed for and on behalf of
R E FRY & ASSOCIATES LIMITED

A handwritten signature in blue ink, appearing to read 'R. E. Fry', with a stylized flourish extending from the bottom.

R E FRY B Sc (Hons), C Eng., MI Struct.E., M.a.P.S.

APPENDIX A

NOTES:
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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



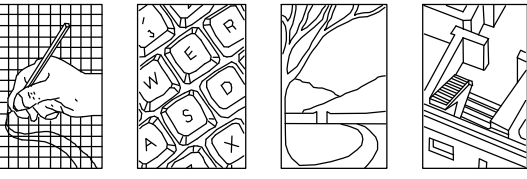
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Job WOODLANDS FARM
GWERSYLLT for
WALES & WEST

Drawing FEASIBILITY SITE
PLAN

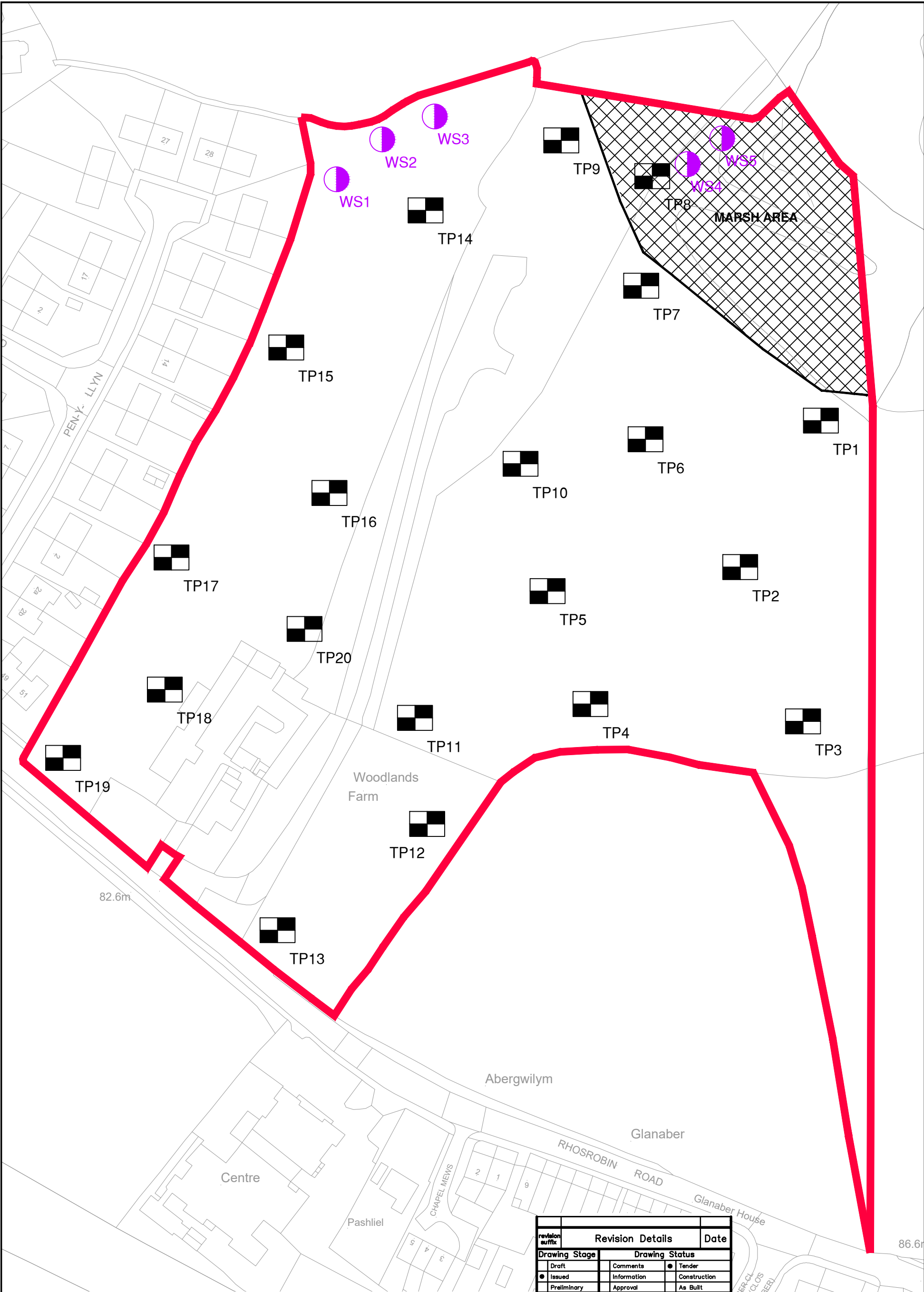
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APPENDIX B



KEY

Site Boundary

Trial Pit Locations

TP1

Window Sampler Locations

WS1

revision suffix	Revision Details			Date
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				

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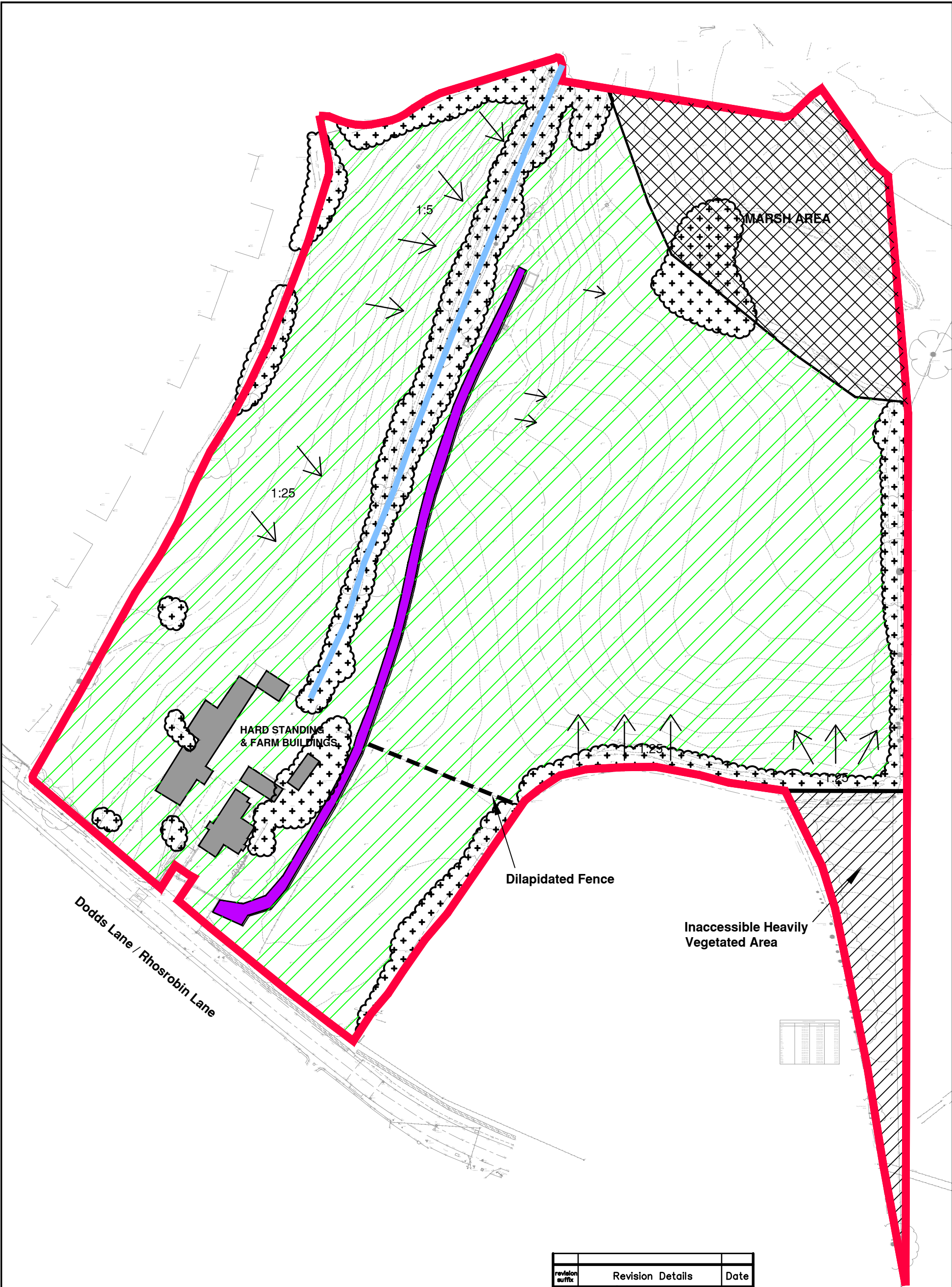
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		18.12.14	1:1000 @ A3	PT
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APPENDIX C



KEY

- Site Boundary
- Ditch Line
- Greenfield Areas With Sporadic Vegetation
- Track
- Approx Gradient

revision suffix	Revision Details		Date
	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 Walk Over Survey			

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APPENDIX D

Photographs of site at walk over appraisal

Photo 1 –General view south west of the farm building and the access from Dodds Lane



Photo 2 – View of contents of farm buildings with general waste



Photo 3 – View south along the access track leading to the front yard of Woodlands Farm



Photo 4 – General view north with the access road present to the left



Photo 5 – Underground tanks relating Welsh Water



Photo 6 – General view north east of the marsh area



Photo 7– General view south east



Photo 8– View north within the most westerly parchment of land



Photo 9 – General view south west within the most westerly parchment of land



Photo 10 – View south of the large stockpiles of vegetation and general waste present with Woodlands Farm located in the rear of the picture

APPENDIX E



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Trial Pit Log

Trialpit No

TP01

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Scale

1:25

Client: Wales and West Housing Association

Depth
1.80

0.6

Logged
MD

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.20			Grass over TOPSOIL: Greyish clayey fine to coarse sand with rootlets.	
							Reddish brown gravelly very clayey fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.	
				1.80				
							End of pit at 1.80 m	
								1
								2
								3
								4
								5

Remarks: Water ingress noted at 1.60m with a moderate to fast flow.

Stability: Pit unstable due to water ingress

AGS



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Trial Pit Log

Trialpit No

TP02

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.50

0.6

Scale

1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.40			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
				1.00			Brown very silty fine to coarse SAND.	
				1.70			Reddish brown gravelly very clayey fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.	1
	2.00	D	HVP=116	2.50			Firm brown mottled grey slightly sandy slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of various lithologies.	2
							End of pit at 2.50 m	3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

AGS



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Trial Pit Log

Trialpit No

TP03

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.30

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.20			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
							Reddish brown very silty fine to medium SAND.	1
				1.30			Light brown clayey fine to medium SAND with occasional clay pockets.	2
				2.30			End of pit at 2.30 m	3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP04

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

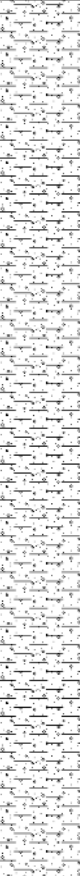
Depth
3.00

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
							Firm brown slightly sandy slightly gravelly CLAY. Gravel is fine to medium subangular to subrounded of various lithologies.	
	1.50	D	HVP=110					1
							Below 2.00m: Frequent bands of silt.	2
				3.00			End of pit at 3.00 m	3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP05

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.00

0.6

Scale

1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.20			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
				0.60			Reddish brown silty fine to coarse SAND.	
	1.00	D	HVP=104	2.00			Firm brown slightly sandy slightly gravelly friable CLAY with occasional sand lenses. Gravel is fine to coarse subangular to subrounded of various lithologies.	1
							End of pit at 2.00 m	2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

AGS



Trialpit No

Sheet 1 of 1

Date
15/12/2014

1:25

0.6

Logged
MD

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.20			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
							Brown gravelly very clayey fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.	
				1.90			End of pit at 1.90 m	



Stability: Pit stable



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Trial Pit Log

Trialpit No

TP07

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.00

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			Vegetation over MADE GROUND: Brown silty gravelly fine to coarse sand. Gravel is fine to coarse angular to rounded of brick and various lithologies.	
							Reddish brown clayey fine to coarse SAND.	1
	1.70	D	HVP=92	1.60			Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sand lenses. Gravel is fine to medium subangular to subrounded of various lithologies.	
				2.00			End of pit at 2.00 m	2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP08

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Scale

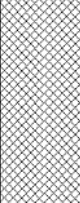
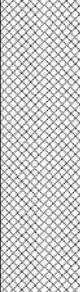
1:25

Client: Wales and West Housing Association

Depth
2.00

0.6

Logged
MD

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.30			Vegetation over MADE GROUND: Brown silty gravelly fine to coarse sand. Gravel is fine to coarse angular to rounded of brick and various lithologies.	
							MADE GROUND: Reddish silty fine to coarse sand.	
	1.20	ES		1.00			MADE GROUND: Grey silty sand fine to coarse angular to subrounded gravel of brick, glass concrete and clinker.	1
				2.00			End of pit at 2.00 m	2
								3
								4
								5

Remarks: Water strike encountered at 1.50m with a fast ingress

Stability: Pit unstable due to water ingress

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Trial Pit Log

Trialpit No

TP09

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

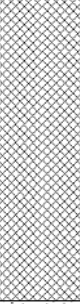
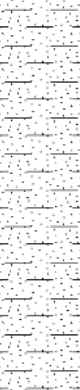
Depth
2.30

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	ES		1.00			Vegetation over MADE GROUND: Grey clayey sandy fine to medium gravel of brick, concrete and mudstone.	1
				2.30			Reddish brown very clayey fine to coarse SAND with occasional pockets of clay.	2
							End of pit at 2.30 m	3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

AGS



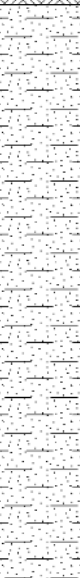
Trialpit No

Sheet 1 of 1

Date
15/12/2014

1:25

Logged
MD

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
	0.50	ES		0.10		 Grass over TOPSOIL: Dark brown sandy silt with rootlets.  Reddish brown clayey fine to coarse SAND with occasional clay bands.	1
				2.00		 End of pit at 2.00 m	2 3 4 5



Stability: Pit stable



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Trial Pit Log

Trialpit No

TP11

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

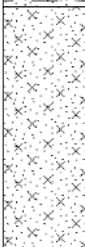
Depth
1.80

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.10			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
							Reddish brown very clayey fine to coarse SAND with pockets of clay.	
				1.00			Light brown very silty fine to coarse SAND with pockets of clay.	1
				1.80			End of pit at 1.80 m	2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP12

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.00

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
				0.20			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
	1.50	D	HVP=98				Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sand lenses. Gravel is fine to medium subangular to subrounded of various lithologies.	1
			HVP=120	2.00			End of pit at 2.00 m	2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP13

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
1.70

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
				0.70			Light brown clayey fine to coarse SAND.	
	1.00	D	HVP=107	1.70			Firm to stiff brown mottled grey slightly sandy slightly gravelly CLAY with occasional sand lenses. Gravel is fine to medium subangular to subrounded of various lithologies.	1
							End of pit at 1.70 m	2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP14

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.00

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES	HVP=116	0.30			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
				1.00			Reddish brown very clayey fine to coarse SAND with pockets of clay.	
	2.00	D		2.00			Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sand lenses. Gravel is fine to medium subangular to subrounded of various lithologies.	1
							End of pit at 2.00 m	2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP15

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
1.50

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.20	ES		0.30			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
							Brown very clayey fine to coarse SAND.	
	1.00	D		0.90			Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sand lenses. Gravel is fine to medium subangular to subrounded of various lithologies.	1
				1.50			End of pit at 1.50 m	
								2
								3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

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Trial Pit Log

Trialpit No

TP16

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.30

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.10	ES		0.20			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
							Brown clayey fine to coarse SAND.	
				0.90			Firm brown mottled grey slightly sandy slightly gravelly CLAY with occasional sand lenses. Gravel is fine to medium subangular to subrounded of various lithologies.	1
				1.70			Reddish brown fine to coarse SAND.	2
				2.30			End of pit at 2.30 m	3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

AGS



Trialpit No

Sheet 1 of 1

Date
15/12/2014

0.6

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10		 Grass over TOPSOIL: Dark brown sandy silt with rootlets.  Reddish brown clayey gravelly fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.	1
				1.80		End of pit at 1.80 m	2
							3
							4
							5



Stability: Pit stable



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Trial Pit Log

Trialpit No

TP18

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

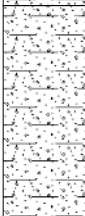
Depth
2.00

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description	
	Depth	Type	Results					
	0.50	ES		0.10			Grass over TOPSOIL: Dark brown sandy silt with rootlets.	
				1.30			Brown clayey gravelly fine to coarse SAND with clay pockets. Gravel is fine to coarse subangular to subrounded of various lithologies.	1
				2.00			Brown slightly clayey gravelly fine to coarse SAND. Gravel is fine to coarse subangular to subrounded of various lithologies.	2
							End of pit at 2.00 m	3
								4
								5

Remarks: No water strikes encountered.

Stability: Pit stable

AGS

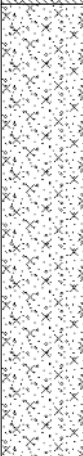


Trialpit No

Sheet 1 of 1

Date
15/12/2014

0.6

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.30			Grass over TOPSOIL: Dark brown sandy silt with rootlets.
							Brown silty gravelly fine to coarse SAND with occasional pockets of clay. Gravel is fine to coarse subangular to subrounded of various lithologies.
				1.80			End of pit at 1.80 m

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Stability: Pit unstable



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Trial Pit Log

Trialpit No

TP20

Sheet 1 of 1

Project Name: Woodlands Farm

Project No.
14155

Co-ords: -
Level:

Date
15/12/2014

Location: Dodds Lane, Gwersylt

Dimensions
(m):

2.5

Depth
2.00

0.6

Scale
1:25

Logged
MD

Client: Wales and West Housing Association

Water Strike	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
	Depth	Type	Results				
				0.10			Grass over TOPSOIL: Dark brown sandy silt with rootlets.
							Brown very clayey fine to coarse SAND with pockets of clay.
				2.00			Below 1.90m: Becoming gravelly. Gravel is fine to medium subangular to subrounded of various lithologies.
							End of pit at 2.00 m

1

2

3

4

5

Remarks: No water strikes encountered.

Stability: Pit stable

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APPENDIX F

Trial Pit Photographs – Woodlands Farm, Dodds Lane, Gwersylt

Photo 1 – Trial Pit 01



Photo 2 – Arising's from Trial Pit 01



Photo 3 – Trial Pit 02



Photo 4 – Arising's Trial Pit 02