A GROUND INVESTIGATION REPORT FOR LAND AT GRESFORD ROAD, LLAY, WREXHAM

ISSUE 1.0

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Prepared for:

Tier Consult Ltd

Richmond House,
Chester Business Park,
Chester,
CH4 9QZ

Prepared by: Oliver Hinds

Tier Environmental Ltd

Chadwick House,
Birchwood Park,
Warrington,
WA3 6AE

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CONTENTS

1. INTRODUCTION 1

2. SITE DETAILS AND DESCRIPTION 3

3. ENVIRONMENTAL SETTING 4

3.1. Site History 4

3.2. Geology 6

3.3. Mining and Quarrying 6

3.4. Hydrogeology 8

3.5. Hydrology 9

3.6. Ecological Features 9

3.7. Landfill and Waste Management Activity 10

3.8. Local Potentially Contaminative Activities 11

3.9. Radon Risk 12

3.10. Summary 12

4. PRELIMINARY CONCEPTUAL MODEL 13

4.1. Justification 13

4.2. Uncertainties 14

5. FIELDWORK 16

5.1. Scope of Investigation 16

5.2. Chemical Testing 17

6. GROUND CONDITIONS AND MATERIAL PROPERTIES 18

6.1. Strata Profile 18

6.2. Visual and Olfactory Signs of Contamination 19

6.3. Groundwater Observations 19
6.4. Determination of pH and Water-Soluble Sulphate 20
6.5. Ground Gas Monitoring 20
7. RESULTS OF CHEMICAL TESTING 22
7.1. Data Interpretation Approach 22
7.2. Human Health 23
7.3. Controlled Waters 24
8. REVISED CONCEPTUAL MODEL AND GENERIC QUANTITATIVE RISK ASSESSMENT OF POLLUTANT LINKAGES 27
8.1. Justification 27
8.2. Uncertainties 28
9. CONCLUSIONS AND RECOMMENDATIONS 30
9.1. General 30
9.2. Flood Risk 30
9.3. Mining and Quarrying 30
9.4. Geotechnical Parameters 30
9.5. Soil and Groundwater Contamination 34
9.6. Invasive Plants 35
9.7. Outline Remediation Requirements 35
10. REFERENCES 37

TABLES

Table 2.1. Current Site Overview. 3
Table 3.1. Site History. 4
Table 3.2. Geological Summary. 6
Table 3.3. Coal Mining Activities. 6
Table 3.4. Other Extractive Industries. 8
Table 3.5. Groundwater Occurrence and Abstraction. 8
Table 3.6. Surface Water Features. 9
Table 3.7. Ecological Features. 9
Table 3.8. Waste Management Activities. 10
Table 3.9. Other Potentially Contaminative Processes in the Locality. 11
Table 3.10. Radon Risk Status. 12
Table 4.1. Preliminary Assessment of Potential Pollutant Linkages. 15
Table 5.1. Schedule of Chemical Testing. 17
Table 6.1. Strata Profile. 18
Table 6.2. Summary of Visual and Olfactory Hydrocarbon Impacted Soils 19
Table 6.3. Field Observations of Groundwater 19
Table 7.1. PAH exceedances in soils across Zone 1 23
Table 8.1. Revised Assessment of Pollutant Linkages. 29
Table 9.1. Summary of Natural Moisture Content and Atterberg Limits 30

APPENDICES

APPENDIX A – FIGURES AND DRAWINGS

APPENDIX B – GLOSSARY OF TERMS

APPENDIX C – EXPLORATORY HOLE LOGS

APPENDIX D – PHOTOGRAPHS TAKEN DURING SITE WALKOVER AND INVESTIGATION

APPENDIX E – DEFINITION OF SOURCE PROTECTION ZONES AND GROUNDWATER VULNERABILITY ASSESSMENTS

APPENDIX F– DEFINITIONS OF TERMS USED IN QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

APPENDIX G – ASSESSMENT CRITERIA APPLIED FOR GROUND GAS

APPENDIX H– HUMAN HEALTH ASSESSMENT CRITERIA

APPENDIX I – CONTROLLED WATERS RISK ASSESSMENT

APPENDIX J – ENGINEER'S FIELD TESTING

APPENDIX K – CHEMICAL TEST SAMPLING

APPENDIX L – RESULTS OF LABORATORY CHEMICAL ANALYSES

APPENDIX M – GAS AND GROUNDWATER MONITORING RESULTS

APPENDIX N – GROUNDSURE REPORT AND HISTORICAL MAPS

APPENDIX O – COMPLYING WITH CONTROL OF ASBESTOS REGULATION 2012

EXECUTIVE SUMMARY

Introduction	Tier Environmental Ltd was commissioned by Tier Consult Ltd to undertake a Ground Investigation Report of Land at Gresford Road, LLay (the "Site"). The Site is currently disused, with 2 No. existing structures comprising a former garage and associated derelict bungalow. The investigation was undertaken to establish the land use history and review available information to determine the environmental setting of the Site, determine the ground conditions prevailing beneath the site, investigate the presence, nature and extent of any contamination present within the underlying soils and groundwater, collate geotechnical information to inform foundation recommendations and analyse ground gas monitoring data to inform determine the prevailing ground gas regime beneath the Site.
Site location	The site is located at Gresford Road, Llay, Wrexham, LL12 0NW. The Site can be centred on National Grid Reference (NGR) 333391, 356219.
Site history	Historically, the Site was developed circa 1949 where 1 No. unspecified building was present in the centre of the Site. Historically, in 1959 it is understood that 2 No. buildings were present on the site where in 1961 the building in the centre of the site is labelled Garage and the derelict bungalow is labelled Woodville.
Fieldwork	Excavation of 10 No. hand dug trial pits to depths of 1.20m bgl to facilitate service clearance, determine shallow (<1.20m bgl) ground conditions and obtain shallow soil samples for subsequent laboratory analysis. Advancement of 10 No. window sample holes (WS1 to WS10) to depths between 3.00m and 5.45m bgl to investigate deeper (up to 5.45m bgl) ground conditions, facilitate *in situ* geotechnical testing, enable the collection of soil samples for subsequent laboratory analysis and enable the installation of ground gas/groundwater monitoring wells.
Laboratory testing	Samples of soil and groundwater were submitted for analysis of a range of metals, other inorganic and organic components. All testing was undertaken at accredited laboratories.
Ground conditions	The ground conditions across the Site comprised of Reworked Topsoil or Hardstanding overlying Made Ground soils from ground level to a maximum depth of 0.70m bgl (in the Made Ground). Glacial Till was observed to underlie the Made Ground soils in all locations with the base not found during this Site Investigation.
Contamination	Made Ground soils should be considered to present a potentially unacceptable risk to human health with respect to benzo(a)pyrene, benzo(b)fluoranthene and aromatic EC21-35 petroleum hydrocarbons for an end land use of residential with home grown produce. A hotspot of elevated dibenzo(ah)anthracene is present within the Made Ground soils in the area of WS5. Groundwater samples collected from across the Site have identified localised (WS5) naphthalene, flouranthene, benzene and total petroleum hydrocarbons in concentrations elevated above the most stringent water quality standards. Due to the low sensitivity of the Site and localised nature of the contamination, it is considered that local groundwater should not be considered to present a potentially unacceptable risk to controlled waters; however, localised excavation is recommended.
Foundations and floor slabs	It is considered that, under the current development proposals, traditional strip footing foundations should be appropriate for the proposed structures, based on an allowable bearing resistance of approximately 145kPa at 1.20m bgl within the natural clay strata. Should a greater bearing resistance be required for the proposed loads, it is considered that they may be attained at increased depth. In the event that the underground storage tank is present and removal is performed, a localised area of deeper Made Ground would be resultant and, as such, would necessitate locally deeper foundations. To obviate any significant damaging settlements we would recommend using a suspended floor slab in accordance with NHBC Standards Chapter 5.2.
Aggressive environments for concrete	It should be considered that concrete buried within Made Ground, natural or to depths in excess of that of the groundwater for any given location would require specification to that of Design Sulphate Class DS-1 and an ACEC sulphate class of AC-1s.
Ground Gas and Vapours	Based upon the ground gas assessment, the Site may be classified as a Characteristic Situation 2 – Low Risk. Given the historic land use of the Site as a garage with associated above ground storage tanks, underground storage tanks and a fuel filling area, a potential risk from volatiles generated from unidentified hydrocarbon contamination is considered possible. As a result, it is considered that the gas protection measures should include a volatile resistant membrane. The site is located within a lower probability radon area as less than 1% of homes are above the action level. As such, no radon protection measures are required.
Waste soils characterisation	The results of preliminary waste characterisation identified Made Ground soils across the site to be classified as inert/non-hazardous.

Outline Remediation Strategy	Removal of potential underground storage tank in east of site. Installation of barrier pipe for water bearing services. Localised excavation of soils and groundwater extraction in proximity to pre-existing re-fuelling pumps (WS5) Installation of 1000mm deep clean cover system in soft landscaped areas. Volatile resistant membrane incorporated within design to cover entire footprint of each new structure.

1. INTRODUCTION

Tier Environmental Ltd was commissioned by Tier Consult Ltd to undertake a Ground Investigation Report of Land at Gresford Road, Llay, Wrexham, LL12 0NW (the "Site"). A site location plan, Drawing No. TE1010/GIR/1, is included within Appendix A of this report.

The Site is currently disused, with 2 No. existing structures comprising a former garage and derelict bungalow.

The investigation was undertaken to establish the land use history and review available information to determine the environmental setting of the Site, determine the ground conditions prevailing beneath the site, investigate the presence, nature and extent of any contamination present within the underlying soils and groundwater, collate geotechnical information to inform foundation recommendations and analyse ground gas monitoring data to inform determine the prevailing ground gas regime beneath the Site.

It has been assumed throughout the report that the Site is to be redeveloped for a residential with home grown produce land use, comprising 2 No. sets of 3 No. houses (6 No. properties in total).

Taking into account the planned future use of the Site, the objectives of this appraisal were:

- To determine the land use history from review of available historical documentation and maps and establish the environmental setting of the Site.
- To produce a Preliminary Conceptual Site Model;
- To determine the ground conditions and groundwater prevailing beneath the Site.
- Identify and summarise any potential contamination which could have resulted from past or current land use(s).
- To determine any potentially unacceptable risk posed by potential soil and groundwater contamination
- Provide recommendations on required remedial measures to manage such risks.
- To provide recommendations regarding foundations and floor slabs.
- To undertake an assessment of risks posed to the Site from hazardous ground gases.

At the time of writing, no previous investigations conducted across the Site have been made available to Tier Environmental Ltd.

This report, which was designed to meet the requirements of all relevant current guidance including CLR 11, presents the factual information available during this investigation, interpretation of the data obtained and recommendations relevant to the defined objectives.

It has been assumed in the production of this report that the Site will be redeveloped for a residential with plant uptake land use. In addition, it is assumed that ground levels will not change significantly from those described in this report. If this is not the case, then amendments to the recommendations made in this report may be required.

Where the report refers to the potential presence of invasive plants (such as Japanese Knotweed) or asbestos-containing materials, such observations are for information only and should be verified by a suitably qualified expert.

The comments and opinions presented in this report are based on the findings of the desk study, ground conditions encountered during intrusive investigation works performed by Tier Environmental and the results of tests carried out within one or more laboratories. There may be other conditions prevailing on the Site which have not been revealed by this investigation and which have not been taken into account by this report. Responsibility cannot be accepted for any conditions not revealed by this investigation. Any diagram or opinion on the possible configuration of the findings is conjectural and given for guidance only. Confirmation of intermediate ground conditions should be undertaken if deemed necessary.

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2. SITE DETAILS AND DESCRIPTION

Table 2.1. Current Site Overview.

Site name	Land at Gresford Road, Llay
Site address	Gresford Road, Llay, Wrexham, LL12 0NW
National Grid Reference	333391, 356219.
Location description	The Site is located within a predominantly residential area, approximately 6km north of Wrexham.
Approximate Site area	0.11ha
Site shape	The Site has a roughly rectangular shape.
General topography and ground levels	The Site is generally flat lying at an elevation of approximately 88.0m AOD.
Current land use	The Site is currently disused.
Existing structures	On Site there are currently 2 No. existing structures, comprising a former garage and a derelict bungalow. A crack in the brickwork of the bungalow was noted.
Site ground surfaces	The Site is largely covered in macadam or concrete, with the exception of the area of land to the south of the garage structure, which is covered in soft garden landscaping.
Sub-surface structures	It is understood that the Site previously contains an underground storage tank which has since been backfilled with concrete. The Wrexham Petroleum Licensing Officer did not possess any records of any storage tanks within the Site. Additional unrecorded services should be anticipated.
Invasive plant species	None were observed during the site investigation; however this should be confirmed by a suitable qualified specialist.

The main Site features are shown on Drawing No. TE1010/GIR/3 within Appendix A. Relevant Site photographs are presented in Appendix D.

3. ENVIRONMENTAL SETTING

3.1. Site History

The environmental setting has been derived from extracts of Ordnance Survey (OS) plans dated from 1872 to 2014 were reviewed. These were obtained as part of the GroundSure report for the Site, which is presented in Appendix O.

Table 3.1 presents a summary of the main aspects of the Site relevant to the current and proposed future land uses. It is not the intention of this report to describe in detail all of the changes that have occurred on or adjacent to the Site, where these are not relevant to the land use.

Table 3.1. Site History.

Source (Map edition, scale)	On-Site features	Off-Site features
1872, 1:10,560	• Primarily on Site agricultural uses.	• The surrounding land use is predominantly agricultural uses with few residential dwellings.
1875, 1:2,500	• Woodland is labelled around the perimeter of the Site.	• Pond located immediately adjacent to the southeast perimeter of the Site. • Pond located approximately 90m south and east of the site of the Site
1899, 1:2,500	• Woodland labelled around the perimeter of the Site in 1875 is no longer labelled on the map.	• Pond located immediately northwest of the Site. • Pump labelled approximately 80m northeast of the Site. • Mound present labelled Gaer (Earthwork) approximately 200m southeast of the Site.
1900, 1:10,560	• No significant changes.	• Sand pit located 600m southeast of the Site.
1909, 1:10,560	• No significant changes.	• No significant changes.
1912, 1:2,500	• No significant changes.	• Wind pump and possible well approximately 60m east of the Site.
1938, 1:10,560	• No significant changes.	• Increase in residential dwellings south of the Site. • No significant changes to the north of the Site. • Llay Main Colliery labelled 500m west of the Site.
1949, 1:10,560	• 1 No. unspecified building present in the centre of the Site.	• Increase in residential dwellings to the west of the Site. • Railway track established 750m west of site. • Wind pump no longer shown.
1959-1961, 1:2,500	• 2 No. buildings present one in the centre and one in the west of the Site.	• Embankment noted 250m west of the Site. • Ponds established on the 1875 map are no longer labelled.

Source (Map edition, scale)	On-Site features	Off-Site features
1961, 1:2,500	• Building in the centre of the Site is split into 2 No. buildings. • Building to the west of the Site is labelled as Woodville. • Buildings in the centre and east of the site are labelled Garage.	• Railway sidings associated with Llay Main Colliery are shown on an embankment 250m west of the Site.
1964, 1:10,560	• 2 No. buildings in the centre of the Site are referred to as 1 No. building again.	• Mine labelled 750m west of the Site.
1968, 1:10,500	• No significant changes.	• No significant changes.
1974, 1:2,500	• No significant changes.	• Railway sidings are no longer shown on the embankment 250m west of the Site.
1981, 1:10,000	• No significant changes.	• Increase in residential dwellings immediately south of the Site. • Factory works labelled 500m southwest of the site and 600m northwest of the site. • Tanks labelled 500m northwest of the Site. • Tip disused labelled 500m west of the Site.
1984, 1:2,500	• No significant changes.	• Increase in residential dwellings east and west of the Site.
1990, 1:2,500	• No significant changes.	• Embankment 250m west of the Site is no longer present. • Extension to the building approximately 250m west of the Site.
1992, 1:10,000	• No significant changes.	• Increase in buildings immediately west of the Site.
1993, 1:2,500	• No significant changes.	• Buildings to the approximately 250m west of the Site labelled as Llay Industrial Estate.
2002, 1:10,000	• No significant changes.	• No significant changes.
2010, 1:10,000	• No significant changes.	• No significant changes.
2014, 1:10,000	• No significant changes.	• No significant changes.
2017, Site walkover	• Potential above and below ground storage tanks identified on site during site walkover	• No significant changes.

3.2. Geology

Table 3.2. Geological Summary.

Maps and publications referenced	BGS GeoIndex - Onshore GroundSure Coal Authority Mining Report Coal Authority Website
Made Ground	Made Ground is anticipated beneath the Site based on the historical development of the Site. Deeper Made Ground may be present in the vicinity of the underground storage tank.
Drift geology	The Site is shown to be underlain by superficial deposits of Till generally comprising clay.
Solid geology	The Site is shown to be underlain by bedrock of the Salop Formation part of the Warwickshire Group consisting of Mudstone, Sandstone and Conglomerate.
Dip of solid strata	Not established
Faults	There are no faults recorded within 500m of the study site.
Coal seams	The Site is situated in an area that could be affected by underground mining in 5 seams of coal at 660m to 940m depth, and last worked in 1966.

3.3. Mining and Quarrying

Table 3.3. Coal Mining Activities.

	Yes/No	Comments
Is the Site in an area of potential shallow coal workings?	Yes	The study site is located within the specified search distance of an identified mining area. The Coal Authority interactive map indicates that the Site is not located within a 'Development High Risk Area'.
Are there any known shafts, adits, tips, lagoons, or opencast workings likely to affect the Site?	No	
Is exploratory work required to investigate the potential risk from shallow mining or quarrying?	No	The Coal Authority Mining Report states that any movement in the ground due to coal mining activity should have stopped.

Coal Mining Risk Assessment

The findings of the Coal Mining Risk Assessment are summarised below, a detailed discussion and recommended actions to the risks to the proposed development from coal mining legacy is presented in Table 3.3.

Sources of Information

The following sources of information were reviewed when undertaking the Coal Mining Risk Assesment:

- GroundSure report (Appendix F);

- Coal Authority CON29M Mining Report – ref: 51001467266001 (Appendix G);
- British Geological Society – Geoindex; and,
- Coal Authority website.

Review of Coal Authority Records

The following points are considered pertinent from Coal Authority records:

- The Site is within a development low risk area.
- The property is in a surface area that could be affected by underground mining in 5 seams of coal at 660m to 940m depth, and last worked in 1966.
- The property is not within an area that could be affected by present underground mining.
- The property is not in an area likely to be affected from any planned future underground coal mining. However, reserves of coal exist in the local area which could be worked at some time in the future.
- The property is not within the boundary of an opencast site from which coal has been removed by opencast methods and the property does not lie within 800 metres of the boundary of an opencast site from which coal is being removed by opencast methods.
- The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres, since 31 October 1994.
- The Coal Authority has no record of a mine gas emission requiring action.

Mining Geology

A review of geological mapping indicates that a BGS Borehole ref: SJ35 NW6 is drilled 700m southwest of the Site and within the same geological fault block. This borehole indicates a 0.05m thick horizon of coal at 80m bgl. At this depth and thickness, even if worked these seams are unlikely to result in significant subsidence and settlement of the site. Therefore, the site at Gresford Road, Llay is considered to be at low risk.

The Coal Mining report is in Appendix G.

Table 3.4. Other Extractive Industries.

	Yes/No	Comments
Superficial drift deposits		
Evidence of extraction on or within 250 m of the Site?	No	
Action required?	No	
Solid Strata		
Any evidence of mineral extraction on or within 250 m of the Site?	No	
Action required?	No	

Other, undocumented mineral workings on or close to the Site cannot be completely dismissed.

3.4. Hydrogeology

Table 3.5. Groundwater Occurrence and Abstraction.

	Presence/location	Comments
Aquifer designation	On Site	Superficial deposits are designated as an unproductive aquifer.
	On Site	Bedrock of the underlying strata is indicated as a Secondary (A) Aquifer.
Direction of flow	Not established	
Licensed abstractions	NR within 1500m of the Site.	
Private wells	NR within 250m of the Site.	Potential historic well (and wind pump) 60m to the east of the Site.
Source Protection Zones	NR within 500m of the Site.	
Springs	NR within 250m of the Site	

NR - none recorded.

For definition of Source Protection Zones, see Appendix E.

3.5. Hydrology

Table 3.6. Surface Water Features.

	Presence/location	Comments
Environment Agency GQA classified watercourses	NR within 500m of the Site.	
Unclassified watercourse(s)	1 No.	Tertiary river 208m southwest of the Site.
Licensed abstractions	NR within 1km of the Site.	
Canals, ponds, lakes, etc.	On-Site	None
	Off-Site	Potentially infilled ponds immediately northwest and southeast of the Site.
Flood risk status	NR	The Site is not shown to be in a Zone 2 (Fluvial/Tidal) or 3 (Fluvial) flood zone and at very low risk of flooding from Rivers and the Sea.
Surface run-off and Site drainage	It is anticipated that surface water runoff will enter existing Site drainage	

NR - none recorded

Environment Agency GQA assessments: A = very good to E = poor

3.6. Ecological Features

Table 3.7. Ecological Features.

	Presence/location	Comments
Designated locations	NR within 1km of the Site.	
Other sensitive locations	NR within 1km of the Site.	
Land use controls	NR within 500m.	
Invasive plants	NR	A survey by a qualified invasive plant consultant is required to confirm the absence or extent of invasive features.
Trees and shrubs	192m southwest of the Site.	Records of Ancient and Semi-Natural Woodland
Other features	NR	

NR - none recorded

3.7. Landfill and Waste Management Activity

Table 3.8. Waste Management Activities.

	Presence/location	Comments
Local authority recorded landfills	815m northwest of the Site.	Refuse Tip, 1996 mapping. NGR:332985 356978.
BGS recorded landfills	NR within 1.5km of the Site.	
Other licensed waste management facilities within 250 m	483m north of Site.	Astbury Landfill, Dark Lane, Burton, Wrexham, Clwyd, LL12 0AE. Landfill Reference: 37116.0. Landfill Type: A4: Household, Commercial and Industrial Waste Landfill.
	660m southeast of Site.	Singret Quarry, Gresford Road, Llay, Wrexham. Site Reference: WMBC L63, NOW-514-L. Waste Type: Inert. Licence issue 31-Dec-1983, licence surrendered 18-Dec-2003.
Is there evidence of other landfilling on or within 250 m of Site?	NR within 250m of the Site.	Potential infilled pond adjacent to the south-eastern site boundary.
Walkover evidence of fly-tipping on Site?	NR	
Is a landfill/ground gas risk assessment required?	Yes	There is a low potential for ground gas associated with the former uses of the site, the potential Made Ground present and the potentially infilled pond adjacent to the south-eastern site boundary. These are potential sources of contamination and should be considered during the investigation.

NR - none recorded

3.8. Local Potentially Contaminative Activities

Other potentially contaminative activities are shown in Table 3.. The entries relate to activities within *circa* 250 m of the Site, with the exception of COMAH facilities where the assessment is extended to a distance of *circa* 1 km from the Site.

Table 3.9. Other Potentially Contaminative Processes in the Locality.

	Location	Comments
Discharge Consents	242m southwest of the Site.	Active: Sewage discharges pumping station. Permit number CG0413901.
	264m west of the Site.	Active: Sewage discharges – sewer storm overflow. Permit number CG0358401.
	315m south of the Site.	Historical: Unspecified. Permit number CM0065001.
	481m west of the Site.	Historical: Unspecified. Permit number CM0060002.
Prosecutions relating to controlled waters	NR within 250m of the Site.	
Substantiated pollution incidents	NR within 250m of the Site.	
IPPC permits/air pollution controls	NR within 250m of the Site.	
Registered radioactive substances	NR within 500m of the Site	
Local Authority Pollution Prevention and Controls	NR within 250m of the Site.	
Prosecutions relating to authorised processes	NR within 250m of the Site	
Enforcement and prohibition notices	NR within 500m of the Site.	
Planning - hazardous substances consents and enforcements	NR within 500m of the Site.	
COMAH sites	NR within 500m of the Site.	
Fuel station entries	On Site	Repair body shop garage with potential tank storage and refuelling facilities
Pertinent contemporary trade directory entries	On Site	Garage on site dated 1959, 1961, 1974, 1984, 1990.
	155m northwest of the Site.	Colliery dated 1949.
	81m southwest of the Site.	Electricity Substation dated 1990.
	184m northwest of the Site.	Unspecified mine dated 1960 and 1968.
	155m northwest of the Site.	Industrial estate dated 1992.

NR - none recorded

COMAH – Control of Major Accident Hazards (regulations); NIHHS – Notification of Installations Handling Hazardous Substances (regulations)

3.9. Radon Risk

Table 3.10. Radon Risk Status.

	Radon protection measures required? (Yes/No)	Comments
BRE (1999), Report 211	No	The site is located within a lower probability radon area as less than 1% of homes are above the action level. As such, no radon protection measures are required.
BGS Site-specific report	Not requested.	

3.10. Summary

- The Site is currently disused and has 2 No. existing structures, comprising a former garage and a derelict bungalow. It is understood that the Site may contain an existing underground storage tank, which has since been backfilled with concrete, as indicated during the site walkover.
- Historically, the Site was developed circa 1949 where 1 No. unspecified building was present in the centre of the Site. Historically, in 1959 it is understood that 2 No. buildings were present on the site where in 1961 the building in the centre of the site is labelled Garage and the bungalow is labelled Woodville.
- Petroleum Licensing Office (LPO) has no records of any above ground or below ground petroleum storage on Site.
- The Site is proposed for re-development as residential dwellings with home grown produce.
- The Site is likely to be underlain by Made Ground given the development of the site.
- The bedrock of the underlying strata of the Salop Formation comprising sandstone, mudstone and conglomerate is shown to be a Secondary (A) Aquifer.
- The Site does not lie within a Zone 2 (Fluvial/Tidal) or Zone 3 (Fluvial) flood zone and at very low risk of flooding from Rivers and the Sea.
- The Site is not located in an area where radon protection measures are required.
- Potential sources of hazardous ground gases have been identified within, and in the vicinity of, the Site.

4. PRELIMINARY CONCEPTUAL MODEL

Based on the assessment of available information summarised in Section 3 of this report, a combined preliminary conceptual site model and conceptual exposure model has been developed for the proposed continued land use. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors. In assessing the likely contaminants present at the Site, reference has also been made to Defra and Environment Agency supporting documentation. A preliminary qualitative risk assessment has also been made of the likelihood of the linkage operating and its potential significance.

The potential pollutant linkages identified and the qualitative risk assessment for these are presented in Table 4.1. The terms used in the preliminary qualitative risk assessment are defined in Appendix F.

4.1. Justification

The following factors are considered pertinent in defining the conceptual model.

- The Site is currently disused and has 2 No. existing structures, comprising a former garage and a derelict bungalow. It is understood that the Site previously contains an underground storage tank which has since been backfilled with concrete (to be confirmed).
- Historically, the Site was developed circa 1949 where 1 No. unspecified building was present in the centre of the Site. Historically, in 1959 it is understood that 2 No. buildings were present on the site where in 1961 the building in the centre of the site is labelled Garage and the outhouse is labelled Woodville.
- Petroleum Licensing Office (LPO) has no records of any above ground or below ground petroleum storage on Site.
- The Site is proposed for re-development as residential dwellings with home grown produce.
- The Site is likely to be underlain by Made Ground given the development of the site.
- The bedrock of the underlying strata of the Salop Formation comprising sandstone, mudstone and conglomerate is shown to be a Secondary (A) Aquifer.
- The Site does not lie within a Zone 2 (Fluvial/Tidal) or Zone 3 (Fluvial) flood zone and at very low risk of flooding from Rivers and the Sea.
- The Site is not located in an area where radon protection measures are required.

Potential Sources

- Possible metals, PAH, phenol, sulphate, hydrocarbon and asbestos contamination of on-site soils from previous Site uses as a bungalow, garage and associated fuel storage;
- Possible hydrocarbons associated with both above ground and underground storage tanks observed during site walkover.

- Potential asbestos containing materials within the existing site structures.
- Potential hazardous soil and gas generation from on and off site soils including ground gas generation from degraded residual hydrocarbons.

Potential Pathways

- Dermal contact, ingestion and inhalation of contaminants on site;
- Migration of ground gas / explosion;
- Lateral and/or vertical migration of mobile contaminants;
- Migration of mobile contaminants from Made Ground soils to adjacent sites along services and conduits;
- Contaminated dust migration during construction;
- Vapour inhalation; and,
- Migration via water pipes.

Potential Receptors

- Future, current and adjacent users of the Site;
- Future maintenance workers;
- Buildings, hardstanding and services;
- Secondary A Aquifer located beneath the Site.

4.2. Uncertainties

The following uncertainties exist in the preliminary conceptual model:

- The presence of any features unrecorded by the historical maps;
- Any unrecorded geological features;
- Any unreported pollution events during the site's history.

Table 4.1. Preliminary Assessment of Potential Pollutant Linkages.

Pollutant linkage				Risk
	Source	**Pathway(s)**	**Receptor(s)**	
1	Possible metals, PAH, phenol, sulphate, TPH and asbestos contamination of on-site Made Ground from previous Site uses including former refuelling facilities.	Dermal contact, ingestion and inhalation of contaminants including contaminated dust migration. Migration via water pipes.	Future site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Current site users (commercial)	Medium x Low likelihood = Moderate/Low Risk
			Adjacent site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Future maintenance workers	Medium x Low likelihood = Moderate/Low Risk
		Migration of mobile contaminants from Made Ground soils to adjacent sites along services and conduits.	Adjacent site users (residential)	Medium x Low likelihood = Moderate/Low Risk
		Lateral and/or vertical migration of mobile contaminants.	Secondary A Aquifer located beneath the Site.	Medium x Low Likelihood = Moderate/Low Risk
2	Possible TPH and phenols associated with both above ground and underground storage tanks observed during site walkover.	Dermal contact, ingestion and inhalation of contaminants. Vapour inhalation. Migration via water pipes.	Future site users (residential)	Medium x Low Likelihood = Moderate/Low Risk
			Current site users (commercial)	Medium x Low Likelihood = Moderate/Low Risk
			Future maintenance workers	Medium x Low Likelihood = Moderate/Low Risk
		Migration of mobile contaminants from Made Ground soils to adjacent sites along services and conduits.	Adjacent site users (residential)	Medium x Low Likelihood = Moderate/Low Risk
		Lateral and/or vertical migration of mobile contaminants.	Secondary A Aquifer located beneath the Site.	Medium x Low Likelihood = Moderate/Low Risk
3	Potential hazardous soil gas generation from on and off site soils, including ground gas generation from degraded residual hydrocarbons.	Inhalation (indoor and outdoor).	Future site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Current site users (commercial)	Medium x Low likelihood = Moderate/Low Risk
			Adjacent site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Future maintenance workers	Medium x Low likelihood = Moderate/Low Risk
		Migration of ground gas / explosion.	Buildings and services	Severe x Low Likelihood = Moderate Risk

For definition of the terms used in the qualitative risk assessment, please see Appendix F.

5. FIELDWORK

5.1. Scope of Investigation

The information contained in this report is limited to areas of land accessible during the investigation within the Site boundary, as indicated on the Site plan, presented in Appendix A as Drawing No. TE1010/GIR/3. Please note that investigation within the buildings was restricted by access.

Tier Environmental scoped the intrusive ground investigation using guidance presented in BS 10175:2011, the remaining CLR document (Defra and Environment Agency) and BS EN 1997:2004 and 2007.

The investigation, which was supervised by a Tier Environmental Geoenvironmental Engineer, took place on 22nd May 2017 and comprised:

- Excavation of 10 No. hand dug trial pits to depths of 1.20m bgl to facilitate service clearance, determine shallow (<1.20m bgl) ground conditions and obtain shallow soil samples for subsequent laboratory analysis.

- Advancement of 10 No. window sample holes (WS1 to WS10) to depths between 3.00m (WS7 and WS10) and 5.45m bgl (WS2) to investigate deeper (up to 5.45m bgl) ground conditions, facilitate *in situ* geotechnical testing, enable the collection of soil samples for subsequent laboratory analysis and enable the installation of ground gas/groundwater monitoring wells.

Permanent monitoring installations for both groundwater and ground gas monitoring purposes were installed a positions WS1 to WS6, with response zones in the Glacial Till.

Exploratory holes without instrumentation were backfilled with arisings. The exploratory hole location and current Site features are shown on Drawing No. TE1010/GIR/3.

Depths and accurate descriptions of strata and groundwater observations made during investigation works, together with details of the samples recovered, are presented on the Engineer's exploratory hole records in Appendix C.

Tier Environmental's standard strata description criteria are compliant with BS EN ISO 14688:2002 and 2004 and BS EN ISO 14689:2003. A brief description of field sampling and testing techniques is provided in Appendix J.

5.2. Chemical Testing

Based upon the historical information available for the Site and the potential pollutant linkages identified for the proposed residential land use, Tier Environmental scheduled chemical laboratory testing on selected soil and soil leachate samples. The purpose of the testing was to:

- Determine the concentration and spatial distribution of potential contaminants in both the Made Ground and underlying natural strata.
- Determine the extent of any hydrocarbon contamination in the vicinity of the above ground storage tank, underground storage tank and former filling stations areas of the site; and,
- Determine the concentration of potential contaminants within shallow groundwater beneath the Site.

Sampling protocols are presented in Appendix K. Tier Environmental's schedule of chemical laboratory testing is presented in Table 5.1. The testing was carried out by Exova Jones, a UKAS and, where appropriate, MCERTS accredited laboratory.

Table 5.1. Schedule of Chemical Testing.

Laboratory analysis	Made Ground	Glacial Till	Groundwater
Tier Environmental standard soil suite*	9	0	NA
Tier Environmental standard water suite*	NA	NA	1
Asbestos screen	9	0	NA
Speciated TPH	9	5	1
PCBs (7 Congeners)	1	0	0
WAC Testing	1	0	NA

*For definition of Tier Environmental standard analytical suites, please see Appendix K.

NA - not applicable.

The analytical laboratory results are presented in Appendix L to this report and discussed in Section 7.

6. GROUND CONDITIONS AND MATERIAL PROPERTIES

Photographs taken during site investigation works are provided in Appendix D.

6.1. Strata Profile

A summary of the strata profile determined at this site is given in Table 6.1.

Table 6.1. Strata Profile.

Strata	Locations and Depths Recorded	Thickness	Description
Hardstanding	Observed in WS6 and WS8 to WS10 From ground level - To between 0.05m and 0.10m bgl.	0.05m (WS6 and WS8) to 0.20m (WS9 and WS10)	Concrete without reinforcement or macadam.
Reworked Topsoil	Observed in WS1 and WS2 From ground level - To a depth of 0.30m bgl.	0.30m	Dark brown, slightly gravelly, clayey sand, with gravel of coal, mudstone and concrete.
Made Ground	Observed in WS3 to WS10 From between ground level and 0.10m bgl - To depths of between 0.15m and 0.70m bgl.	0.15m (WS7) to 0.65m (WS8)	Red, brown or grey, locally mottled black, locally clayey, sandy gravel, with gravel of brick, tile, macadam, coal, limestone, sandstone and mudstone.
Glacial Till	Observed in all locations From depths of between 0.15m and 0.70m bgl - Proven to depths of between 3.00m and 5.45m bgl.	Base not found during this investigation.	Firm to very stiff consistency, reddish brown and locally orange and mottled pink, grey and yellow, sandy gravelly clay with gravels of sandstone, mudstone, limestone, quartzite and coal. Locally containing decayed organic material. Locally interbedded with layers of gravelly sand and sandy gravel.

NR - not recorded

Hardstanding

Hardstanding was encountered within the former forecourt and western side driveway of the Site, comprising either concrete without reinforcement or macadam to between 0.05m and 0.10m bgl.

Reworked Topsoil

Reworked topsoil comprising dark brown and locally mottled grey slightly gravelly, clayey sand with gravel of coal, mudstone and concrete was encountered within the garden area to the south of the existing garage.

Made Ground

Made Ground soils comprising red, brown or grey, locally mottled black, locally clayey, sandy gravel, with gravel of brick, tile, macadam, coal, limestone, sandstone and mudstone was encountered either from surface or directly underlying the aforementioned hardstanding.

Glacial Till

Glacial Till comprising firm to very stiff consistency, reddish brown and locally orange and mottled pink, grey and yellow, sandy gravelly clay with gravels of sandstone, mudstone, limestone, quartzite and coal. The clay was locally observed to contain decayed organic material. Interbedding layers of gravelly sand and sandy gravel of mudstone was observed locally.

6.2. Visual and Olfactory Signs of Contamination

A summary of visual and/or olfactory evidence of hydrocarbon contamination (or similar) noted during Tier Environmental investigations is summarised in Table 6.2.

Table 6.2. Summary of Visual and Olfactory Hydrocarbon Impacted Soils

Exploratory Hole Location	Depth (m bgl)	Formation	Observations
WS04	0.20 to 0.50	Made Ground	Mild hydrocarbon odour
WS05	0.00 to 0.40	Made Ground	Moderate diesel odour
	0.40 to 1.30	Glacial Till	Mild diesel odour
WS08	0.20 to 0.70	Made Ground	Moderate hydrocarbon odour
	0.70 to 1.30	Glacial Till	Faint hydrocarbon odour
WS10	0.60 to 1.10	Glacial Till	Mild hydrocarbon odour

6.3. Groundwater Observations

Table 6.3 provides a summary of the groundwater encountered within the boreholes during fieldworks at the Site. The observations indicate localised perched groundwater to be present within shallow soils, with water strikes from depths of between 0.80m and 5.00m bgl, as indicated by a lack of rise of hydraulic head when encountered, the presence of underlying, qualitatively low permeability soils, i.e. clays, which act as aquitard confining strata.

Table 6.3. Field Observations of Groundwater

Borehole	Strike (m bgl)	Rise in Groundwater after 20 minutes (m bgl)	Formation	Observations
WS1	3.00	None	Glacial Till	Perched groundwater.
WS2	2.10	None	Glacial Till	Perched groundwater.
WS3	0.20	None	Made Ground	Perched groundwater.
WS4	3.20	None	Glacial Till	Perched groundwater.
WS5	0.30	None	Made Ground	Perched groundwater.

6.4. Determination of pH and Water-Soluble Sulphate

Representative soil samples of the materials encountered in the exploratory holes and trial pits, were tested to determine their pH and concentrations of water-soluble sulphate (SO_4^{2-}). The results are presented in Appendix M or L (depending upon the laboratory used for these parameters).

Chemical analysis of soil and groundwater samples reported a minimum pH of 6.89 and a maximum water soluble sulphate concentration of 0.101 g/l. As such, it should be considered that concrete buried within Made Ground, natural or to depths in excess of that of the groundwater for any given location would require specification to that of Design Sulphate Class DS-1 and an ACEC sulphate class of AC-1s.

6.5. Ground Gas Monitoring

A series of combined gas and groundwater monitoring wells were installed at the Site at WS1 to WS6 with response zones in the Glacial Till.

Monitoring comprised measurement of pressure, methane (CH_4), carbon dioxide (CO_2), oxygen (O_2), hydrogen sulphide (H_2S), carbon monoxide (CO) and gas flow rate.

The ground gas monitoring presented in this report has been performed on 6 No. occasions on 8th June 2017 and 15th August 2017. The rationale behind this monitoring period was to determine the preliminary hazardous ground gas concentrations from a low risk source for a proposed residential land use.

The full ground gas monitoring results from the installations are presented in Appendix M.

The total atmospheric pressure range of the ground gas monitoring data included in this report was 990 mbar to 1007 mbar. This range covers low to high atmospheric pressures. Monitoring events have been undertaken during periods of rising and falling pressure.

The results of the ground gas monitoring have been assessed in accordance with the criteria specified for this Site, which were derived as described in Appendix G. The maximum measured peak and steady concentration of carbon dioxide was reported as 10.0% v/v and 6.3% v/v respectively, at WS2. A maximum peak methane concentration of 0.2% v/v was reported at WS6.

Detectable peak flow rates of between 0.1 l/hr and 27.4 l/hr have been reported from monitoring wells installed across the Site; however, monitoring works also identified very shallow groundwater, with all wells reporting detectable flow rates noted either to be flooded or with groundwater being present within the unscreened, plain pipe section of the installation. Additionally, it is noted that a maximum steady flow rate of 0.1 l/hr reported across the Site. As such, it is considered that the peak flow rates reported are indicative of active groundwater pumping action, by which the rise in hydraulic head is resulting in increased positive pressure within the confined plain pipe section of the installations, resulting in erroneous flow rate readings due to groundwater pumping. By way of mitigating these exaggerated flow rates, the maximum steady flow rate of 0.1 l/hr is considered to be representative of the Site.

A conservative Gas Screening Value (GSV) has been calculated assuming a maximum flow rate of 27.4l/hr and a maximum carbon dioxide concentration of 10.0% v/v. This has produced a GSV of 2.74l/hr, which places the site in a Characteristic Situation 3 -

Moderate Risk Scenario in accordance with CIRIA C665. This is based on the flow rates that are considered to be due to groundwater pumping. It is therefore considered that the Site should be categorised as CS2 (low risk) based on the maximum recorded carbon dioxide concentration of 10% v/v, the Site is considered to be CS2 (low risk).

A maximum peak carbon monoxide concentration of 15ppm was reported which is below the workplace long term exposure limit (30ppm) and the workplace short term exposure limit (200ppm) published by the Health and Safety Executive (EH40/2005 Workplace Exposure Limits). The maximum steady carbon monoxide concentration of 6ppm was found to exceed the WHO long term (24 hours) indoor exposure guideline value (5.68ppm); however, this was only observed during a single visit on the 27th July 2017, with the next highest being 4ppm. No measured concentrations of hydrogen sulphide have been reported in excess of the instrument's detection limit.

7. RESULTS OF CHEMICAL TESTING

Results of chemical analysis are presented in full in Appendix L

7.1. Data Interpretation Approach

The analytical data obtained were reviewed for completeness and consistency. The data for each sample type was then compiled and screened against the most sensitive GACs for the potential end land uses for the site; residential with plant uptake.

No zoning of the Site was undertaken as part of the interpretation. The historic land use and proposed development pattern meant that zoning was not appropriate or beneficial to the site investigation or subsequent data interpretation.

Selection of Generic Assessment Criteria (GAC)

The approach for the selection of the GACs used as screening criteria for this assessment is provided in Appendix H. In short, for the majority of the contaminants of concern, LQM/CIEH Suitable 4 Use Levels (S4ULs) published recently in 2015 have been adopted as GACs for a residential with home grown produce land use. These values are considered as appropriate screening criteria as they incorporate updated assumption exposures derived for the production of C4SLs but within the context of deriving screening criteria above which assessment of the risks or remedial action may be needed (i.e. within the context of the planning regime rather than Part 2A context for which C4SLs were derived).

The measured concentrations of determinands have been assessed against the most sensitive, residential with home grown produce, applicable GAC.

Assessment of outliers and data distribution

Assessment of data distribution and the identification of statistical outliers was performed iteratively, applying appropriate data distribution and outlier tests for the complete and outlier-censored datasets.

The presence of outliers was determined using One-Sample T-Test working with untransformed values for normally distributed data and natural log-transformed values for non-normally distributed data.

The data were tested for normality by at least two of the following methods:

- Probability histogram
- Probability (q-q) plots
- Shapiro-Wilk normality test

Outliers were considered to form part of the overall site dataset *except* they were not considered to be statistically representative of the shallow soils as a whole.

Calculation of 95% upper confidence limit of the sample mean

Based upon the normality and outlier tests, the 95% UCL of each contaminant of concern was calculated by:

- One-Sample T-Test for datasets that are normally distributed or close to normal distribution;
- One-sided Chebyshev test for datasets that are significantly non-normal.

Where both the One-Sample T-Test and one-sided Chebyshev 95th percentile results were both below the critical concentration, normality tests were not undertaken, as this would have had no effect upon the final outcome.

7.2. Human Health

Metals and Metalloids

After initial screening against the relevant GACs, no measured concentrations of metals or metalloids were reported in excess of the GACs relevant for a residential with home grown produce end land use.

It is therefore considered that Made Ground at the site should be considered to be uncontaminated with respect to metals and metalloids for a residential with home grown produce end land use.

PAHs

Polycyclic aromatic hydrocarbons (PAHs) are a wide range of over 200 different compounds normally associated with combustion or processing of hydrocarbons and coal. Elevated levels of PAHs can also be found in tarmacadam. Sixteen PAHs (usually known as the USEPA 16) comprise the more common individual carcinogenic PAH compounds.

Table 7.1. PAH exceedances in soils across Zone 1

Determinant	No. samples	No. samples in exceedance	GAC	Outlier or representative data set?	95% UCL any outliers removed	Comments
Dibenzo (ah)-anthracene	9	1	0.24	Outlier	0.02	Indicates a hotspot of elevated dibenzo(ah)anthracene within the Made Ground soil at WS5 at 0.30m bgl.
Benzo(a)-pyrene	9	2	2.20	Representative	3.243	Following analysis of the data using the Chebyshev test on the non-normally distributed data, the 95th percentile was shown to exceed the GAC for benzo(a)pyrene.
Benzo(b)-fluoranthene	9	2	2.60	Representative	3.9933	Following analysis of the data using the Chebyshev test on the non-normally distributed data, the 95th percentile was shown to exceed the GAC for benzo(b)fluoranthene.

NB: 1. All units in mg/kg. 2. Outliers only removed where they were not considered to be statistically representative of the soils as a whole. 3. GACs are representative of residential with home grown produce land use

It is therefore considered that Made Ground soils should be considered to present a potentially unacceptable risk to human health with respect to benzo(a)pyrene and benzo(b)fluoranthene for a residential with home grown produce end land use. Additionally, although concentrations of dibenzo(ah)anthracene are not considered to present a potentially unacceptable risk to human health, a hot spot of elevated dibenzo(ah)anthracene is believed to be present within the Made Ground soils in the area of WS5 at 0.30m bgl.

Petroleum Hydrocarbons and BTEX

Visual and/or olfactory evidence of contamination encountered across the site was summarised in Table 7.2 in Section 7. Samples taken from within these potentially hydrocarbon impacted soils were submitted for TPHCWG analysis.

For this part of the assessment, the results have been screened against the most conservative GAC applicable to the site, residential with home grown produce, from the LQM (2014) GACs for the TPHCWG set of hydrocarbon bands. These are considered the most appropriate set of assessment criteria to be used for the specified land use.

The majority of the 14 No. samples reported detectable concentrations of TPH with the exception of WS01 at 0.20m bgl and WS03 at 0.80m bgl. A sample from WS2 at a depth of 0.20m bgl within the Made Ground recorded concentrations in excess of the GAC associated with residential with home grown produce.

Benzene was recorded at a concentration greater than the relevant GAC (87µg/kg) in the sample from WS8 at 0.5m bgl (165µg/kg).

It is therefore considered that the Made Ground soils across the Site should be considered to present a potentially unacceptable risk to human health with respect to petroleum hydrocarbons for an end land use of residential with home grown produce.

PCBs

After initial screening, no measured concentrations of PCBs were reported in excess of the laboratory method detection limit. As such, there is no evidence of any significant concentrations of PCBs that are likely to be indicative of a potentially significant risk to human health or the wider environment.

Asbestos

Asbestos can be present in soil as fragments of bulk Asbestos Containing Materials (ACMs) (e.g. asbestos cement sheeting) and also as discrete asbestos fibres within the soil matrix. This investigation has carried out assessments to determine whether both bulk fragments and / or fibres are present in the soil at the site. The asbestos assessment commenced on site with inspection of the Made Ground by our site staff for the presence of bulk ACMs. During the fieldwork no suspected ACMs were identified.

Of the 9 No. representative samples which were screened for asbestos, none were found to contain asbestos fibres. It is therefore considered that Made Ground at the Site does not present a potentially significant risk to human health with respect to asbestos for a residential with home grown produce land use.

7.3. Controlled Waters

In order to assess whether a potential source of pollution to controlled waters is present across the Site, groundwater samples were submitted for laboratory chemical analysis. In accordance with Part 2A of the Environmental Protection Act 1990, Tier Environmental

has made regard to all of the water quality standards that are relevant to the specific site and a judgment has been made against the most stringent of those relevant standards.

In accordance with best practice, consideration of the following sources of water quality standards has been made:

- EQS Directive 2008/105/EC
- Priority Substances Directive 2013/39/EU
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- UK Drinking Water Standards (UK DWS)
- World Health Organisation (WHO Guidelines) for Drinking Water Quality
- Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking water directive)

Further details on the derivation of the GAC values is described in Appendix I.

In some instances, the laboratory method detection limit is greater than the appropriate EQS/UKDWS value. In these instances, only measured concentrations in excess of the laboratory method detection limit have been considered likely to potentially represent a possible significant risk to controlled waters.

Please note that there is no quantitative criterion for total petroleum hydrocarbons (TPH), or speciated TPH fractions. Historically, standards provided for petroleum hydrocarbons ranges from 10 µg/l (Private Water Supply Regulations 1991, removed from the 2009 regulations) to 50µg/l-1000µg/l (Surface Waters (Abstraction for Drinking Water) Regulations 1989) which related to the degree of treatment of water prior to use as drinking water. Over time, the legislative standards have been rescinded and no alternative standard provided, although the Environment Agency planned to release speciated TPH criteria (Fretwell et al., 2009). In the absence of suitable criteria, Tier Environmental adopts a value of 10 µg/l for more sensitive locations (e.g. unprotected Principal Aquifer, drinking water abstraction), and a value of 50 µg/l for locations considered less sensitive (e.g. low permeability aquifers) or where a site is located in close proximity to a surface watercourse. As such, a value of 50 µg/l has been adopted for this Site to compare against the Total TPH concentrations reported in each case.

Groundwater Analysis

The Site has been shown to be underlain by Glacial Till (Unproductive Aquifer), which in turn is indicated to be underlain by the Warwickshire Group from an unknown depth (Principal Aquifer). The low permeability cohesive Glacial Till has been proven to be of a thickness (5.45m thick). The Site is not located within 500m of a Source Protection Zone. The closest surface water receptor is a tertiary river 210m to the south west of the Site. There are no groundwater or surface water abstractions within 1500m of the Site. On this basis, the controlled water sensitivity is considered to be low.

For those determinands where the selected water quality standard is dependent on hardness, a hardness value of >250 mg CaCO3/l has been conservatively selected based on the results of groundwater analysis at the Site.

No measured concentrations of metals were reported in excess of the most stringent applicable water quality standards.

The majority of the recorded PAHs, TPHCWG and BTEX concentrations were below the laboratory limits of detection, with the exception of those reported from location WS5. Chemical analysis of groundwater samples from WS5 reported concentrations of naphthalene, flouranthene, benzene and total petroleum hydrocarbons in excess of the most stringent water quality standards criteria. Each exceedences were observed to be within between the same order of magnitude and 2 No. orders of magnitude.

Given that:

- the exceedences are marginal;
- that there is a significant distance to the nearest surface water receptor (210m);
- that other installations within the assumed water flow direction (southwest), despite intersecting higher permeability granular deposits, generally reported concentrations of less than the limit of detection and none in exceedence of the water quality standards;
- that there is a discontinuous groundwater body beneath the Site which will restrict lateral flow; and
- that there is a significant potential for dilution between the Site and the nearest significant receptor;

it is not considered that the Site represents a potentially significant risk to controlled waters.

8. REVISED CONCEPTUAL MODEL AND GENERIC QUANTITATIVE RISK ASSESSMENT OF POLLUTANT LINKAGES

The preliminary combined conceptual site model and conceptual exposure model, developed from the desk study information and presented in Section 4, has been revised in light of the ground investigation and the chemical analysis results presented above.

The revised conceptual model has been developed for the proposed future land use. This summarises the understanding of surface and sub-surface features, the potential contaminant sources, transport pathways and receptors.

The potential pollutant linkages identified and a generic quantitative risk assessment (based on the GAC values defined in Section 0) are presented in Table 8.1. The terms used in the generic quantitative risk assessment are defined in Appendix F.

8.1. Justification

Investigation Findings

- The ground conditions across the Site comprised of Reworked Topsoil or Hardstanding overlying Made Ground soils from ground level to a maximum depth of 0.70m bgl (in the Made Ground). Glacial Till was observed to underlie the Made Ground soils in all locations with the base not found during this Site Investigation.
- Groundwater was encountered within boreholes WS1 to WS5 during fieldworks at the Site.
- Mild to moderate hydrocarbon and diesel odours were detected at locations WS04, WS05, WS08 and WS10.
- Made Ground soils should be considered to present a potentially unacceptable risk to human health with respect to benzo(a)pyrene, benzo(b)fluoranthene and aromatic EC21-35 petroleum hydrocarbons for an end land use of residential with home grown produce. A hot spot of elevated dibenzo(ah)anthracene is present within the Made Ground soils in the area of WS5.
- Based on a maximum flow rate of 0.1 l/hr and a maximum carbon dioxide concentration of 10.0% v/v a GSV value of 0.01 l/hr, which places the site in a Characteristic Situation 1 - Very Low Risk Scenario in accordance with CIRIA C665.
- A maximum peak carbon monoxide concentration of 15 ppm was reported which is below the workplace long term exposure limit (30ppm) and the workplace short term exposure limit (200ppm) published by the Health and Safety Executive (EH40/2005 Workplace Exposure Limits).

Sources

- Benzo(a)pyrene, benzo(b)fluoranthene and aromatic EC21-35 petroleum hydrocarbons present within the Made Ground soils.
- A hot spot of elevated dibenzo(ah)anthracene.
- Potential unidentified petroleum hydrocarbons within subsurface of the Site.

Pathways

- Dermal contact, ingestion and inhalation of contaminants on site;
- Vapour inhalation; and,
- Migration via water pipes.

Receptors

- Future, current and adjacent users of the Site;
- Future maintenance workers;
- Buildings, hardstanding and services;
- Secondary A Aquifer located beneath the Site.

8.2. Uncertainties

The following uncertainties exist in the present conceptual model.

Due to the widespread occurrence of petroleum hydrocarbons within both the Made Ground soils and natural Glacial Till strata, and considering the historical applications of the site as a car repair shop with associated refuelling facilities, it is considered that a residual risk with respect to petroleum hydrocarbons may exist, despite exceedences of only aromatic EC21-35 having been identified.

Table 8.1. Revised Assessment of Pollutant Linkages.

Pollutant linkage				Risk
	Source	**Pathway(s)**	**Receptor(s)**	
1	Benzo(a)pyrene, benzo(b)fluoranthene and aromatic EC21-35 petroleum hydrocarbons contamination within the Made Ground soils from previous Site uses including former refuelling facilities.	Dermal contact, ingestion and inhalation of contaminants including contaminated dust migration.	Future site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Current site users (commercial)	Medium x Low likelihood = Moderate/Low Risk
			Adjacent site users (residential)	Medium x Low likelihood = Moderate/Low Risk
		Migration via water pipes.	Future maintenance workers	Medium x Low likelihood = Moderate/Low Risk
		Migration of mobile contaminants from Made Ground soils to adjacent sites along services and conduits.	Adjacent site users (residential)	Medium x Low likelihood = Moderate/Low Risk
		Lateral and/or vertical migration of mobile contaminants.	Secondary A Aquifer located beneath the Site.	Medium x Low Likelihood = Moderate/Low Risk
2	A hot spot of elevated dibenzo(ah)anthracene.	Dermal contact, ingestion and inhalation of contaminants. Vapour inhalation. Migration via water pipes.	Future site users (residential)	Medium x Unlikely = Low Risk
			Current site users (commercial)	Medium x Unlikely = Low Risk
			Future maintenance workers	Medium x Unlikely = Low Risk
		Migration of mobile contaminants from Made Ground soils to adjacent sites along services and conduits.	Adjacent site users (residential)	Medium x Unlikely = Low Risk
3	Potential unidentified petroleum hydrocarbons within subsurface of the Site.	Inhalation (indoor and outdoor).	Future site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Current site users (commercial)	Medium x Low likelihood = Moderate/Low Risk
			Adjacent site users (residential)	Medium x Low likelihood = Moderate/Low Risk
			Future maintenance workers	Medium x Low likelihood = Moderate/Low Risk
		Migration of ground gas / explosion.	Buildings and services	Severe x Low Likelihood = Moderate Risk

For definition of the terms used in the qualitative risk assessment, please see Appendix F.

9. CONCLUSIONS AND RECOMMENDATIONS

9.1. General

This Ground Investigation Report has been performed for Land at Gresford Road, located at Llay, Wrexham, LL12 0NW.

It has been assumed in the production of this report that the Site is to be redeveloped for a residential with home grown produce land use, comprising 2 No. sets of 3 No. houses. In addition, it has been assumed that ground levels will not change significantly from those described in this report. If this is not the case, then amendments to the interpretation and conclusions in this report may be required.

9.2. Flood Risk

The Site is not located in an area vulnerable to flooding.

9.3. Mining and Quarrying

Although the Site is located within an area in which historical mining activity has been identified, the Site is not considered to be at risk from shallow mining, due to the absence of shafts in shafts and cavities and the great depths (660m to 940m bgl) at which coal seams are present. Localised workings of shallow strata cannot be wholly discontented but given the historical use of the Site this is considered unlikely.

9.4. Geotechnical Parameters

The data obtained during the Ground Investigation has been assessed for the recorded soil types in order to provide characteristic values in order to aid the final foundation design.

Soil Classification

Cohesive Soils

Moisture content and Atterberg Limit testing was undertaken on samples from cohesive superficial material at the site. A summary of the results is shown in Table 9.1.

Table 9.1. Summary of Natural Moisture Content and Atterberg Limits

Parameter	No. Tests	Minimum	Maximum	Average
Natural MC %	4	11	15	10.8
Plastic Limit %	4	15	18	16.5
Liquid Limit %	4	32	37	33
Plasticity Index	4	13	19	16.5
Modified Plasticity Index	4	9.2	15.8	13

4 No. Atterberg Limit Tests were performed on samples of identified cohesive soil. All tests confirm the samples to be low plasticity clay materials with a low volume change potential.

Shear Strength

Standard Penetration Tests (SPTs) were carried out in all of the boreholes. The undrained shear strength of the natural clay strata tested has been estimated using the relationship developed by Stroud, where:

Cu = f1 x SPT N60 value

The value of f1 is dependent on the Modified Plasticity Index (Ip). By using the conservative Modified Plasticity Index of 16, a characteristic value of f1 = 6.5 has been derived.

Due to the shallow nature of hardstanding, reworked topsoil and Made Ground soils across the Site, with a maximum depth of 0.70m bgl, these strata were surpassed by the hand dug pits excavated to 1.20m bgl for service clearance. As such, there are no SPTs reported for these strata.

Within the cohesive Glacial Till 24 No. SPTs were performed, reporting N values ranging between N= 13 and N = 39. By applying the relationship developed by Stroud, as detailed above, shear strength values of between 85kPa and255kPa have been estimated for the natural clay strata. A general increase in estimated shear strength can be observed to correlate with increasing depth across the Site.

Based on these results a moderately conservative design undrained shear strength of 85kPa at 1.20m bgl, increasing to 135kPa at 3.00m bgl is assessed for the natural clay strata.

Granular Soils

Density Parameters

Due to the shallow nature of hardstanding, reworked topsoil and Made Ground soils across the Site, with a maximum depth of 0.70m bgl, these strata were surpassed by the hand dug pits excavated to 1.20m bgl for service clearance. As such, there are no SPTs reported for these strata.

A single SPT was performed on a granular sand layer contained within the Glacial Till, reporting an N value of N=14 at a depth of 1.20m bgl. As such, a representative angle of shearing resistance (φ) of approximately 31° is tentatively proposed for the purposes of guidance; however, it is considered that, due to the limited data pool from which this value has been derived, it is recommended that this value be used with caution.

Foundation Recommendations

It is considered that, under the current development proposals, traditional strip footing foundations should be appropriate for the proposed structures, due to the relatively thin nature of the Made Ground soils, with a maximum depth of 0.70m bgl, and the conservative estimated shear strength of 85kPa at 1.20m bgl, indicating an allowable bearing resistance of approximately 145kPa. Should a greater bearing resistance be required for the proposed loads, it is considered that they may be attained at increased depth, due to the correlative increased shear strength with depth.

It should be maintained that all foundations should be designed to specifications as described in NHBC Standards Chapter 4.2, with reference to foundation design in clays with a low volume change potential.

Portions of the Site are covered by former or existing facilities on the Site, including hard standing, floor slabs, foundations and a potential existing underground storage tank. This material is unsuitable for foundations and relict buried tanks, foundations and floor slabs should be broken out and removed to avoid the formation of hard spots. It may also be considered that, in the event that the underground storage tank is present and removal is performed, a localised area of deeper Made Ground would be resultant and, as such, would necessitate locally deeper foundations.

Floors

With regard to the design and construction of normal ground bearing floor slabs, it must be noted at the outset, that due to the thickness of Made Ground, unless appropriate measures are taken there may be a risk of significant total and differential settlements, the extent of which will be a matter of chance rather than being assessable by calculation.

Intermediate support designed on the same basis as the main foundations where the spans are too large for economical single suspended slab design for each individual plot.

Made Ground soils across the Site reach depths of up to 0.70m bgl, therefore, suspended floor slabs would be required in accordance with NHBC standards.

Earthworks

Construction plant should be provided with an adequate working platform in line with the requirements of BRE report, "BR 470: Working Platforms for Tracked Plant". Further advice should be sought from the temporary works designer; however, the following factors should be considered:

- It is understood that the existing Made Ground at the Site is to be excavated and re-engineered to remove buried obstructions beneath the proposed plots. Excavated materials will be processed and re-engineered as an Engineered Fill.
- The new Design CBR should be assumed to be equivalent to 2.5%; however, values of between 10% and 20% should be achievable given the material present at the Site.
- During construction, the *in situ* CBR value must be checked against the Design CBR value, to confirm design requirements are being met.
- Any excavation to remove the potential underground storage tank should be backfilled with suitably compacted material in order to minimise the risk of total differential settlement.

Groundworks, Excavation Stability and Groundwater Dewatering

Considering the high resting water levels reported during groundwater monitoring across the Site, it is our opinion that groundwater may present a potential difficulty when excavating the strata indicated in the boreholes. Excavations into existing Made Ground and the underlying natural soils should be assumed to be unstable. No man entry into unsupported excavations should be allowed without an appropriate risk assessment. Reference to CIRIA report 097 (1983) should be made to establish suitable means of support or battering of excavation sides.

It is recommended that all excavations to greater than 1.20 metres depth, or for shallower excavations where groundwater is encountered above this level are closely supported, especially where man entry is required. Alternatively, where space permits, the excavations might be battered back to an appropriate angle. Standing groundwater levels of between 0.20m and 3.00m were encountered in the boreholes. Should groundwater seepages occur and water accumulate in shallow excavations it should be able to be removed by pumping from a filtered sump; however, groundwater control by more robust means, such as well pointing, may be required locally.

It should be noted that should deep basements be constructed as part of the development then we would recommend that the standpipes are monitored for groundwater levels for an extended period of time and take into consideration seasonal variations and periods of very wet weather to measure the fluctuation of the standing water levels. It should be noted that groundwater inflows and levels are likely to be subject to seasonal and climatic variations.

Great care will need to be taken if reducing groundwater levels to ensure that adjoining nearby buildings, structures and services are not affected.

Pavements and Highways

Once the design layout is known and demolition/remediation is complete, then *in situ* testing should be carried out to derive CBR values.

The design of pavements and highways should be discussed with the relevant local authority if highways are to be subject to Section 38 agreement.

9.5. Soil and Groundwater Contamination

Risk Evaluation for the Proposed Land Use

Human health receptors

Olfactory evidence of contamination was encountered during the site works, comprising faint to moderate diesel and or undifferentiated hydrocarbon odours. No visual signs of contamination such as sheens or staining were observed in either the groundwater or soils encountered during exploratory works.

No asbestos was reported in any of the representative Made Ground samples obtained from the Site.

Measured concentrations of aromatic EC21 to EC35 and benzene were locally reported in excess of the respective screening criteria protective of human health for a residential with home grown produce land use. As such, it is considered that Made Ground soils at the site could present a potentially unacceptable risk to human health with respect to the proposed residential with home grown produce land use. As such, remedial measures are recommended in order to mitigate the potential risk to human health, as discussed in Section 7.

Controlled waters receptors

Groundwater samples collected from across the Site have identified localised (WS5) naphthalene, flouranthene, benzene and total petroleum hydrocarbons in concentrations elevated above the most stringent water quality standards. Due to the low sensitivity of the Site and localised nature of the contamination, it is considered that local groundwater should not be considered to present a potentially unacceptable risk to controlled waters; however, localised excavation is recommended to remove the remaining impacted soils and groundwater to minimise the potential risk.

Ecological receptors

No potential pollutant linkages to ecological receptors have been identified for the Site.

Maintenance Workers

Contamination may pose a short-term (acute) or long-term (chronic) risk to workers during maintenance. The potential risks must be specifically assessed as part of the health and safety evaluation for the works to be performed in accordance with prevailing legislation. Site practices must conform to the specific legislative requirements and follow appropriate guidance (e.g., HSE, 1991; CIRIA, 1996).

On the basis of the information obtained, it is recommended that potential risks are effectively communicated to future workers and that appropriate PPE is provided to reduce the risk or mitigate completely direct contact, inhalation and ingestion pathways.

Ground Gas

Based upon the ground gas assessment, the Site may be classified as a Characteristic Situation 2 – Low Risk; however, given the historic land use of the Site as a garage with associated storage tanks, underground storage tanks and a fuel filling area, a potential risk from volatiles generated from unidentified hydrocarbon contamination is considered possible. As a result, it is considered that a volatile resistant membrane be installed. This is considered to that a volatile resistant membrane will also provide sufficient protection from the potential minor carbon monoxide infiltration.

9.6. Invasive Plants

Invasive plant species were not observed on this Site. It is recommended that the presence of invasive plant species is confirmed by a qualified consultant ecologist and their advice taken on appropriate treatment. Treatment of any invasive species should take place in advance of the proposed construction works.

9.7. Outline Remediation Requirements

Clean Cover in Private Garden Areas

In order to remove the remaining pollutant linkages, it is considered that the soft landscaped/garden areas of the Site should be covered with a 600mm deep clean cover system (150mm Topsoil layer underlain by 450mm subsoil and a hi visibility Terram geotextile membrane). It is considered that as the proposed development is for residential with privately owned gardens with a potential for home grown produce, that a 600mm clean cover system with a geotextile membrane will provide sufficient thickness for the exposure scenarios typical for such a land use and the geotextile will provide a hi-visibility physical barrier in the unlikely event that any excavations are undertaken to this depth.

The source of the aggregates, imported subsoil and Topsoil material should be inspected and tested **prior to being brought to site** to ensure its chemical suitability and absence of any deleterious materials such as glass, metal, roots, invasive weed species and the like.

The depth and chemical suitability of the clean cover soils should be undertaken by a suitably experienced consultant and a verification report produced to discharge any associated planning conditions.

Water Supply Protection

Due to the known presence of hydrocarbon contamination on site, it is recommended that a Pipeline Risk Assessment be completed in order to assess the necessary piping required for implementation for water services on site; however, at this time it is anticipated that barrier pipe will be required for all proposed water services on site.

Uplift and Disposal of Underground Storage Tanks

Before soil removal can take place, it will be necessary to remove any existing and potentially previously unidentified USTs/interceptors on the site, notably in the western area of the Site, as identified during the site walkover and discussed in Section 3.

The procedures detailed in the Institute of Petroleum publication "Guidelines for the Uplift of Product from Petrol Filling Stations and Customer Tanks" should be followed. Prior to the commencement of works, the PLO will need to be notified with two weeks' notice.

Notwithstanding the above comments, before any work is commenced on the rendering permanently safe of an underground petroleum storage tank, any residual product within the tank shall be removed as far as is practically possible, this is known as "bottoming". In addition, it may also be then necessary to treat the base of the tank with a proprietary emulsifier or hydrocarbon adsorbent to ensure, so far as is practicable, that all residual hydrocarbons are removed.

Excavation and Offsite Removal of Soils bearing Visual/Olfactory evidence of Impact

If the site is to be redeveloped and materials are disposed off-site, then material exported from the site to landfill shall be hauled by a registered waste carrier in accordance with Duty of Care Regulations, 1991 and the Hazardous Waste Regulations, 2005.

It will be necessary to register the site in advance of the intended reclamation works with the Environment Agency before disposal to landfill can take place. There will be requirement for the waste producer to provide appropriate Waste Acceptance Criteria (WAC) testing of the soils for disposal to ensure that the soils are appropriately classified and that the landfill is licensed to receive such soils. A consignment note shall be completed, signed and retained by all parties involved. The consignment note shall state the volume of waste, a physical description of the material and statement of its chemical composition. The waste consignment notes shall be kept by the contractor for a period of at least two years.

Asbestos screen testing did not identify asbestos fibres in any of the Made Ground samples tested.

Final categorisation is the responsibility of the producer or holder of the waste. Additionally, liaison with the intended landfill operator may be required to confirm the acceptance and subsequent receipt of the waste.

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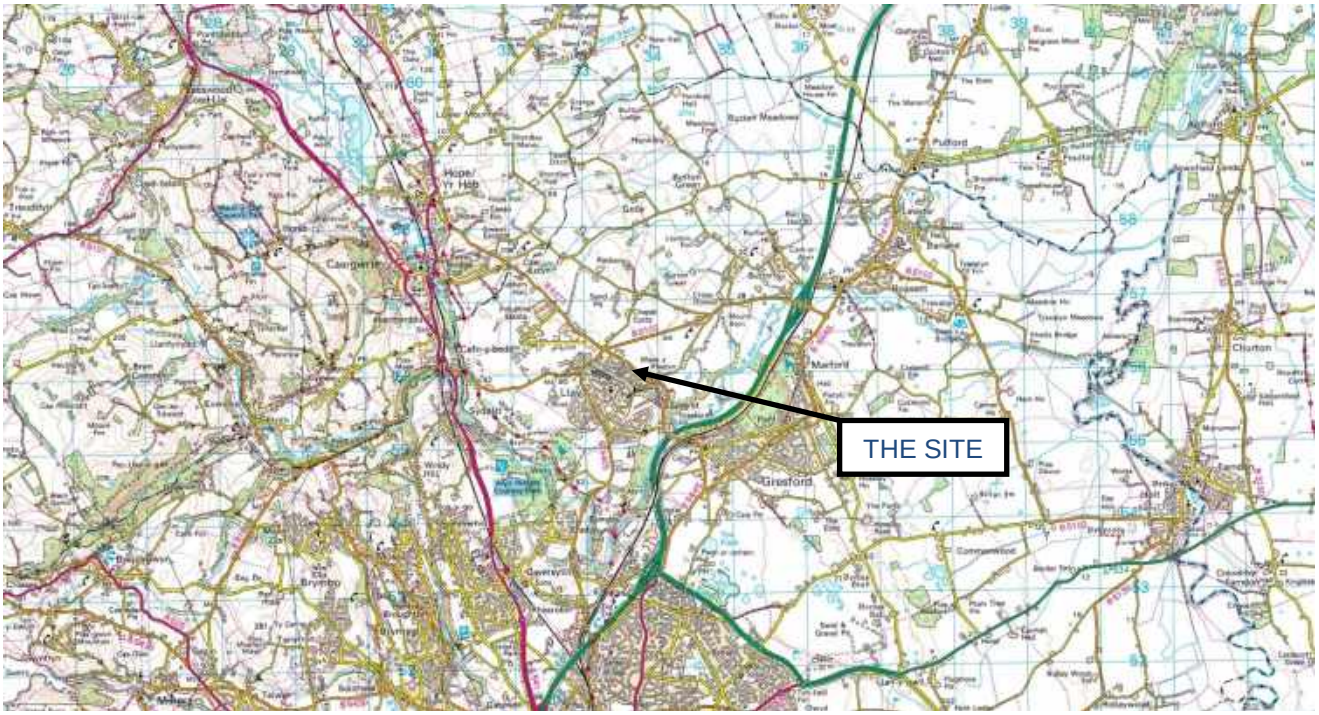
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APPENDIX A – FIGURES AND DRAWINGS

Contract Number	**TE1010**
Contract	Llay, Wrexham
Client	Tier Consult Ltd

Site Location Plan



Reproduced from the Ordnance Survey map with the permission of The Controller of Her Majesty's Stationary Office, © Crown Copyright. All rights reserved.

Scale	**NTS**		
Drawn by	OH	**Approved**	SL
Drawing Number	**TE1010/GIR/1**		

DO NOT SCALE

WS - Window Sample Location

REV	DATE	BY	DESCRIPTION	CHK	APD

DRAWING STATUS: DRAFT

Tier Consult Ltd.
Richmond House
Sandpiper Court
Chester Business Pa
Chester
CH4 9QZ
Telephone:
01244 684900
Fax:
01244 684901
Mobile:
07966 687066
Email:
info@tieruk.com

CLIENT: Tier Consult Ltd

ARCHITECT:

PROJECT: Llay
Wrexham

TITLE: Window Sample Location Plan

SCALE @ SIZE:	CHECKED:	APPROVED:
NTS	???	???
CAD FILE:	DESIGN/DRAWN:	DATE:
TE1010.GIR.WSLP	RH	May '17
PROJECT No:	DRAWING No:	REV:
TE1010	TE1010/GIR/WSLP	0

APPENDIX B – GLOSSARY OF TERMS

ACEC	Aggressive Chemical Environment for Concrete (classification)
aOD	Above Ordnance Datum
bgl	Below ground level
BGS	British Geological Survey
BRE	Building Research Establishment
CBR	California Bearing Ratio (test)
COMAH	Control of Major Accident Hazards (regulations)
Designated location	Site (and the ecosystem on that site) protected under national of international legislation. A potential ecological receptor to be considered as part of the assessment of land contamination. Example designated locations include SSSIs (q.v.), SACs (q.v.), national nature reserves, Ramsar sites and bird special protection areas.
DQA	Data Quality Assessment
DQO	Data Quality Objective
DQRA	Detailed Quantitative Risk Assessment
DWS	Drinking Water Standard
EQS	Environmental Quality Standard
GAC	Generic Assessment Criterion
GQA	General Quality Assessment (Environment Agency)
GSV	Gas Screening Value
HCV	Health Criteria Value
IPPC	Integrated Pollution Prevention and Control (regulations)
K_{ow}	Octanol-water partition coefficient
LEL	Lower Explosive Limit
LL	Liquid Limit
LoD	Limit of Detection (analytical)
LoQ	Limit of Quantification (analytical)
Mean Value Test	Statistical test (described in the CIEH Guidance) to estimate the mean value of a normally distributed population of data at a given level of confidence. Normally for contaminated land assessment, the 95th percentile (referred to as the 95%UCL or US95) is applied as a reasonable but conservative estimate of the mean concentration for comparison with the relevant assessment criteria.
Maximum Value Test	Statistical test (described in the CIEH Guidance) to identify whether an elevated concentration within a normally distributed data set forms part of the underlying population from which it has been sampled or whether it is an outlier (such as a localised area of contamination) that merits further consideration.
MC	Moisture Content
NGR	National Grid Reference
NIHHS	Notification of Installations Handling Hazardous Substances (regulations)
OS	Ordnance Survey
PI	Plasticity Index
PID	Photoionisation Detector
PL	Plastic Limit
ppm	Parts per million
ppmv	Parts per million by volume
QA	Quality Assurance
QC	Quality Control
SAC	Special Area of Conservation
SOM	Soil Organic Matter
SPT	Standard Penetration Test
SPZ	Source Protection Zone (see Appendix E)
SSAC	Site-Specific Assessment Criterion
SSSI	Site of Special Scientific Interest
SVOC	Semi-Volatile Organic Compound

TEF	Toxicity Equivalent Factor
TPH	Total Petroleum Hydrocarbons
TWA	Time Weighted Average
US95	95th percentile estimate of the true mean value of a data population (also known as 95%UCL).
VOC	Volatile Organic Compound

APPENDIX C – EXPLORATORY HOLE LOGS

Borehole Log

Borehole No. **WS01**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.72	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20 0.20	B ES		0.30	86.42		MADE GROUND: Dark brown, slightly gravelly, very clayey, fine SAND. Gravel is subangular, fine to coarse of coal and mudstone. REWORKED TOPSOIL
		1.20 1.20 - 1.65	D	N=20 (3,4/5,4,5,6)				Firm, stiff and very stiff consistency, red and mottled bluish grey, grey, pink and orange, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies sandstone, mudstone, quartzite and coal. Decayed plant present. GLACIAL TILL *A layer of angular, fine to coarse gravel of mudstone between 0.80m and 0.85m bgl.*
		2.00 2.00 - 2.45	D	N=30 (4,5/7,7,8,8)				
	▼	3.00 3.00 - 3.45	D	N=34 (4,5/6,5,6,17)				
		4.00		N=39 (4,5/6,6,10,17)				
					4.45	82.27		End of borehole at 4.45 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) Groundwater encountered at 3.00m bgl.

Borehole Log

Borehole No. **WS02**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.98	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.30	86.68		MADE GROUND: Dark brown and mottled dark grey, clayey, very gravelly, fine SAND. Gravel is angular to subangular, fine to coarse of mudstone, coal and concrete.
					0.60	86.38		REWORKED TOPSOIL
		1.20		N=14 (2,2/3,3,4,4)				Firm consistency, orange and mottled pink, grey and yellow, sandy, gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of limestone and mudstone. Decayed rootlets present.
								GLACIAL TILL
					1.80	85.18		Red, gravelly, medium SAND. Gravel is subangular to subrounded, fine of mixed natural lithologies including coal and quartz.
	▼	2.00		N=22 (3,4/4,5,6,7)				GLACIAL TILL
		2.00 - 2.45	D					*Interbedded layer of bluish grey and mottled yellow, slightly gravelly, sandy CLAY between 0.90m and 1.00m bgl. Gravel is angular, fine to medium of coal. Decayed plant debris present.*
		3.00		N=32 (6,7/7,8,8,9)				*Interbedded layer of bluish grey and mottled yellow, slightly gravelly, sandy CLAY between 1.15m and 1.20m bgl. Gravel is angular, fine to medium of coal. Decayed plant debris present.*
		3.00 - 3.45	D					*Becoming firm consistency, very gravelly from 1.30m bgl. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including coal and mudstone.*
								Interbedded layer of bluish grey and mottled yellow, slightly gravelly, sandy CLAY between 1.45m and 1.50m bgl. Gravel is angular, fine to medium of coal. Decayed plant debris present.
		4.00		N=33 (6,7/7,8,8,10)				Stiff and very stiff consistency, red and mottled pink and grey, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of limestone, sandstone and coal. Decayed plant debris present.
		4.00 - 4.45	D					GLACIAL TILL
		5.00		N=34 (6,6/8,8,9,9)				*Very wet between 2.10m and 2.40m bgl. Gravel becoming subangular to subrounded, fine to medium of mixed igneous and metamorphic lithologies.*
		5.00 - 5.45	D					*Becoming mottled blue from 3.80m bgl.*
					5.45	81.53		End of borehole at 5.45 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) Groundwater encountered at 2.10m bgl.

Borehole Log

Borehole No. **WS03**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.92	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼	0.30	ES		0.40	86.52		MADE GROUND: Red and mottled pink, brown, sandy GRAVEL. Gravel is angular to subrounded, fine to coarse of limestone, mudstone, tile and brick. MADE GROUND
		0.80	ES					Firm and stiff consistency, reddish brown, becoming brown, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including sandstone, quartzite, coal and mudstone. GLACIAL TILL
		1.20 1.20 - 1.65	D	N=19 (2,3/4,5,5,5)				*Becoming stiff consistency from 1.50m bgl.*
		2.00 2.00 - 2.45	D	N=20 (3,4/5,5,5,5)				
		3.00 3.00 - 3.45	D	N=23 (3,4/5,5,6,7)				
		4.00 4.00 - 4.45	D	N=27 (4,5/5,7,7,8)				
					5.00	81.92		End of borehole at 5.00 m

Remarks

1) Borehole cored to 1.00m bgl. 2) Hand dug pit to 1.20m bgl for service clearance purposes. 3) Borehole stable. 4) Groundwater encountered at 0.20m bgl.

Borehole Log

Borehole No. **WS04**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.92	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.40	ES		0.20	86.72		MADE GROUND: Greyish brown, sandy GRAVEL. Gravel is angular to subangular, fine to coarse of concrete and limestone. MADE GROUND
		0.80	ES		0.50	86.42		MADE GROUND: Soft consistency, grey, sandy, gravelly CLAY. Gravel is angular to subangular, fine to coarse of limestone and coal. Mild hydrocarbon and humic odour. MADE GROUND
		1.20 1.20 - 1.65	D	N=22 (3,4/5,5,6,6)	1.00	85.92		Firm consistency, grey and mottled yellow and brown, sandy, gravelly CLAY. Gravel is angular to subangular, fine to coarse of coal and mudstone. GLACIAL TILL
		2.00 2.00 - 2.45	D	N=24 (4,5/5,6,6,7)				Stiff and very stiff consistency, reddish brown and mottled pink, grey and yellow, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including limestone, coal, mudstone and quartzite. GLACIAL TILL
		3.00 3.00 - 3.45	D	N=25 (4,5/6,5,6,8)				
		4.00 4.00 - 4.45	D	N=31 (4,5/7,7,8,9)				
					4.45	82.47		End of borehole at 4.45 m

Remarks

1) Borehole cored to 1.00m bgl. 2) Hand dug pit to 1.20m bgl for service clearance purposes. 3) Borehole stable. 4) Groundwater encountered between 3.10m and 3.20m bgl.

Borehole Log

Borehole No. **WS05**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.65	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼	0.30	ES		0.40	86.25		MADE GROUND: Grey, sandy, very clayey GRAVEL. Gravel is angular, fine to coarse of brick, concrete, macadam, limestone and sandstone. Moderate diesel odour. MADE GROUND
		0.90	ES					Firm and stiff consistency, yellow and mottled grey, becoming reddish brown and mottled grey, sandy, gravelly CLAY. Gravel is angular to rounded, fine to coarse of coal and mudstone., sandstone and quartzite. GLACIAL TILL
		1.20 1.20 - 1.65	D	N=14 (3,3/3,3,4,4)				*Mild hydrocarbon odour between 0.40m and 1.30m bgl. Becoming stiff consistency, reddish brown and mottled grey from 1.50m bgl.*
		2.00 2.00 - 2.45	D	N=18 (3,4/4,4,4,6)				
		3.00 3.00 - 3.45	D	N=23 (4,4/5,5,6,7)				
		4.00 4.00 - 4.45	ES	N=26 (4,5/5,6,7,8)				
					4.45	82.20		End of borehole at 4.45 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) Groundwater encountered at 0.30m bgl.

Borehole Log

Borehole No. **WS06**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.66	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20	ES		0.05	86.61		MADE GROUND: Concrete.
					0.30	86.36		MADE GROUND
								MADE GROUND: Red, very gravelly, medium SAND. Gravel is angular to subangular, fine to coarse of brick, quartzite and limestone.
								MADE GROUND
		1.20		N=13 (2,3/3,3,3,4)				Firm consistency, becoming stiff and very stiff consistency, orange and mottled pink and grey, becoming reddish brown and mottled grey, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including mudstone, coal quartzite. Decayed plant debris present.
		1.20 - 1.65	D					
		1.90 - 2.00	D					
		2.00		N=20 (3,4/4,5,5,6)				GLACIAL TILL
		3.00		N=26 (4,5/6,6,7,7)				
		3.00 - 3.45	D					
		4.00		N=26 (4,4/5,6,7,8)				
		4.00 - 4.45	D					
					4.45	82.21		End of borehole at 4.45 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) No groundwater ingress encountered.

Borehole Log

Borehole No. **WS07**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.96	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.15	86.81		MADE GROUND: Grey, sandy, GRAVEL. Gravel is angular, fine to coarse of limestone, flint, quartzite and mudstone. MADE GROUND
		1.00	D					Stiff, becoming very stiff consistency, brown, becoming reddish brown and mottled grey, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including mudstone, quartzite, coal and limestone. GLACIAL TILL
		2.00	D					*Becoming very stiff consistency and reddish brown from 1.40m bgl.*
					3.00	83.96		End of borehole at 3.00 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) No groundwater ingress encountered.

Borehole Log

Borehole No. **WS08**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.87	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.05	86.82		MADE GROUND: Tarmacadam.
					0.20	86.67		MADE GROUND
		0.50	ES					MADE GROUND: Grey, sandy GRAVEL. Gravel is angular to subangular, fine to coarse of concrete and limestone.
					0.70	86.17		MADE GROUND
		1.10	ES					MADE GROUND: Firm consistency, grey, sandy, gravelly CLAY. Gravel is angular to subangular, fine to coarse of brick, coal and mudstone. Moderate hydrocarbon odour.
								MADE GROUND
		2.10 - 2.20	D					Firm consistency, becoming stiff consistency grey and mottled yellow, becoming red and mottled grey, sandy, gravelly CLAY. Gravel is angular to subangular, fine to coarse of mixed natural lithologies including mudstone, limestone, quartzite and coal.
								GLACIAL TILL
								A faint hydrocarbon odour between 0.70m and 1.30m bgl.
								Becoming stiff consistency, red and mottled grey from 2.00m bgl.
					3.00	83.87		End of borehole at 3.00 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) No groundwater ingress encountered.

Borehole Log

Borehole No. **WS09** Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.58	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30	ES		0.10	86.48		MADE GROUND: Tarmacadam. MADE GROUND
					0.40	86.18		MADE GROUND: Dark brown, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of brick, sandstone and limestone. MADE GROUND
								Firm consistency, becoming stiff consistency, yellow and mottled grey, becoming red and mottled bluish grey and pink, sandy, gravelly CLAY. Gravel is subangular to subrounded, fine to coarse of mixed natural lithologies including mudstone, limestone, sandstone and quartzite. GLACIAL TILL
								Becoming stiff consistency, red and mottled bluish grey and pink from 1.30m bgl.
					3.00	83.58		End of borehole at 3.00 m

Remarks
1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) No groundwater ingress encountered.

Borehole Log

Borehole No. **WS10**

Sheet 1 of 1

Project Name: Llay, Wrexham	Project No. TE1010	Co-ords: -	Hole Type WS
Location: Wrexham, North Wales		Level: 86.72	Scale 1:50
Client: Tier Consult		Dates: 22/05/2017 -	Logged By OH

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.40	ES		0.10	86.62		MADE GROUND: Tarmacadam.
					0.30	86.42		MADE GROUND
					0.60	86.12		MADE GROUND: Dark grey and mottled black, sandy GRAVEL. Gravel is angular to subrounded, fine to coarse of brick and limestone.
		1.00	ES					MADE GROUND
								MADE GROUND: Firm consistency, grey and mottled yellow, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of brick and mixed natural lithologies including mudstone. Reworked clay.
								MADE GROUND
								Firm consistency, becoming stiff consistency, yellowish brown and mottled grey, becoming red and mottled bluish grey and yellow, sandy, gravelly CLAY. Gravel is angular to subrounded, fine to coarse of mixed natural lithologies including mudstone, sandstone and quartzite.
					3.00	83.72		GLACIAL TILL
								A mild hydrocarbon odour between 0.60m and 1.10m bgl.
								End of borehole at 3.00 m

Remarks

1) Hand dug pit to 1.20m bgl for service clearance purposes. 2) Borehole stable. 3) No groundwater ingress encountered.

APPENDIX D – PHOTOGRAPHS TAKEN DURING SITE WALKOVER AND INVESTIGATION

Photograph 1: Western side of the former dealership, looking east, showing above ground tank



Photograph 2: View of crack in eastern wall of former bungalow, looking northwest



Photograph 3: View of courtyard, looking north, showing potential underground storage tank



Photograph 4: View of forecourt, looking east, showing former fuelling pump location



APPENDIX E – DEFINITION OF SOURCE PROTECTION ZONES AND GROUNDWATER VULNERABILITY ASSESSMENTS

Source Protection Zones

Source Protection Zones (SPZs) are defined by the Environment Agency (for England and Wales), SEPA (Scotland) and the Environment and Heritage Service (Northern Ireland) for groundwater sources such as wells, boreholes and springs that are used for public drinking water supply. The zones show the risk of contamination from activities that might cause groundwater pollution in the area. The size and shape of a zone depends upon subsurface conditions, how the groundwater is removed, and other environmental factors.

SPZs are classified into four categories:

- **Zone 1 (Inner protection zone).** Any pollution that can travel to the abstraction point within 50 days from any point within the zone is classified as being inside Zone 1. This applies at and below the groundwater table. This zone also has a minimum 50 m protection radius around the abstraction point. These criteria are designed to protect against the transmission of toxic chemicals and water-borne disease.

- **Zone 2 (Outer protection zone).** The outer zone covers pollution that takes up to 400 days to travel to the abstraction point, or 25% of the total catchment area, whichever area is the largest. This travel time is the minimum period over which the Environment Agency considers that pollutants need to be diluted, reduced in strength or delayed by the time they reach the abstraction point.

- **Zone 3 (Total catchment).** This is the total area needed to support removal of water from the abstraction point, and to support any discharge from this.

- **Zone of special interest.** This may occasionally be defined as a special case. This is usually where local conditions mean that industrial sites and other potential sources of contamination could affect the groundwater source, even though they are outside the normal catchment area.

Groundwater Vulnerability Assessments

From 1 April 2010 The Environment Agency Groundwater Protection Policy began to use aquifer designations which are consistent with the Water Framework Directive. These designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems.

The aquifer designation data is based on geological mapping provided by the British Geological Survey. It is updated regularly to reflect their ongoing programme of improvements to these maps. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.

- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Table 1. Aquifer Classification ("Geological Classification").

Classification	Definition
Principal Aquifers (Highly Permeable)	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A Aquifers	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifers	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifers	This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

APPENDIX F- DEFINITIONS OF TERMS USED IN QUALITATIVE AND QUANTITATIVE RISK ASSESSMENTS

For the qualitative and quantitative assessment of risks posed by potential pollutant linkages have been undertaken using the risk matrix adapted from CIRIA C552 and outlined in the table below.

	Category	Definition
Potential severity	Severe	Acute (short term) risk to human health, Major pollution of sensitive controlled waters, ecosystems or habitat. Catastrophic damage to buildings or property or crops.
	Medium	Chronic (Medium / long term) risk to human health Pollution of sensitive controlled waters, ecosystems or species, Significant damage to crops, buildings or structures
	Mild	Easily preventable permanent health effects on humans. Pollution of non-sensitive controlled waters. Minor damage to buildings or structures.
	Minor	Easily preventable non-permanent health effects on humans, or no effects. Minor, low level and localised contamination of on-site soil. Easily repairable damage to buildings or structures.
Probability of risk	High Likelihood	Pollutant linkage may be present and the risk is almost certain to occur , or there is evidence of harm already occurring.
	Likely	Pollutant linkage may be present and it is probable that the risk will occur over the long term.
	Low Likelihood	Pollutant linkages may be present and there is a possibility of the risk occurring, although there is no certainty that it will do so.
	Unlikely	Pollutant linkage may be present but the circumstances under which harm would occur are improbable.

		Potential Severity			
		Severe	**Medium**	**Mild**	**Minor**
Probability of risk	**High Likelihood**	Very high	High	Moderate	Moderate/Low
	Likely	High	Moderate	Moderate/Low	Low
	Low Likelihood	Moderate	Moderate/Low	Low	Negligible
	Unlikely	Moderate/Low	Low	Negligible	Negligible

APPENDIX G – ASSESSMENT CRITERIA APPLIED FOR GROUND GAS

Monitoring for the following is generally performed as part of ground gas assessment:

- Methane (CH_4): an odourless, flammable gas. Mixtures of methane with air containing between 5 and 15% v/v methane are explosive.
- Carbon dioxide (CO_2): an asphyxiant at elevated concentrations. Denser than air, it can accumulate in excavations, and within low points inside buildings
- Oxygen (O_2): important in the assessment of the potential formation of explosive mixtures with methane. Monitoring normally measures both methane and oxygen concentrations in ground gas to derive an indication of the risk of explosive mixture formation, expressed as a percentage of the Lower Explosive Limit (LEL). Low concentrations of oxygen in ground gas can also exacerbate the risk of CO_2 asphyxiation.
- Hydrogen sulphide (H_2S): odorous and toxic, capable of forming flammable mixtures with air.
- Volatile Organic Compounds (VOCs): present as chemical contaminants of soil and sometimes also biologically produced in low concentrations.

Assessment of methane (CH_4) and carbon dioxide (CO_2)

Methane and CO_2 can arise from natural geological sources, mine workings, rotting organic matter (peat, landfilled materials, etc.) and/or contaminant biodegradation. Assessment of ground gas composition and flows is therefore an essential part of site assessment. The need to adequately address potential risks from ground gas on development sites is therefore required under the planning regime.

In order to appropriately assess the site risks, the Construction Industry Research and Information Association (CIRIA) and others have issued several guidance documents on landfill and ground gas that are intended to provide advice on how to investigate and deal with gas contaminated ground with respect to development. These are:

- Report 149: ‘Protecting Development from Methane’ (CIRIA, 1995a)
- Report 150: ‘Methane Investigation Strategies’ (CIRIA, 1995b)
- Report 151: ‘Interpreting Measurement of Gas in the Ground’ (CIRIA, 1995c)
- Report 152: ‘Risk Assessment for Methane and Other Gases from the Ground’ (CIRIA, 1995d)

More recent guidance has been published to update the documents detailed above to collaborate and promote industry ‘good practice’. These are:

- CIRIA Report 665: ‘Assessing risks posed by hazardous ground gases to buildings (CIRIA, 2008)
- NHBC: ‘Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present’ (NHBC, 2007)
- •BS8485: Code of Practice for the characterisation and remediation from ground gas in affected developments (BSI Group, 2007)

The earlier CIRIA 149 approach is now considered to be too conservative. A more realistic measure of the risk posed by methane and CO_2 in ground gas can be established by determining an appropriate Gas Screening Value (GSV), using the methods described in the NHBC and CIRIA 659 documents. These values are based upon earlier work undertaken by Wilson and Card (1999).

GSVs are calculated by multiplying the borehole flow rate (l/hr) by the percentage (% v/v) concentration in the gas stream of the specific component, i.e.:

GSV = (Concentration / 100) x Flow rate.

A risk-based methodology for deriving GSVs is defined for two situations (designated A and B), which are adequate for the great majority of site cases:

- Situation A: All development types except low rise housing with gardens
- Situation B: Low rise housing with gardens.

Under Situation A, classification of the scope of protection required is determined from the site GSV, summarised in Table 1. For Situation B, GSVs derived are used in a 'Traffic Light' classification (summarised in Table 2) which determines the required level and scope of protection measures. Tables 1 and 2 are summaries only: the details provided in the body text, footnotes and appendices of the above-referenced documents should be read in conjunction with the results to determine the appropriate level of protection.

For conservatism, Tier Environmental uses the maximum concentration and gas flow rate of methane detected in any borehole during all of the monitoring visits in deriving recommendations on appropriate protection measures. This represents the worst-case risk of forming an explosive mixtures. For CO_2, steady state concentrations and flow data are applied, as these determine the development of an asphyxiating mixture. All values are selected whether or not they occurred in the same borehole or during the same monitoring event.

Exceedences of the maximum concentrations used in a Tier 1 Gas Risk Assessment can be tolerated, when the conceptual model indicates that it is safe to do so. However, GSV values must never be exceeded - where site-specific circumstances permit the derivation of alternative GSVs according to the defined conceptual model, then the appropriate GSV values should be applied.

Table 1. GSV Categories Defined for Situation A (Summarised from CIRIA Report 665).

Risk classification	GSV (CH_4 or CO_2; l/hr)	Additional factors	Characteristic situation
Very low	<0.07	Typically methane <=1% and/or CO_2<=5%, otherwise consider increase to Low Risk.	1
Low	<0.7	Typically borehole ground gas flow rate <=70 l/hr; otherwise consider increase to Moderate Risk.	2
Moderate	<3.5	---	3
Moderate to high	<15	QRA required to evaluate scope of remediation measures.	4
High	<70	---	5
Very high	>70	---	6

Table **2.** GSV Categories Defined for Situation B (Summarised from NHBC, 2007).

Methane		CO_2		"Traffic light" classification
Typical max. conc. (% v/v)	GSV (l/hr)	Typical max. conc. (% v/v)	GSV (l/hr)	
				Green
1	0.13	5	0.78	
5	0.63	10	1.60	Amber 1
20	1.60	30	3.10	Amber 2
				Red

Assessment of hydrogen sulphide (H_2S)

H_2S is toxic and highly odorous ("rotten eggs") gas. It is often a minor component within mine gases, in ground gas within or overlying strata rich in pyrites or other sulphide-rich ores, and in most natural gas fields.

H_2S can be generated biologically in significant concentrations by the decomposition by sulphate-reducing bacteria of natural or anthropogenic organic matter under oxygen-free conditions. Its potential generation will be greater in environments containing elevated sulphate concentrations (including sea water). H_2S is therefore common within the gas arising from estuarine and marine sediments, pond sediment, stagnant water bodies, bogs and marshlands and landfilled waste, for example.

It must be noted that H_2S normally occurs together with other potentially hazardous ground gases. The measures adopted for protection against these will prove equally protective against H_2S.

There are no standards by which H_2S concentrations in ground gas can be assessed directly. Therefore, the significance of measured H_2S concentrations in ground gas must be evaluated on a case-by-case basis, taking into account the measured concentrations of other components and the specific conceptual site and exposure models. To assist in this process, the following standards and guidance may be applied.

General protection of land users

There are no UK air quality standards for general exposure to H_2S. The World Health Organisation has derived ambient air quality standards (WHO, 2000) for this gas, which may be used to inform risk assessment and decision-making:

- The 24 hour average exposure guideline value for ambient air: 0.15 mg/m^3 (0.1 ppmv, approx.; this was derived by the application of a 100x safety factor to the LOAEL for long-term exposure).
- This is significantly above the odour threshold, which is typically around 0.01 mg/m^3. To avoid substantial nuisance odour complaints, WHO (2000) recommends that the 30 minute average H_2S concentration in ambient air should not exceed: 0.007 mg/m^3 (0.005 ppmv, approx.).

Occupational exposures

For occupational exposure, the HSE (2005) limits for H_2S are applicable:

- 8 hour time weighted average occupational exposure limit: 5 ppmv (7 mg/m^3).
- Short-term exposure limit (15 minute reference period): 10 ppmv (14 mg/m^3).

Assessment of VOC data

The assessment of VOC concentrations is not covered by above-referenced reports. These data can be used to inform the human health risk assessment for site occupants but should not be relied upon to assess human health risk due to uncertainties in the ground gas flow regime, variability in the (generally low) contaminant concentrations measured and inaccuracies in the concentrations measured by PID instruments.

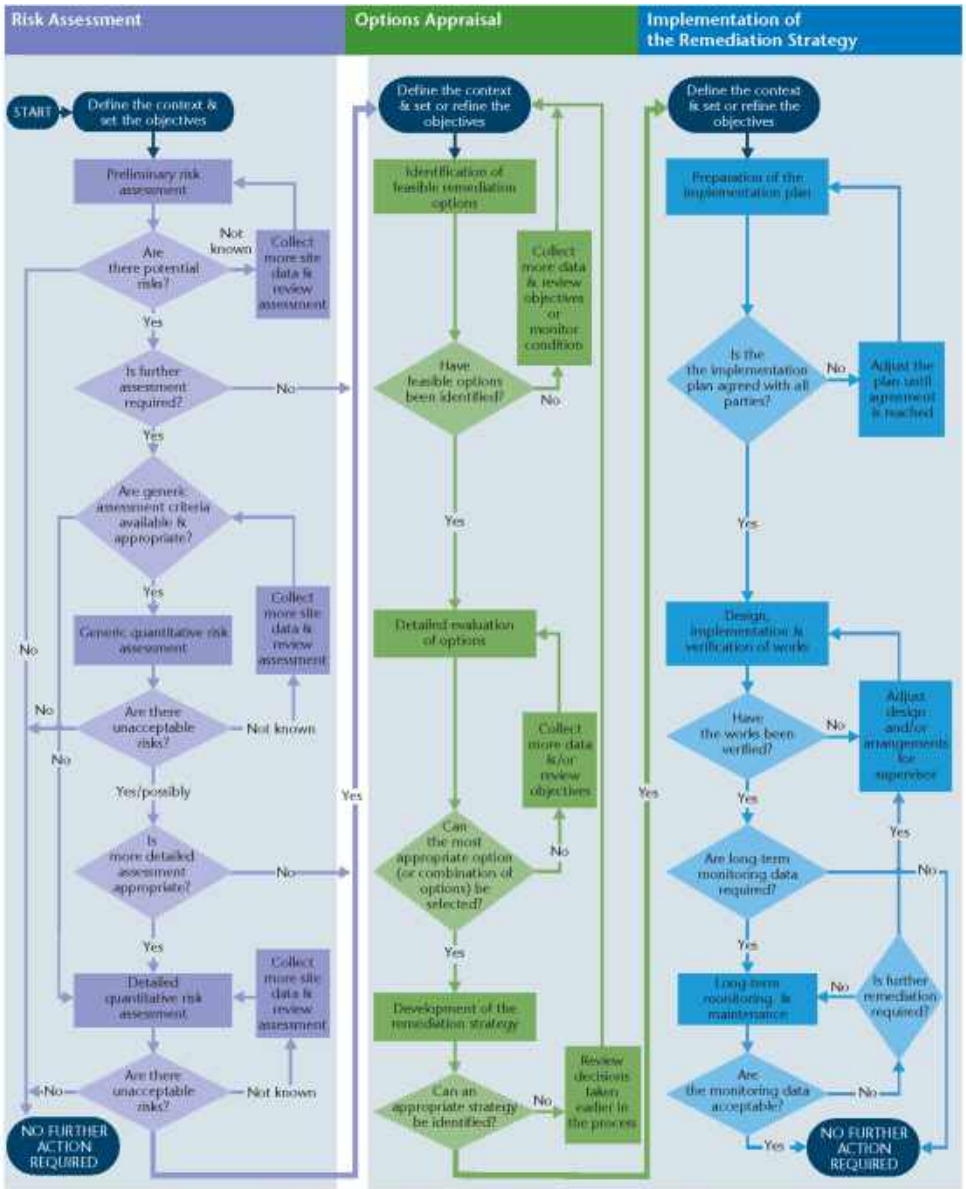
Data on the VOC concentration in ground gas can also help inform potential occupational exposure risks to construction and similar workers. For this purpose, the measured values can be compared to the relevant occupational exposure limit (OEL) for the contaminant(s) of concern, as given in HSE (2005). In cases of doubt as to the identity of the organic contaminants within the ground gas or when these are present as a complex mixture, then the 8 hour time-weighted average (TWA) exposure limit for benzene (1 ppmv) will be applied for screening purposes. This is a reasonably conservative approach since the OEL for benzene is lower than that for the great majority of organic contaminants commonly encountered in soil and groundwater at contaminated sites

APPENDIX H- HUMAN HEALTH ASSESSMENT CRITERIA

Context

Contaminated Land is defined under law through Part IIA of the Environmental Protection Act 1990, implemented through Section 57 of the Environment Act 1995 and associated guidance ("Part IIA"). These specify that a "suitable for use" approach is to be applied in the assessment of potentially contaminated land, implemented through a phased programme of site investigation and risk assessment appropriate to the site under consideration.

The assessment of potential risks posed by contaminated land is based upon the assessment of plausible contaminant source - pathway - receptor linkages ("pollutant linkages") for the current and/or proposed future use of the site. The process for the assessment of contaminated land adopted in this report is in line with guidance issued by DEFRA and Environment Agency (EA) 2004: "Model Procedures for the Management of Contaminated Land (CLR11)". The overall process for the management of land contamination is shown Figure 1 of CLR11 and reproduced below:



Note: The process may apply to one or more pollutant linkages each of which may follow a different route. For some linkages, it may be possible to stop at an early stage – others will progress all the way through the process. The level of complexity of each stage may also vary and in some cases may be very simple.

The risk assessment and subsequent investigation, remediation and verification must address all potential sources of pollutants that may be present on the site (the "hazards"), all receptors that may be harmed by these (e.g. human health, controlled waters, ecological receptors) and the pathways by which the contamination may be transported from the

contaminant source(s) to the receptor(s). This is defined within the conceptual model for the site, which represents the characteristics of the site in a form that shows the possible pollutant linkages. As further information becomes available (for example, through site investigation), so the conceptual model will be refined.

Remedial action can be specified at any phase within this assessment process to break the identified pollutant linkage In determining whether or not to undertake further assessment or to undertake remediation, the potential cost-savings arising from a more thorough assessment of the pollutant linkages and more tightly defined remedial strategy must be considered against the direct costs involved in the work and the time that this will take to execute and gain regulatory approval.

A different approach to the statistical appraisal of data is required depending on whether the assessment is being undertaken to assess land as Contaminated Land in accordance with the regulations or whether the assessment is to assess whether the site is suitable for new development in accordance with the Planning regime. The statistical approach to assessment is discussed further in CL:AIRE:2009 “Guidance on Comparing Data with a Critical Concentration”.

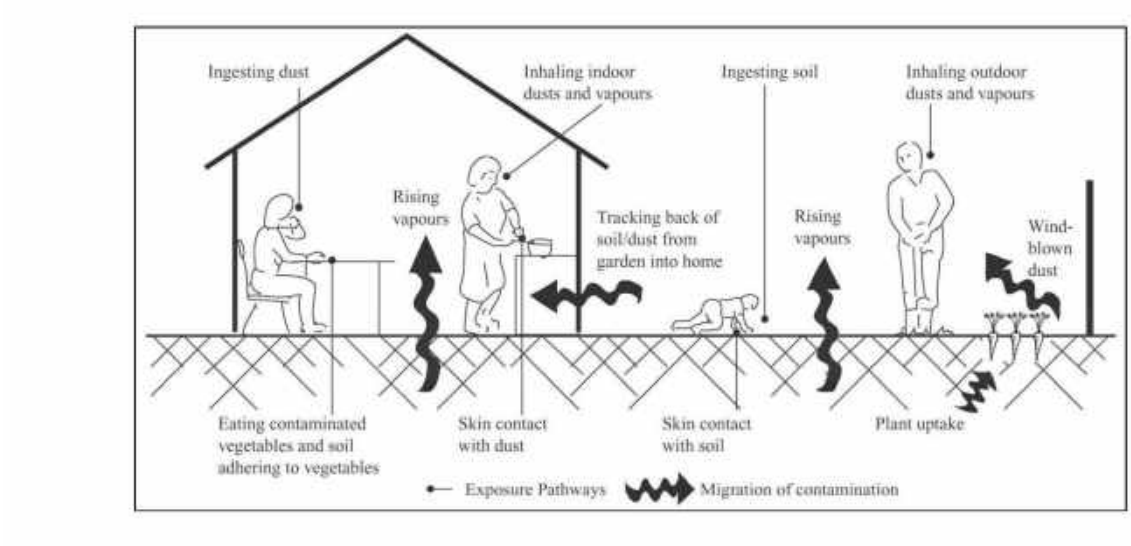
Some form of Detailed Quantitative Risk Assessment (DQRA) will be essential for those cases where appropriate GAC values cannot be established for the contaminant linkages under consideration.

Generic Assessment Criteria for Human Health Risk Assessment

In March 2002, the Department for Environment, Food and Rural Affairs (DEFRA) and the Environment Agency (EA) published the Contaminated Land Exposure Assessment (CLEA) Model and a series of related reports and guidance. These were designed to provide a scientifically based framework for the assessment of chronic risks to human health from contaminated land. The initial documents (CLR7 – 10) were withdrawn and replaced with revised guidance issued by the Environment Agency including:

- "Using Soil Guideline Values"; SC050021/SGV Introductions, EA,2009;
- "Human Health toxicology assessment of contaminants in soil"; SC050021/SR2, EA, 2009;
- "Update technical background to the CLEA model"; SC050021/SR3, EA, 2009;
- CLEA Software (Version) Handbook; SC050021/SR4; EA, 2008;
- Compilation of Data for priority Organic Contaminants for Derivation of Soil Guideline Values; Science Report SC050021/SR7, 2008; and,
- Guidance on Comparing Data with a Critical Concentration; CL:AIRE, 2009.

The CLEA model and associated guidance was developed to calculate an estimated tolerable daily intake (TDI) of contaminants for site users given a set of 'typical 'human health exposure pathways which are detailed in "SR3: Updated technical background to the CLEA model" (Science Report SC050021/SR3, EA, 2009) and reproduced below.



- **Ingestion**
  - Outdoor soil;
  - Indoor dust;
  - Home grown produce;
  - Soil attached to home grown produce.
- **Dermal Contact**
  - Outdoor soil;
  - Indoor dust.
- **Inhalation**
  - Outdoor dust;
  - Indoor dust;
  - Outdoor vapour;
  - Indoor vapour.

It should be noted that the CLEA model does not include an exhaustive list of potential exposure pathways, e.g. certain compounds can pass through plastic water pipes into drinking water supply.

The potential significance of each of the exposure pathways is dependent upon the type of land use and the nature of the contaminant being considered. The CLEA model considers principal 'default' land use scenarios and makes a series of assumptions with regards to building type (where applicable), identification of the critical human receptor group, exposure frequency and duration. The definitions of the principal land use types given in SR3 (EA, 2009) are:

- **Residential land use;**
  A typical residential property consisting of a two story terraced house built on a ground-bearing slab of 0.15m thickness with a private garden consisting of lawn, flowerbeds, and a small fruit and vegetable patch. The occupants are assumed to be parents with young children, who make regular use of the garden. The critical receptor is a 0 – 6 year old female.

  Active exposure pathway are: ingestion of outdoor soil, ingestion of indoor dust, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and indoor dust and vapour.

- **Allotments**
  A plot of open space commonly made available by the Local Authority to tenants to grow fruit and vegetables for their own consumption. There are usually several plots to a site and the overall site area may cover more than one hectare. The tenants are assumed to be the parents or grandparents and that young children make occasional accompanied visits to the plots. The critical receptor is a 0 – 6 year old female and there is no building present on Site.

  Active exposure pathways are ingestion of outdoor soil, ingestion of home grown produce and soil adhering to home grown produce; direct dermal contact with outdoor soil; inhalation of outdoor vapour.

- **Commercial and industrial land use.**
  A typical commercial or light industrial property consisting of a three-story office building (pre-1970) with a ground bearing floor slab at which employees spend most time indoors and are involved in office based or related light physical work. The critical receptor is a working female adult aged 16 – 65 years.

  Active exposure pathway are ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor dust; inhalation of outdoor dust and vapour and inhalation of indoor dust and vapour.

Soil Guideline Values

Based on the assumption of each land use type, the EA and DEFRA developed and published Soil Guideline Value (SGV) using the CLEA model for a number of principal contaminants and 'default' end-use scenarios of residential, allotments and commercial/industrial use. The primary purpose of the SGVs are as trigger value for the tolerable daily intake (TDI), below which it can be assumed that the soil does not pose an unacceptable risk to the identified receptor. Where soils contamination is present above this level further assessment may be required. SGVs were developed for the following contaminants:

- Heavy metals and other inorganic compounds: arsenic, cadmium, chromium, cyanide, lead (now withdrawn), mercury, nickel and selenium;
- Benzene, ethylbenzene, toluene and xylenes;
- Phenol;
- Dioxins and dioxin-like polychlorinated biphenyls (PCBs)
- Polycyclic aromatic hydrocarbons (PAHs) – 11 substances

LQM/CIEH Generic Assessment Criteria of Human Health Risk Assessment

In addition, in 2009 CIEH through LQM and EIC published generic assessment criteria (GACs) for 82 substances including metals, petroleum hydrocarbons, PAHs and explosive substances for a variety of soil types and the three 'default' land uses – (residential, allotments and commercial end-uses) as described in SR3 (EA, 2009). These have been superseded as described below.

Category 4 Screening Values

In 2013 "SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination" (CL:AIRE 2013) was issued which detailed findings of a research project undertaken by CL:AIRE to set out the framework by which potential Category 4 Screening Levels (pC4SL) may be derived. This was supplemented in 2014 by "SP1010: Development of Category 4 Screening Levels for the Assessment of Land Affected by Contamination – Policy Companion Document" (DEFRA, 2014). SP1010 proposed several updated toxicology information relating to contaminant behaviour updated assumptions relating to the modelling of human exposure to soil contaminants, derivation of separate C4SLs for residential with the consumption of home grown produce, residential without the consumption of home grown produce, and two new land uses: public open spaces near residential housing (POS resi) and public parks (POS park).

- **Public Open Space: Residential**
  For public open space in close proximity to residential housing and the central green area around which houses are located, as on many housing estates from the 1930s to 1970s. It is also applicable for smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soil with planting. It is considered to be a generally grassed area up to 0.5ha with up to 50% bare soil. The land use is an important resource for children and the area is near the homes. The critical receptor is a female child age >3 - <9 years old (CLEA age class 4 – 9) as younger children are unlikely to play outdoors unsupervised.

  Active exposure pathways are: ingestion of outdoor soil, ingestion of indoor dust; direct dermal contact with outdoor soil and indoor soil derived dust; inhalation of outdoor and indoor dust and inhalation of outdoor vapour.

- **Public Open Space: Park**
  A public park is defined as an area of open space provided for recreational use and usually owned and maintained by the Local Authority. It is anticipated the park could be used for a wide range of activities, including the following:
    - Family visits and picnics;
    - Children's play area;
    - Sporting activities such as football on an informal basis (i.e. no a dedicated sports pitch); and
    - Dog walking.

  The park is modelled as an area >0.5 ha of predominantly grasses open space with no more than 25% of exposed soil.
  The critical receptor is a female child with CLEA age classes 1 – 6.

  Active exposure pathway are: ingestion of outdoor soil; direct dermal contact with outdoor soil; inhalation of outdoor dust and inhalation of outdoor vapour.

Furthermore the C4SLs are based on a different toxicological benchmark, the 'low level of toxicological concern' (LLTC). This difference in approach was adopted because the C4SLs were primarily intended for use under Part2A of the EPA 1990 to quickly screen out Category 4 sites where there is "*no risk or that the level of risk posed is low*". SGVs and LQM GACs are

based on the more conservative 'minimal or tolerable level of risk' as defined in SR2 (EA, 2009) and were derived for assessment of contamination for the Planning process.

Lead

The SGV for lead was withdrawn in 2011 and is not used in this report. The C4SL for lead provides a technically robust and conservative assessment tool using significantly updated toxicological modelling than the withdrawn SGV and derived in line with current science of lead toxicology.

LQM/CIEH Suitable 4 Use Levels (S4ULs)

The publication of the C4SLs resulted in considerable and inconclusive debate about the applicability of the lower level of protection of the C4SL, which are underlain by the LLTC, outside of the Part 2A context for which they were derived. In 2014 LQM/CIEH presented a Suitable 4 Use Levels (S4ULs), which incorporate the updated assumption exposure derived for the production of the C4SLs but within the context of deriving screening criteria above which further assessment of the risks or remedial action may be needed. The S4ULs replace the 82 substances, species and fractions and congeners contained in the previous LQM/CIEH GACs issued in 2009. Additionally, following changes and new land uses proposed in the C4SL research project, S4ULs have also been derived for the majority of substances for which the EA derived SGVs in 2009.

The GAC values adopted in this report are summarised in Table 1, below.

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	
Metals/metalloids																			
Arsenic	37			40			43			640			79			170			LQM (2014)
Beryllium	1.7			1.7			35			12			2.2			63			LQM (2014)
Boron	290			11000			45			240000			21000			46000			LQM (2014)
Cadmium	11			85			1.9			190			120			532			LQM (2014)
Chromium III	910			910			18000			8600			1500			33000			LQM (2014)
Chromium VI	6			6			1.8			33			7.7			220			LQM (2014)
Copper	2400			7100			520			68000			12000			44000			LQM (2014)
Lead	200			310			80			2330			630			1300			C4SL
Mercury (elemental)	1.2			1.2			21			58 (25.8)			16			30 (25.8)			LQM (2014)
Mercury (Inorganic)	40			56			19			1100			120			240			LQM (2014)
Methylmercury	11			15			6			320			40			68			LQM (2014)
Nickel	180			180			230			980			230			3400			LQM (2014)
Selenium	250			430			88			12000			1100			1800			LQM (2014)
Vanadium	410			1200			91			9000			2000			5000			LQM (2014)
Zinc	3700			40000			620			730000			81000			170000			LQM (2014)
Other																			
Total Sulphate	2,400			2,400			2,400			2,400			2,400			2,400			BRE (2005)
Water Soluble Sulphate (g/l)	0.5			0.5			0.5			0.5			0.5			0.5			BRE (2005)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
PAHs																			
Acenaphthene	210	510	1100	3000 (57)	4700(141)	6000 (336)	34	85	200	84000 (57)	97000 (141)	100000	15000	15000	15000	29000	30000	30000	LQM (2014)
Acenaphthylene	170	420	920	2900 (86.1)	4600 (212)	6000 (506)	28	69	160	8300 (86.1)	97000 (212)	100000	15000	15000	15000	29000	30000	30000	LQM (2014)
Anthracene	2400	5400	11000	31000 (1.17)	35000	37000	380	950	2200	520000	540000	540000	74000	74000	74000	150000	150000	150000	LQM (2014)
Benzo(a)anthracene	7.2	11	13	11	14	15	2.9	6.5	13	170	170	180	29	29	29	49	56	62	LQM (2014)
Benzo(a)pyrene	2.2	2.7	3	3.2	3.2	3.2	0.97	2	3.5	35	35	36	5.7	5.7	5.7	11	12	13	LQM (2014)
Benzo(b)fluoranthene	2.6	3.3	3.7	3.9	4	4	0.99	2.1	3.9	44	44	45	7.1	7.1	7.1	13	15	16	LQM (2014)
Benzo(g,h,i)perylene	320	340	350	360	360	360	290	470	640	3900	4000	4000	640	640	640	1400	1500	1600	LQM (2014)
Benzo(k)fluoranthene	77	93	100	110	110	110	37	75	130	1200	1200	1200	190	190	190	370	410	440	LQM (2014)
Chrysene	15	22	27	30	31	32	4.1	9.4	19	350	350	350	57	57	57	93	110	120	LQM (2014)
Dibenz(a,h)anthracene	0.24	0.28	0.3	0.31	0.32	0.32	0.14	0.27	0.61	3.5	3.6	3.6	0.57	0.57	0.58	1.1	1.3	1.4	LQM (2014)
Fluoranthene	280	560	890	1500	1600	1600	52	130	290	23000	23000	23000	3100	3100	3100	63	6300	6400	LQM (2014)
Fluorene	170	400	860	2800 (30.9)	3800 (76.5)	4500 (183)	27	67	160	63000 (30.9)	68000	71000	9900	9900	9900	20000	20000	20000	LQM (2014)
Indeno(1,2,3-cd)pyrene	27	36	41	45	46	46	9.5	21	39	500	510	510	82	82	82	150	170	180	LQM (2014)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	
Naphthalene	2.3	5.6	13	2.3	5.6	13	4.1	10	24	190 (76.4)	460 (183)	1100 (432)	4900	4900	4900	1200 (76.4)	1900 (183)	3000	LQM (2014)
Phenanthrene	95	220	440	1300 (36)	1500	1500	15	38	90	22000	22000	23000	3100	3100	3100	6200	6200	6300	LQM (2014)
Pyrene	620	1200	2000	3700	3800	3800	110	270	620	54000	54000	54000	7400	7400	7400	15000	15000	15000	LQM (2014)
Coal Tar (BaP as surrogate marker)	0.79	0.98	1.1	1.2	1.2	1.2	0.32	0.67	1.2	15	15	15	2.2	2.2	2.2	4.4	4.7	4.8	LQM (2014)
BTEX and TPH																			
Benzene	0.087	0.17	0.37	0.38	0.7	1.4	0.017	0.034	0.075	27	47	90	72	72	73	90	100	110	LQM (2014)
Toluene	130	290	660	880 vap (869)	1900	3900	22	51	120	56000 vap (869)	110000 vap (1920)	180000 vap (4360)	56000	56000	56000	87000 vap (869)	95000 vap (1920)	100000 vap (4360)	LQM (2014)
Ethylbenzene	47	110	260	83	190	440	16	39	91	5700 vap (518)	13000 vap (1220)	27000 vap (2840)	24000	24000	25000	17000 vap (518)	22000 vap (1220)	27000 vap (2840)	LQM (2014)
Xylene - o	60	140	330	88	210	480	28	67	160	6600 (478)	15000 (1120)	33000 (2620)	41000	42000	43000	17000 (478)	24000 (1120)	33000 (2620)	LQM (2014)
Xylene - m	59	140	320	82	190	450	31	74	170	6200 (625)	14000 (1470)	31000 (3460)	41000	42000	43000	17000 (625)	24000 (1470)	32000 (3460)	LQM (2014)
Xylene - p	56	130	310	79	180	430	29	69	160	5900 (576)	14000 (1350)	30000 (3170)	41000	42000	43000	17000 (576)	23000 (1350)	31000 (3170)	LQM (2014)
Aliphatic EC 5-6	42	78	160	42	78	160	730	1700	3900	3200 (304)	5900 (558)	12000 (1150)	570000 (304)	590000	600000	95000 (304)	130000 (558)	180000 (1150)	LQM (2014)
Aliphatic EC >6-8	100	230	530	100	230	530	2300	5600	13000	7800 (144)	17000 (322)	40000 (736)	600000	610000	620000	150000 (144)	220000 (322)	320000 (736)	LQM (2014)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
Aliphatic EC >8-10	27	65	150	27	65	150	320	770	1700	2000 (78)	4800 (190)	11000 (451)	13000	13000	13000	14000 (78)	18000 (190)	21000 (451)	LQM (2014)
Aliphatic EC >10-12	130 (48)	330 (118)	760 (283)	130 (48)	330 (118)	760 (283)	2200	4400	7300	9700 (48)	23000 (118)	47000 (283)	13000	13000	13000	21000 (48)	23000 (118)	24000(283)	LQM (2014)
Aliphatic EC >12-16	1100 (24)	2400 (59)	4300 (142)	1100 (24)	2400 (59)	4300 (142)	11000	13000	13000	59000 (24)	82000 (59)	90000 (142)	13000	13000	13000	25000 (24)	25000 (59)	26000 (142)	LQM (2014)
Aliphatic EC >16-35	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	LQM (2014)
Aliphatic EC >35-44	65000 (8.48)	92000 (21)	110000	65000 (8.48)	92000 (21)	110000	260000	270000	270000	1600000	1700000	1800000	250000	250000	250000	450000	480000	490000	LQM (2014)
Aromatic EC 5-7	70	140	300	370	690	1400	13	27	57	26000 (1220)	46000 (2260)	86000 (4710)	56000	56000	56000	76000 (1220)	84000 (2260)	92000 (4710)	LQM (2014)
Aromatic EC >7-8	130	290	660	860	1800	3900	22	51	120	56000 (869)	110000 (1920)	180000 (4360)	56000	56000	56000	87000 (869)	95000 (1920)	100000 (4360)	LQM (2014)
Aromatic EC >8-10	34	83	190	47	110	270	8.6	21	51	3500 (613)	8100 (1500)	17000 (3580)	5000	5000	5000	7200 (613)	8500 (1500)	9300 (3580)	LQM (2014)
Aromatic EC >10-12	74	180	380	250	590	1200	13	31	74	16000 (364)	28000 (899)	34000 (2150)	5000	5000	5000	9200 (364)	9700 (899)	10000	LQM (2014)
Aromatic EC >12-16	140	330	660	1800	2300 (419)	2500	23	27	130	36000 (169)	37000	38000	5100	5100	5000	10000	10000	10000	LQM (2014)
Aromatic EC >16-21	260	540	930	1900	1900	1900	46	110	260	28000	28000	28000	3800	3800	3800	7600	7700	7800	LQM (2014)
Aromatic EC >21-35	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	
Aromatic EC >35-44	1100	1500	1700	1900	1900	1900	370	820	1600	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
Aromatic EC >44-75	1600	1800	1900	1900	1900	1900	1200	2100	3000	28000	28000	28000	3800	3800	3800	7800	7800	7900	LQM (2014)
VOCs																			
1,2-dichloroethane (1,2-DCA)	0.0071	0.011	0.019	0.0092	0.013	0.023	0.0046	0.0083	0.016	0.67	0.97	1.7	29	29	29	21	24	28	LQM (2014)
1,1,1-trichloroethane	8.8	18	39	9	18	40	48	110	240	660	1300	3000	140000	140000	140000	57000 (1425)	76000 (2915)	100000 (6392)	LQM (2014)
1,1,2,2,tetrachloroethane	1.6	3.4	7.5	3.9	8	17	0.41	0.89	2	270	550	1100	1400	1400	1400	1800	2100	2300	LQM (2014)
tetrachloroethene	0.18	0.39	0.9	0.18	0.4	0.92	0.65	1.5	3.6	19	45	95	1400	1400	1400	810 (424)	1100 (951)	1500	LQM (2014)
tetrachloromethane (Carbon tetrachloride)	0.026	0.056	0.13	0.026	0.056	0.13	0.45	1	2.4	2.9	6.3	14	890	920	950	190	270	400	LQM (2014)
Trichloroethene	0.016	0.034	0.075	0.017	0.036	0.08	0.041	0.091	0.21	1.2	2.6	5.7	120	120	120	70	91	120	LQM (2014)
Trichloromethane (chloroform)	0.91	1.7	3.4	1.2	2.1	4.2	0.42	0.83	1.7	99	170	350	2500	2500	2500	2600	2800	3100	LQM (2014)
Chloroethene (Vinyl chloride)	0.00064	0.00087	0.0014	0.00077	0.001	0.0015	0.00055	0.001	0.0018	0.059	0.077	0.12	3.5	3.5	3.5	4.8	5	5.4	LQM (2014)
2,4,6 Trinitrotoluene (TNT)	1.6	3.7	8.1	65	66	66	0.24	0.58	1.4	1000	1000	1000	130	130	130	260	270	270	LQM (2014)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
RDX	120	250	540	13000	13000	13000	17	38	85	210000	210000	210000	26000	26000	27000	49000 (18.7)	51000	53000	LQM (2014)
HMX	5.7	13	26	6700	6700	6700	0.86	1.9	3.9	110000	110000	110000	13000	13000	13000	23000 (0.35)	23000 (0.39)	24000 (0.48)	LQM (2014)
Aldrin	5.7	6.6	7.1	7.3	7.4	7.5	3.2	6.1	9.6	170	170	170	18	18	18	30	31	31	LQM (2014)
Dieldrin	0.97	2	3.5	7	7.3	7.4	0.17	0.41	0.96	170	170	170	18	18	18	30	30	31	LQM (2014)
Atrazine	3.3	7.6	17.4	610	620	620	0.5	1.2	2.7	9300	9400	9400	1200	1200	1200	2300	2400	2400	LQM (2014)
Dichlovos	0.032	0.066	0.014	6.4	6.5	6.6	0.0049	0.01	0.022	140	140	140	16	16	16	26	26	27	LQM (2014)
Alpha-Endosulfan	7.4	18	41	160 (0.003)	280 (0.007)	410 (0.016)	1.2	2.9	6.8	5600 (0.003)	7400 (0.007)	8400 (0.016)	1200	1200	1200	2400	2400	2500	LQM (2014)
alpha-Hexachlorocyclohexane	0.23	0.55	1.2	6.9	9.2	11	0.035	0.087	0.21	170	180	180	24	24	24	47	48	48	LQM (2014)
beta-hexachlorocyclohexanes	0.085	0.2	0.46	3.7	3.8	3.8	0.013	0.032	0.077	65	65	65	8.1	8.1	8.1	15	15	16	LQM (2014)
gamma-hexachlorocyclohexanes	0.06	0.14	0.33	2.9	3.3	3.5	0.0092	0.023	0.054	67	69	70	8.2	8.2	8.2	14	15	15	LQM (2014)
Chlorobenzene	0.46	1	2.4	0.46	1	2.4	5.9	14	32	56	130	290	11000	13000	14000	1300 (675)	2000 (1520)	2900	LQM (2014)
1,2-Dichlorobenzene	23	55	130	24	57	130	94	230	540	2000 (571)	4800 (1370)	11000 (3240)	90000	95000	98000	24000 (571)	36000 (1370)	51000 (3240)	LQM (2014)
1,3-Dichlorobenzene	0.4	1	2.3	0.44	1.1	2.5	0.25	0.6	1.5	30	73	170	300	300	300	390	440	470	LQM (2014)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	**1%**	**2.50%**	**6%**	
1,4-Dichlorobenzene	61	150	350	61	150	350	15	37	88	4400 (224)	10000 (540)	25000 (1280)	17000	17000	17000	36000 (224)	36000 (540)	36000 (1280)	LQM (2014)
VOCs Continued																			
1,2,3-Trichlorobenzene	1.5	3.6	8.6	1.5	3.7	8.8	4.7	12	28	102	250	590	1800	1800	1800	770 (134)	1100 (330)	1600 (789)	LQM (2014)
1,2,4-Trichlorobenzene	2.6	6.4	15	2.6	6.4	15	55	140	320	220	530	1300	15000	17000	19000	1700 (318)	2600 (786)	4000 (1880)	LQM (2014)
1,3,5-Trichlorobenzene	0.33	0.81	1.9	0.33	0.81	1.9	4.7	12	28	23	55	130	1700	1700	1800	380 (36.7)	580 (90.8)	860 (217)	LQM (2014)
1,2,3,4-Tetrachlorobenzene	15	36	78	24	56	120	4.4	11	26	1700 (122)	3080 (304)	4400 (728)	830	830	830	1500 (122)	1600	1600	LQM (2014)
1,2,3,5-Tetrachlorobenzene	0.66	1.6	3.7	0.75	1.9	4.3	0.38	0.9	2.2	49 (39.4)	120 (98.1)	240 (235)	78	79	79	110 (39)	120	130	LQM (2014)
1,2,4,5-Tetrachlorobenzene	0.33	0.77	1.6	0.73	1.7	3.5	0.06	0.16	0.37	42 (19.7)	72 (49.1)	96	13	13	13	25	26	26	LQM (2014)
Pentachlorobenzene	5.8	12	22	19	30	38	1.2	3.1	7	640 (43)	770 (107)	830	100	100	100	190	190	190	LQM (2014)
Hexachlorobenzene	1.8 (0.2)	3.3 (0.5)	4.9	4.1 (0.2)	5.7 (0.5)	6.7 (1.2)	0.47	1.1	2.5	110 (0.2)	120	120	16	16	16	30	30	30	LQM (2014)
Phenol	280	550	1100	750	1300	2300	66	140	280	760 $_{dir}$ (31000)	1500 $_{dir}$ (35000)	3200 $_{dir}$ (37000)	760 $_{dir}$ (31000)	1500 $_{dir}$ (35000)	3200 $_{dir}$ (37000)	760 $_{dir}$ (31000)	1500 $_{dir}$ (35000)	3200 $_{dir}$ (37000)	LQM (2014)

Parameter	Residential with homegrown produce (mg/kg, unless otherwise stated)			Residential without homegrown produce (mg/kg, unless otherwise stated)			Allotment (mg/kg, unless otherwise stated)			Commercial / Industrial (mg/kg, unless otherwise stated)			Public Open Space near Residential (mg/kg, unless otherwise stated)			Public Open Space - Park (mg/kg, unless otherwise stated)			Source
SOM	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	1%	2.50%	6%	
Chlorophenols (excluding pentachlorophenol)	0.87 (g)	2	4.5	94	150	210	0.13 (g)	0.3	0.7	3500	4000	4300	620	620	620	1100	1100	1100	LQM (2014)
Pentachlorophenol	0.22	0.52	1.2	27 (16.4)	29	31	0.03	0.08	0.19	400	400	400	60	60	60	110	120	120	LQM (2014)
Carbon Disulphide	0.14	0.29	0.62	0.14	0.29	0.62	4.8	10	23	11	22	47	11000	11000	12000	1300	1900	2700	LQM (2014)
Hexachlorobutadiene	0.29	0.7	1.6	0.32	0.78	1.8	0.25	0.61	1.4	31	66	120	25	25	25	48	50	51	LQM (2014)

(g) derived based on 2,3,4,6-tetrachlorophenol; dir - based on a threshold protective of direct skin contact with phenol (guideline in brackets based on health effects following long term exposure provided for illustration only); (vap) calculated for vapour phase only. SOM – Soil Organic Matter; (4.5) solubility.

APPENDIX I – CONTROLLED WATERS RISK ASSESSMENT

CURRENT GUIDANCE FOR CONTROLLED WATERS RISK ASSESSMENT

Regulatory Context

Government policy is based upon a "suitable for use approach," which is relevant to both the current use of land and also to any proposed future use. When considering the current use of land, Part IIA of the Environment Protection Act 1990 (EPA 1990) provides the regulatory regime, which was introduced by Section 57 of the Environment Act 1995, which came into force in England on 1 April 2000. The main objective of introducing the Part IIA regime is to provide an improved system for the identification and remediation of land where contamination is causing unacceptable risks to human health, controlled waters or the wider environment given the current use and circumstances of the land. Part IIA provides a statutory definition of contaminated land under Section 78A(2) as:

"any land which appears to the Local Authority in whose area it is situated to be in such a condition, by reason of substances in, on, or under the land, that:

(a) Significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) Pollution of controlled waters is being, or is likely to be, caused."

Part IIA provides a statutory definition of the pollution of controlled waters under Section 78A(9) as:

"the entry into controlled waters of any poisonous, noxious or polluting matter or any solid waste matter"

Controlled Waters are defined Section 104 of the Water Resources Act 1991. They include in summary: Relevant territorial waters which extend seaward for three miles from the low-tide limit from which the territorial sea adjacent to England and Wales is measured.

The Environment Agency has powers under Part 7 of The Water Resources Act (1991) to take action to prevent or remedy the pollution of controlled waters, including circumstances where the pollution arises from contamination in the land. This is reinforced in The Contaminated Land (England) (Amendment) Regulations 2012 and Contaminated Land Statutory Guidance (DEFRA, 2012) which came into force in early April 2012.

Part IIA introduces the concept of a contaminant linkage; where for potential harm to exist there must be a connection between the source of the hazard and the receptor via a pathway. Risk assessment in contaminated land is therefore directed towards identifying the contaminants, pathways and receptors that can provide contaminant linkages. This is known as the contaminant-pathway-receptor link (CPR or contaminant linkage).

Part IIA places contaminated land responsibility as a part of the planning and redevelopment process, rather than Local Authority or Environment Agency directly, except in cases of very high pollution risk or where harm is occurring. In the planning process, guidance is provided by National Planning Policy Framework (NPPF) of March 2012. The NPPF requires that a site which has been developed shall not be capable of being determined "contaminated land" under Part IIA. Therefore, appropriate risk-based investigation is required to identify the contaminant linkages that can then be assessed, and then mitigated using methods that can be agreed with the planners.

Environment Agency Guidance

The Environment Agency's stance on groundwater resources is:

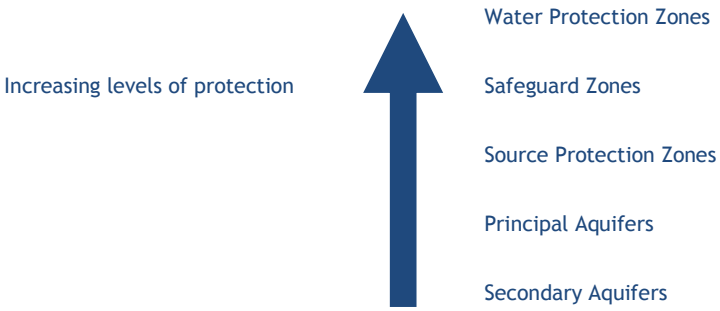
"to protect and manage groundwater resources for present and future generations in ways that are appropriate for the risks we identify"(Groundwater Protection: Policy and Practice GP3, 2012).

At present, the legislation and guidance pertaining to the protection of controlled waters in the UK is complex; however, the core objectives seek to enforce the position given above.

In 1992, the National Rivers Authority published their Policy and Practice for the Protection of Groundwater (PPPG), this document introduced areas of focus for developments such as Source Protection Zones (SPZs) and Groundwater Vulnerability Maps. The Policy was revised in 1998, since which there have been substantial changes in legislation, driven by key European Directives relating to groundwater include the Groundwater Directive (80/68/EEC) and the Water Framework Directive (2000/60/EC). Aspects of these directives are controlled by primary UK legislation such as the Water Resources Act 1991 as amended by the Water Act 2003. Gaps in the 1998 PPPG that emerged as the result of further legislative changes were addressed in the Environment Agency Policy document *Groundwater Protection: Policy and Practice (GP3), Version 1* of November 2012. The three main parts of GP3 were:

- Groundwater principals;
- Position statements and legislation; and
- Technical information.

The Environment Agency has a tiered risk based approach to drinking water protection as summarised below:



Controlled Waters Risk Assessment

A number of tools are available (as detailed in GP3) in order for a developer of a potentially contaminated site to fulfil their obligations under the legislation. A site assessment would be required in order to identify any potential risks to controlled waters and to derive suitable clean up criteria, if required, to ensure the protection of controlled waters.

There are three main stages to any risk assessment of controlled waters:

1) Risk Screening (devise Conceptual Site Model, making reference to groundwater vulnerability maps, site setting, controlled waters context etc)

2) Generic Risk Assessment (EA Remedial Targets Methodology Tier 1 / Comparison of groundwater data with relevant standards)

3) Detailed Quantitative Risk Assessment (Consideration of aquifer properties and site specific parameters, EA Remedial Targets Methodology Tiers 2 & 3)

Risk Screening

Here, the Conceptual Site Model (CSM) is a critical tool to assessing any potentially contaminated site. The information from a robust CSM can be used to establish any pathways or receptors that do not require further assessment at an early stage. For example, it may be possible to confirm the absence of a particular sensitive controlled water receptor (such as a surface water feature) within the vicinity of the Site thereby breaking the associated source-pathway-receptor pollutant linkage. Information from subsequent tiers of risk assessment, such as following intrusive investigations, are used to update the CSM accordingly.

Generic Risk Assessment - England and Wales

When undertaking the Generic Hydrogeological Risk Assessment (EA Remedial Targets Methodology Tier 1), comparison of chemical analytical results is made with those screening criteria. Values of screening criteria with which chemical test results can be compared are published in the following:

- EQS Directive 2008/105/EC
- Priority Substances Directive 2013/39/EU
- Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015
- UK Drinking Water Standards (UK DWS)
- World Health Organisation (WHO Guidelines) for Drinking Water Quality
- Council Directive 98/83/EC on the quality of water intended for human consumption (Drinking water directive)

Generic Risk Assessment is generally undertaken via comparison of reported leachate and/or groundwater concentrations against selected assessment criteria for the potential contaminants of concern identified for the Site from a preliminary desk based assessment.

The selected Generic Assessment Criteria (GAC) derived from a Water Quality Standard (WQS) for any specific substance may not necessarily be a simple number and can often be found to be expressed as:

- Annual mean concentration;
- Maximum allowable concentration;
- 95th percentile concentration for *n* samples;
- Total concentration;
- Dissolved concentration (applicable to filtered samples)

The values may sometimes be expressed for individual substances (e.g. arsenic or for groups of substances e.g. total xylenes or sums of certain PAHs).

Environmental Quality Standards (EQS) have been used where available for Priority Substances and Priority Hazardous Substances set at a European level:

- Priority Substances Directive 2013/39/EU;
- Amending 2008/105 and 2000/118/EC

In addition, EQS values derived for Specific Pollutants have been used as presented in The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015.

For assessing risks to potable water abstraction supplies, UK Drinking Water Standards presented in the Water Supply (Water Quality) Regulations 2000 (SI/2000/3184) (as amended) have been applied.

In selecting a GAC for a particular Site, Tier Environmental considers the following factors:

- Current use/function of the groundwater (e.g. drinking water, irrigation water, industrial use, base-flow to rivers and streams);
- Plausible, proposed or planned future uses of the water and nearby waters;
- Sensitivity of the critical receptor (e.g. human health, aquatic life); and,
- Requirements to trigger action under the legal context

In accordance with Part 2A:

"in deciding whether pollution of controlled waters is occurring, the assessor will have regard to all of the water quality standards that are relevant to the specific site and make a judgment against the most stringent of those relevant standards".

Please note that there is no quantitative criterion for total petroleum hydrocarbons (TPH), or speciated TPH fractions. Historically, standards provided for petroleum hydrocarbons ranges from 10µg/l (Private Water Supply Regulations 1991, removed from the 2009 regulations) to 50µg/l-1000µg/l (Surface Waters (Abstraction for Drinking Water) Regulations 1989) which related to the degree of treatment of water prior to use as drinking water. Over time, the legislative standards have been rescinded and no alternative standard provided, although the Environment Agency planned to release speciated TPH criteria (Fret well et al., 2009). In the

absence of suitable criteria, Tier Environmental adopts a value of 10 go/l for more sensitive locations (e.g. Principal Aquifer, drinking water abstraction), and a value of 50µg/l for locations considered less sensitive (e.g. low permeability aquifers) or where a site is located in close proximity to a surface watercourse.

Should the Level 1 or 2 assessments indicate threshold levels to be exceeded, then there are three alternative ways in which to proceed:

- To devise suitable remedial solutions;
- To carry out more investigation, sampling and analysis;
- To conduct a site-specific Detailed Quantitative Risk Assessment (DQRA) to whether or not the soil materials are suitable for their site-specific intended use or to devise a site-specific clean-up level.

Detailed Quantitative Risk Assessment (DQRA)

The decision to carry out a DQRA will be informed by the initial qualitative and generic assessment. The scope of any such assessment will be accurately defined by the outcomes of the former two stages. The robust CSM will be sufficiently refined by this stage that only certain contaminants of concern, certain pathways and certain receptors will require further assessment.

Additional site specific data is normally required for this stage of assessment, as explained above, more processes that are capable of affecting contaminant concentrations are considered (such as dilution and attenuation).

Remediation criteria derived will therefore be specific to each site and will be based on a detailed assessment of the potential impact at the identified receptor or compliance point. A greater level of confidence can be placed on the predicted impact on the compliance point following a DQRA.

Aquifer Designations

The Environment Agency have classified different types of aquifer from which groundwater can be extracted. The aquifer designations reflect the importance of aquifers in terms of groundwater as a resource (drinking water supply) but also their role in supporting surface water flows and wetland ecosystems. The aquifer designation data is based on geological mapping provided by the British Geological Survey. It is updated regularly to reflect their ongoing programme of improvements to these maps. The maps are split into two different type of aquifer designation:

- Superficial (Drift) - permeable unconsolidated (loose) deposits. For example, sands and gravels.
- Bedrock -solid permeable formations e.g. sandstone, chalk and limestone.

The maps display the following aquifer designations:

Classification	Definition
Principal Aquifers (Highly Permeable)	These are layers of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.
Secondary A Aquifers	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers.
Secondary B Aquifers	Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.
Secondary Undifferentiated Aquifers	This has been assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type.
Unproductive Strata	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow.

Hazardous and Non Hazardous Substances

The Groundwater (England and Wales) Regulations 2009 control the disposal to the hydrogeological environment of potentially polluting substances which are divided into Hazardous Substances and Non-hazardous Contaminants (this roughly approximates to the former List 1 and List 2 substances).

Hazardous Substances are the most damaging and toxic and must be prevented from directly or indirectly entering the groundwater environment. Hazardous Substances include mineral oils and hydrocarbons, pesticides, biocides, herbicides, solvents and some metals. Discharge of Hazardous Substances to Controlled Waters must be prevented.

Non-hazardous Pollutants are any contaminants other than Hazardous Substances. Non-hazardous Pollutants are potentially toxic but are less harmful than Hazardous Substances, but their direct discharge to groundwater is generally not permitted and any indirect discharge to groundwater must be limited and be controlled by technical precautions in order to prevent pollution. Non-hazardous Pollutants include ammonia and nitrites, many metals and fluorides.

APPENDIX J – ENGINEER'S FIELD TESTING

Samples for field testing were selected by a representative of Tier Environmental during the site investigation works in accordance with the sampling specification presented elsewhere in this report.

Field testing for geotechnical parameters

In situ Standard Penetration Tests (SPTs) were also carried out throughout the full depth of the cable percussive boreholes using either a split spoon sampler or a 60° solid cone. These tests assess the relative density of granular soils encountered and indicate the undrained shear strength of cohesive soils or the strength of rock. The results of these tests are shown as 'N' values and can be found adjacent to the appropriate sample level on the exploratory hole records in Appendix C.

Hand shear vane testing was also undertaken, where required, to establish the undrained shear strength of cohesive soils within trial pits. Testing was performed, when safe to do so, at shallow depth (<1.0m) within the trial pit or upon intact samples collected within the digger bucket. Where possible a set of at least 3 No. tests was performed at each depth.

In order for stratum descriptions to comply with BS EN ISO 14688 and 14689, the Engineer performs the following assessment of soil properties in the field.

- Determination of consistency (BS EN ISO 14688 Part 1 Section 5.14);
- Assessment of dry strength (BS EN ISO 14688 Part 1 Section 5.6);
- Shear strength (BS EN ISO 14688 Part 2 Section 5.3);
- Plasticity (BS EN ISO 14688 Part 1 Section 5.8);
- Assessment of particle shape (BS EN ISO 14688 Part 1 Section 5.2).

APPENDIX K – CHEMICAL TEST SAMPLING

Samples were selected by a representative of Tier Environmental during the site investigation works in accordance with the sampling approach described elsewhere in this report.

Samples for chemical analysis

All samples for chemical analysis were placed into clean new containers as summarised in Table 1. Unless explicitly stated elsewhere in this report, no preservatives were used to eliminate the risk that preservatives cause contaminant dissolution or analytical interference. Containers for VOC analysis were fully filled to exclude headspace.

Soil samples were dispensed as soon as possible after collection using reusable stainless steel spatulas, trowels or similar implements.

Ground water samples were collected from boreholes using single-use Teflon bailers or dedicated Waterra tubing with foot valves, except as otherwise noted within this report. Caution was taken to avoid excessive agitation during collection

New disposable gloves were used by the engineer for the collection of each sample.

Reusable equipment was washed down with distilled or deionised water between samples, except where tarry or similarly sticky materials were present. In such cases specific cleaning procedures were adopted as specifically described elsewhere in this report.

All sub-samples taken for chemical analysis were placed into refrigerators or cool boxes containing frozen ice packs immediately after aliquoting. All samples were transferred in cool boxes containing frozen ice packs to the relevant UKAS/MCERTS accredited laboratory as soon as possible. Recommended maximum holding times before analysis are summarised in Table 1.

Table **1.** Sample containers and holding times.

Analysis	Container/special requirements	Max. holding time at 4°C before analysis
Soil and sediment samples		
VOCs	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner. *Must be fully filled.*	14 days
TPHCWG	30-60 g brown or green glass jar with VOC-resistant cap and inert cap liner **PLUS** 250-500 g brown or green glass jar with unwaxed cap liner.[1] *The former must be fully filled.*	14 days
All other organics	250-500 g brown or green glass jar with unwaxed cap liner.	7 days
Inorganics	Air-tight 0.5-2.0 kg plastic container (250-500 g brown or green glass jar may also be used).	14 days[2]
Water samples		
VOCs	40-50 ml glass vial with VOC resistant screw cap and inert liner. *Must be fully filled.*	14 days
TPHCWG	40-50 ml glass vial with VOC resistant screw cap and inert liner **PLUS** 500-1000 ml brown or green glass bottle with screw cap and unwaxed liner.[1] *The former must be fully filled, the latter should be filled if possible.*	14 days
All other organics	500-1000 ml brown or green glass bottle with screw cap. *Fill if possible.*	7 days
Inorganics	500-1000 ml translucent or opaque screw cap plastic *or* brown or green glass bottles. *Fill if possible.*	14 days[3]

[1]The smaller vessel is used for analysis of the volatile components within the TPH mixture and the larger one is for the non-volatile components.

[2] 14 days is set as a reasonable limit for all routine analyses of soil for those inorganic components vulnerable to chemical and/or biological breakdown. Samples for sulphate analysis are vulnerable to biological sulphate-reduction but can be held for up to 28 days. For total metals, a holding period of up to 6 months is acceptable.

[3] 14 days applies for all routine analyses of most inorganic components that may be vulnerable to chemical and/or biological reactions. In the specific cases of sulphide, nitrite, nitrate and phosphate analyses, storage time must not exceed 48 hours. For total metals, a holding time of up to 6 months is acceptable.

Tier Environmental standard analytical suites

The analyses included with Tier Environmental's standard analytical suites for soil, soil leachate and water samples are presented in Table 2. Other individual analyses were specified as described within this report.

Table 2. Tier Environmental Standard Analytical Suites.

Parameter	Sample type					
	Soil		Leachate[1]		Water	
		LoD[2] (mg/kg or as stated)		LoD (µg/l or as stated)		LoD (µg/l or as stated)
Metals and metalloids						
Arsenic	✓	1	✓	10	✓	10
Cadmium	✓	1	✓	5	✓	5
Chromium	✓	1	✓	5	✓	5
Mercury	✓	1	✓	1	✓	1
Lead	✓	1	✓	4	✓	4
Selenium	✓	2	✓	10	✓	10
Copper	✓	1	✓	1	✓	1
Nickel	✓	1	✓	50	✓	50
Zinc	✓	1	✓	8	✓	8
Other inorganics						
Ammonia (as NH_4-N)					✓	15
Total sulphate	✓	100			✓	50 mg/l
Water-soluble sulphate	✓	0.1 g/l				
Hardness (as $CaCO_3$)					✓	1 mg/l
Organics						
Monohydric phenol	✓	1	✓	0.5	✓	0.5
Speciated PAHs (USEPA 16)	✓	0.1	✓	0.01	✓	0.01
Total Organic Carbon	✓	0.1 wt%				
Others						
Electrical conductivity					✓	NA
pH	✓	NA	✓	NA	✓	NA

NA - Not applicable

1 Leachate preparation according to NRA (1994), 10:1 liquid to solid ratio.

2 The table presents the desired limit of detection for the analysis. Higher LoDs may be reported on analytical data sheets due to interference between analytes within specific samples or if the laboratory needed to dilute samples to achieve results within the calibrated range for that instrument.

Analytical QA procedures

Introduction

Quality Assurance (QA) is a system of review and audit that assesses the effectiveness of that product and assures the producer and user that defined standards of quality have been met. If we consider site investigation and chemical analysis, QA is the management system that ensures these measures are in place and working as intended.

QA within the laboratory form part of relevant certification programmes (such as UKAS and MCERTS) and, indeed, will be undertaken in some form by any reputable analyst, whether for a certified technique or not. Laboratory QA/QC is beyond the control of Tier Environmental and will not be considered further in this document, although the relevant laboratory documentation can be obtained upon request. QA must also form part of the design and execution of a site investigation.

Two parameters often used to assess measurement quality objectives are bias and precision. Bias is a systematic deviation in the data. For example, a positive bias (concentrations higher than in reality) would be introduced if sampling bottles were a source of the analyte and this fact was unknown. Precision is the variation in the measurements around a central ‘expected 'value. This could be due both to real variability in the environmental medium being measured and random errors in the analytical process. Both precision and bias can be assessed by the use of appropriate blanks and replicates within the site investigation programme.

The objectives of the QA activities undertaken in this present site investigation were to recognise and quantify systematic bias within the analytical dataset and to obtain an indication of precision. In environmental samples, much of the observed variability is likely to result from heterogeneity in the sampled medium, particularly for soil and sediment samples.

Such QA practice within the sampling programme is required by current guidance (e.g., Environment Agency report P5-065/TR (2000); Environment Agency LFTGN02 (2002); BS 10175:2001).

Alternative QA procedures to the generic approach presented in this appendix may be specified for a project, provided case-specific justification is given.

QA checking procedure (data validation)

The responsible Engineer and Project Reviewer are required to undertake data validation and provide comment on data quality within the main body of the report(s) issued, when noteworthy matters arise. This QA checking should involve:

- Confirming that data reported by the laboratory have achieved the standards specified by the certification scheme (MCERTS or UKAS). This will be indicated on the analytical certificates issued by the laboratory.

- Checking that the limit of detection (LoD) and limit of quantification (LoQ) achieved by the laboratory for an individual analyte is appropriate for the purposes of the report. LoD and LoQ will vary dependent upon analyte concentrations, sample matrix properties and interference from co-contaminants.

- A check that the reported range of concentrations are reasonable for the analyte. For example, the dissolved concentration of an analyte in a water sample should not exceed saturation. If it does, then this merits further consideration (e.g., was colloidal organic matter or other solid-phase material present or could there have been unobserved free-phase organic liquid?) and explicit comment. At its simplest, there may be a unit error.

- Where analysis involves reporting of Tentatively Identified Compounds (TICs; normally by mass spectrometry), the reviewers should check that these might reasonably be expected at the site under consideration. The uncertainties in identification by MS mean that it is not uncommon that TICs are incorrectly assigned. In cases of doubt, the analytical laboratory can re-check the raw data and confirm.

- A review of the analytical precision by comparing data obtained for duplicate samples. There is no absolute threshold - variability is entirely dependent upon the sample matrix and manner in which the contaminant has entered the sample. Variability that cannot reasonably be assigned to such factors (for example a very high apparent variability in data for sediment-free water samples) should be reviewed with the laboratory. Variability that is attributable to the sample matrix can nevertheless provide important pointers to improve understanding of contaminant transport pathways and the risks posed by pollutant linkages (e.g., soil heterogeneity, the association of contamination with particular soil fractions, the presence of residual NAPL within soil pores or the role of suspended sediments in contaminant transport).

- Confirmation that no errors have been introduced by data transcription, unit conversion or corrections between preliminary and certificates issued by the laboratory. The reviewer should audit a proportion (typically 5-10%) of all data from the original (final) certificates of analysis through to the equivalent values in the report for those specific samples.

In is important to consult the analytical laboratory if apparent QA issues arise. Many apparent concerns can be adequately resolved on the basis of revisiting the raw analytical data or by obtaining a better understanding of the inherent limitations of the analysis for a particular matrix or sample type.

APPENDIX L – RESULTS OF LABORATORY CHEMICAL ANALYSES

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Tier Environmental
Suite 513, Chadwick House
Warrington Rd
Birchwood
Warrington
WA3 6AE

Attention :	Adrian Read
Date :	11th July, 2017
Your reference :	TE1010
Our reference :	Test Report 17/11101 Batch 1
Location :	
Date samples received :	28th June, 2017
Status :	Final report
Issue :	1

One sample was received for analysis on 28th June, 2017 of which one was scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:



Bruce Leslie
Project Co-ordinator

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/11101

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

J E Sample No.	1-6										Please see attached notes for all abbreviations and acronyms		
Sample ID	WS2												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	28/06/2017												
Sample Type	Ground Water												
Batch Number	1										LOD/LOR	Units	Method No.
Date of Receipt	28/06/2017												
Dissolved Arsenic #	<0.9										<0.9	ug/l	TM30/PM14
Dissolved Cadmium #	<0.03										<0.03	ug/l	TM30/PM14
Total Dissolved Chromium #	<0.2										<0.2	ug/l	TM30/PM14
Dissolved Copper #	<3										<3	ug/l	TM30/PM14
Dissolved Lead #	<0.4										<0.4	ug/l	TM30/PM14
Dissolved Mercury #	<0.5										<0.5	ug/l	TM30/PM14
Dissolved Nickel #	3.6										<0.2	ug/l	TM30/PM14
Dissolved Selenium #	<1.2										<1.2	ug/l	TM30/PM14
Dissolved Zinc #	<1.5										<1.5	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	331										<1	mg/l	TM30/PM14
PAH MS													
Naphthalene	<0.1										<0.1	ug/l	TM4/PM30
Acenaphthylene	<0.01										<0.01	ug/l	TM4/PM30
Acenaphthene	<0.01										<0.01	ug/l	TM4/PM30
Fluorene	<0.01										<0.01	ug/l	TM4/PM30
Phenanthrene	<0.01										<0.01	ug/l	TM4/PM30
Anthracene	<0.01										<0.01	ug/l	TM4/PM30
Fluoranthene	<0.01										<0.01	ug/l	TM4/PM30
Pyrene	<0.01										<0.01	ug/l	TM4/PM30
Benzo(a)anthracene	<0.01										<0.01	ug/l	TM4/PM30
Chrysene	<0.01										<0.01	ug/l	TM4/PM30
Benzo(bk)fluoranthene	<0.01										<0.01	ug/l	TM4/PM30
Benzo(a)pyrene	<0.01										<0.01	ug/l	TM4/PM30
Indeno(123cd)pyrene	<0.01										<0.01	ug/l	TM4/PM30
Dibenzo(ah)anthracene	<0.01										<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene	<0.01										<0.01	ug/l	TM4/PM30
PAH 16 Total	<0.1										<0.1	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01										<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01										<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	77										<0	%	TM4/PM30
TPH CWG													
Aliphatics													
>C5-C6 #	<10										<10	ug/l	TM36/PM12
>C6-C8 #	<10										<10	ug/l	TM36/PM12
>C8-C10 #	<10										<10	ug/l	TM36/PM12
>C10-C12 #	<5										<5	ug/l	TM5/PM30
>C12-C16 #	<10										<10	ug/l	TM5/PM30
>C16-C21 #	<10										<10	ug/l	TM5/PM30
>C21-C35 #	<10										<10	ug/l	TM5/PM30
Total aliphatics C5-35 #	<10										<10	ug/l	TM5/TM36/PM30/PM12

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/11101

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

J E Sample No.	1-6												
Sample ID	WS2												
Depth													
COC No / misc													
Containers	V P G												
Sample Date	28/06/2017												
Sample Type	Ground Water												
Batch Number	1												
Date of Receipt	28/06/2017												

Please see attached notes for all abbreviations and acronyms

											LOD/LOR	Units	Method No.
TPH CWG													
Aromatics													
>C5-EC7 #	<10										<10	ug/l	TM36/PM12
>EC7-EC8 #	<10										<10	ug/l	TM36/PM12
>EC8-EC10 #	<10										<10	ug/l	TM36/PM12
>EC10-EC12 #	<5										<5	ug/l	TM5/PM30
>EC12-EC16 #	<10										<10	ug/l	TM5/PM30
>EC16-EC21 #	<10										<10	ug/l	TM5/PM30
>EC21-EC35 #	<10										<10	ug/l	TM5/PM30
Total aromatics C5-35 #	<10										<10	ug/l	TM5/TM36/PM30/PM12
Total aliphatics and aromatics(C5-35) #	<10										<10	ug/l	TM5/TM36/PM30/PM12
MTBE #	<5										<5	ug/l	TM31/PM12
Benzene #	<5										<5	ug/l	TM31/PM12
Toluene #	<5										<5	ug/l	TM31/PM12
Ethylbenzene #	<5										<5	ug/l	TM31/PM12
m/p-Xylene #	<5										<5	ug/l	TM31/PM12
o-Xylene #	<5										<5	ug/l	TM31/PM12
Total Phenols HPLC	<0.1										<0.1	mg/l	TM26/PM0
Sulphate as SO4 #	86.9										<0.5	mg/l	TM38/PM0
Total Ammonia as N #	<0.03										<0.03	mg/l	TM38/PM0
Electrical Conductivity @25C #	686										<2	uS/cm	TM76/PM0
pH #	6.89										<0.01	pH units	TM73/PM0

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
No deviating sample report results for job 17/11101						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/11101

SOILS

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

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

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

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

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

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

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

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

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

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

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

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

WATERS

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

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

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

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

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

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

DILUTIONS

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

BLANKS

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

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

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

JE Job No: 17/11101

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID. Including determination of BTEX and calculation of Aliphatic fractions	PM30/PM12	CWG GC-FID	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

JE Job No: 17/11101

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Tier Environmental
Suite 513, Chadwick House
Warrington Rd
Birchwood
Warrington
WA3 6AE

Attention :	Adrian Read
Date :	29th June, 2017
Your reference :	TE1010
Our reference :	Test Report 17/10332 Batch 1
Location :	Gresford Road, Llay
Date samples received :	14th June, 2017
Status :	Final report
Issue :	1

Four samples were received for analysis on 14th June, 2017 of which four were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton BSc
Project Manager

Client Name: Tier Environmental
Reference: TE1010
Location: Gresford Road, Llay
Contact: Adrian Read
JE Job No.: 17/10332

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

J E Sample No.	1-6	7-12	13-18	19-25							LOD/LOR	Units	Method No.
Sample ID	WS3	WS4	WS5	WS6									
Depth													
COC No / misc													
Containers	V P G	V P G	V P G	V H P G									
Sample Date	14/06/2017	14/06/2017	14/06/2017	14/06/2017									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	14/06/2017	14/06/2017	14/06/2017	14/06/2017									
Dissolved Arsenic #	1.1	<0.9	1.4	-							<0.9	ug/l	TM30/PM14
Dissolved Cadmium #	<0.03	<0.03	<0.03	-							<0.03	ug/l	TM30/PM14
Total Dissolved Chromium #	1.4	<0.2	<0.2	-							<0.2	ug/l	TM30/PM14
Dissolved Copper #	<3	3	<3	-							<3	ug/l	TM30/PM14
Dissolved Lead #	<0.4	<0.4	<0.4	-							<0.4	ug/l	TM30/PM14
Dissolved Mercury #	<0.5	<0.5	<0.5	-							<0.5	ug/l	TM30/PM14
Dissolved Nickel #	<0.2	2.0	3.2	-							<0.2	ug/l	TM30/PM14
Dissolved Selenium #	<1.2	<1.2	<1.2	-							<1.2	ug/l	TM30/PM14
Dissolved Zinc #	<1.5	<1.5	<1.5	-							<1.5	ug/l	TM30/PM14
Total Hardness Dissolved (as CaCO3)	113	353	158	-							<1	mg/l	TM30/PM14
PAH MS													
Naphthalene	<0.1	<0.1	10.3	-							<0.1	ug/l	TM4/PM30
Acenaphthylene	<0.01	<0.01	0.01	-							<0.01	ug/l	TM4/PM30
Acenaphthene	<0.01	<0.01	0.06	-							<0.01	ug/l	TM4/PM30
Fluorene	<0.01	<0.01	0.04	-							<0.01	ug/l	TM4/PM30
Phenanthrene	<0.01	<0.01	0.07	-							<0.01	ug/l	TM4/PM30
Anthracene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Fluoranthene	<0.01	<0.01	0.03	-							<0.01	ug/l	TM4/PM30
Pyrene	<0.01	<0.01	0.02	-							<0.01	ug/l	TM4/PM30
Benzo(a)anthracene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Chrysene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Benzo(bk)fluoranthene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Benzo(a)pyrene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Indeno(123cd)pyrene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Dibenzo(ah)anthracene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Benzo(ghi)perylene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
PAH 16 Total	<0.1	<0.1	10.5	-							<0.1	ug/l	TM4/PM30
Benzo(b)fluoranthene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
Benzo(k)fluoranthene	<0.01	<0.01	<0.01	-							<0.01	ug/l	TM4/PM30
PAH Surrogate % Recovery	88	87	73	-							<0	%	TM4/PM30
TPH CWG													
Aliphatics													
>C5-C6 #	<10	<10	269	<10							<10	ug/l	TM36/PM12
>C6-C8 #	<10	<10	392	<10							<10	ug/l	TM36/PM12
>C8-C10 #	<10	<10	346	<10							<10	ug/l	TM36/PM12
>C10-C12 #	<5	<5	<5	<5							<5	ug/l	TM5/PM30
>C12-C16 #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
>C16-C21 #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
>C21-C35 #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
Total aliphatics C5-35 #	<10	<10	1007	<10							<10	ug/l	TM5/TM36/PM30/PM12

Please see attached notes for all abbreviations and acronyms

Client Name: Tier Environmental
Reference: TE1010
Location: Gresford Road, Llay
Contact: Adrian Read
JE Job No.: 17/10332

Report : Liquid

Liquids/products: V=40ml vial, G=glass bottle, P=plastic bottle
H=H_2SO_4, Z=ZnAc, N=NaOH, HN=$HN0_3$

Please see attached notes for all abbreviations and acronyms

J E Sample No.	1-6	7-12	13-18	19-25							LOD/LOR	Units	Method No.
Sample ID	WS3	WS4	WS5	WS6									
Depth													
COC No / misc													
Containers	V P G	V P G	V P G	V H P G									
Sample Date	14/06/2017	14/06/2017	14/06/2017	14/06/2017									
Sample Type	Ground Water	Ground Water	Ground Water	Ground Water									
Batch Number	1	1	1	1									
Date of Receipt	14/06/2017	14/06/2017	14/06/2017	14/06/2017									
TPH CWG													
Aromatics													
>C5-EC7 #	<10	<10	24	<10							<10	ug/l	TM36/PM12
>EC7-EC8 #	<10	<10	11	<10							<10	ug/l	TM36/PM12
>EC8-EC10 #	<10	<10	415	<10							<10	ug/l	TM36/PM12
>EC10-EC12 #	<5	<5	30	<5							<5	ug/l	TM5/PM30
>EC12-EC16 #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
>EC16-EC21 #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
>EC21-EC35 #	<10	<10	<10	<10							<10	ug/l	TM5/PM30
Total aromatics C5-35 #	<10	<10	480	<10							<10	ug/l	TM5/TM36/PM30/PM12
Total aliphatics and aromatics(C5-35) #	<10	<10	1487	<10							<10	ug/l	TM5/TM36/PM30/PM12
MTBE #	<5	<5	<5	<5							<5	ug/l	TM31/PM12
Benzene #	<5	<5	24	<5							<5	ug/l	TM31/PM12
Toluene #	<5	<5	11	<5							<5	ug/l	TM31/PM12
Ethylbenzene #	<5	<5	64	<5							<5	ug/l	TM31/PM12
m/p-Xylene #	<5	<5	331	<5							<5	ug/l	TM31/PM12
o-Xylene #	<5	<5	19	<5							<5	ug/l	TM31/PM12
Total Phenols HPLC	<0.1	<0.1	<0.1	-							<0.1	mg/l	TM26/PM0
Sulphate as SO4 #	19.4	110.3	23.9	-							<0.5	mg/l	TM38/PM0
Total Ammonia as N #	<0.03	0.03	0.06	-							<0.03	mg/l	TM38/PM0
Electrical Conductivity @25C #	276	746	460	-							<2	uS/cm	TM76/PM0
pH #	7.14	7.24	7.33	-							<0.01	pH units	TM73/PM0

Client Name: Tier Environmental

Reference: TE1010

Location: Gresford Road, Llay

Contact: Adrian Read

Matrix : Liquid

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
17/10332	1					Liquid Samples were received at a temperature above 9°C.

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.

Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/10332

SOILS

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

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

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

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

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

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

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

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

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

WATERS

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

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

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

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

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

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

DILUTIONS

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

BLANKS

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

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

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

JE Job No: 17/10332

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.				
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM30	Water samples are extracted with solvent using a magnetic stirrer to create a vortex.	Yes			
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID. Including determination of	PM30/PM12	CWG GC-FID	Yes			
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.				
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM14	Analysis of waters and leachates for metals by ICP OES/ICP MS. Samples are filtered for dissolved metals and acidified if required.	Yes			
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes			
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes			
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

JE Job No: 17/10332

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM76	Modified US EPA method 120.1. Determination of Specific Conductance by Metrohm automated probe analyser.	PM0	No preparation is required.	Yes			

Exova Jones Environmental

Registered Address : Exova (UK) Ltd, Lochend Industrial Estate, Newbridge, Midlothian, EH28 8PL

Unit 3 Deeside Point
Zone 3
Deeside Industrial Park
Deeside
CH5 2UA

Tel: +44 (0) 1244 833780
Fax: +44 (0) 1244 833781

Tier Environmental
Suite 513, Chadwick House
Warrington Rd
Birchwood
Warrington
WA3 6AE

Attention :	Adrian Read
Date :	8th June, 2017
Your reference :	TE1010
Our reference :	Test Report 17/9031 Batch 1
Location :	
Date samples received :	22nd May, 2017
Status :	Final report
Issue :	1

Fourteen samples were received for analysis on 22nd May, 2017 of which fourteen were scheduled for analysis. Please find attached our Test Report which should be read with notes at the end of the report and should include all sections if reproduced. Interpretations and opinions are outside the scope of any accreditation, and all results relate only to samples supplied.
All analysis is carried out on as received samples and reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected.

Compiled By:

Phil Sommerton BSc
Project Manager

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/9031

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	LOD/LOR	Units	Method No.
Sample ID	WS1	WS2	WS3	WS3	WS4	WS4	WS5	WS5	WS6	WS8			
Depth	0.20	0.20	0.30	0.80	0.40	0.80	0.30	0.90	0.20	0.50			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017			
Arsenic #	10.7	2.5	13.4	-	8.4	-	5.5	-	8.4	8.0	<0.5	mg/kg	TM30/PM15
Cadmium #	0.3	0.3	0.6	-	0.2	-	1.8	-	0.7	0.2	<0.1	mg/kg	TM30/PM15
Chromium #	60.7	55.7	62.2	-	58.2	-	54.0	-	63.4	53.7	<0.5	mg/kg	TM30/PM15
Copper #	21	27	23	-	13	-	38	-	22	15	<1	mg/kg	TM30/PM15
Lead #	24	33	32	-	47	-	183	-	29	54	<5	mg/kg	TM30/PM15
Mercury #	<0.1	<0.1	<0.1	-	<0.1	-	<0.1	-	<0.1	<0.1	<0.1	mg/kg	TM30/PM15
Nickel #	29.8	26.6	29.9	-	16.9	-	22.8	-	25.1	16.6	<0.7	mg/kg	TM30/PM15
Selenium #	1	1	1	-	1	-	2	-	2	<1	<1	mg/kg	TM30/PM15
Total Sulphate as SO4 #	196	200	1064	-	336	-	563	-	760	716	<50	mg/kg	TM50/PM29
Zinc #	76	108	287	-	55	-	143	-	90	46	<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	<0.04	<0.40$_{AA}$	0.05	-	<0.04	-	0.55$_{AA}$	-	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Acenaphthylene	<0.03	0.53$_{AA}$	<0.03	-	<0.03	-	<0.30$_{AA}$	-	<0.03	<0.03	<0.03	mg/kg	TM4/PM8
Acenaphthene #	<0.05	<0.50$_{AA}$	<0.05	-	<0.05	-	<0.50$_{AA}$	-	<0.05	<0.05	<0.05	mg/kg	TM4/PM8
Fluorene #	<0.04	<0.40$_{AA}$	<0.04	-	<0.04	-	<0.40$_{AA}$	-	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Phenanthrene #	<0.03	0.54$_{AA}$	0.18	-	<0.03	-	1.58$_{AA}$	-	0.08	<0.03	<0.03	mg/kg	TM4/PM8
Anthracene #	<0.04	1.50$_{AA}$	0.05	-	<0.04	-	0.94$_{AA}$	-	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Fluoranthene #	0.07	2.32$_{AA}$	0.48	-	<0.03	-	4.37$_{AA}$	-	0.24	<0.03	<0.03	mg/kg	TM4/PM8
Pyrene #	0.06	4.15$_{AA}$	0.44	-	<0.03	-	3.97$_{AA}$	-	0.22	<0.03	<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	<0.06	1.47$_{AA}$	0.29	-	<0.06	-	2.10$_{AA}$	-	0.19	<0.06	<0.06	mg/kg	TM4/PM8
Chrysene #	0.06	2.19$_{AA}$	0.30	-	<0.02	-	2.14$_{AA}$	-	0.16	<0.02	<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	<0.07	6.86$_{AA}$	0.61	-	<0.07	-	5.87$_{AA}$	-	0.34	<0.07	<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	<0.04	3.96$_{AA}$	0.25	-	<0.04	-	3.51$_{AA}$	-	0.15	<0.04	<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	<0.04	1.74$_{AA}$	0.28	-	<0.04	-	3.62$_{AA}$	-	0.16	<0.04	<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	<0.04	<0.40$_{AA}$	<0.04	-	<0.04	-	0.48$_{AA}$	-	<0.04	<0.04	<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	<0.04	1.73$_{AA}$	0.24	-	<0.04	-	3.51$_{AA}$	-	0.16	<0.04	<0.04	mg/kg	TM4/PM8
Coronene	-	-	-	-	-	-	0.75$_{AA}$	-	-	-	<0.04	mg/kg	TM4/PM8
PAH 16 Total	<0.6	27.0$_{AA}$	3.2	-	<0.6	-	32.6$_{AA}$	-	1.7	<0.6	<0.6	mg/kg	TM4/PM8
PAH 17 Total	-	-	-	-	-	-	33.39$_{AA}$	-	-	-	<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	<0.05	4.94$_{AA}$	0.44	-	<0.05	-	4.23$_{AA}$	-	0.24	<0.05	<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	<0.02	1.92$_{AA}$	0.17	-	<0.02	-	1.64$_{AA}$	-	0.10	<0.02	<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	88	84$_{AA}$	91	-	90	-	84$_{AA}$	-	89	94	<0	%	TM4/PM8
Mineral Oil (C10-C40)	-	-	-	-	-	-	477	-	-	-	<30	mg/kg	TM5/PM16

Please see attached notes for all abbreviations and acronyms

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/9031

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	LOD/LOR	Units	Method No.
Sample ID	WS1	WS2	WS3	WS3	WS4	WS4	WS5	WS5	WS6	WS8			
Depth	0.20	0.20	0.30	0.80	0.40	0.80	0.30	0.90	0.20	0.50			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017			
TPH CWG													
Aliphatics													
>C5-C6 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	0.3	<0.1	0.4	<0.1	mg/kg	TM36/PM12
>C6-C8 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	1.0	2.8	<0.1	1.0	<0.1	mg/kg	TM36/PM12
>C8-C10	<0.1	<0.1	<0.1	<0.1	0.1	0.6	2.7	6.2	<0.1	3.3	<0.1	mg/kg	TM36/PM12
>C10-C12 #	<0.2	<0.2	<0.2	<0.2	<0.2	15.8	15.4	2.8	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4	<4	<4	<4	32	22	<4	<4	<4	<4	mg/kg	TM5/PM16
>C16-C21 #	<7	35	<7	<7	<7	<7	46	<7	<7	<7	<7	mg/kg	TM5/PM16
>C21-C35 #	<7	840	205	<7	16	<7	303	<7	30	<7	<7	mg/kg	TM5/PM16
Total aliphatics C5-35	<19	875	205	<19	<19	48	390	<19	30	<19	<19	mg/kg	TM5/TM36/PM12/PM16
Aromatics													
>C5-EC7 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.1	<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	<0.1	<0.1	<0.1	<0.1	<0.1	<0.1	0.2	0.8	<0.1	3.2	<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	<0.2	<0.2	<0.2	<0.2	<0.2	0.5	19.2	10.6	<0.2	<0.2	<0.2	mg/kg	TM5/PM16
>EC12-EC16 #	<4	<4	<4	<4	<4	6	21	<4	<4	<4	<4	mg/kg	TM5/PM16
>EC16-EC21 #	<7	51	<7	<7	<7	<7	76	<7	<7	<7	<7	mg/kg	TM5/PM16
>EC21-EC35 #	<7	1966	119	<7	11	<7	630	<7	69	<7	<7	mg/kg	TM5/PM16
Total aromatics C5-35 #	<19	2017	119	<19	<19	<19	746	<19	69	<19	<19	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-35)	<38	2892	324	<38	<38	48	1136	<38	99	<38	<38	mg/kg	TM5/TM36/PM12/PM16
MTBE #	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	<5	ug/kg	TM31/PM12
Benzene #	<5	<5	<5	<5	<5	<5	-	<5	<5	165	<5	ug/kg	TM31/PM12
Toluene #	<5	<5	<5	<5	<5	<5	-	15	<5	24	<5	ug/kg	TM31/PM12
Ethylbenzene #	<5	<5	<5	<5	13	<5	-	78	<5	181	<5	ug/kg	TM31/PM12
m/p-Xylene #	<5	<5	<5	<5	59	13	-	664	<5	2868	<5	ug/kg	TM31/PM12
o-Xylene #	<5	<5	<5	<5	11	<5	-	19	<5	119	<5	ug/kg	TM31/PM12
PCB 28 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
PCB 52 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
PCB 101 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
PCB 118 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
PCB 138 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
PCB 153 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
PCB 180 #	-	-	-	-	-	-	<5	-	-	-	<5	ug/kg	TM17/PM8
Total 7 PCBs #	-	-	-	-	-	-	<35	-	-	-	<35	ug/kg	TM17/PM8
Total Phenols HPLC	<0.15	<0.15	<0.15	-	<0.15	-	<0.15	-	<0.15	<0.15	<0.15	mg/kg	TM26/PM21
Natural Moisture Content	42.2	10.8	9.8	20.3	26.6	17.1	13.1	16.2	15.3	23.4	<0.1	%	PM4/PM0
Sulphate as SO4 (2:1 Ext) #	<0.0015	0.0078	0.1011	-	0.0284	-	0.0898	-	0.0273	0.0363	<0.0015	g/l	TM38/PM20
Total Organic Carbon #	0.49	2.97	0.46	-	2.41	-	4.48	-	0.40	2.91	<0.02	%	TM21/PM24

Please see attached notes for all abbreviations and acronyms

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/9031

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	1-3	4-6	7-9	10-12	13-15	16-18	19-21	22-24	25-27	28-30	LOD/LOR	Units	Method No.
Sample ID	WS1	WS2	WS3	WS3	WS4	WS4	WS5	WS5	WS6	WS8			
Depth	0.20	0.20	0.30	0.80	0.40	0.80	0.30	0.90	0.20	0.50			
COC No / misc													
Containers	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T	V J T			
Sample Date	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017			
Sample Type	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil	Soil			
Batch Number	1	1	1	1	1	1	1	1	1	1			
Date of Receipt	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017	22/05/2017			
ANC at pH4	-	-	-	-	-	-	0.25	-	-	-	<0.03	mol/kg	TM77/PM0
ANC at pH7	-	-	-	-	-	-	NDP	-	-	-	<0.03	mol/kg	TM77/PM0
Loss on Ignition #	-	-	-	-	-	-	5.5	-	-	-	<1.0	%	TM22/PM0
pH #	8.09	8.13	9.22	-	7.24	-	8.07	-	8.85	7.31	<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/9031

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	31-33	34-36	37-39	40-41							LOD/LOR	Units	Method No.
Sample ID	WS8	WS9	WS10	WS10									
Depth	1.10	0.30	0.40	1.00									
COC No / misc													
Containers	V T	V T	V J T	V T									
Sample Date	22/05/2017	22/05/2017	22/05/2017	22/05/2017									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	22/05/2017	22/05/2017	22/05/2017	22/05/2017									
Arsenic #	-	6.9	7.8	-							<0.5	mg/kg	TM30/PM15
Cadmium #	-	0.2	0.1	-							<0.1	mg/kg	TM30/PM15
Chromium #	-	52.7	55.5	-							<0.5	mg/kg	TM30/PM15
Copper #	-	14	13	-							<1	mg/kg	TM30/PM15
Lead #	-	54	42	-							<5	mg/kg	TM30/PM15
Mercury #	-	<0.1	<0.1	-							<0.1	mg/kg	TM30/PM15
Nickel #	-	12.7	14.6	-							<0.7	mg/kg	TM30/PM15
Selenium #	-	2	<1	-							<1	mg/kg	TM30/PM15
Total Sulphate as SO4 #	-	583	324	-							<50	mg/kg	TM50/PM29
Zinc #	-	36	37	-							<5	mg/kg	TM30/PM15
PAH MS													
Naphthalene #	-	0.11	<0.04	-							<0.04	mg/kg	TM4/PM8
Acenaphthylene	-	<0.03	<0.03	-							<0.03	mg/kg	TM4/PM8
Acenaphthene #	-	<0.05	<0.05	-							<0.05	mg/kg	TM4/PM8
Fluorene #	-	<0.04	<0.04	-							<0.04	mg/kg	TM4/PM8
Phenanthrene #	-	0.04	<0.03	-							<0.03	mg/kg	TM4/PM8
Anthracene #	-	<0.04	<0.04	-							<0.04	mg/kg	TM4/PM8
Fluoranthene #	-	0.12	<0.03	-							<0.03	mg/kg	TM4/PM8
Pyrene #	-	0.11	<0.03	-							<0.03	mg/kg	TM4/PM8
Benzo(a)anthracene #	-	0.08	<0.06	-							<0.06	mg/kg	TM4/PM8
Chrysene #	-	0.05	<0.02	-							<0.02	mg/kg	TM4/PM8
Benzo(bk)fluoranthene #	-	0.15	<0.07	-							<0.07	mg/kg	TM4/PM8
Benzo(a)pyrene #	-	0.08	<0.04	-							<0.04	mg/kg	TM4/PM8
Indeno(123cd)pyrene #	-	0.08	<0.04	-							<0.04	mg/kg	TM4/PM8
Dibenzo(ah)anthracene #	-	<0.04	<0.04	-							<0.04	mg/kg	TM4/PM8
Benzo(ghi)perylene #	-	0.07	<0.04	-							<0.04	mg/kg	TM4/PM8
Coronene	-	-	-	-							<0.04	mg/kg	TM4/PM8
PAH 16 Total	-	0.9	<0.6	-							<0.6	mg/kg	TM4/PM8
PAH 17 Total	-	-	-	-							<0.64	mg/kg	TM4/PM8
Benzo(b)fluoranthene	-	0.11	<0.05	-							<0.05	mg/kg	TM4/PM8
Benzo(k)fluoranthene	-	0.04	<0.02	-							<0.02	mg/kg	TM4/PM8
PAH Surrogate % Recovery	-	88	92	-							<0	%	TM4/PM8
Mineral Oil (C10-C40)	-	-	-	-							<30	mg/kg	TM5/PM16

Please see attached notes for all abbreviations and acronyms

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/9031

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	31-33	34-36	37-39	40-41							LOD/LOR	Units	Method No.
Sample ID	WS8	WS9	WS10	WS10									
Depth	1.10	0.30	0.40	1.00									
COC No / misc													
Containers	V T	V T	V J T	V T									
Sample Date	22/05/2017	22/05/2017	22/05/2017	22/05/2017									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	22/05/2017	22/05/2017	22/05/2017	22/05/2017									
TPH CWG													
Aliphatics													
>C5-C6 #	0.9	0.1	0.5	0.2							<0.1	mg/kg	TM36/PM12
>C6-C8 #	2.7	<0.1	0.8	1.6							<0.1	mg/kg	TM36/PM12
>C8-C10	5.2	0.1	1.0	5.4							<0.1	mg/kg	TM36/PM12
>C10-C12 #	3.1	<0.2	<0.2	2.3							<0.2	mg/kg	TM5/PM16
>C12-C16 #	<4	<4	<4	<4							<4	mg/kg	TM5/PM16
>C16-C21 #	<7	<7	<7	<7							<7	mg/kg	TM5/PM16
>C21-C35 #	<7	12	<7	<7							<7	mg/kg	TM5/PM16
Total aliphatics C5-35	<19	<19	<19	<19							<19	mg/kg	TM5/TM36/PM12/PM16
Aromatics													
>C5-EC7 #	<0.1	<0.1	<0.1	<0.1							<0.1	mg/kg	TM36/PM12
>EC7-EC8 #	<0.1	<0.1	<0.1	<0.1							<0.1	mg/kg	TM36/PM12
>EC8-EC10 #	2.5	<0.1	0.8	1.2							<0.1	mg/kg	TM36/PM12
>EC10-EC12 #	3.7	<0.2	<0.2	4.4							<0.2	mg/kg	TM5/PM16
>EC12-EC16 #	<4	<4	<4	<4							<4	mg/kg	TM5/PM16
>EC16-EC21 #	<7	<7	<7	<7							<7	mg/kg	TM5/PM16
>EC21-EC35 #	<7	30	<7	<7							<7	mg/kg	TM5/PM16
Total aromatics C5-35 #	<19	30	<19	<19							<19	mg/kg	TM5/TM36/PM12/PM16
Total aliphatics and aromatics(C5-35)	<38	<38	<38	<38							<38	mg/kg	TM5/TM36/PM12/PM16
MTBE #	<5	<5	<5	<5							<5	ug/kg	TM31/PM12
Benzene #	15	9	62	56							<5	ug/kg	TM31/PM12
Toluene #	26	<5	22	22							<5	ug/kg	TM31/PM12
Ethylbenzene #	387	17	<5	317							<5	ug/kg	TM31/PM12
m/p-Xylene #	2024	<5	686	800							<5	ug/kg	TM31/PM12
o-Xylene #	26	<5	37	19							<5	ug/kg	TM31/PM12
PCB 28 #	-	-	-	-							<5	ug/kg	TM17/PM8
PCB 52 #	-	-	-	-							<5	ug/kg	TM17/PM8
PCB 101 #	-	-	-	-							<5	ug/kg	TM17/PM8
PCB 118 #	-	-	-	-							<5	ug/kg	TM17/PM8
PCB 138 #	-	-	-	-							<5	ug/kg	TM17/PM8
PCB 153 #	-	-	-	-							<5	ug/kg	TM17/PM8
PCB 180 #	-	-	-	-							<5	ug/kg	TM17/PM8
Total 7 PCBs #	-	-	-	-							<35	ug/kg	TM17/PM8
Total Phenols HPLC	-	<0.15	<0.15	-							<0.15	mg/kg	TM26/PM21
Natural Moisture Content	18.3	29.8	21.3	16.8							<0.1	%	PM4/PM0
Sulphate as SO4 (2:1 Ext) #	-	0.0058	0.0053	-							<0.0015	g/l	TM38/PM20
Total Organic Carbon #	-	3.78	1.80	-							<0.02	%	TM21/PM24

Please see attached notes for all abbreviations and acronyms

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read
JE Job No.: 17/9031

Report : Solid

Solids: V=60g VOC jar, J=250g glass jar, T=plastic tub

J E Sample No.	31-33	34-36	37-39	40-41							LOD/LOR	Units	Method No.
Sample ID	WS8	WS9	WS10	WS10									
Depth	1.10	0.30	0.40	1.00									
COC No / misc													
Containers	V T	V T	V J T	V T									
Sample Date	22/05/2017	22/05/2017	22/05/2017	22/05/2017									
Sample Type	Soil	Soil	Soil	Soil									
Batch Number	1	1	1	1									
Date of Receipt	22/05/2017	22/05/2017	22/05/2017	22/05/2017									
ANC at pH4	-	-	-	-							<0.03	mol/kg	TM77/PM0
ANC at pH7	-	-	-	-							<0.03	mol/kg	TM77/PM0
Loss on Ignition #	-	-	-	-							<1.0	%	TM22/PM0
pH #	-	7.09	7.28	-							<0.01	pH units	TM73/PM11

Please see attached notes for all abbreviations and acronyms

Mass of sample taken (kg)	-	Moisture Content Ratio (%) =	11.7
Mass of dry sample (kg) =	0.09	Dry Matter Content Ratio (%) =	89.5
Particle Size <4mm =	>95%		

		Landfill Waste Acceptance Criteria Limits		
JEFL Job No	**17/9031**			
Sample No	**21**			
Client Sample No	**WS5**	**Inert Waste Landfill**	**Stable Non-reactive Hazardous Waste in Non-Hazardous Landfill**	**Hazardous Waste Landfill**
Depth/Other	**0.30**			
Sample Date	**22/05/2017**			
Batch No	**1**			
Solid Waste Analysis				
Total Organic Carbon (%)	4.48	3	5	6
Loss on Ignition (%)	5.5	-	-	10
Sum of BTEX (mg/kg)	0.197	6	-	-
Sum of 7 PCBs (mg/kg)	<0.035	1	-	-
Mineral Oil (mg/kg)	477	500	-	-
PAH Sum of 17(mg/kg)	33.39	100	-	-
pH (pH Units)	8.07	-	>6	-
ANC to pH 7 (mol/kg)	NDP	-	to be evaluated	to be evaluated
ANC to pH 4 (mol/kg)	0.25	-	to be evaluated	to be evaluated

Eluate Analysis	**10:1 conc^{n} leached**		**Limit values for compliance leaching test using BS EN 12457-2 at L/S 10 l/kg**		
	C_{10}	**A_{10}**			
	mg/l	**mg/kg**	**mg/kg**		
Arsenic	<0.0025	<0.025	0.5	2	25
Barium	0.022	0.22	20	100	300
Cadmium	<0.0005	<0.005	0.04	1	5
Chromium	<0.0015	<0.015	0.5	10	70
Copper	<0.007	<0.07	2	50	100
Mercury	<0.001	<0.01	0.01	0.2	2
Molybdenum	0.018	0.18	0.5	10	30
Nickel	<0.002	<0.02	0.4	10	40
Lead	<0.005	<0.05	0.5	10	50
Antimony	0.015	0.15	0.06	0.7	5
Selenium	<0.003	<0.03	0.1	0.5	7
Zinc	<0.003	<0.03	4	50	200
Chloride	0.7	7	800	15000	25000
Fluoride	0.6	6	10	150	500
Sulphate as SO4	14.67	146.6	1000	20000	50000
Total Dissolved Solids	91	910	4000	60000	100000
Phenol	<0.01	<0.1	1	-	-
Dissolved Organic Carbon	9	90	500	800	1000

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read

Note:

Analysis was carried out in accordance with our documented in-house methods PM042 and TM065 and HSG 248 by Stereo and Polarised Light Microscopy using Dispersion Staining Techniques and is covered by our UKAS accreditation. Samples are retained for not less than 6 months from the date of analysis unless specifically requested.

Opinions, including ACM type and Asbestos level, lie outside the scope of our UKAS accreditation.

Where the sample is not taken by a Jones Environmental Laboratory consultant, Jones Environmental Laboratory cannot be responsible for inaccurate or unrepresentative sampling.

Signed on behalf of Jones Environmental Laboratory:



Ryan Butterworth
Asbestos Team Leader

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
17/9031	1	WS1	0.20	2	01/06/2017	**General Description (Bulk Analysis)**	soil/stones
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS2	0.20	5	01/06/2017	**General Description (Bulk Analysis)**	soil-stones
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS3	0.30	8	01/06/2017	**General Description (Bulk Analysis)**	soil-stones
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS4	0.40	14	01/06/2017	**General Description (Bulk Analysis)**	Soil/Stone
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS5	0.30	20	01/06/2017	**General Description (Bulk Analysis)**	Soil/Stone
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Date Of Analysis	Analysis	Result
17/9031	1	WS5	0.30	20	01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS6	0.20	26	01/06/2017	**General Description (Bulk Analysis)**	Soil/Stone
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS8	0.50	29	01/06/2017	**General Description (Bulk Analysis)**	soil/stones
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS9	0.30	36	01/06/2017	**General Description (Bulk Analysis)**	soil-stones
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD
17/9031	1	WS10	0.40	38	01/06/2017	**General Description (Bulk Analysis)**	soil-stones
					01/06/2017	**Asbestos Fibres**	NAD
					01/06/2017	**Asbestos Fibres (2)**	NAD
					01/06/2017	**Asbestos ACM**	NAD
					01/06/2017	**Asbestos ACM (2)**	NAD
					01/06/2017	**Asbestos Type**	NAD
					01/06/2017	**Asbestos Type (2)**	NAD
					01/06/2017	**Asbestos Level Screen**	NAD

Client Name: Tier Environmental **Matrix : Solid**
Reference: TE1010
Location:
Contact: Adrian Read

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	NDP Reason
17/9031	1	WS5	0.30	19-21	Sample received is below pH7

Client Name: Tier Environmental
Reference: TE1010
Location:
Contact: Adrian Read

J E Job No.	Batch	Sample ID	Depth	J E Sample No.	Analysis	Reason
No deviating sample report results for job 17/9031						

Please note that only samples that are deviating are mentioned in this report. If no samples are listed it is because none were deviating.
Only analyses which are accredited are recorded as deviating if set criteria are not met.

NOTES TO ACCOMPANY ALL SCHEDULES AND REPORTS

JE Job No.: 17/9031

SOILS

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

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

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

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

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

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

All analysis is reported on a dry weight basis unless stated otherwise. Results are not surrogate corrected. Samples are dried at 35°C ±5°C unless otherwise stated. Moisture content for CEN Leachate tests are dried at 105°C ±5°C.

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

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

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

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

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

WATERS

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

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

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

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

DEVIATING SAMPLES

Samples must be received in a condition appropriate to the requested analyses. All samples should be submitted to the laboratory in suitable containers with sufficient ice packs to sustain an appropriate temperature for the requested analysis. If this is not the case you will be informed and any test results that may be compromised highlighted on your deviating samples report.

SURROGATES

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

DILUTIONS

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

BLANKS

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

NOTE

Data is only reported if the laboratory is confident that the data is a true reflection of the samples analysed. Data is only reported as accredited when all the requirements of our Quality System have been met. In certain circumstances where all the requirements of the Quality System have not been met, for instance if the associated AQC has failed, the reason is fully investigated and documented. The sample data is then evaluated alongside the other quality control checks performed during analysis to determine its suitability. Following this evaluation, provided the sample results have not been effected, the data is reported but accreditation is removed. It is a UKAS requirement for data not reported as accredited to be considered indicative only, but this does not mean the data is not valid.
Where possible, and if requested, samples will be re-extracted and a revised report issued with accredited results. Please do not hesitate to contact the laboratory if further details are required of the circumstances which have led to the removal of accreditation.

ABBREVIATIONS and ACRONYMS USED

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

JE Job No: 17/9031

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.				
PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.	PM0	No preparation is required.			AR	
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.			AR	Yes
TM4	Modified USEPA 8270 method for the solvent extraction and determination of 16 PAHs by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5	Modified USEPA 8015B method for the determination of solvent Extractable Petroleum Hydrocarbons (EPH) with carbon banding within the range C8-C40 GC-FID.	PM16	Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID. Including determination of	PM12/PM16	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis./Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.			AR	Yes
TM5/TM36	TM005: Modified USEPA 8015B. Determination of solvent Extractable Petroleum Hydrocarbons (EPH) including column fractionation in the carbon range of C10-35 into aliphatic and aromatic fractions by GC-FID. TM036: Modified USEPA 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C5-10 by headspace GC-FID. Including determination of	PM12/PM16	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis./Fractionation into aliphatic and aromatic fractions using a Rapid Trace SPE.	Yes		AR	Yes
TM17	Modified US EPA method 8270. Determination of specific Polychlorinated Biphenyl congeners by GC-MS.	PM8	End over end extraction of solid samples for organic analysis. The solvent mix varies depending on analysis required.	Yes		AR	Yes
TM20	Modified BS 1377-3: 1990/USEPA 160.3 Gravimetric determination of Total Dissolved Solids/Total Solids	PM0	No preparation is required.			AR	Yes

JE Job No: 17/9031

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM21	Modified USEPA 415.1. Determination of Total Organic Carbon or Total Carbon by combustion in an Eltra TOC furnace/analyser in the presence of oxygen. The CO2 generated is quantified using infra-red detection.	PM24	Dried and ground solid samples are washed with hydrochloric acid, then rinsed with deionised water to remove the mineral carbon before TOC analysis.	Yes		AD	Yes
TM22	Modified USEPA 160.4. Gravimetric determination of Loss on Ignition by temperature controlled Muffle Furnace (450°C)	PM0	No preparation is required.	Yes		AD	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM0	No preparation is required.			AR	Yes
TM26	Determination of phenols by Reversed Phased High Performance Liquid Chromatography and Electro-Chemical Detection.	PM21	As received solid or water samples are extracted in Methanol: Sodium Hydroxide (0.1M NaOH) (60:40) by orbital shaker.			AR	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM15	Acid digestion of dried and ground solid samples using Aqua Regia refluxed at 112.5 °C. Samples containing asbestos are not dried and ground.	Yes		AD	Yes
TM30	Determination of Trace Metal elements by ICP-OES (Inductively Coupled Plasma - Optical Emission Spectrometry). Modified US EPA Method 200.7, 6010B and BS EN ISO 11885 2009	PM17	Modified method EN12457-2 As received solid samples are leached with water in a 10:1 water to soil ratio for 24 hours, the moisture content of the sample is included in the ratio.	Yes		AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM31	Modified USEPA 8015B. Determination of Methyltertbutylether, Benzene, Toluene, Ethylbenzene and Xylene by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.			AR	Yes
TM36	Modified US EPA method 8015B. Determination of Gasoline Range Organics (GRO) in the carbon chain range of C4-12 by headspace GC-FID.	PM12	Modified US EPA method 5021. Preparation of solid and liquid samples for GC headspace analysis.	Yes		AR	Yes

JE Job No: 17/9031

Test Method No.	Description	Prep Method No. (if appropriate)	Description	ISO 17025 (UKAS/SANAS)	MCERTS (UK soils only)	Analysis done on As Received (AR) or Dried (AD)	Reported on dry weight basis
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM0	No preparation is required.	Yes		AR	Yes
TM38	Soluble Ion analysis using the Thermo Aquakem Photometric Automatic Analyser. Modified US EPA methods 325.2, 375.4, 365.2, 353.1, 354.1	PM20	Extraction of dried and ground or as received samples with deionised water in a 2:1 water to solid ratio using a reciprocal shaker for all analytes except hexavalent chromium. Extraction of as received sample using 10:1 ratio of 0.2M sodium hydroxide to soil for hexavalent chromium using a reciprocal shaker.	Yes		AD	Yes
TM50	Acid soluble sulphate (Total Sulphate) analysed by ICP-OES	PM29	Dried and ground solid sample is boiled with dilute hydrochloric acid, the resulting liquor is then analysed.	Yes		AD	Yes
TM60	Modified USEPA 9060. Determination of TOC by calculation from Total Carbon and Inorganic Carbon using a TOC analyser, the carbon in the sample is converted to CO2 and then passed through a non-dispersive infrared gas analyser (NDIR).	PM0	No preparation is required.			AR	Yes
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.			AR	
TM65	Asbestos Bulk Identification method based on HSG 248.	PM42	Solid samples undergo a thorough visual inspection for asbestos fibres prior to asbestos identification using TM065.	Yes		AR	
TM73	Modified US EPA methods 150.1 and 9045D and BS1377:1990. Determination of pH by Metrohm automated probe analyser.	PM11	Extraction of as received solid samples using one part solid to 2.5 parts deionised water.	Yes		AR	No
TM77	Modified DDCEN/TS method 15364:2006. Determination of Acid Neutralization Capacity by Metrohm automated probe analyser.	PM0	No preparation is required.			AR	No
TM173	Analysis of fluoride by ISE (Ion Selective Electrode) using modified ISE method 340.2	PM0	No preparation is required.			AR	Yes
NONE	No Method Code	PM4	Gravimetric measurement of Natural Moisture Content and % Moisture Content at either 35°C or 105°C. Calculation based on ISO 11465 and BS1377.			AR	

APPENDIX M – GAS AND GROUNDWATER MONITORING RESULTS

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Llay, Wrexham	**Job No:**	TE1010		
Client:		**Visit No:**	1	of	
Site:	Llay, Wrexham	**Operator:**	David Bromley		
Date:	08/06/2017	**Project Manager:**	Sean Lee		

Monitoring Point	GAS CONCENTRATIONS												FLOW DATA		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS06													10.1	ND	0.10	3.06				WELL FLOODED
WS05													10.6	ND	0.03	2.80				WELL FLOODED
WS04	ND	ND			1.2	1.2	ND	ND	ND	ND	19.5	19.5	0.1	ND	0.27	3.01				PUMPING WATER
WS03													27.4	ND	0.14	3.15				WELL FLOODED
WS02			0.1	0.1	6.3	6.3	2	ND	ND	ND	6.3	6.3	ND	ND	1.30	3.29				
WS01	0.1	0.1			ND	ND	1	1	ND	ND	19.7	19.7	ND	ND	1.53	3.53				
Max	**0.1**	**0.1**	**0.1**	**0.1**	**6.3**	**6.3**	**2.0**	**1.0**	ND	ND	**19.7**	**19.7**	**27.4**	**0.1**	**1.53**	**3.53**				
Min	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	**0.1**	ND	ND	ND	ND	**6.3**	**6.3**	**0.1**	**0.1**	**0.03**	**2.80**				

METEOROLOGICAL AND SITE INFORMATION:									
State of ground:		Dry		Moist	X	Wet		Snow		Frozen
Wind:		Calm	X	Light		Moderate		Strong	
Cloud cover:		None		Slight		Cloudy	X	Overcast	
Preciptation:		None	X	Slight		Moderate		Heavy	
Barometric pressure (mbar):			992	Before			992	After	
Pressure trend:				Falling		Steady		Rising	
Ground gas meter:	**GA2000**								
Ambient Gas concentration:		**CH_4**	ND	**CO_2**	ND	**O_2**	20.5%		

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Llay, Wrexham	**Job No:**	TE1010		
Client:		**Visit No:**	2	of	
Site:	Llay, Wrexham	**Operator:**	ED		
Date:	14/06/2017	**Project Manager:**	Sean Lee		

Monitoring Point	**GAS CONCENTRATIONS**												**FLOW DATA**		**WELL AND WATER DATA**					**Comments**
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS06	0.1		2.0		ND	ND	2	1	ND	ND	19.8	19.8	-14.7	-0.1	0.24	3.01				Pumped water, cut short earthy/
WS05													-0.5	ND	FULL	2.82				waterlogged well
WS04	0.1	0.1	2.0	2.0	0.5	0.4	1	1	ND	ND	19.3	19.7	ND	ND	0.36	3.01				water pumped but good readings
WS03	0.1		2.0		ND		5		ND	ND	17.4		-3.5	-0.1	0.18	3.13				well full of water, terminated ea
WS02	0.1	0.1	2.0	2.0	2.5	2.5	8	1	ND	ND	17.9	17.9	ND	ND	1.21	3.28				
WS01	0.1	0.1	2.0	2.0	5.0	ND	5	ND	ND	ND	19.7	19.8	ND	ND	1.63	3.50				
Max	**0.1**	**0.1**	**2.0**	**2.0**	**5.0**	**2.5**	**8.0**	**1.0**	ND	ND	**19.8**	**19.8**	**-0.5**	**-0.1**	**1.63**	**3.50**				
Min	**0.1**	**0.1**	**2.0**	**2.0**	**0.1**	**0.1**	**1.0**	ND	ND	ND	**17.4**	**17.9**	**0.1**	**0.1**	**0.18**	**2.82**				

METEOROLOGICAL AND SITE INFORMATION:										
State of ground:	X	Dry		Moist		Wet		Snow		Frozen
Wind:		Calm	X	Light		Moderate		Strong		
Cloud cover:		None	X	Slight		Cloudy		Overcast		
Preciptation:	X	None		Slight		Moderate		Heavy		
Barometric pressure (mbar):			1007	Before			1007	After		
Pressure trend:			X	Falling		Steady		Rising		
Ground gas meter:	**GA2000**									
Ambient Gas concentration:	**CH_4**	ND	**CO_2**	ND	**O_2**	20.2%				

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Llay, Wrexham	**Job No:**	TE1010		
Client:		**Visit No:**	3	of	
Site:	Llay, Wrexham	**Operator:**	ED		
Date:	28.6.17	**Project Manager:**	Sean Lee		

Monitoring Point	GAS CONCENTRATIONS												FLOW DATA		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS06																				WATERLOGGED
WS05																				WATERLOGGED
WS04	0.1	0.1	2.0	2.0	1.6	1.4	ND	ND	ND	ND	18.9	18.9	ND	ND	0.91	3.02				
WS03	0.1	0.1	2.0	2.0	0.8	0.8	ND	ND	ND	ND	17.2	17.2	-0.1	ND	1.28	3.12				
WS02	0.1	0.1	2.0	2.0	5.4	5.4	1	ND	ND	ND	9.3	9.4	ND	ND	1.73	3.23				
WS01	ND	ND	ND	ND	0.4	0.4	3	ND	ND	ND	19.2	19.2	ND	ND	DRY	3.50				
Max	**0.1**	**0.1**	**2.0**	**2.0**	**5.4**	**5.4**	**3.0**	ND	ND	ND	**19.2**	**19.2**	**-0.1**	**0.1**	**3.50**	**3.50**				
Min	**0.1**	**0.1**	**2.0**	**2.0**	**0.4**	**0.4**	ND	ND	ND	ND	**9.3**	**9.4**	**0.1**	**0.1**	**0.91**	**3.02**				

METEOROLOGICAL AND SITE INFORMATION:												
State of ground:		Dry		Moist	X	Wet		Snow		Frozen		
Wind:	X	Calm		Light		Moderate		Strong				
Cloud cover:		None		Slight		Cloudy	X	Overcast				
Preciptation:		None		Slight	X	Moderate		Heavy				
Barometric pressure (mbar):			990	Before			990	After				
Pressure trend:				Falling		Steady		Rising				
Ground gas meter:	**GA2000**											
Ambient Gas concentration:	**CH_4**	ND	**CO_2**	ND	**O_2**	20.3%						

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Llay, Wrexham	**Job No:**	TE1010		
Client:		**Visit No:**	4	of	
Site:	Llay, Wrexham	**Operator:**	Megan Nicholson		
Date:	27/07/2017	**Project Manager:**	Sean Lee		

Monitoring Point	**GAS CONCENTRATIONS**												**FLOW DATA**		**WELL AND WATER DATA**					**Comments**
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS06	0.1	0.1	2.0	2.0	1.0	1.0	7	2	ND	ND	18.5	18.5	ND	ND	0.20	3.00				
WS05																				WATERLOGGED
WS04	ND	ND	ND	ND	0.2	0.1	10	ND	ND	ND	19.5	19.6	ND	ND	0.50	3.00				
WS03	ND	ND	ND	ND	0.3	0.3	11	6	ND	ND	16.6	16.6	ND	ND	0.25	3.20				
WS02																				NO ACCESS- GATED
WS01																				NO ACCESS- GATED
Max	**0.1**	**0.1**	**2.0**	**2.0**	**1.0**	**1.0**	**11.0**	**6.0**	ND	ND	**19.5**	**19.6**	**0.1**	**0.1**	**0.50**	**3.20**				
Min	**0.1**	**0.1**	**2.0**	**2.0**	**0.2**	**0.1**	**7.0**	ND	ND	ND	**16.6**	**16.6**	**0.1**	**0.1**	**0.20**	**3.00**				

METEOROLOGICAL AND SITE INFORMATION:												
State of ground:	X	Dry		Moist		Wet		Snow		Frozen		
Wind:		Calm	X	Light		Moderate		Strong				
Cloud cover:		None	X	Slight		Cloudy		Overcast				
Preciptation:	X	None		Slight		Moderate		Heavy				
Barometric pressure (mbar):			992	Before			992	After				
Pressure trend:				Falling	X	Steady		Rising				
Ground gas meter:	**GA2000**											
Ambient Gas concentration:	**CH_4**	ND	**CO_2**	1.0%	**O_2**	19.7%						

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Llay, Wrexham	**Job No:**	TE1010		
Client:		**Visit No:**	5	of	
Site:	Llay, Wrexham	**Operator:**	MEGAN		
Date:	03/08/2017	**Project Manager:**	Sean Lee		

Monitoring Point	GAS CONCENTRATIONS												FLOW DATA		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS06	0.1	ND	2.0	ND	1.5	1.3	5	4	ND	ND	17.8	18.1	0.1	ND	0.25	3.00				
WS05															FULL	2.82				WATERLOGGED
WS04	ND	ND	ND	ND	0.7	0.7	2	1	ND	ND	19.1	19.1	ND	ND	0.60	3.00				
WS03	ND	ND	ND	ND	0.8	0.6	4	4	ND	ND	18.5	18.6	ND	ND	0.80	3.20				
WS02																				LOCKED
WS01																				LOCKED
Max	**0.1**	**0.1**	**2.0**	**0.1**	**1.5**	**1.3**	**5.0**	**4.0**	ND	ND	**19.1**	**19.1**	**0.1**	**0.1**	**0.80**	**3.20**				
Min	**0.1**	**0.1**	**2.0**	**0.0**	**0.7**	**0.6**	**2.0**	**1.0**	ND	ND	**17.8**	**18.1**	**0.1**	**0.1**	**0.25**	**2.82**				

METEOROLOGICAL AND SITE INFORMATION:												
State of ground:	X	Dry		Moist		Wet		Snow		Frozen		
Wind:		Calm	X	Light		Moderate		Strong				
Cloud cover:		None		Slight	X	Cloudy		Overcast				
Preciptation:	X	None		Slight		Moderate		Heavy				
Barometric pressure (mbar):			991	Before			991	After				
Pressure trend:				Falling		Steady	X	Rising				
Ground gas meter:	**GA2000**											
Ambient Gas concentration:	**CH_4**	ND	**CO_2**	ND	**O_2**	20.4%						

GAS MONITORING ACROSS BOREHOLE LOCATIONS

JOB DETAILS:	Llay, Wrexham	**Job No:**	TE1010		
Client:		**Visit No:**	6	of	
Site:	Llay, Wrexham	**Operator:**	Megan		
Date:	15/08/2017	**Project Manager:**	Sean Lee		

Monitoring Point	GAS CONCENTRATIONS												FLOW DATA		WELL AND WATER DATA					Comments
	Methane (%v/v)		%LEL		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Water Depth (mbgl)	Depth of Well (mbgl)	Ground Level (mAOD)	Water Level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady						
WS06	0.2	ND	4.0	ND	0.3	ND	4	2	ND	ND	19.1	19.1	0.2	0.1	FULL	3.00				WATERLOGGED
WS05	0.1	0.1	2.0	2.0	0.1	0.1	1	ND	ND	ND	14.7	14.7	ND	ND	FULL	2.80				WATERLOGGED
WS04	ND	ND	ND	ND	0.1	ND	ND	ND	ND	ND	18.5	18.6	0.1	ND	0.40	3.00				
WS03	0.1	ND	2.0	ND	ND	ND	7	1	ND	ND	19.7	19.8	ND	ND	0.20	3.20				
WS02	0.1	0.1	2.0	2.0	10.0	1.0	15	2	ND	ND	15.4	18.6	ND	ND	1.41	3.30				
WS01	0.1	ND	2.0	ND	7.0	2.0	9	1	ND	ND	19.1	19.1	ND	ND	1.95	3.50				
Max	**0.2**	**0.1**	**4.0**	**2.0**	**10.0**	**2.0**	**15.0**	**2.0**	ND	ND	**19.7**	**19.8**	**0.2**	**0.1**	**1.95**	**3.50**				
Min	**0.1**	**0.1**	**2.0**	**2.0**	**0.1**	**0.1**	ND	ND	ND	ND	**14.7**	**14.7**	**0.1**	**0.1**	**0.20**	**2.80**				

METEOROLOGICAL AND SITE INFORMATION:											
State of ground:	X	Dry		Moist		Wet		Snow		Frozen
Wind:	X	Calm		Light		Moderate		Strong		
Cloud cover:		None	X	Slight		Cloudy		Overcast		
Preciptation:	X	None		Slight		Moderate		Heavy		
Barometric pressure (mbar):			1004	Before			1004	After		
Pressure trend:				Falling		Steady	X	Rising		
Ground gas meter:	**GA2000**									
Ambient Gas concentration:	**CH_4**	ND	**CO_2**	ND	**O_2**	20.3%				

SUMMARY OF MAXIMUM GAS MONITORING EVENTS

JOB DETAILS:				**Job No:**	
Client:				**Total Visits:**	
Site:	Llay, Wrexham			**Project Manager:**	Sean Lee
Date:	08/06/2017	to	15/08/2017		

Monitoring Point	GAS CONCENTRATIONS										FLOW DATA		WELL AND WATER DATA						Comments
	Methane (%v/v)		Carbon dioxide (%v/v)		Carbon monoxide (ppm)		Hydrogen sulphide (ppm)		Oxygen (%v/v)		Flow rate (l/hr)		Minimum Water Depth (mbgl)	Maximum Water Depth (mbgl)	Depth of well (m)	Ground level (mAOD)	Water level (mAOD)	Response Zone	
	Peak	Steady	Peak	Steady	Peak	Steady	Peak	Steady	Lowest	Steady	Peak	Steady							
WS06	0.2	0.1	1.5	1.3	7	4	ND	ND	17.8	18.1	10.1	0.1	0.10	0.25	3.06	NR			
WS05	0.1	0.1	0.1	0.1	1	ND	ND	ND	14.7	14.7	10.6	0.1	0.0	0.03	2.82	NR			
WS04	0.1	0.1	1.6	1.4	10	1	ND	ND	18.5	18.6	0.1	0.1	0.3	0.91	3.02	NR			
WS03	0.1	0.1	0.8	0.8	11	6	ND	ND	16.6	16.6	27.4	-0.1	0.1	1.28	3.20	NR			
WS02	0.1	0.1	10.0	6.3	15	2	ND	ND	6.3	6.3	0.1	0.1	1.2	1.73	3.30	NR			
WS01	0.1	0.1	7.0	2.0	9	1	ND	ND	19.1	19.1	0.1	0.1	1.5	DRY	3.53	NR			
Max	**0.2**	**0.1**	**10.0**	**6.3**	**15.0**	**6.0**	ND	ND	**19.1**	**19.1**	**27.4**	**0.1**		**1.7**	**3.5**	**ND**	**ND**		
Min	**0.1**	**0.1**	**0.1**	**0.1**	**1.0**	ND	ND	ND	**6.3**	**6.3**	**0.1**	**-0.1**	**0.0**	**0.0**	**2.8**	**ND**	**0.0**		
GSV (l/hr)	0.05		**2.74**																

Date, Pressure state and Flow rates

Visit No.	Date	Atmospheric pressure before (mbar)	Atmospheric pressure after (mbar)	Max. Flow (Peak) (l/hr)	Max. Flow (Steady) (l/hr)
Visit 1	08/06/2017	992	992	27.4	0.1
Visit 2	14/06/2017	1007	1007	-0.5	-0.1
Visit 3	28.6.17	990	990	-0.1	0.1
Visit 4	27/07/2017	992	992	0.1	0.1
Visit 5	03/08/2017	991	991	0.1	0.1
Visit 6	15/08/2017	1004	1004	0.2	0.1
Visit 7					
Visit 8					
Visit 9					
Visit 10					
Visit 11					
Visit 12					

APPENDIX N – GROUNDSURE REPORT AND HISTORICAL MAPS

TIER ENVIRONMENTAL

SUIT 513, CHADWICK HOUSE, WARRINGTON ROAD,
WARRINGTON, WA3 6AE

Groundsure Reference:	GS-3880766
Your Reference:	TE1010_PE01394
Report Date	15 May 2017
Report Delivery Method:	Email - pdf

Groundsure Geo Insight

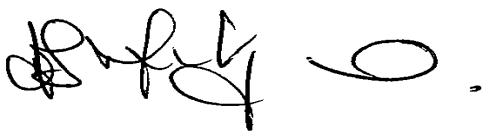
Address: 22, GRESFORD ROAD, WREXHAM, LL12 0NW

Dear Sir/ Madam,

Thank you for placing your order with Groundsure. Please find enclosed the **Groundsure Geo Insight** as requested.

If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above Groundsure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
Groundsure Geo Insight

Groundsure Geo Insight

Address:	**22, GRESFORD ROAD, WREXHAM, LL12 0NW**
Date:	**15 May 2017**
Reference:	**GS-3880766**
Client:	**TIER ENVIRONMENTAL**

NW N NE

W E



SW S SE

Aerial Photograph Capture date:	09-Jun-2013
Grid Reference:	333391,356219
Site Size:	0.11ha

Contents Page

Contents Page ... 3
Overview of Findings ... 5
1:10,000 Scale Availability ... 8
Availability of 1:10,000 Scale Geology Mapping ... 9
1 Geology (1:10,000 scale) ... 10
1.1 Artificial Ground Map (1:10,000 scale) ... 10
1. Geology 1:10,000 scale ... 11
1.1 Artificial Ground ... 11
1.2 Superficial Deposits and Landslips Map (1:10,000 scale) ... 12
1.2 Superficial Deposits and Landslips ... 13
1.2.1 Superficial Deposits/ Drift Geology ... 13
1.2.2 Landslip ... 13
1.3 Bedrock and Faults Map (1:10,000 scale) ... 14
1.3 Bedrock and Faults ... 15
1.3.1 Bedrock/ Solid Geology ... 15
1.3.2 Faults ... 15
2 Geology 1:50,000 Scale ... 16
2.1 Artificial Ground Map ... 16
2. Geology 1:50,000 scale ... 17
2.1 Artificial Ground ... 17
2.1.1 Artificial/ Made Ground ... 17
2.1.2 Permeability of Artificial Ground ... 17
2.2 Superficial Deposits and Landslips Map (1:50,000 scale) ... 18
2.2 Superficial Deposits and Landslips ... 19
2.2.1 Superficial Deposits/ Drift Geology ... 19
2.2.2 Permeability of Superficial Ground ... 19
2.2.3 Landslip ... 19
2.2.4 Landslip Permeability ... 20
2.3 Bedrock and Faults Map (1:50,000 scale) ... 21
2.3 Bedrock, Solid Geology & Faults ... 22
2.3.1 Bedrock/Solid Geology ... 22
2.3.2 Permeability of Bedrock Ground ... 22
2.3.3 Faults ... 22
3 Radon Data ... 23
3.1 Radon Affected Areas ... 23
3.2 Radon Protection ... 23
4 Ground Workings Map ... 24
4 Ground Workings ... 25
4.1 Historical Surface Ground Working Features derived from Historical Mapping ... 25
4.2 Historical Underground Working Features derived from Historical Mapping ... 26
4.3 Current Ground Workings ... 26
5 Mining, Extraction & Natural Cavities ... 29
5.1 Historical Mining ... 29
5.2 Coal Mining ... 29
5.3 Johnson Poole and Bloomer ... 30
5.4 Non-Coal Mining ... 30
5.5 Non-Coal Mining Cavities ... 30
5.6 Natural Cavities ... 30
5.7 Brine Extraction ... 31
5.8 Gypsum Extraction ... 31
5.9 Tin Mining ... 31
5.10 Clay Mining ... 31
6 Natural Ground Subsidence ... 32
6.1 Shrink-Swell Clay Map ... 32
6.2 Landslides Map ... 33
6.3 Ground Dissolution of Soluble Rocks Map ... 34
6.4 Compressible Deposits Map ... 35
6.5 Collapsible Deposits Map ... 36
6.6 Running Sand Map ... 37

6 Natural Ground Subsidence..... 38
6.1 Shrink-Swell Clays..... 38
6.2 Landslides..... 38
6.3 Ground Dissolution of Soluble Rocks..... 38
6.4 Compressible Deposits..... 39
6.5 Collapsible Deposits..... 39
6.6 Running Sands..... 39
7 Borehole Records..... 41
8 Estimated Background Soil Chemistry..... 42
9 Railways and Tunnels Map..... 43
9 Railways and Tunnels..... 44
9.1 Tunnels..... 44
9.2 Historical Railway and Tunnel Features..... 44
9.3 Historical Railways..... 45
9.4 Active Railways..... 45
9.5 Railway Projects..... 45

Overview of Findings

The Groundsure Geo Insight provides high quality geo-environmental information that allows geo-environmental professionals and their clients to make informed decisions and be forewarned of potential ground instability problems that may affect the ground investigation, foundation design and possibly remediation options that could lead to possible additional costs.

The report is based on the BGS 1:50,000 and 1:10,000 Digital Geological Map of Great Britain, BGS Geosure data; BRITPITS database; Non-coal mining data and Borehole Records, Coal Authority data including brine extraction areas, PBA non-coal mining and natural cavities database, Johnson Poole and Bloomer mining data and Groundsure's unique database including historical surface ground and underground workings.

For further details on each dataset, please refer to each individual section in the report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1: Geology 1:10,000 Scale		
1.1 Artificial Ground	1.1 Is there any Artificial Ground/ Made Ground present beneath the study site at 1:10,000 scale?	No
1.2 Superficial Geology and Landslips	1.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site at 1:10,000 scale?*	Yes
	1.2.2 Are there any records of landslip within 500m of the study site boundary at 1:10,000 scale?	No
1.3 Bedrock, Solid Geology and Faults	1.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	1.3.2 Are there any records of faults within 500m of the study site boundary at 1:10,000 scale?	No

Section 2: Geology 1:50,000 Scale		
2.1 Artificial Ground	2.1.1 Is there any Artificial Ground/ Made Ground present beneath the study site?	No
	2.1.2 Are there any records relating to permeability of artificial ground within the study site*boundary?	No
2.2 Superficial Geology and Landslips	2.2.1 Is there any Superficial Ground/Drift Geology present beneath the study site?*	Yes
	2.2.2 Are there any records of permeability of superficial ground within 500m of the study site?	Yes
	2.2.3 Are there any records of landslip within 500m of the study site boundary?	No
	2.2.4 Are there any records relating to permeability of landslips within the study site* boundary?	No

Section 2: Geology 1:50,000 Scale

2.3 Bedrock, Solid Geology and Faults	2.3.1 For records of Bedrock and Solid Geology beneath the study site* see the detailed findings section.	
	2.3.2 Are there any records relating to permeability of bedrock ground within the study site boundary?	Yes
	2.3.3 Are there any records of faults within 500m of the study site boundary?	No

Section 3: Radon

3. Radon	3.1Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.
	3.2Radon Protection	No radon protective measures are necessary.

Section 4: Ground Workings	On-site	0-50m	51-250	251-500	501-1000
4.1 Historical Surface Ground Working Features from Small Scale Mapping	2	0	17	Not Searched	Not Searched
4.2 Historical Underground Workings from Small Scale Mapping	0	0	3	0	4
4.3 Current Ground Workings	0	0	0	0	7

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.1 Historical Mining	0	0	3	0	4
5.2 Coal Mining	1	0	0	0	0
5.3 Johnson Poole and Bloomer Mining Area	0	0	0	0	0
5.4 Non-Coal Mining*	0	0	0	0	1
5.5 Non–Coal Mining Cavities	0	0	0	0	0
5.5 Natural Cavities	0	0	0	0	0

Section 5: Mining, Extraction & Natural Cavities	On-site	0-50m	51-250	251-500	501-1000
5.6 Brine Extraction	0	0	0	0	0
5.7 Gypsum Extraction	0	0	0	0	0
5.8 Tin Mining	0	0	0	0	0
5.9 Clay Mining	0	0	0	0	0

Section 6: Natural Ground Subsidence	On-site
6.1 Shrink-Swell Clay	Very Low
6.2 Landslides	Very Low
6.3 Ground Dissolution of Soluble Rocks	Negligible
6.4 Compressible Deposits	Negligible
6.5 Collapsible Deposits	Very Low
6.5 Running Sand	Very Low

Section 7: Borehole Records	On-site	0-50m	51-250
7 BGS Recorded Boreholes	0	0	0

Section 8: Estimated Background Soil Chemistry	On-site	0-50m	51-250
8 Records of Background Soil Chemistry	1	0	0

Section 9: Railways and Tunnels	On-site	0-50m	51-250	250-500
9.1 Tunnels	0	0	0	Not Searched
9.2 Historical Railway and Tunnel Features	0	0	5	Not Searched
9.3 Historical Railways	0	0	1	Not Searched
9.4 Active Railways	0	0	0	Not Searched
9.5 Railway Projects	0	0	0	0

1:10,000 Scale Availability

NW N NE

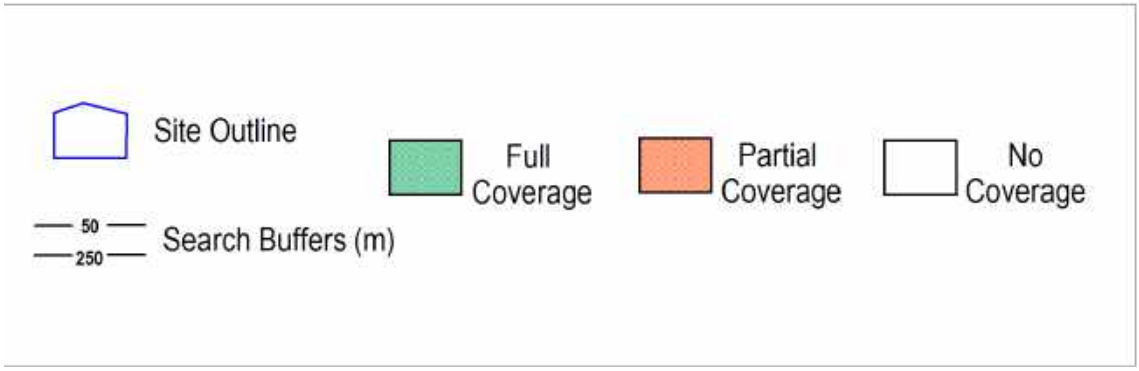
W E

SW S SE



1_10,000 Availability Legend

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Availability of 1:10,000 Scale Geology Mapping

The following information represents the availability of the key components of the 1:10,000 scale geological data.

ID	Distance	Artificial Coverage	Superficial Coverage	Bedrock Coverage	Mass Movement Coverage
1	0.0	Some deposits are mapped	Full	Full	Some deposits are mapped
N2	1199.0	Some deposits are mapped	Full	Full	Some deposits are mapped
N3	1584.0	Some deposits are mapped	Full	Full	Some deposits are mapped

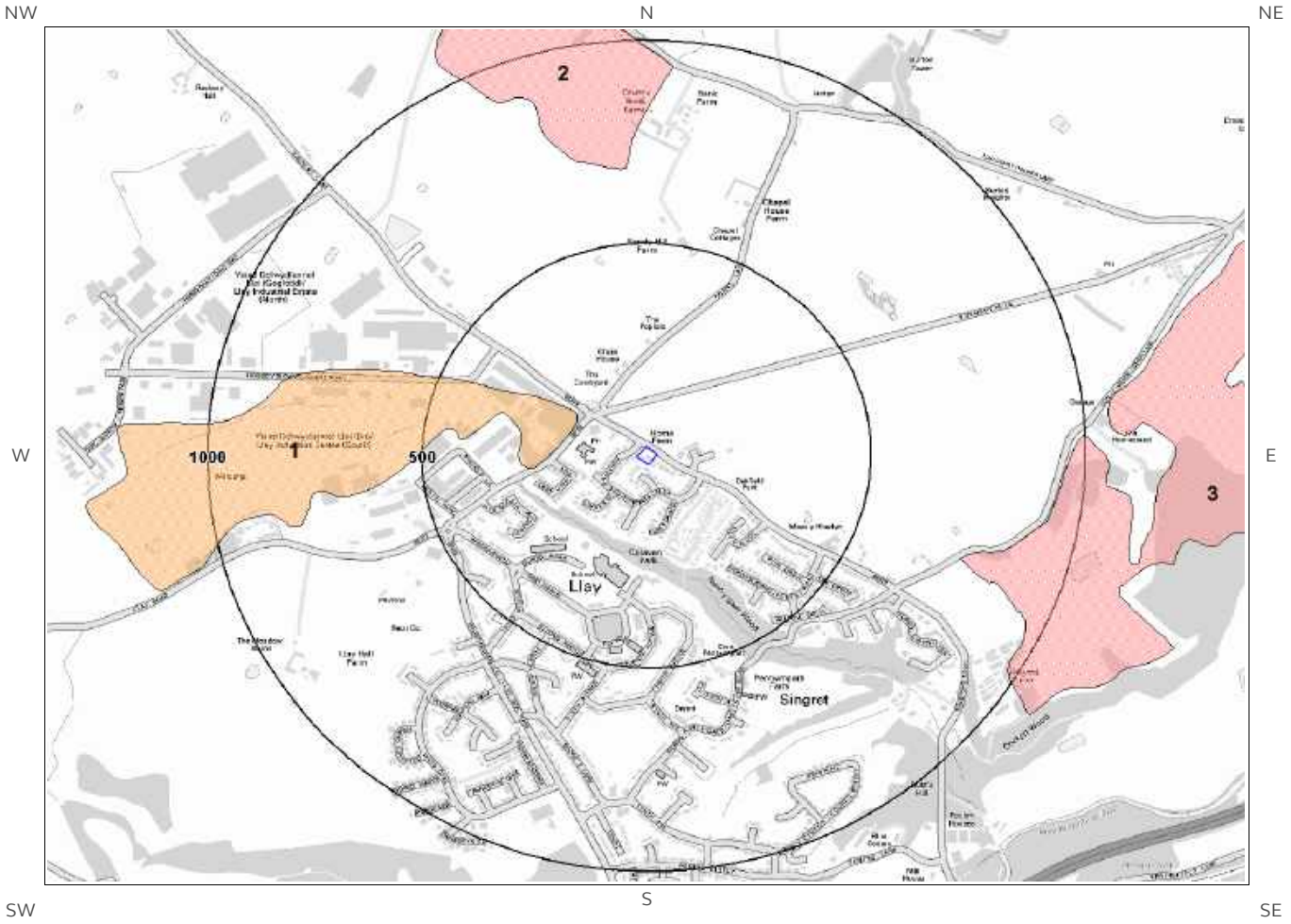
Guidance: The 1:10,000 scale geological interpretation is the most detailed generally available from BGS and is the scale at which most geological surveying is carried out in the field. The database is presented as four types of geology (artificial, mass movement, superficial and bedrock), although not all themes are mapped or available on every map sheet. Therefore a coverage layer showing the availability of the four themes is presented above.

The definitions of coverage are as follows:

Geology	Full Coverage	Partial Coverage	No Coverage
Bedrock	The whole tile has been mapped	Some but not all the tile has been mapped	No coverage
Superficial	The whole tile has been mapped	Some but not all of the tile has been mapped	No coverage
Artificial	Some deposits are mapped on this tile	-	No deposits are mapped
Mass Movement	Some deposits are mapped on this tile	-	No coverage

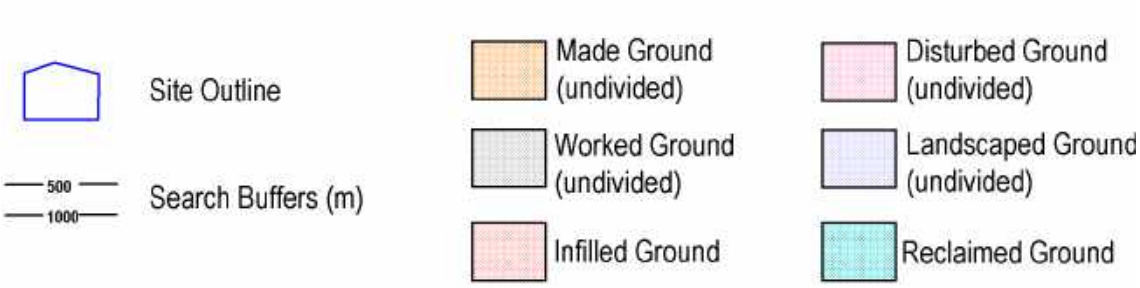
1 Geology (1:10,000 scale).

1.1 Artificial Ground Map (1:10,000 scale)



Artificial Ground Legend

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1. Geology 1:10,000 scale

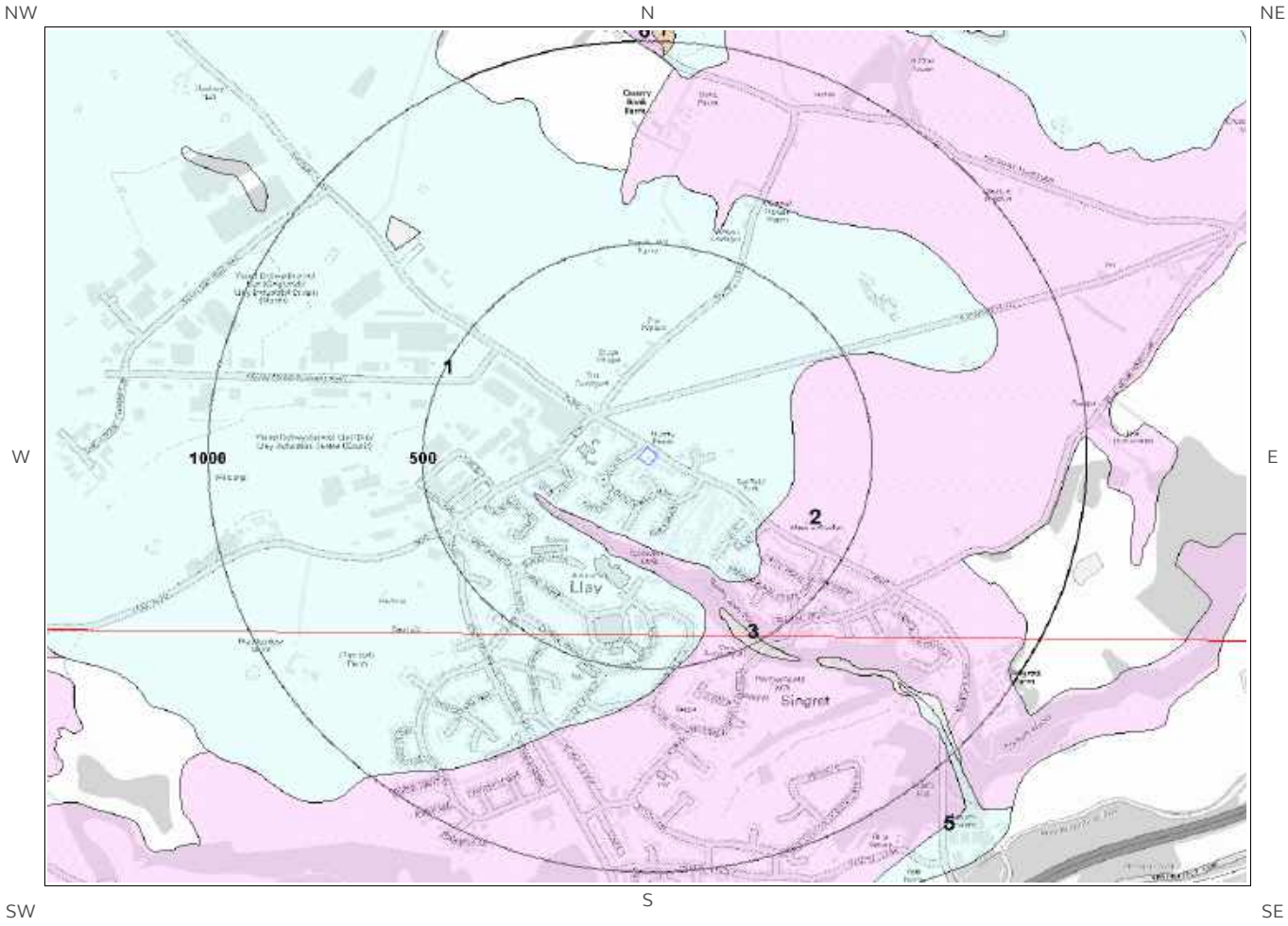
1.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

Are there any records of Artificial/ Made Ground within 500m of the study site boundary at 1:10,000 scale? Yes

ID	Distance	Direction	LEX Code	Description	Rock Description
1	164.0	NW	MGR-ARTDP	Made Ground (Undivided)	Artificial Deposit

1.2 Superficial Deposits and Landslips Map (1:10,000 scale)



Artificial Ground Legend

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Site Outline

500
1000
Search Buffers (m)

1.2 Superficial Deposits and Landslips

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping

1.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary at 1:10,000 scale? Yes

ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	TILL-DMTN	Till - Diamicton	Diamicton
2	182.0	S	GFDU-XSV	Glaciofluvial Deposits - Sand And Gravel	Sand And Gravel
3	388.0	SE	GLLD-C	Glaciolacustrine Deposits - Clay	Clay

1.2.2 Landslip

Are there any records of Landslip within 500m of the study site boundary at 1:10,000 scale?

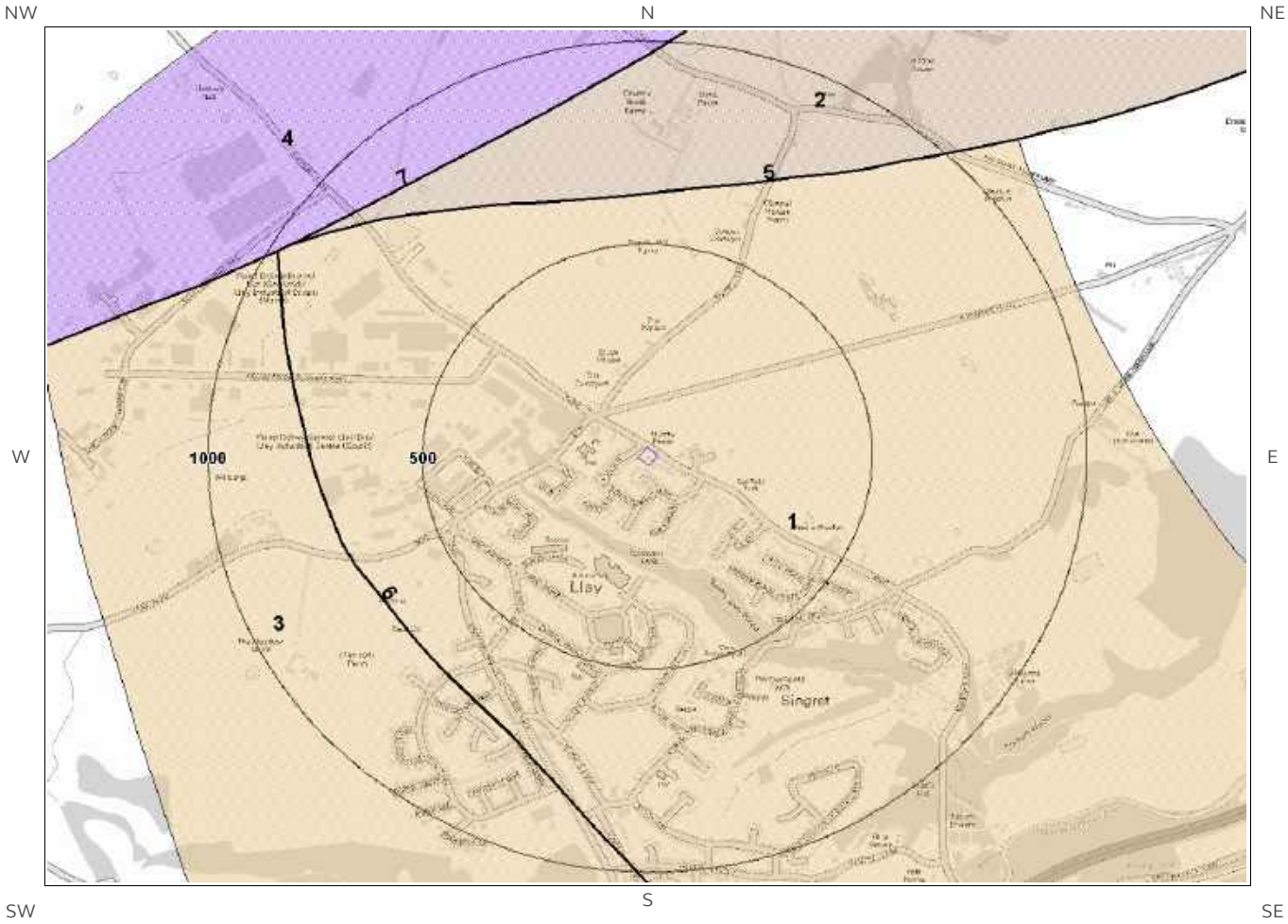
No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:10,000 scale

This Geology shows the main components as discrete layers, these are: Artificial / Made Ground, Superficial / Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

1.3 Bedrock and Faults Map (1:10,000 scale)



Bedrock and Faults Legend

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Site Outline

500
1000
Search Buffers (m)

1.3 Bedrock and Faults

The following geological information represented on the mapping is derived from 1:10,000 scale BGS Geological mapping.

1.3.1 Bedrock/ Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary at 1:10,000 scale.

ID	Distance (m)	Direction	LEX Code	Description	Rock Age
1	0.0	On Site	SAL-MDSC	Salop Formation - Mudstone, Sandstone And Conglomerate	Cisuralian Epoch - Westphalian D Sub-age

1.3.2 Faults

Are there any records of Faults within 500m of the study site boundary at 1:10,000 scale? No

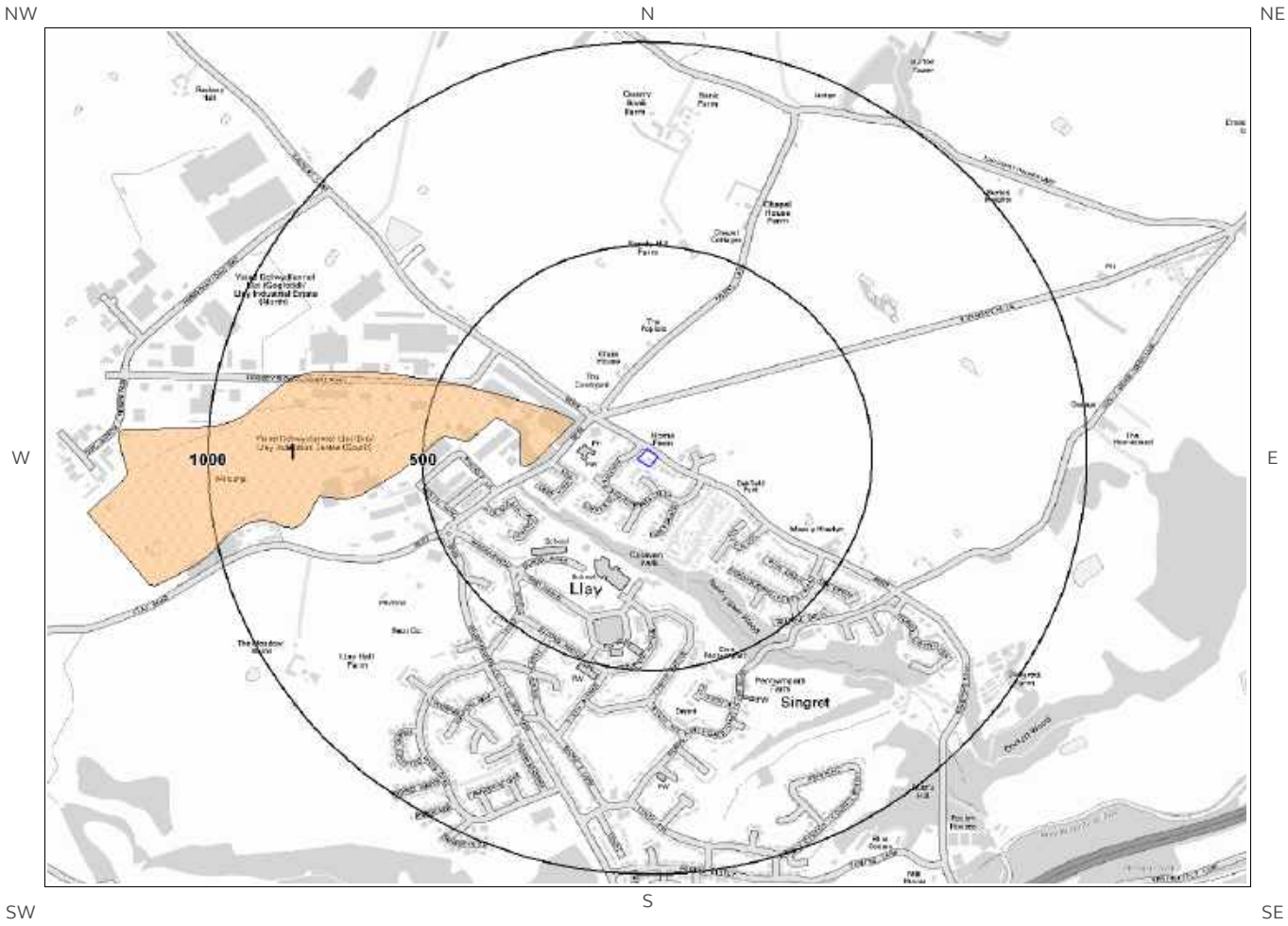
Database searched and no data found at this scale.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of great Britain at 1:10,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/ Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

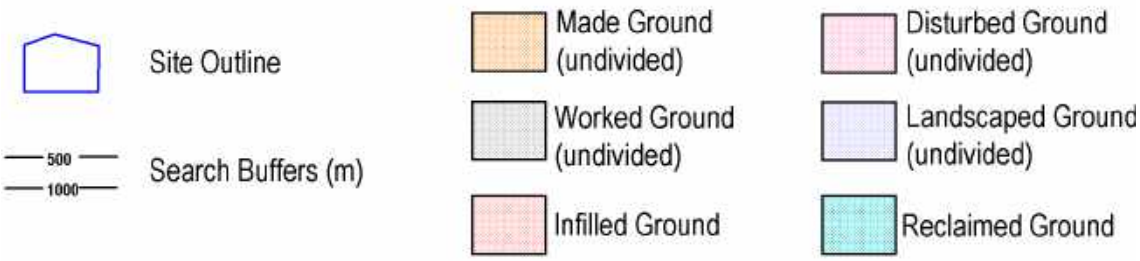
2 Geology 1:50,000 Scale

2.1 Artificial Ground Map



Ground Workings Legend

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2. Geology 1:50,000 scale

2.1 Artificial Ground

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 108

2.1.1 Artificial/ Made Ground

Are there any records of Artificial/ Made Ground within 500m of the study site boundary? Yes

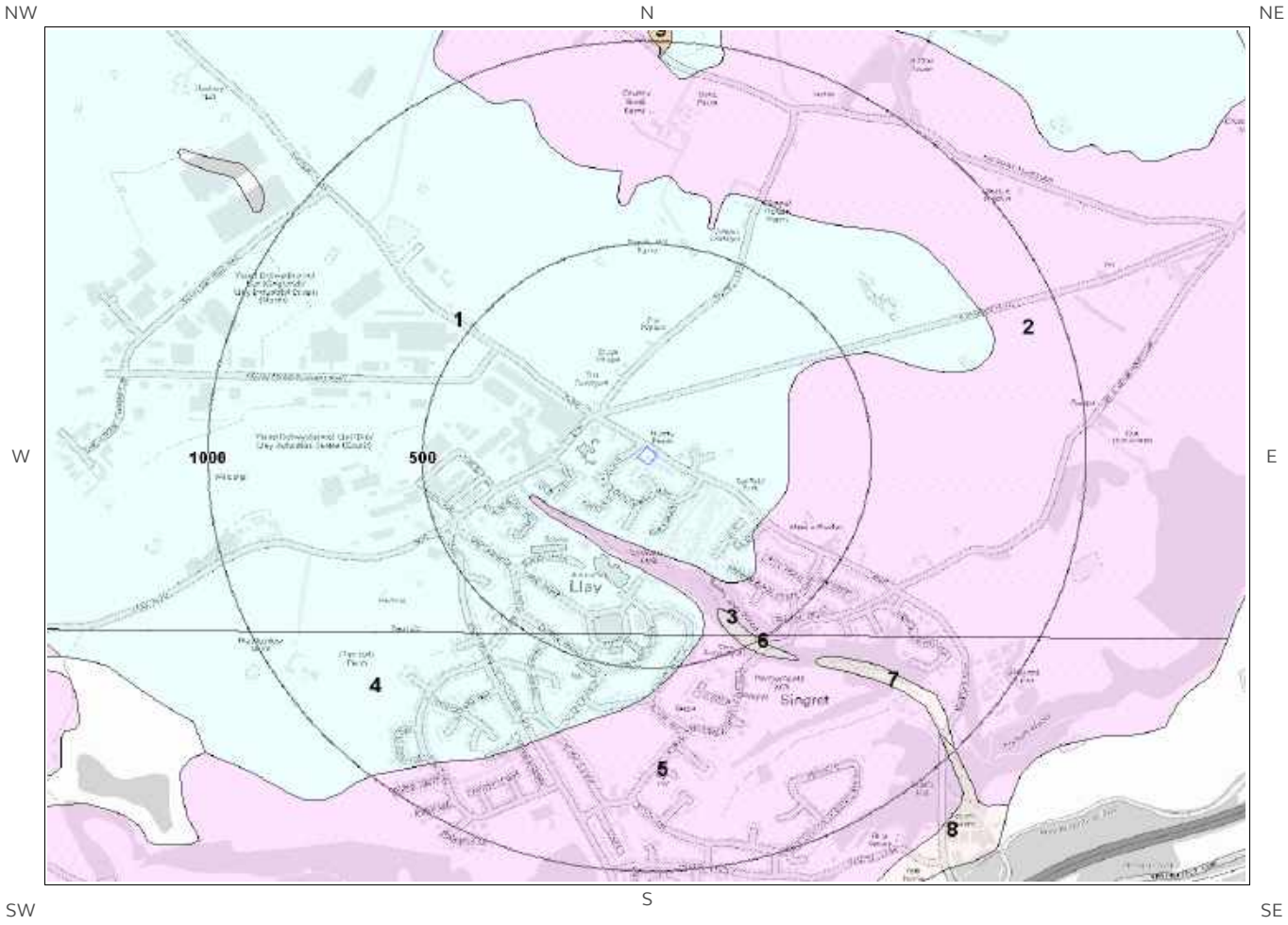
ID	Distance (m)	Direction	LEX Code	Description	Rock Description
1	174.0	NW	MGR-ARTDP	MADE GROUND (UNDIVIDED)	ARTIFICIAL DEPOSIT

2.1.2 Permeability of Artificial Ground

Are there any records relating to permeability of artificial ground within the study site boundary? No

Database searched and no data found.

2.2 Superficial Deposits and Landslips Map (1:50,000 scale)



Ground Workings Legend

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Site Outline

500
1000
Search Buffers (m)

2.2 Superficial Deposits and Landslips

2.2.1 Superficial Deposits/ Drift Geology

Are there any records of Superficial Deposits/ Drift Geology within 500m of the study site boundary? Yes

ID	Distance	Direction	LEX Code	Description	Rock Description
1	0.0	On Site	TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON
2	192.0	S	GFSDD-XSV	GLACIOFLUVIAL SHEET DEPOSITS, DEVENSIAN	SAND AND GRAVEL
3	387.0	SE	GLLDD-XCZ	GLACIOLACUSTRINE DEPOSITS, DEVENSIAN	CLAY AND SILT
4	416.0	S	TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON
5	435.0	S	GFDUD-XSV	GLACIOFLUVIAL DEPOSITS, DEVENSIAN	SAND AND GRAVEL
6	458.0	SE	GLLDD-XCZ	GLACIOLACUSTRINE DEPOSITS, DEVENSIAN	CLAY AND SILT

2.2.2 Permeability of Superficial Ground

Are there any records relating to permeability of superficial ground within the study site boundary? Yes

Distance (m)	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Mixed	High	Low

2.2.3 Landslip

Are there any records of Landslip within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

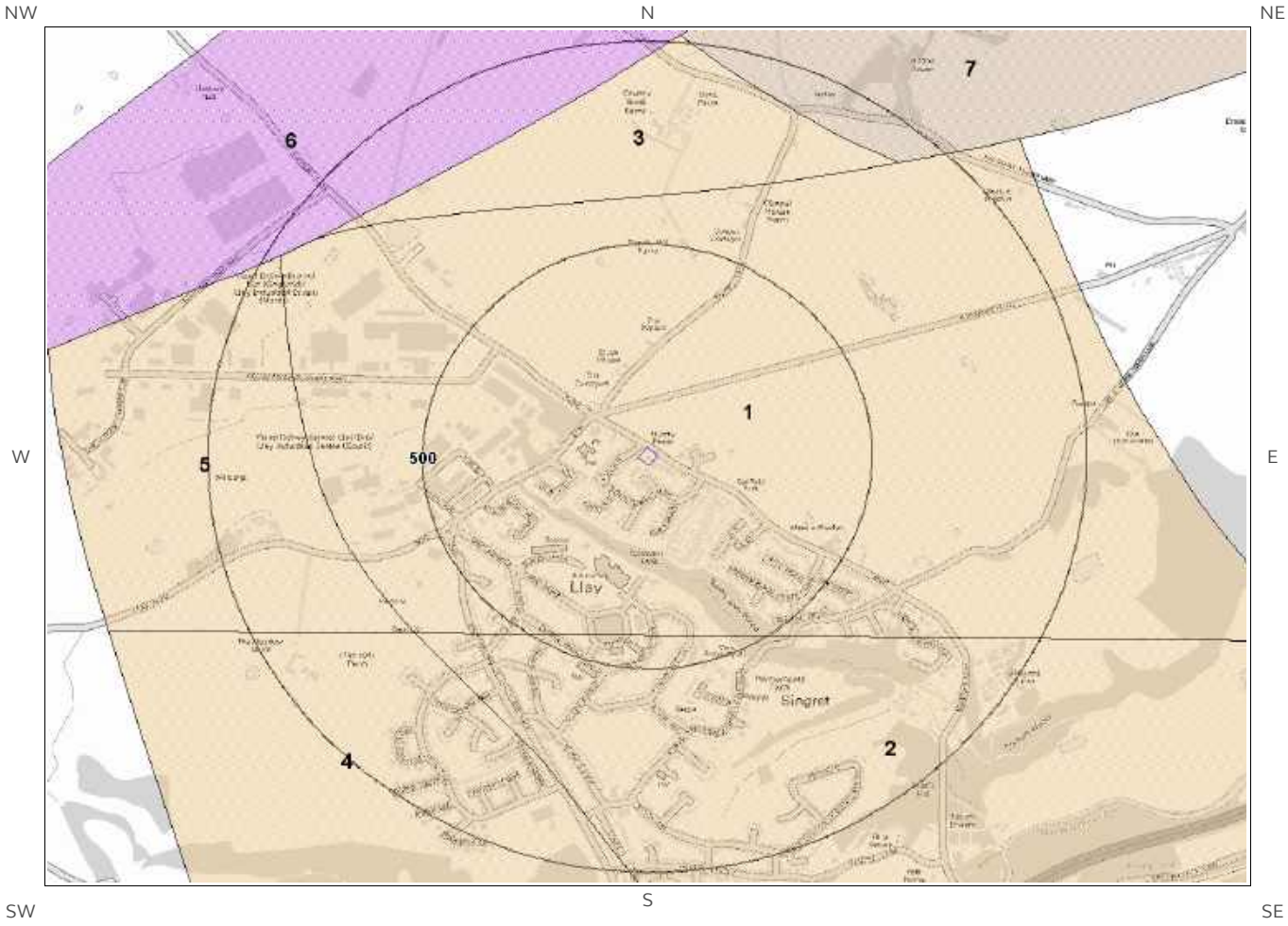
This Geology shows the main components as discrete layers, there are: Artificial/ Made Ground, Superficial/ Drift Geology and Landslips. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nationwide coverage.

2.2.4 Landslip Permeability

Are there any records relating to permeability of landslips within the study site boundary?	No

Database searched and no data found.

2.3 Bedrock and Faults Map (1:50,000 scale)



Ground Workings Legend

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Site Outline

500
1000
Search Buffers (m)

2.3 Bedrock, Solid Geology & Faults

The following geological information represented on the mapping is derived from 1:50,000 scale BGS Geological mapping, Sheet No: 108

2.3.1 Bedrock/Solid Geology

Records of Bedrock/Solid Geology within 500m of the study site boundary:

ID	Distance	Direction	LEX Code	Rock Description	Rock Age
1	0.0	On Site	SAL-MDSC	SALOP FORMATION - MUDSTONE, SANDSTONE AND CONGLOMERATE	WESTPHALIAN
2	416.0	S	SAL-MDSC	SALOP FORMATION - MUDSTONE, SANDSTONE AND CONGLOMERATE	WESTPHALIAN

2.3.2 Permeability of Bedrock Ground

Are there any records relating to permeability of bedrock ground within the study site boundary? Yes

Distance	Direction	Flow Type	Maximum Permeability	Minimum Permeability
0.0	On Site	Fracture	Moderate	Low

2.3.3 Faults

Are there any records of Faults within 500m of the study site boundary? No

Database searched and no data found.

The geology map for the site and surrounding area are extracted from the BGS Digital Geological Map of Great Britain at 1:50,000 scale.

This Geology shows the main components as discrete layers, these are: Bedrock/Solid Geology and linear features such as Faults. These are all displayed with the BGS Lexicon code for the rock unit and BGS sheet number. Not all of the main geological components have nation wide coverage.

3 Radon Data

3.1 Radon Affected Areas

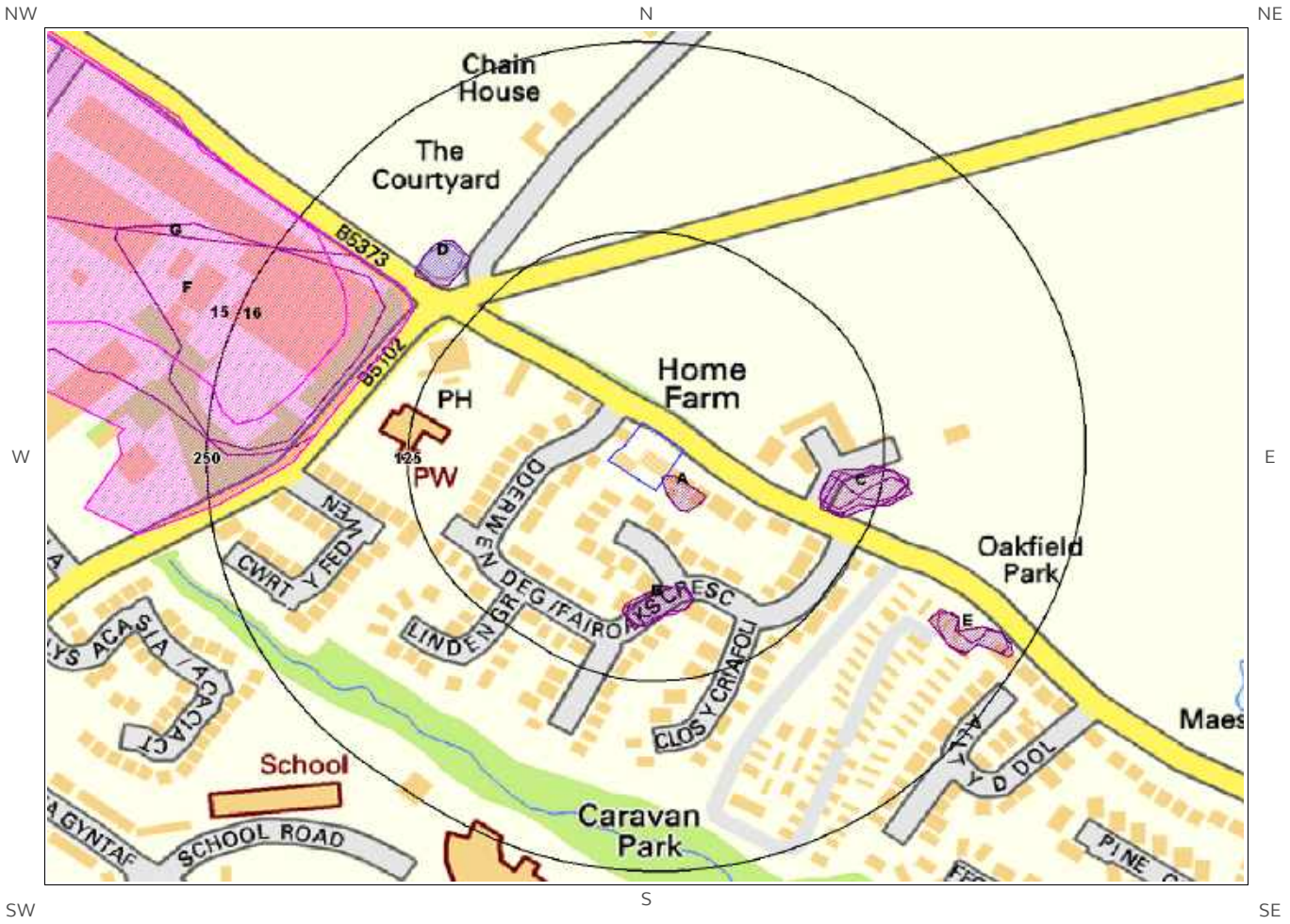
Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

3.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

---

4 Ground Workings Map



Ground Workings Legend

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Site Outline

125
250
Search Buffers (m)

Historic Surface Ground Workings

Historic Underground Workings

Current Ground Workings

4 Ground Workings

4.1 Historical Surface Ground Working Features derived from Historical Mapping

This dataset is based on Groundsure's unique Historical Land Use Database derived from 1:10,560 and 1:10,000 scale historical mapping

Are there any Historical Surface Ground Working Features within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Use	Date
1A	0.0	On Site	333417 356197	Pond	1960
2A	0.0	On Site	333417 356197	Pond	1968
3B	63.0	S	333400 356122	Ponds	1949
4B	64.0	S	333402 356123	Ponds	1872
5B	64.0	S	333402 356123	Ponds	1900
6C	89.0	E	333530 356196	Ponds	1872
7C	90.0	E	333528 356201	Pond	1900
8C	93.0	SE	333529 356197	Pond	1960
9C	93.0	SE	333529 356197	Pond	1968
10D	150.0	NW	333267 356348	Pond	1992
11D	150.0	NW	333267 356348	Pond	1968
12D	150.0	NW	333267 356348	Pond	1979
13D	150.0	NW	333267 356348	Pond	1960
14F	155.0	NW	332577 356462	Colliery	1949
15	155.0	NW	333022 356314	Refuse Heap	1949
16	169.0	NW	333147 356300	Unspecified Heap	1979
17E	188.0	SE	333594 356106	Ponds	1949
18E	192.0	SE	333583 356104	Ponds	1900
19E	192.0	SE	333583 356104	Ponds	1872

4.2 Historical Underground Working Features derived from Historical Mapping

This data is derived from the Groundsure unique Historical Land Use Database. It contains data derived from 1:10,000 and 1:10,560 historical Ordnance Survey Mapping and includes some natural topographical features (Shake Holes for example) as well as manmade features that may have implications for ground stability. Underground and mining features have been identified from surface features such as shafts. The distance that these extend underground is not shown.

Are there any Historical Underground Working Features within 1000m of the study site boundary? Yes

The following Historical Underground Working Features are provided by Groundsure:

ID	Distance (m)	Direction	NGR	Use	Date
20F	155.0	NW	332577 356462	Colliery	1949
21G	184.0	NW	332841 356423	Unspecified Mine	1968
22G	184.0	NW	332841 356423	Unspecified Mine	1960
Not shown	614.0	NW	332807 356478	Unspecified Disused Shafts	1992
Not shown	620.0	NW	332796 356480	Unspecified Disused Shafts	1979
Not shown	695.0	W	332714 356479	Unspecified Disused Shafts	1979
Not shown	700.0	W	332716 356479	Unspecified Disused Shafts	1992

4.3 Current Ground Workings

This dataset is derived from the BGS BRITPITS database covering active; inactive mines; quarries; oil wells; gas wells and mineral wharves; and rail deposits throughout the British Isles.

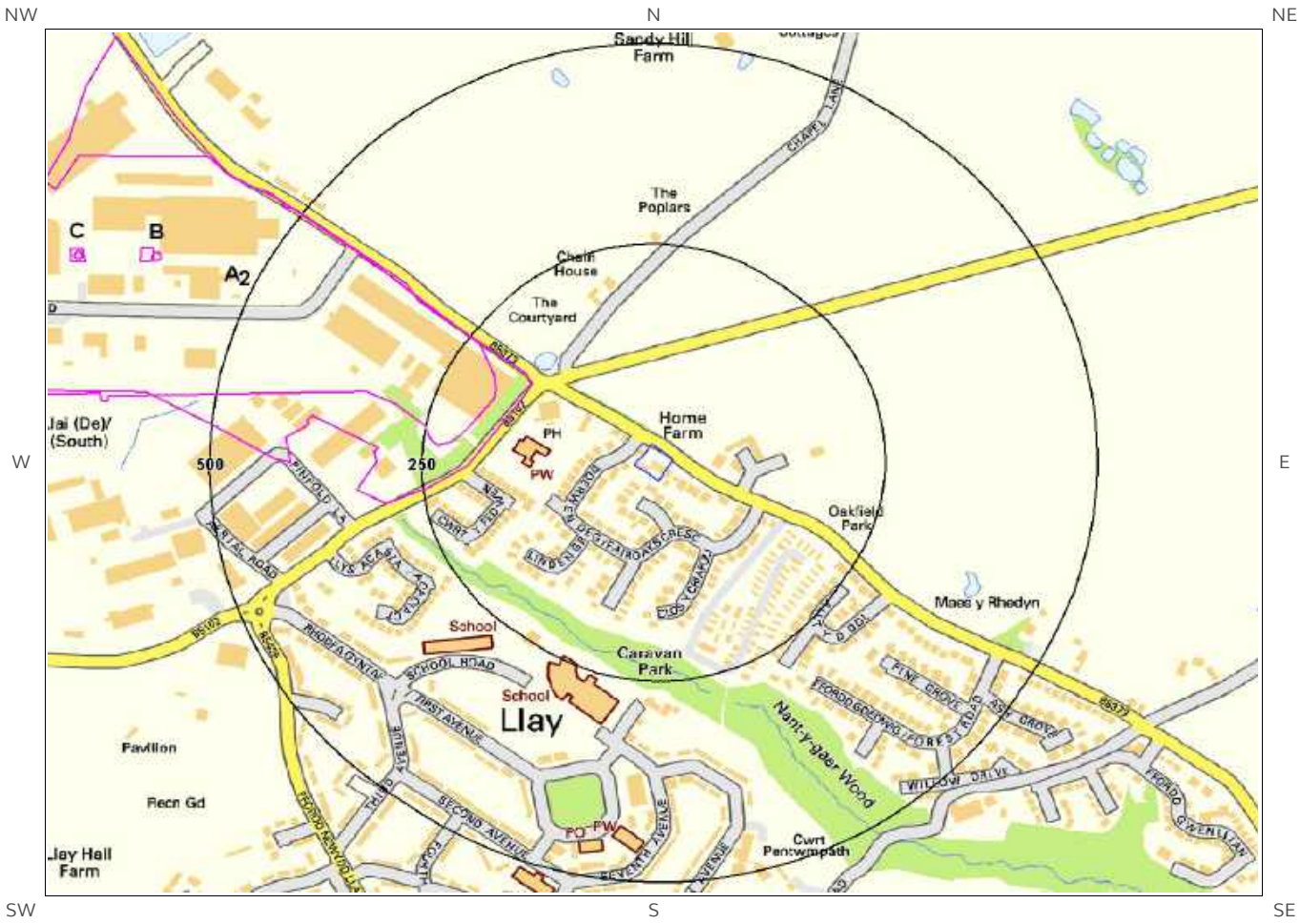
Are there any BGS Current Ground Workings within 1000m of the study site boundary? Yes

The following Current Ground Workings information is provided by British Geological Survey:

ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
Not shown	590.0	E	333966 356011	Sand	Oak Cottage	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	636.0	NW	332790 356479	Coal, Deep	Llay Main Colliery, No. 1 Shaft	Working is wholly underground, access by shaft, adit or drift. Working may be termed Colliery, Mine, Drift Mine, Slant, Level, Adit or Ingoing Eye (Ingaun Ee - Scots)	Ceased
Not shown	709.0	W	332710 356479	Coal, Deep	Llay Main Colliery, No. 2 Shaft	Working is wholly underground, access by shaft, adit or drift. Working may be termed Colliery, Mine, Drift Mine, Slant, Level, Adit or Ingoing Eye (Ingaun Ee - Scots)	Ceased

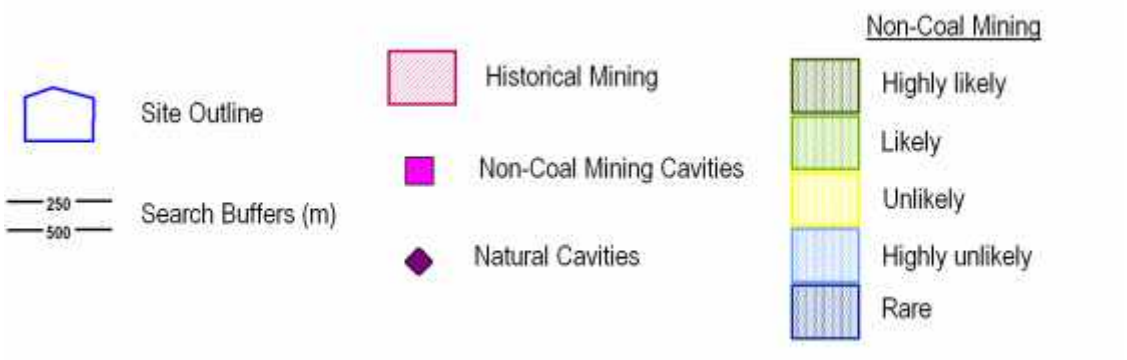
ID	Distance (m)	Direction	NGR	Commodity Produced	Pit Name	Type of working	Status
Not shown	892.0	W	332480 356150	Clay & Shale	Llay Main Colliery Tip	Tip at a mine, quarry or other location from which mineral is being extracted. Working may be termed Slate Waste Tip, Shale Bing, Coal Tip or Coal Bing	Inactive
Not shown	934.0	N	333338 357176	Sand	Yr Ackery Sand Pit	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	982.0	N	333130 357190	Sand & Gravel	Bank Farm	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased
Not shown	993.0	SE	333988 355399	Sand & Gravel	Bull's Hill	A surface mineral working. It may be termed Quarry, Sand Pit, Clay Pit or Opencast Coal Site	Ceased

5 Mining, Extraction & Natural Cavities Map



Mining, Extraction and Natural Cavities Legend

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5 Mining, Extraction & Natural Cavities

5.1 Historical Mining

This dataset is derived from Groundsure unique Historical Land-use Database that are indicative of mining or extraction activities.

Are there any Historical Mining areas within 1000m of the study site boundary? Yes

The following Historical Mining information is provided by Groundsure:

ID	Distance (m)	Direction	NGR	Details	Date
2	155.0	NW	332577 356462	Colliery	1949
3A	184.0	NW	332841 356423	Unspecified Mine	1968
4A	184.0	NW	332841 356423	Unspecified Mine	1960
5B	614.0	NW	332807 356478	Unspecified Disused Shafts	1992
6B	620.0	NW	332796 356480	Unspecified Disused Shafts	1979
7C	695.0	W	332714 356479	Unspecified Disused Shafts	1979
8C	700.0	W	332716 356479	Unspecified Disused Shafts	1992

5.2 Coal Mining

This dataset provides information as to whether the study site lies within a known coal mining affected area as defined by the coal authority.

Are there any Coal Mining areas within 1000m of the study site boundary? Yes

The following Coal Mining information provided by the Coal Authority is not represented on Mapping:

Distance (m)	Direction	Details
0.0	On Site	The study site is located within the specified search distance of an identified mining area. Further details concerning this can be obtained from the Coal Authority Helpline on 0845 762 6848.

5.3 Johnson Poole and Bloomer

This dataset provides information as to whether the study site lies within an area where JPB hold information relating to mining.

Are there any JPB Mining areas within 1000m of the study site boundary? No

The following information provided by JPB is not represented on mapping: Database searched and no data found.

5.4 Non-Coal Mining

This dataset provides information as to whether the study site lies within an area which may have been subject to non-coal historic mining.

Are there any Non-Coal Mining areas within 1000m of the study site boundary? Yes

The following non-coal mining information is provided by the BGS:

ID	Distance (m)	Direction	Name	Commodity	Assessment of likelihood
Not shown	823.0	NW	Not available	Vein Mineral	Sporadic underground mining of restricted extent may have occurred. Potential for difficult ground conditions are unlikely and localised and are at a level where they need not be considered

5.5 Non-Coal Mining Cavities

This dataset provides information from the Peter Brett Associates (PBA) mining cavities database (compiled for the national study entitled “Review of mining instability in Great Britain, 1990” PBA has also continued adding to this database) on mineral extraction by mining.

Are there any Non-Coal Mining cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.6 Natural Cavities

This dataset provides information based on Peter Brett Associates natural cavities database.

Are there any Natural Cavities within 1000m of the study site boundary? No

Database searched and no data found.

5.7 Brine Extraction

This data provides information from the Coal Authority issued on behalf of the Cheshire Brine Subsidence Compensation Board.

Are there any Brine Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.8 Gypsum Extraction

This dataset provides information on Gypsum extraction from British Gypsum records.

Are there any Gypsum Extraction areas within 1000m of the study site boundary? No

Database searched and no data found.

5.9 Tin Mining

This dataset provides information on tin mining areas and is derived from tin mining records. This search is based upon postcode information to a sector level..

Are there any Tin Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

5.10 Clay Mining

This dataset provides information on Kaolin and Ball Clay mining from relevant mining records.

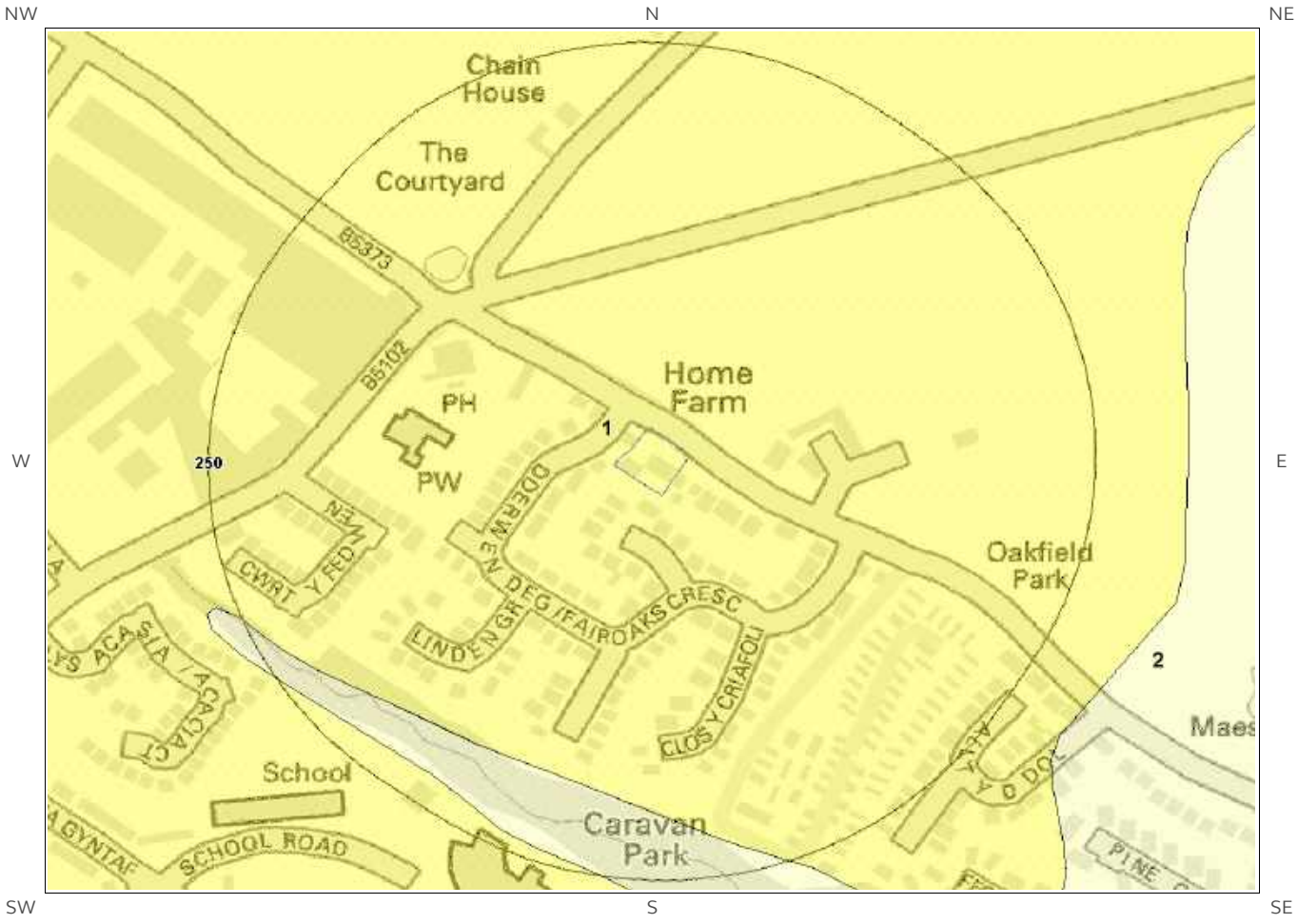
Are there any Clay Mining areas within 1000m of the study site boundary? No

Database searched and no data found.

---

6 Natural Ground Subsidence

6.1 Shrink-Swell Clay Map

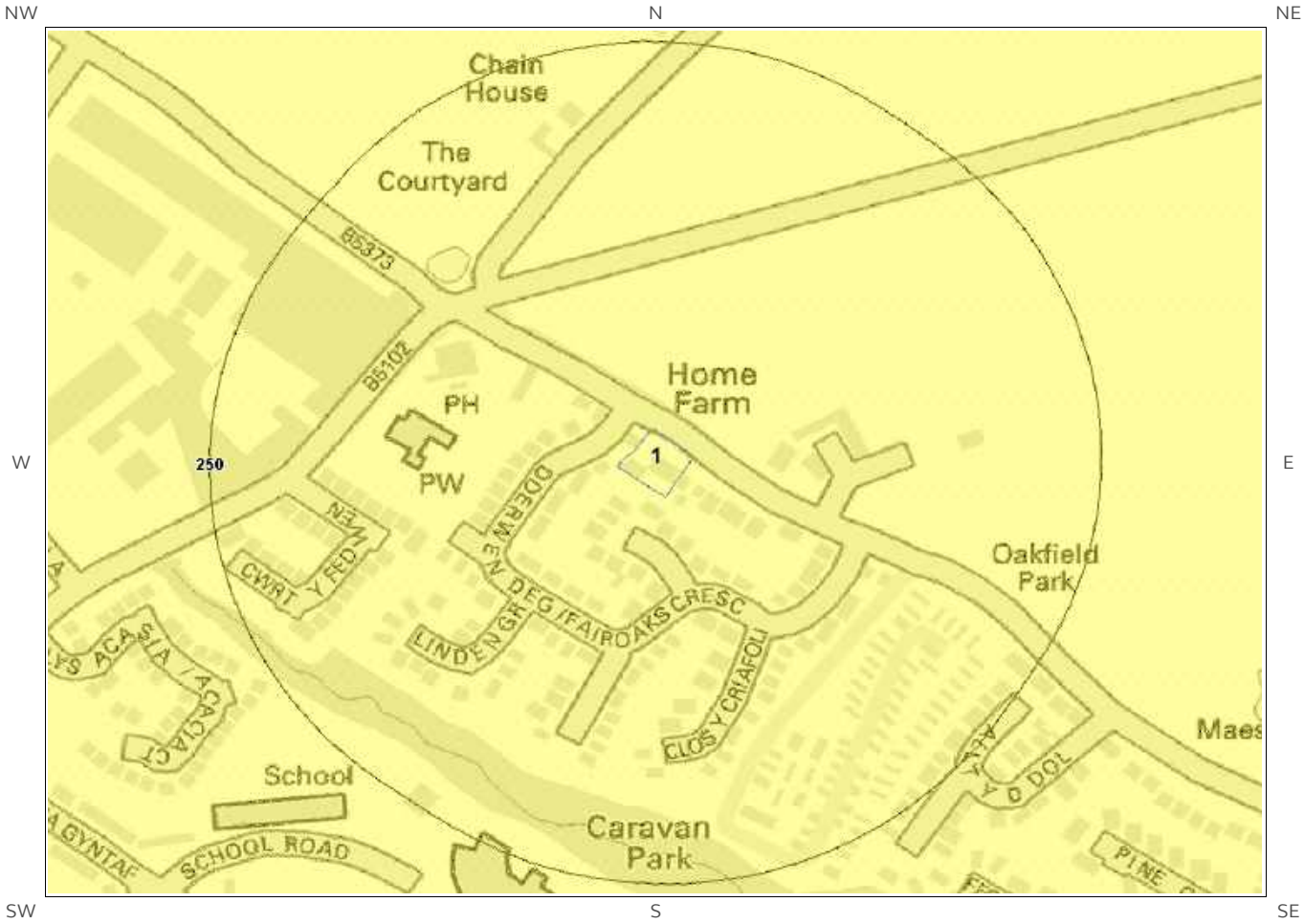


Shrink Swell Clay Legend

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6.2 Landslides Map

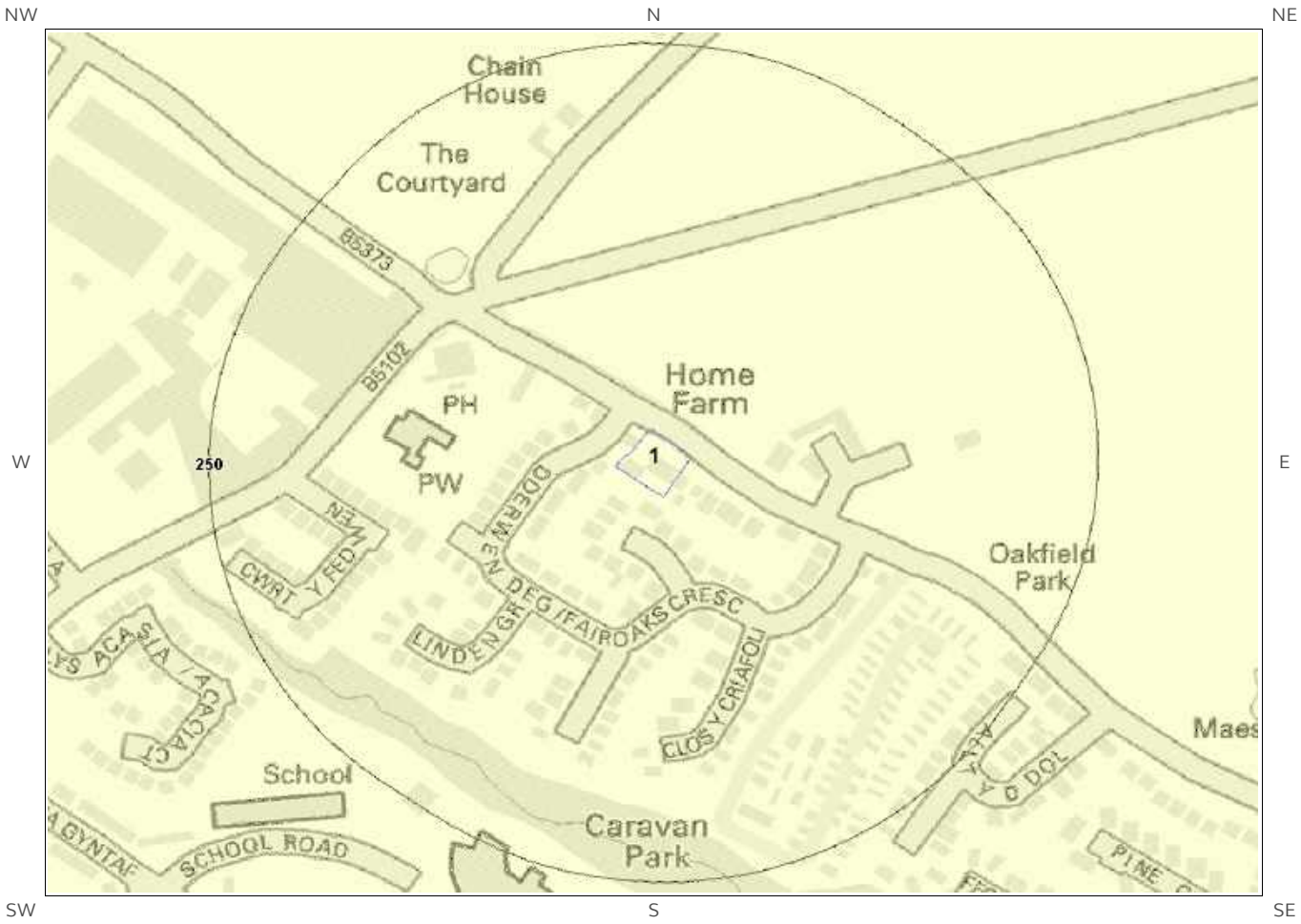


Landslides Legend

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6.3 Ground Dissolution of Soluble Rocks Map

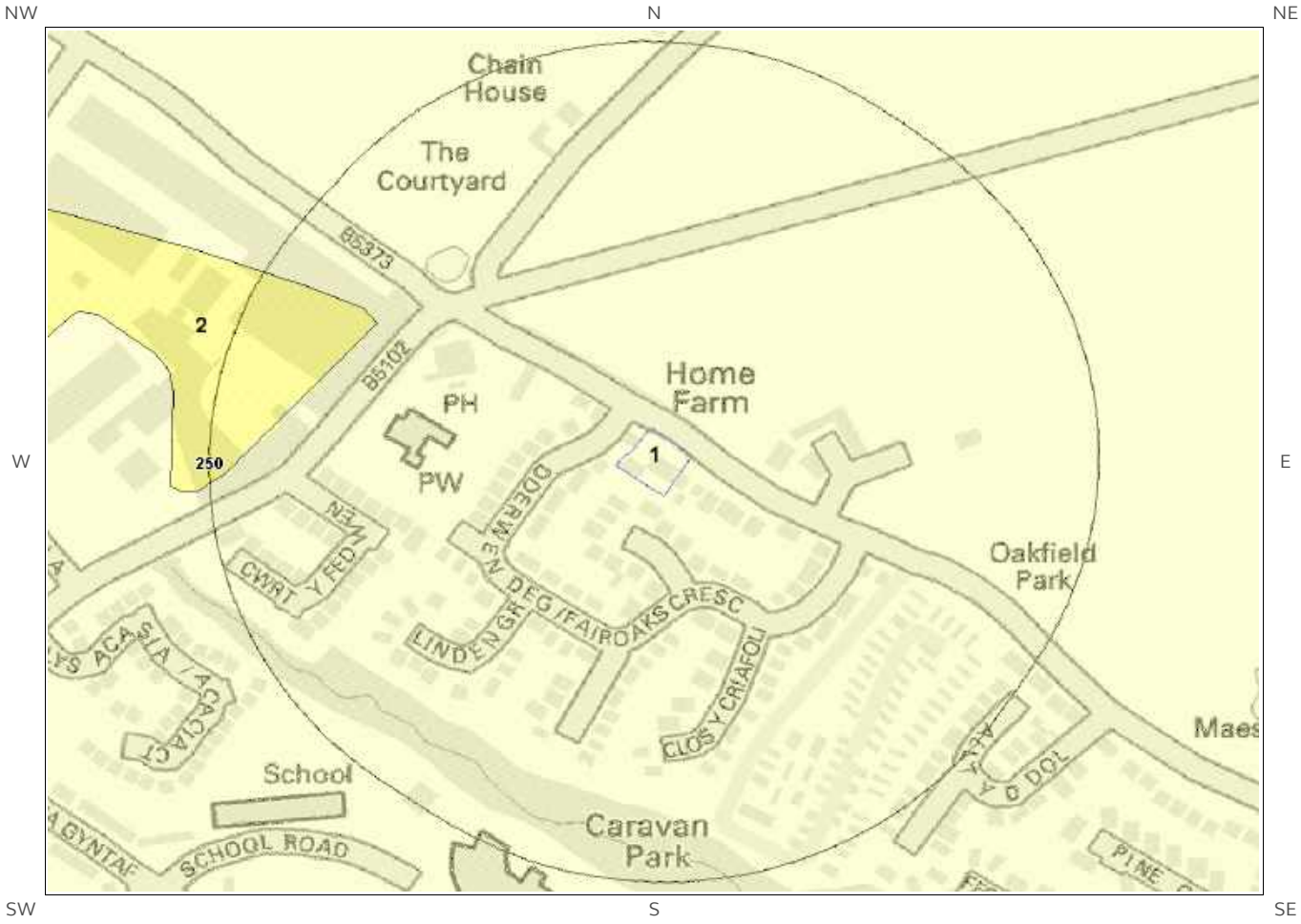


Ground Dissolution Soluble Rocks Legend

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6.4 Compressible Deposits Map

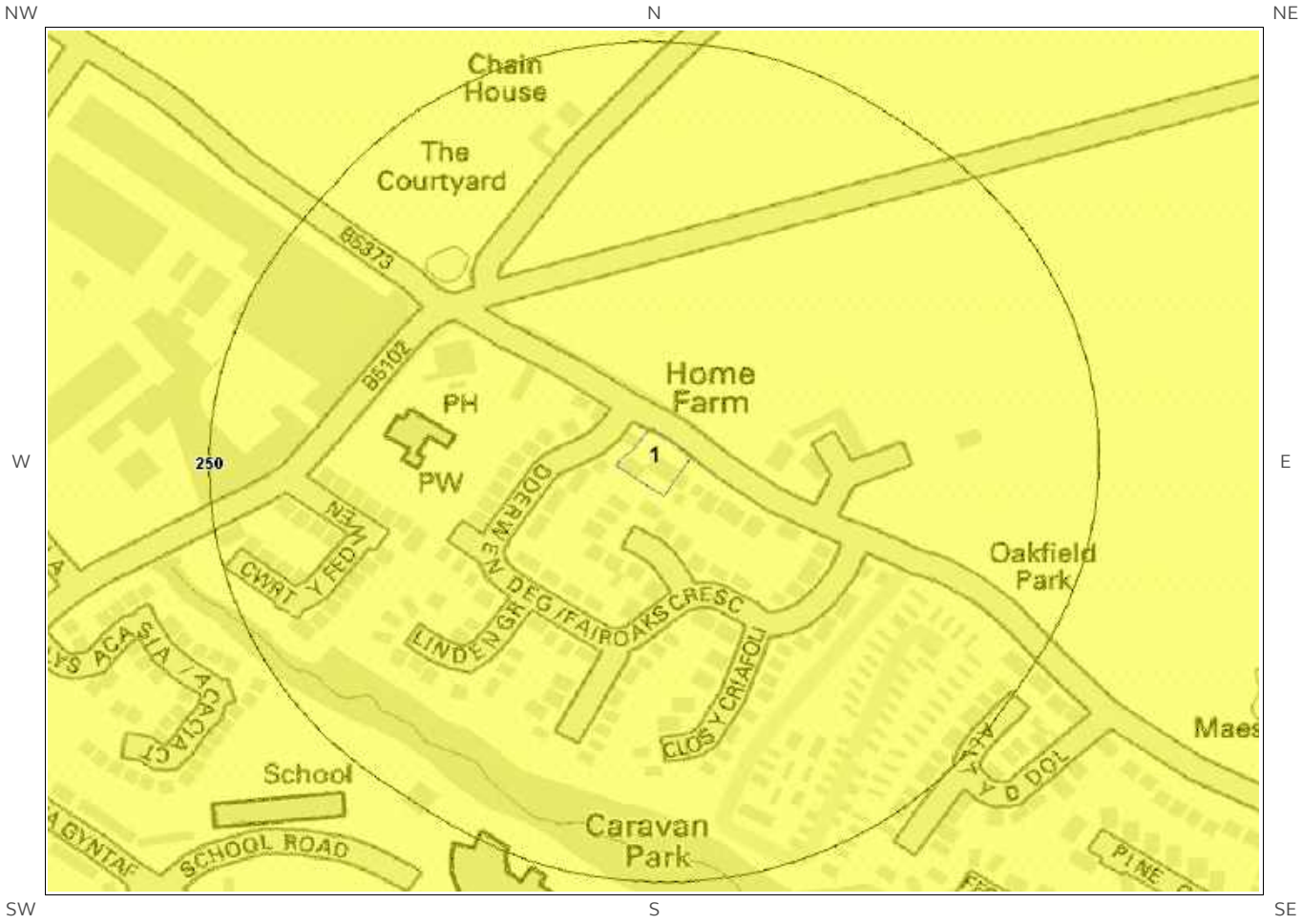


Compressible Deposits Legend

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6.5 Collapsible Deposits Map

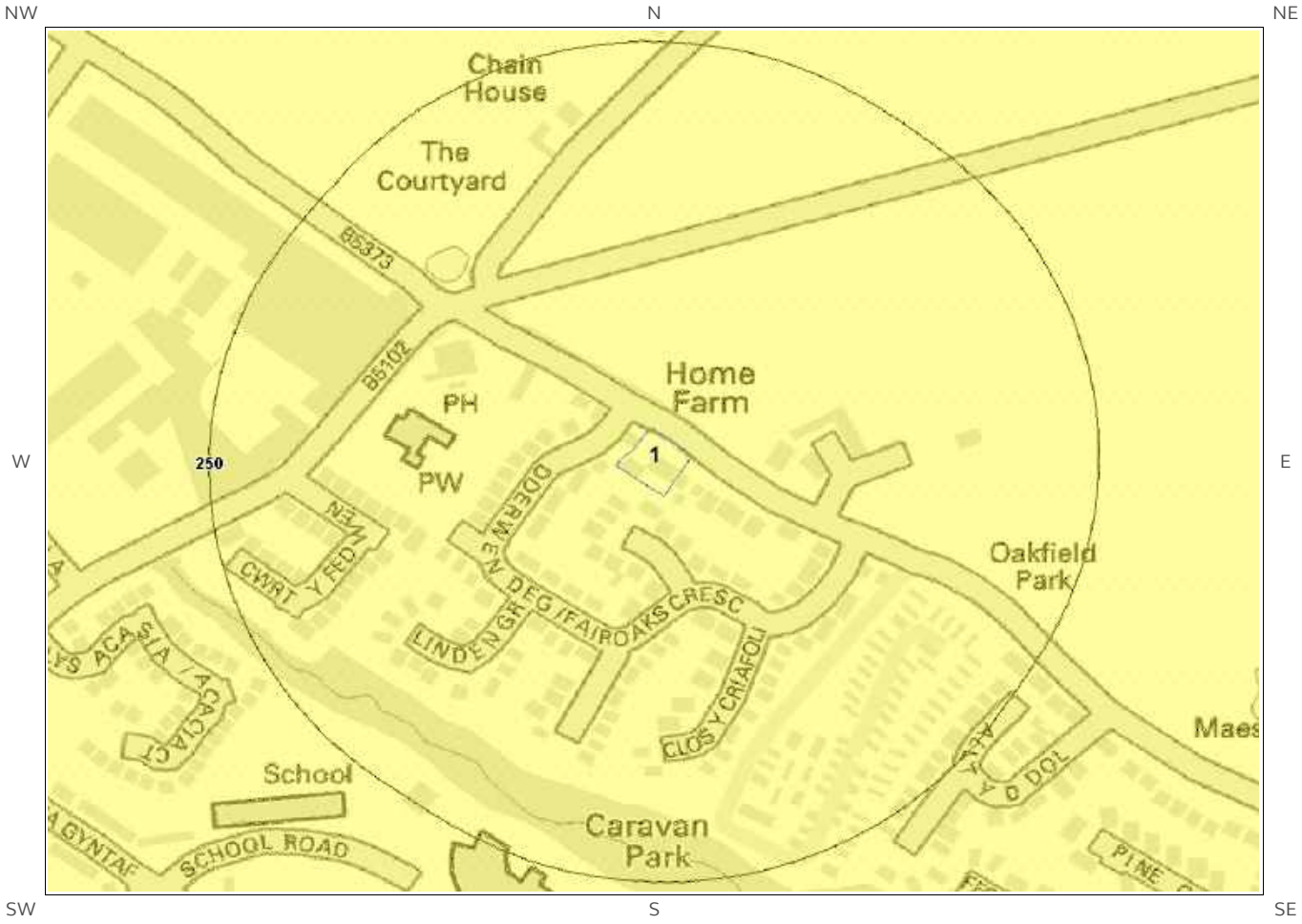


Collapsible Deposits Legend

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6.6 Running Sand Map



Running Sand Legend

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6 Natural Ground Subsidence

The National Ground Subsidence rating is obtained through the 6 natural ground stability hazard datasets, which are supplied by the British Geological Survey (BGS).

The following GeoSure data represented on the mapping is derived from the BGS Digital Geological map of Great Britain at 1:50,000 scale.

What is the maximum hazard rating of natural subsidence within the study site*[*] boundary? Very Low

6.1 Shrink-Swell Clays

The following Shrink Swell information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.

6.2 Landslides

The following Landslides information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

6.3 Ground Dissolution of Soluble Rocks

The following Ground Dissolution information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

* This includes an automatically generated 50m buffer zone around the site

6.4 Compressible Deposits

The following Compressible Deposits information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Negligible	No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

6.5 Collapsible Deposits

The following Collapsible Rocks information provided by the British Geological Survey:

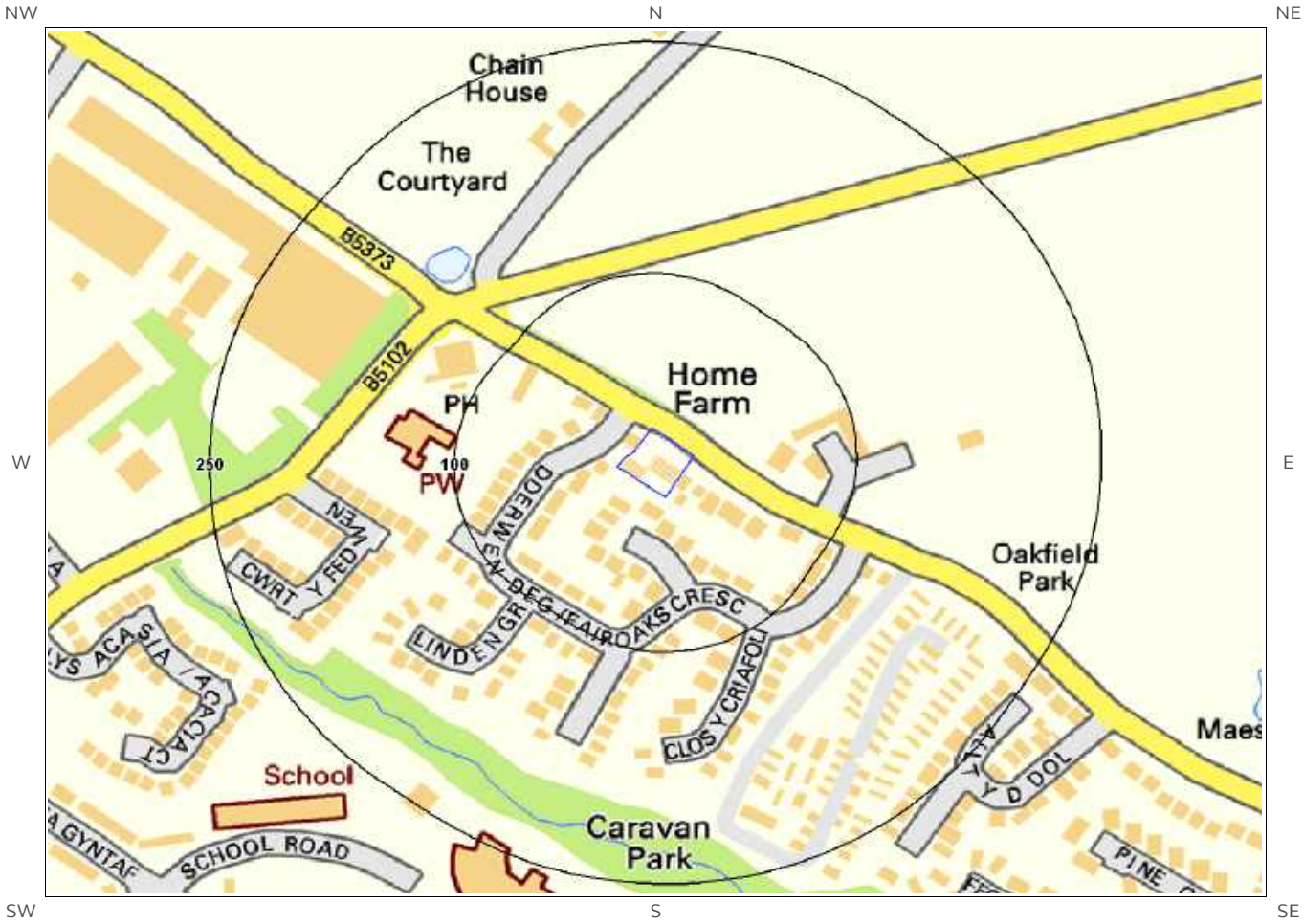
ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

6.6 Running Sands

The following Running Sands information provided by the British Geological Survey:

ID	Distance (m)	Direction	Hazard Rating	Details
1	0.0	On Site	Very Low	Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

7 Borehole Records Map



Borehole Records Legend

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Site Outline

Borehole Locations

125
250
Search Buffers (m)

7 Borehole Records

The systematic analysis of data extracted from the BGS Borehole Records database provides the following information.

Records of boreholes within 250m of the study site boundary: 0

Database searched and no data found.

8 Estimated Background Soil Chemistry

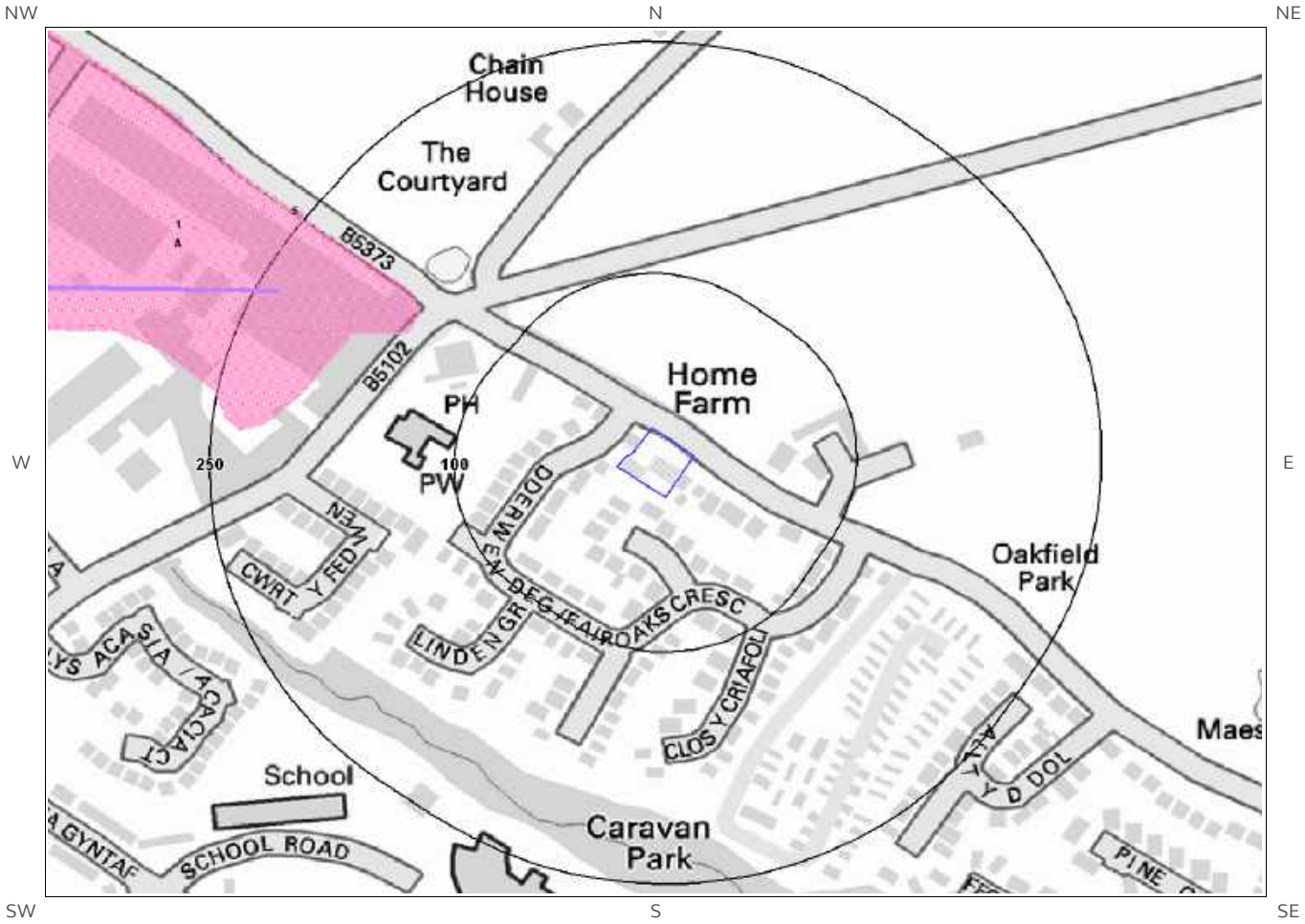
Records of background estimated soil chemistry within 250m of the study site boundary: 1

For further information on how this data is calculated and limitations upon its use, please see the Groundsure Geo Insight User Guide, available on request.

Distance (m)	Direction	Sample Type	Arsenic (As)	Cadmium (Cd)	Chromium (Cr)	Nickel (Ni)	Lead (Pb)
0.0	On Site	RuSoilExAs	<15 mg/kg	<1.8 mg/kg	60 - 90 mg/kg	<15 mg/kg	<100 mg/kg

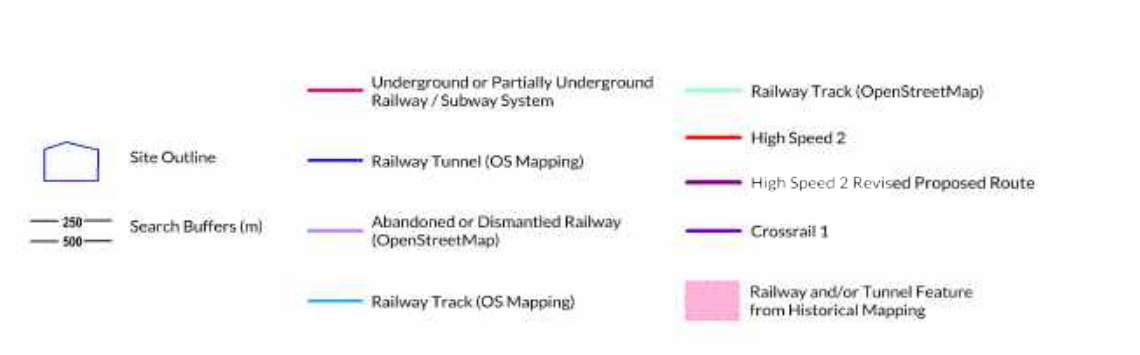
*As this data is based upon underlying 1:50,000 scale geological information, a 50m buffer has been added to the search radius.

9 Railways and Tunnels Map



Railways and Tunnels Legend

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9 Railways and Tunnels

9.1 Tunnels

This data is derived from OpenStreetMap and provides information on the possible locations of underground railway systems in the UK - the London Underground, the Tyne & Wear Metro and the Glasgow Subway.

Have any underground railway lines been identified within the study site boundary? No

Have any underground railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

This data is derived from Ordnance Survey mapping and provides information on the possible locations of railway tunnels forming part of the UK overground railway network.

Have any other railway tunnels been identified within the site boundary? No

Have any other railway tunnels been identified within 250m of the site boundary? No

Database searched and no data found.

Any records that have been identified are represented on the Railways and Tunnels Map.

9.2 Historical Railway and Tunnel Features

This data is derived from Groundsure's unique Historical Land-use Database and contains features relating to tunnels, railway tracks or associated works that have been identified from historical Ordnance Survey mapping.

Have any historical railway or tunnel features been identified within the study site boundary? No

Have any historical railway or tunnel features been identified within 250m of the study site boundary? Yes

ID	Distance (m)	Direction	NGR	Details	Date
1	155	NW	332792 356529	Railway Sidings	1949
2A	184	NW	332543 356423	Railway Sidings	1968
3A	184	NW	332543 356423	Railway Sidings	1960
4	191	NW	332601 356445	Mineral Railway Sidings	1961
5	248	NW	333113 356378	Railway Sidings	1975

Any records that have been identified are represented on the Railways and Tunnels Map.

9.3 Historical Railways

This data is derived from OpenStreetMap and provides information on the possible alignments of abandoned or dismantled railway lines in proximity to the study site.

Have any historical railway lines been identified within the study site boundary? No

Have any historical railway lines been identified within 250m of the study site boundary? Yes

Distance (m)	Direction	Status
237	NW	Abandoned

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

9.4 Active Railways

These datasets are derived from Ordnance Survey mapping and OpenStreetMap and provide information on the possible locations of active railway lines in proximity to the study site.

Have any active railway lines been identified within the study site boundary? No

Have any active railway lines been identified within 250m of the study site boundary? No

Database searched and no data found.

Multiple sections of the same track may be listed in the detail above
Any records that have been identified are represented on the Railways and Tunnels Map.

9.5 Railway Projects

These datasets provide information on the location of large scale railway projects High Speed 2 and Crossrail 1 .

Is the study site within 5km of the route of the High Speed 2 rail project? No

Is the study site within 500m of the route of the Crossrail 1 rail project? No

Further information on proximity to these routes, the project construction status and associated works can be obtained through the purchase of a Groundsure HS2 and Crossrail 1 Report.

The route data has been digitised from publicly available maps by Groundsure. The route as provided relates to the Crossrail 1 project only, and does not include any details of the Crossrail 2 project, as final details of the route for Crossrail 2 are still under consultation.

Please note that this assessment takes account of both the original Phase 2b proposed route and the amended route proposed in 2016. As the Phase 2b route is still under consultation, Groundsure are providing information on both options until the final route is formally confirmed. Practitioners should take account of this uncertainty when advising clients.

Contact Details

Groundsure Helpline

Telephone: 08444 159 000
info@groundsure.com

British Geological Survey Enquiries

Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143.
Fax: 0115 936 3276.
Email:**enquiries@bgs.ac.uk**
Web:**www.bgs.ac.uk**
BGS Geological Hazards Reports and general geological enquiries

British Gypsum

British Gypsum Ltd
East Leake
Loughborough
Leicestershire
LE12 6HX

The Coal Authority

200 Lichfield Lane
Mansfield
Notts NG18 4RG
Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk

Public Health England

Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
https://www.gov.uk/government/organisations/public-health-england
Email: **enquiries@phe.gov.uk**
Main switchboard: 020 7654 8000

Johnson Poole & Bloomer Limited

Harris and Pearson Building, Brettel Lane
Brierley Hill, West Midlands
DY5 3LH
Tel: +44 (0) 1384 262 000
Email:**enquiries.gs@jpb.co.uk**
Website: **www.jpb.co.uk**

Ordnance Survey

Adanac Drive, Southampton
SO16 0AS

Tel: 08456 050505
Website: http://www.ordnancesurvey.co.uk/

Getmapping PLC

Virginia Villas, High Street, Hartley Witney,
Hampshire RG27 8NW
Tel: 01252 845444
Website:**http://www1.getmapping.com/**

Peter Brett Associates
Caversham Bridge House
Waterman Place
Reading
Berkshire RG1 8DN
Tel: +44 (0)118 950 0761 E-mail:**reading@pba.co.uk**
Website:**http://www.peterbrett.com/home**

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https://www.groundsure.com/terms-and-conditions-sept-2016/

TIER ENVIRONMENTAL

SUIT 513, CHADWICK HOUSE, WARRINGTON ROAD,
WARRINGTON, WA3 6AE

Groundsure Reference:	GS-3880765
Your Reference:	TE1010_PE01394
Report Date	15 May 2017
Report Delivery Method:	Email - pdf

Groundsure Enviro Insight

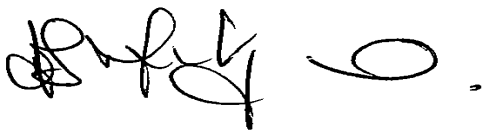
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If you need any further assistance, please do not hesitate to contact our helpline on 08444 159000 quoting the above Groundsure reference number.

Yours faithfully,



Managing Director
Groundsure Limited

Enc.
Groundsure Enviroinsight

Groundsure Enviro Insight

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Date:	**15 May 2017**
Reference:	**GS-3880765**
Client:	**TIER ENVIRONMENTAL**

NW N NE

W E



SW S SE

Aerial Photograph Capture date:	09-Jun-2013
Grid Reference:	333391,356219
Site Size:	0.11ha

Report Reference: GS-3880765
Client Reference: TE1010_PE01394

Contents Page

Contents Page 3
Overview of Findings 6
Using this report 10
1. Historical Land Use 11
1. Historical Industrial Sites 12
1.1 Potentially Contaminative Uses identified from 1:10,000 scale Mapping....12
1.2 Additional Information – Historical Tank Database....12
1.3 Additional Information – Historical Energy Features Database....13
1.4 Additional Information – Historical Petrol and Fuel Site Database....13
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database....14
1.6 Potentially Infilled Land....14
2. Environmental Permits, Incidents and Registers Map 16
2. Environmental Permits, Incidents and Registers 17
2.1 Industrial Sites Holding Licences and/or Authorisations....17
2.1.1 Records of historic IPC Authorisations within 500m of the study site:....17
2.1.2 Records of Part A(1) and IPPC Authorised Activities within 500m of the study site:....17
2.1.3 Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site:....17
2.1.4 Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site:....17
2.1.5 Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site:....18
2.1.6 Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site: 18
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations:....18
2.1.8 Records of Licensed Discharge Consents within 500m of the study site:....18
2.1.9 Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site: 19
2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site:....19
2.2 Dangerous or Hazardous Sites....19
2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents....20
2.3.1 Records of National Incidents Recording System, List 2 within 500m of the study site:....20
2.3.2 Records of National Incidents Recording System, List 1 within 500m of the study site:....22
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990....23
3. Landfill and Other Waste Sites Map 24
3. Landfill and Other Waste Sites 25
3.1 Landfill Sites....25
3.1.1 Records from Environment Agency/Natural Resources Wales landfill data within 1000m of the study site: 25
3.1.2 Records of Environment Agency/Natural Resources Wales historic landfill sites within 1500m of the study site: 25
3.1.3 Records of BGS/DoE non-operational landfill sites within 1500m of the study site:....26
3.1.4 Records of Landfills from Local Authority and Historical Mapping Records within 1500m of the study site:....26
3.2 Other Waste Sites....26
3.2.1 Records of waste treatment, transfer or disposal sites within 500m of the study site: 26
3.2.2 Records of Environment Agency/Natural Resources Wales licensed waste sites within 1500m of the study site: 27
4. Current Land Use Map 34
4. Current Land Uses 35
4.1 Current Industrial Data....35
4.2 Petrol and Fuel Sites....35
4.3 National Grid High Voltage Underground Electricity Transmission Cables....35
4.4 National Grid High Pressure Gas Transmission Pipelines....36

5. Geology 37
5.1 Artificial Ground and Made Ground 37
5.2 Superficial Ground and Drift Geology 37
5.3 Bedrock and Solid Geology 37
6 Hydrogeology and Hydrology 38
6a. Aquifer Within Superficial Geology 38
6b. Aquifer Within Bedrock Geology and Abstraction Licenses 39
6c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses 40
6d. Hydrogeology – Source Protection Zones within confined aquifer 41
6e. Hydrology – Detailed River Network and River Quality 42
6.Hydrogeology and Hydrology 43
6.1 Aquifer within Superficial Deposits 43
6.2 Aquifer within Bedrock Deposits 43
6.3 Groundwater Abstraction Licences 44
6.4 Surface Water Abstraction Licences 44
6.5 Potable Water Abstraction Licences 45
6.6 Source Protection Zones 45
6.7 Source Protection Zones within Confined Aquifer 45
6.8 Groundwater Vulnerability and Soil Leaching Potential 46
6.9 River Quality 46
6.9.1 Biological Quality: 46
6.9.2 Chemical Quality: 47
6.10 Detailed River Network 47
6.11 Surface Water Features 47
7a. Environment Agency/Natural Resources Wales Flood Map for Planning (from rivers and the sea) 48
7b. Environment Agency/Natural Resources Wales Risk of Flooding from Rivers and the Sea (RoFRaS) Map 49
7 Flooding 50
7.1 River and Coastal Zone 2 Flooding 50
7.2 River and Coastal Zone 3 Flooding 50
7.3 Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating 50
7.4 Flood Defences 50
7.5 Areas benefiting from Flood Defences 50
7.6 Areas benefiting from Flood Storage 51
7.7 Groundwater Flooding Susceptibility Areas 51
7.7.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site? Yes 51
7.7.2 What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions? 51
7.8 Groundwater Flooding Confidence Areas 51
8. Designated Environmentally Sensitive Sites Map 52
8. Designated Environmentally Sensitive Sites 53
8.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site: 53
8.2 Records of National Nature Reserves (NNR) within 2000m of the study site: 53
8.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site: 53
8.4 Records of Special Protection Areas (SPA) within 2000m of the study site: 53
8.5 Records of Ramsar sites within 2000m of the study site: 54
8.6 Records of Ancient Woodland within 2000m of the study site: 55
8.7 Records of Local Nature Reserves (LNR) within 2000m of the study site: 58
8.8 Records of World Heritage Sites within 2000m of the study site: 58
8.9 Records of Environmentally Sensitive Areas within 2000m of the study site: 58

8.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site: 59
8.11 Records of National Parks (NP) within 2000m of the study site: 59
8.12 Records of Nitrate Sensitive Areas within 2000m of the study site: 59
8.13 Records of Nitrate Vulnerable Zones within 2000m of the study site: 59
8.14 Records of Green Belt land within 2000m of the study site: 59
9. Natural Hazards Findings 60
9.1 Detailed BGS GeoSure Data 60
9.1.1 Shrink Swell 60
9.1.2 Landslides 60
9.1.3 Soluble Rocks 60
9.1.4 Compressible Ground 61
9.1.5 Collapsible Rocks 61
9.1.6 Running Sand 61
9.2 Radon 61
9.2.1 Radon Affected Areas 61
9.2.2 Radon Protection 62
10. Mining 63
10.1 Coal Mining 63
10.2 Non-Coal Mining 63
10.3 Brine Affected Areas 63
Contact Details 64
Standard Terms and Conditions 66

Overview of Findings

For further details on each dataset, please refer to each individual section in the main report as listed. Where the database has been searched a numerical result will be recorded. Where the database has not been searched '-' will be recorded.

Section 1: Historical Industrial Sites	On-site	0-50	51-250	251-500
1.1 Potentially Contaminative Uses identified from 1:10,000 scale mapping	0	0	11	12
1.2 Additional Information – Historical Tank Database	0	0	0	6
1.3 Additional Information – Historical Energy Features Database	0	0	1	18
1.4 Additional Information – Historical Petrol and Fuel Site Database	0	0	0	0
1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database	5	0	0	4
1.6 Potentially Infilled Land	2	0	20	8

Section 2: Environmental Permits, Incidents and Registers	On-site	0-50m	51-250	251-500
2.1 Industrial Sites Holding Environmental Permits and/or Authorisations				
2.1.1 Records of historic IPC Authorisations	0	0	0	0
2.1.2 Records of Part A(1) and IPPC Authorised Activities	0	0	0	0
2.1.3 Records of Red List Discharge Consents	0	0	0	0
2.1.4 Records of List 1 Dangerous Substances Inventory sites	0	0	1	0
2.1.5 Records of List 2 Dangerous Substances Inventory sites	0	0	0	0
2.1.6 Records of Part A(2) and Part B Activities and Enforcements	0	0	0	1
2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations	0	0	0	0
2.1.8 Records of Licensed Discharge Consents	0	0	1	3
2.1.9 Records of Water Industry Referrals	0	0	0	0
2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site	0	0	0	0
2.2 Records of COMAH and NIHHS sites	0	0	0	0
2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents				
2.3.1 National Incidents Recording System, List 2	0	0	25	4
2.3.2 National Incidents Recording System, List 1	0	0	0	1
2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990	0	0	0	0

Section 3: Landfill and Other Waste Sites	On-site	0-50m	51-250	251-500	501-1000	1000-1500
3.1 Landfill Sites						
3.1.1 Environment Agency/Natural Resources Wales Registered Landfill Sites	0	0	0	1	0	Not searched
3.1.2 Environment Agency/Natural Resources Wales Historic Landfill Sites	0	0	0	0	3	2
3.1.3 BGS/DoE Landfill Site Survey	0	0	0	0	0	0
3.1.4 Records of Landfills in Local Authority and Historical Mapping Records	0	0	0	0	1	0
3.2 Landfill and Other Waste Sites Findings						
3.2.1 Operational and Non-Operational Waste Treatment, Transfer and Disposal Sites	0	0	0	0	Not searched	Not searched
3.2.2 Environment Agency/Natural Resources Wales Licensed Waste Sites	0	0	0	0	11	24

Section 4: Current Land Use	On-site	0-50m	51-250	251-500
4.1 Current Industrial Sites Data	1	0	1	Not searched
4.2 Records of Petrol and Fuel Sites	0	0	1	0
4.3 National Grid Underground Electricity Cables	0	0	0	0
4.4 National Grid Gas Transmission Pipelines	0	0	0	0

Section 5: Geology	
5.1 Are there any records of Artificial Ground and Made Ground present beneath the study site?	No
5.2 Are there any records of Superficial Ground and Drift Geology present beneath the study site?	Yes
5.3 For records of Bedrock and Solid Geology beneath the study site see the detailed findings section.	

Section 6: Hydrogeology and Hydrology	0-500m
6.1 Are there any records of Strata Classification in the Superficial Geology within 500m of the study site?	Yes
6.2 Are there any records of Strata Classification in the Bedrock Geology within 500m of the study site?	Yes

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
6.3 Groundwater Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	2
6.4 Surface Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	4
6.5 Potable Water Abstraction Licences (within 2000m of the study site)	0	0	0	0	0	0
6.6 Source Protection Zones (within 500m of the study site)	0	0	0	0	Not searched	Not searched
6.7 Source Protection Zones within Confined Aquifer	0	0	0	0	Not searched	Not searched
6.8 Groundwater Vulnerability and Soil Leaching Potential (within 500m of the study site)	1	1	0	1	Not searched	Not searched

Section 6: Hydrogeology and Hydrology

	0-500m					
	On-site	0-50m	51-250	251-500	501-1000	1000-1500
6.9 Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site?	No	No	No	No	No	Yes
6.10 Detailed River Network entries within 500m of the site	0	0	1	0	Not searched	Not searched
6.11 Surface water features within 250m of the study site	No	No	Yes	Not searched	Not searched	Not searched

Section 7: Flooding

7.1 Are there any Enviroment Agency Zone 2 floodplains within 250m of the study site?	No
7.2 Are there any Environment Agency/Natural Resources Wales Zone 3 floodplains within 250m of the study site	No
7.3 What is the Risk of flooding from Rivers and the Sea (RoFRaS) rating for the study site?	Very Low
7.4 Are there any Flood Defences within 250m of the study site?	No
7.5 Are there any areas benefiting from Flood Defences within 250m of the study site?	No
7.6 Are there any areas used for Flood Storage within 250m of the study site?	No
7.7 What is the maximum BGS Groundwater Flooding susceptibility within 50m of the study site?	Limited potential
7.8 What is the BGS confidence rating for the Groundwater Flooding susceptibility areas?	High

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.1 Records of Sites of Special Scientific Interest (SSSI)	0	0	0	0	0	2
8.2 Records of National Nature Reserves (NNR)	0	0	0	0	0	0
8.3 Records of Special Areas of Conservation (SAC)	0	0	0	0	0	0
8.4 Records of Special Protection Areas (SPA)	0	0	0	0	0	0
8.5 Records of Ramsar sites	0	0	0	0	0	0
8.6 Records of Ancient Woodlands	0	0	1	0	4	59
8.7 Records of Local Nature Reserves (LNR)	0	0	0	0	0	1
8.8 Records of World Heritage Sites	0	0	0	0	0	0
8.9 Records of Environmentally Sensitive Areas	0	0	0	0	0	0

Section 8: Designated Environmentally Sensitive Sites

	On-site	0-50m	51-250	251-500	501-1000	1000-2000
8.10 Records of Areas of Outstanding Natural Beauty (AONB)	0	0	0	0	0	0
8.11 Records of National Parks	0	0	0	0	0	0
8.12 Records of Nitrate Sensitive Areas	0	0	0	0	0	0
8.13 Records of Nitrate Vulnerable Zones	0	0	0	0	0	0
8.14 Records of Green Belt land	0	0	0	0	0	0

Section 9: Natural Hazards

9.1 What is the maximum risk of natural ground subsidence?	Very Low
9.1.1 What is the maximum Shrink-Swell hazard rating identified on the study site?	Very Low
9.1.2 What is the maximum Landslides hazard rating identified on the study site?	Very Low
9.1.3 What is the maximum Soluble Rocks hazard rating identified on the study site?	Negligible
9.1.4 What is the maximum Compressible Ground hazard rating identified on the study site?	Negligible
9.1.5 What is the maximum Collapsible Rocks hazard rating identified on the study site?	Very Low
9.1.6 What is the maximum Running Sand hazard rating identified on the study site?	Very Low
9.2 Radon	
9.2.1 Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level?	The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.
9.2.2 Is the property in an area where Radon Protection are required for new properties or extensions to existing ones as described in publication BR211 by the Building Research Establishment?	No radon protective measures are necessary.

Section 10: Mining

10.1 Are there any coal mining areas within 75m of the study site?	Yes
10.2 Are there any Non-Coal Mining areas within 50m of the study site boundary?	No
10.3 Are there any brine affected areas within 75m of the study site?	No

Using this report

The following report is designed by Environmental Consultants for Environmental Professionals bringing together the most up-to-date market leading environmental data. This report is provided under and subject to the Terms & Conditions agreed between Groundsure and the Client. The document contains the following sections:

1. Historical Industrial Sites

Provides information on past land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. Potentially Infilled Land features are also included. This search is conducted using radii of up to 500m.

2. Environmental Permits, Incidents and Registers

Provides information on Regulated Industrial Activities and Pollution Incidents as recorded by Regulatory Authorities, and sites determined as Contaminated Land. This search is conducted using radii up to 500m.

3. Landfills and Other Waste Sites

Provides information on landfills and other waste sites that may pose a risk to the study site. This search is conducted using radii up to 1500m.

4. Current Land Uses

Provides information on current land uses that may pose a risk to the study site in terms of potential contamination from activities or processes. These searches are conducted using radii of up to 500m. This includes information on potentially contaminative industrial sites, petrol stations and fuel sites as well as high pressure gas pipelines and underground electricity transmission lines.

5. Geology

Provides information on artificial and superficial deposits and bedrock beneath the study site.

6. Hydrogeology and Hydrology

Provides information on productive strata within the bedrock and superficial geological layers, abstraction licenses, Source Protection Zones (SPZs) and river quality. These searches are conducted using radii of up to 2000m.

7. Flooding

Provides information on river and coastal flooding, flood defences, flood storage areas and groundwater flood areas. This search is conducted using radii of up to 250m.

8. Designated Environmentally Sensitive Sites

Provides information on the Sites of Special Scientific Interest (SSSI), National Nature Reserves (NNR), Special Areas of Conservation (SAC), Special Protection Areas (SPA), Ramsar sites, Local Nature Reserves (LNR), Areas of Outstanding Natural Beauty (AONB), National Parks (NP), Environmentally Sensitive Areas, Nitrate Sensitive Areas, Nitrate Vulnerable Zones and World Heritage Sites and Scheduled Ancient Woodland. These searches are conducted using radii of up to 2000m.

9. Natural Hazards

Provides information on a range of natural hazards that may pose a risk to the study site. These factors include natural ground subsidence and radon..

10. Mining

Provides information on areas of coal and non-coal mining and brine affected areas.

11. Contacts

This section of the report provides contact points for statutory bodies and data providers that may be able to provide further information on issues raised within this report. Alternatively, Groundsure provide a free Technical Helpline (08444 159000) for further information and guidance.

Note: Maps

Only certain features are placed on the maps within the report. All features represented on maps found within this search are given an identification number. This number identifies the feature on the mapping and correlates it to the additional information provided below. This identification number precedes all other information and takes the following format -Id: 1, Id: 2, etc. Where numerous features on the same map are in such close proximity that the numbers would obscure each other a letter identifier is used instead to represent the features. (e.g. Three features which overlap may be given the identifier “A” on the map and would be identified separately as features 1A, 3A, 10A on the data tables provided).

Where a feature is reported in the data tables to a distance greater than the map area, it is noted in the data table as “Not Shown”.

All distances given in this report are in Metres (m). Directions are given as compass headings such as N: North, E: East, NE: North East from the nearest point of the study site boundary.

1. Historical Land Use



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Site Outline

250
500
Search Buffers (m)

Historical 1:10,000 and 1:10,560 scale mapping

Industrial Land Use

Potentially Infilled Land

Historical 1:2,500, 1:1,250 and 1:500 scale mapping

Energy Features

Petrol Stations

Tanks

Garages

1. Historical Industrial Sites

1.1 Potentially Contaminative Uses identified from 1:10,000 scale Mapping

The systematic analysis of data extracted from standard 1:10,560 and 1:10,000 scale historical maps provides the following information:

Records of sites with a potentially contaminative past land use within 500m of the search boundary: 23

ID	Distance [m]	Direction	Use	Date
1	64	E	Wind Pump	1909
2	147	SE	Earthwork	1909
3A	155	NW	Colliery	1949
4A	155	NW	Railway Sidings	1949
5T	155	NW	Refuse Heap	1949
6	155	NW	Industrial Estate	1992
7U	169	NW	Unspecified Heap	1979
8B	184	NW	Railway Sidings	1960
9B	184	NW	Railway Sidings	1968
10C	184	NW	Unspecified Mine	1968
11C	184	NW	Unspecified Mine	1960
12D	331	NW	Colliery	1938
13D	331	NW	Colliery	1938
14E	401	SW	Police Station	1979
15E	401	SW	Police Station	1968
16E	401	SW	Police Station	1992
17E	401	SW	Police Station	1960
18G	454	NW	Unspecified Factory	1979
19	456	W	Unspecified Factory	1979
20	460	NW	Magazine	1949
21	465	NW	Unspecified Works	1979
22F	481	NW	Unspecified Tanks	1992
23F	481	NW	Unspecified Tanks	1979

1.2 Additional Information – Historical Tank Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical tanks within 500m of the search boundary: 6

ID	Distance (m)	Direction	Use	Date

24G	491	NW	Tanks	1996
25F	492	NW	Tanks	1974
26F	493	NW	Tanks	1990
27F	493	NW	Tanks	1984
28F	493	NW	Tanks	1986
29F	493	NW	Tanks	1990

1.3 Additional Information – Historical Energy Features Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical energy features within 500m of the search boundary: 19

ID	Distance (m)	Direction	Use	Date
30	81	SW	Electricity Substation	1990
31H	302	W	Electricity Substation	1959
32H	302	W	Electricity Substation	1984
33H	302	W	Electricity Substation	1990
34I	390	NW	Electricity Substation	1984
35I	390	NW	Electricity Substation	1990
36J	426	SW	Electricity Substation	1983
37J	426	SW	Electricity Substation	1969
38J	428	SW	Electricity Substation	1980
39J	428	SW	Electricity Substation	1990
40K	434	W	Electricity Substation	1984
41K	434	W	Electricity Substation	1990
42K	434	W	Electricity Substation	1986
43L	451	SE	Electricity Substation	1990
44L	451	SE	Electricity Substation	1980
45L	452	SE	Electricity Substation	1983
46M	453	S	Electricity Substation	1980
47M	453	S	Electricity Substation	1990
48M	454	S	Electricity Substation	1983

1.4 Additional Information – Historical Petrol and Fuel Site Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical petrol stations and fuel sites within 500m of the search boundary: 0

Database searched and no data found.

1.5 Additional Information – Historical Garage and Motor Vehicle Repair Database

The systematic analysis of data extracted from High Detailed 1:1,250 and 1:2,500 scale historical maps provides the following information.

Records of historical garage and motor vehicle repair sites within 500m of the search boundary: 9

ID	Distance (m)	Direction	Use	Date
49N	0	On Site	Garage	1990
50N	0	On Site	Garage	1961
51N	0	On Site	Garage	1974
52N	0	On Site	Garage	1959
53N	0	On Site	Garage	1984
54O	353	W	Vehicle Storage Depot	1990
55O	353	W	Vehicle Storage Depot	1959
56O	353	W	Vehicle Storage Depot	1984
57	364	W	Vehicle Storage Depot	1974

1.6 Potentially Infilled Land

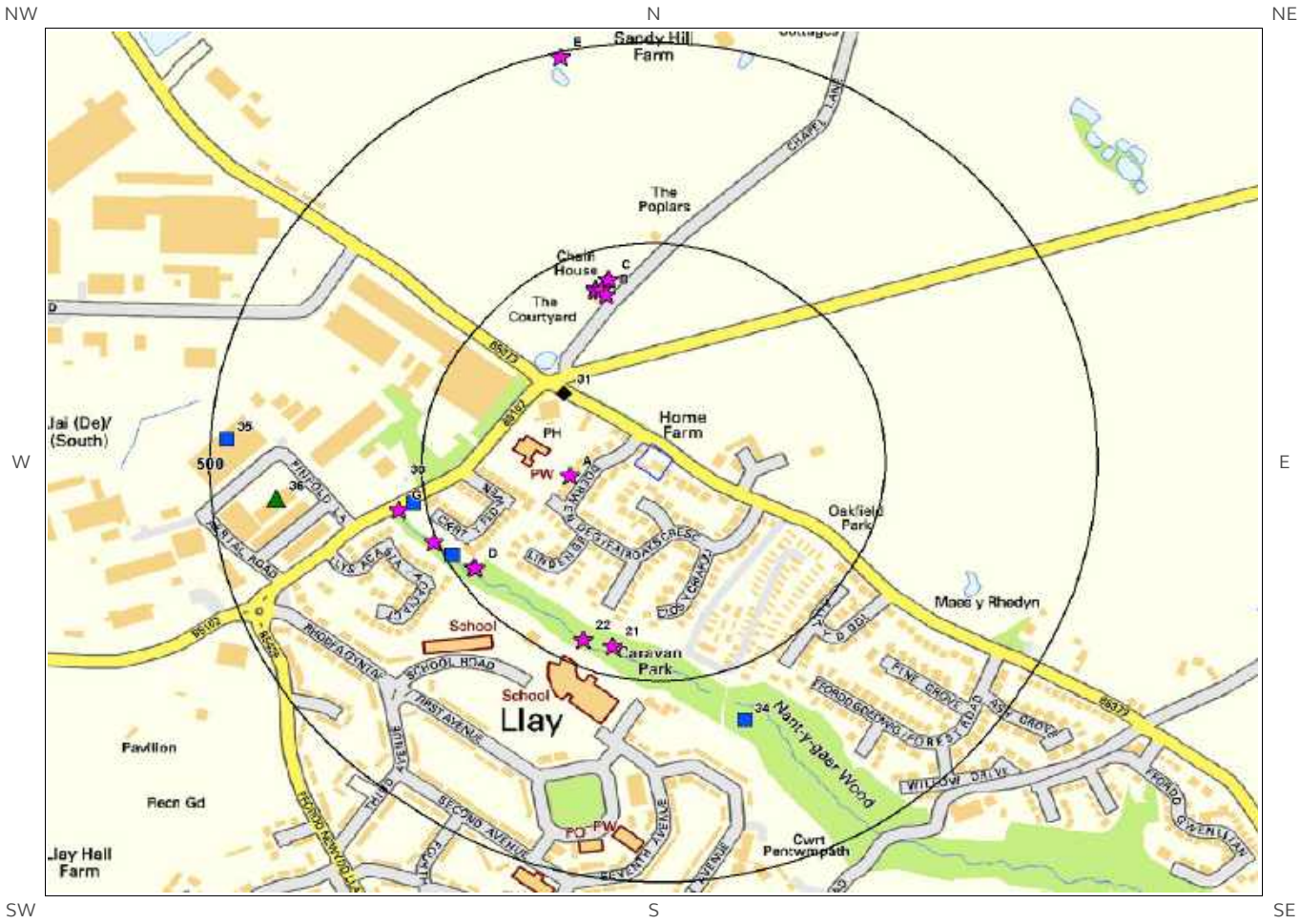
Records of Potentially Infilled Features from 1:10,000 scale mapping within 500m of the study site: 30

The following Historical Potentially Infilled Features derived from the Historical Mapping information is provided by Groundsure:

ID	Distance(m)	Direction	Use	Date
58P	0	On Site	Pond	1968
59P	0	On Site	Pond	1960
60Q	61	S	Ponds	1938
61Q	63	S	Ponds	1949
62Q	64	S	Ponds	1872
63Q	64	S	Ponds	1900
64R	89	E	Ponds	1872
65R	90	E	Pond	1900
66R	93	SE	Pond	1968
67R	93	SE	Pond	1960
68S	150	NW	Pond	1992
69S	150	NW	Pond	1979
70S	150	NW	Pond	1968
71S	150	NW	Pond	1960
72T	155	NW	Refuse Heap	1949
73A	155	NW	Colliery	1949
74U	169	NW	Unspecified Heap	1979
75C	184	NW	Unspecified Mine	1968

76C	184	NW	Unspecified Mine	1960
77V	188	SE	Ponds	1949
78V	192	SE	Ponds	1872
79V	192	SE	Ponds	1900
80D	331	NW	Colliery	1938
81D	331	NW	Colliery	1938
82	407	SE	Pond	1872
83W	485	N	Ponds	1900
84W	485	N	Pond	1968
85W	485	N	Pond	1979
86W	485	N	Pond	1960
87W	486	N	Ponds	1949

2. Environmental Permits, Incidents and Registers Map



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- Site Outline
- Search Buffers (m) 250 500
- Recorded Pollution Incident
- Dangerous Substances (List 1)
- Dangerous Substances (List 2)
- Water Industry Referrals
- Licenced Discharge Consents
- Red List Discharge Consents
- RAS 3 & 4 Authorisations
- Part A(1) Authorised Processes and Historic IPC Authorisations
- Part A(2) and Part B Authorised Processes
- COMAH / NIHHS Sites
- Sites Determined as Contaminated Land
- Hazardous Substance Consents and Enforcements

2. Environmental Permits, Incidents and Registers

2.1 Industrial Sites Holding Licences and/or Authorisations

Searches of information provided by the Environment Agency/Natural Resources Wales and Local Authorities reveal the following information:

2.1.1 Records of historic IPC Authorisations within 500m of the study site:

0

Database searched and no data found.

2.1.2 Records of Part A(1) and IPPC Authorised Activities within 500m of the study site:

0

Database searched and no data found.

2.1.3 Records of Red List Discharge Consents (potentially harmful discharges to controlled waters) within 500m of the study site:

0

Database searched and no data found.

2.1.4 Records of List 1 Dangerous Substances Inventory Sites within 500m of the study site:

1

The following List 1 Dangerous Substance Inventory Site records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
31	120	NW	333287 356306	Name: Trefn Engineering Ltd, Unit 7, Llay Ind.est, Rackery Lane, L Status: Not Active Receiving Water: -	Authorised Substances: Cadmium

2.1.5 Records of List 2 Dangerous Substance Inventory Sites within 500m of the study site:

0

Database searched and no data found.

2.1.6 Records of Part A(2) and Part B Activities and Enforcements within 500m of the study site:

1

The following Part A(2) and Part B Activities are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
36	424	W	332948 356173	Address: Star Counties Textile Services Ltd, Unit 4, Aerial Road, Llay Industrial Estate, Llay, Wrexham, LL12 0TU Process: Dry Cleaning Status: Current Permit Permit Type: Part B	Enforcement: No Enforcement Notified. Date of Enforcement: No Enforcement Notified. Comment: No Enforcement Notified.

2.1.7 Records of Category 3 or 4 Radioactive Substances Authorisations:

0

Database searched and no data found.

2.1.8 Records of Licensed Discharge Consents within 500m of the study site:

4

The following Licensed Discharge Consents records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
32F	242	SW	333155 356106	Address: PUMPING STATION ON DEVELOPMENT LAND, OFF LLAY ROAD, WREXHAM, WALES, UNITED KINGDOM, LL12 0TX Effluent Type: SEWAGE DISCHARGES - PUMPING STATION - NOT WATER COMPANY Permit Number: CG0413901 Permit Version: 1	Receiving Water: SINGRET BROOK Status: NEW CONSENT (WRA 91, S88 & SCHED 10 AS AMENDED BY ENV ACT 1995) Issue date: 22/01/2004 Effective Date: 22-Jan-2004 Revocation Date: -
33G	264	W	333110 356170	Address: CHAPEL LANE OPPOSITE GARDEN CENTRE, CHAPEL LANE OPPOSITE GARDEN CENT, OPPOSITE GARDEN CENTRE LLAY ,, LLAY ,, LLAY ,, , Effluent Type: SEWAGE DISCHARGES - SEWER STORM OVERFLOW - WATER COMPANY Permit Number: CG0358401 Permit Version: 1	Receiving Water: AFON ALYN TRIBUTARY Status: NEW CONSENT, BY APPLICATION (WRA 91, SECTION 88) Issue date: 21/07/1994 Effective Date: 21-Jul-1994 Revocation Date: -

ID	Distance (m)	Direction	NGR	Details	
34	315	S	333500 355900	Address: LLAY GRESFORD ROAD, LLAY GRESFORD ROAD, GRESFORD ROAD, UNKNOWN, UNKNOWN, UNKNOWN Effluent Type: UNSPECIFIED Permit Number: CM0065001 Permit Version: 1	Receiving Water: SINGRET BROOK Status: CONSENT EXPIRED - TIME LIMIT Issue date: 24/05/1971 Effective Date: 24-May-1971 Revocation Date: 23/02/1995
35	481	W	332890 356250	Address: LLAY IND ESTATE, LLAY IND ESTATE, UNKNOWN, UNKNOWN, UNKNOWN, UNKNOWN Effluent Type: UNSPECIFIED Permit Number: CM0060002 Permit Version: 1	Receiving Water: SINGRET BROOK Status: CONSENT EXPIRED - TIME LIMIT Issue date: 14/10/1969 Effective Date: 14-Oct-1969 Revocation Date: 06/02/1995

2.1.9 Records of Water Industry Referrals (potentially harmful discharges to the public sewer) within 500m of the study site:

0

Database searched and no data found.

2.1.10 Records of Planning Hazardous Substance Consents and Enforcements within 500m of the study site:

0

Database searched and no data found.

2.2 Dangerous or Hazardous Sites

Records of COMAH & NIHHS sites within 500m of the study site: 0

Database searched and no data found.

2.3 Environment Agency/Natural Resources Wales Recorded Pollution Incidents

2.3.1 Records of National Incidents Recording System, List 2 within 500m of the study site:

29

The following NIRS List 2 records are represented as points on the Environmental Permits, Incidents and Registers Map:

ID	Distance (m)	Direction	NGR	Details	
1A	77	W	333294 356204	Incident Date: 11-May-2001 Incident Identification: 5234 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Sulphide Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
2A	77	W	333294 356204	Incident Date: 11-May-2001 Incident Identification: 5234 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Sulphide Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
3B	194	N	333336 356430	Incident Date: 16-Dec-2001 Incident Identification: 48422 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
4B	194	N	333336 356430	Incident Date: 16-Dec-2001 Incident Identification: 48422 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
5B	201	N	333331 356435	Incident Date: 15-Dec-2001 Incident Identification: 48308 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
6B	203	N	333324 356435	Incident Date: 01-Mar-2002 Incident Identification: 61231 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
7B	203	N	333324 356435	Incident Date: 10-Aug-2001 Incident Identification: 23432 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
8B	203	N	333324 356435	Incident Date: 04-Apr-2002 Incident Identification: 68864 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
9B	203	N	333324 356435	Incident Date: 01-Mar-2002 Incident Identification: 61231 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
10B	203	N	333324 356435	Incident Date: 25-Dec-2001 Incident Identification: 49539 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)

ID	Distance (m)	Direction	NGR	Details	
11B	206	N	333324 356438	Incident Date: 15-Dec-2001 Incident Identification: 48307 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
12C	212	N	333340 356449	Incident Date: 16-Dec-2001 Incident Identification: 48423 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
13C	212	N	333340 356449	Incident Date: 16-Dec-2001 Incident Identification: 48423 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
14C	212	N	333339 356449	Incident Date: 09-May-2001 Incident Identification: 4903 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Sulphide Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
15C	212	N	333339 356449	Incident Date: 31-Aug-2001 Incident Identification: 28237 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
16C	212	N	333339 356449	Incident Date: 06-Jul-2001 Incident Identification: 14519 Pollutant: Other Pollutant Pollutant Description: Other	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
17C	212	N	333339 356449	Incident Date: 26-Jul-2001 Incident Identification: 19467 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
18C	212	N	333339 356449	Incident Date: 13-Dec-2001 Incident Identification: 47986 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
19C	212	N	333339 356449	Incident Date: 06-Aug-2001 Incident Identification: 22099 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
20C	212	N	333339 356449	Incident Date: 06-Jul-2001 Incident Identification: 14519 Pollutant: Other Pollutant Pollutant Description: Other	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
21	214	S	333344 355992	Incident Date: 06-Feb-2005 Incident Identification: 291717 Pollutant: Oils and Fuel Pollutant Description: Cutting Oils	Water Impact: Category 2 (Significant) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
22	218	SW	333310 356000	Incident Date: 20-May-2002 Incident Identification: 80015 Pollutant: Sewage Materials Pollutant Description: Crude Sewage	Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
23D	228	SW	333182 356089	Incident Date: 27-Dec-2001 Incident Identification: 49674 Pollutant: Sewage Materials Pollutant Description: Crude Sewage	Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)

ID	Distance (m)	Direction	NGR	Details	
24D	228	SW	333182 356089	Incident Date: 27-Dec-2001 Incident Identification: 49674 Pollutant: Sewage Materials Pollutant Description: Crude Sewage	Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
25D	229	SW	333180 356091	Incident Date: 30-Apr-2001 Incident Identification: 3861 Pollutant: Sewage Materials Pollutant Description: Storm Sewage	Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
26F	256	W	333133 356122	Incident Date: 14-Apr-2003 Incident Identification: 150789 Pollutant: Organic Chemicals/Products Pollutant Description: Other Organic Chemical or Product	Water Impact: Category 3 (Minor) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
27G	283	W	333092 356162	Incident Date: 03-Feb-2005 Incident Identification: 291092 Pollutant: Oils and Fuel Pollutant Description: Cutting Oils	Water Impact: Category 2 (Significant) Land Impact: Category 4 (No Impact) Air Impact: Category 4 (No Impact)
28E	493	N	333283 356725	Incident Date: 04-Sep-2001 Incident Identification: 28772 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)
29E	493	N	333283 356725	Incident Date: 04-Sep-2001 Incident Identification: 28772 Pollutant: Atmospheric Pollutants and Effects Pollutant Description: Landfill Odour	Water Impact: Category 4 (No Impact) Land Impact: Category 4 (No Impact) Air Impact: Category 3 (Minor)

2.3.2 Records of National Incidents Recording System, List 1 within 500m of the study site:

1

The following NIRS List 1 records are represented as points on the Environmental Permits, Incidents and Registers Map:

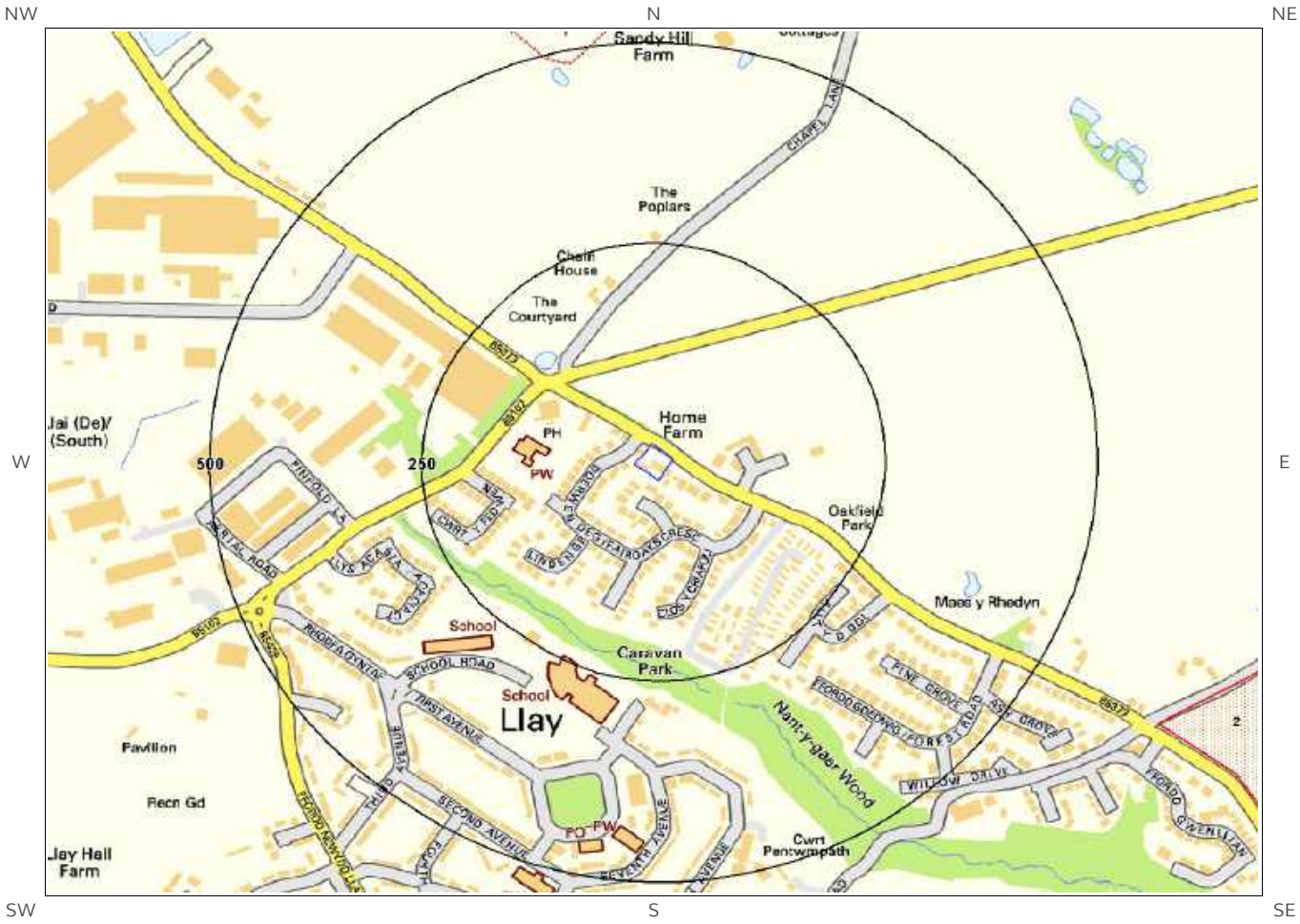
ID	Distance(m)	Direction	NGR	Details	
30	270	W		Incident Date: 01-Sep-1999 Incident Identification: 4813.0 Catchments Name: SINGRET BROOK Water Description: RIVER STRETCH (FRESHWATER) Water Course: SINGRET BROOK Incident Substantiated: Yes	Priority Description: Immediate (2 Hours) Waste Description: Not Available Water Impact: Significant Impact Land Impact: No Impact Air Impact: No Impact Action Taken: Not Available

2.4 Sites Determined as Contaminated Land under Part 2A EPA 1990

How many records of sites determined as contaminated land under Section 78R of the Environmental Protection Act 1990 are there within 500m of the study site? 0

Database searched and no data found.

3. Landfill and Other Waste Sites Map



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Site Outline

250
500
Search Buffers (m)

EA/NRW Active Landfill

EA/NRW Historic Landfill

BGS / DoE Survey Landfill

Historic and Planned Waste Sites

EA/NRW Licensed Waste Site

Local Authority/Historical Mapping Landfill Records

3. Landfill and Other Waste Sites

3.1 Landfill Sites

3.1.1 Records from Environment Agency/Natural Resources Wales landfill data within 1000m of the study site:

1

The following Environment Agency/Natural Resources Wales landfill records are represented as polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
1	483	N	332747 356798	Address: Astbury Landfill, Dark Lane, Burton, Wrexham, Clwyd, LL12 0AE Landfill Reference: 37116.0 Environmental Permitting Regulations (Waste) Reference: CAI002 Landfill Type: A4 : Household, Commercial & Industrial Waste Landfill	Operator: W R G Environmental Ltd Status: Modified IPPC Reference: EPR Reference:

3.1.2 Records of Environment Agency/Natural Resources Wales historic landfill sites within 1500m of the study site:

5

The following landfill records are represented as either points or polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
2	660	SE	334300 355900	Site Address: Singret Quarry, Gresford Road, Llay, Wrexham Waste Licence: Yes Site Reference: WMBC L63, NOW-514-L Waste Type: Inert, Industrial Environmental Permitting Regulations (Waste) Reference: WW1/L/BOD001	Licence Issue: 31-Dec-1983 Licence Surrendered: 18-Dec-2003 Licence Holder Address: - Operator: Bodfari (quarries) Licence Holder: Tarmac First Recorded: 31-Dec-1976 Last Recorded: 30-Jun-1998
Not shown	748	N	333100 357100	Site Address: Astbury Quarry, Dark Lane, Llay, Wrexham Waste Licence: Yes Site Reference: WMBC L/13, NOW-510-L, 6955/0062 Waste Type: Inert, Industrial, Commercial, Household, Special Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 31-Dec-1983 Licence Surrendered: 31-Dec-1987 Licence Holder Address: - Operator: - Licence Holder: Shanks First Recorded: 31-Dec-1983 Last Recorded: 31-Dec-1987

ID	Distance (m)	Direction	NGR	Details	
Not shown	860	NW	333100 357100	Site Address: Astbury Quarry, Dark Lane, Llay, Wrexham Waste Licence: Yes Site Reference: WMBC L/13, NOW-510-L, 6955/0062 Waste Type: Inert, Industrial, Commercial, Household, Special Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 31-Dec-1983 Licence Surrendered: 31-Dec-1987 Licence Holder Address: - Operator: - Licence Holder: Shanks First Recorded: 31-Dec-1983 Last Recorded: 31-Dec-1987
Not shown	1222	E	335000 356300	Site Address: Ballswood Quarry, Rossett, Wrexham, Clwyd Waste Licence: Yes Site Reference: WMBC L/47 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 19-Jul-1977 Licence Surrendered: Licence Holder Address: - Operator: - Licence Holder: RMC Limited First Recorded: 31-Dec-1977 Last Recorded: 31-Dec-1985
Not shown	1348	E	335000 356300	Site Address: Ballswood Quarry, Rossett, Wrexham, Clwyd Waste Licence: Yes Site Reference: WMBC L/47 Waste Type: Inert Environmental Permitting Regulations (Waste) Reference: -	Licence Issue: 19-Jul-1977 Licence Surrendered: Licence Holder Address: - Operator: - Licence Holder: RMC Limited First Recorded: 31-Dec-1977 Last Recorded: 31-Dec-1985

3.1.3 Records of BGS/DoE non-operational landfill sites within 1500m of the study site:

0

Database searched and no data found.

3.1.4 Records of Landfills from Local Authority and Historical Mapping Records within 1500m of the study site:

1

The following landfill records are represented as points or polygons on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Site Address	Source	Data Type
Not shown	815	NW	332985 356978	Refuse Tip	1996 mapping	Polygon

3.2 Other Waste Sites

3.2.1 Records of waste treatment, transfer or disposal sites within 500m of the study site:

0

Database searched and no data found.

3.2.2 Records of Environment Agency/Natural Resources Wales licensed waste sites within 1500m of the study site:

35

The following waste treatment, transfer or disposal sites records are represented as points on the Landfill and Other Waste Sites map:

ID	Distance (m)	Direction	NGR	Details	
Not shown	848	NW	332743 356790	Site Address: Dark Lane, Burton, Rossett, Wrexham, LL12 0AE Type: Household, Commercial & Industrial Waste Landfill Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CAI002 EPR reference: - Operator: Caird Environmental Ltd Waste Management licence No: 37116 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: - Modified: 29/01/2003 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Astbury Landfill (rossett) Correspondence Address: Wrg Waste Services Ltd, Ground Floor West, 900, Pavilion Drive, Nothampton Business Park, Northampton, NN4 7RG
Not shown	850	NW	332747 356798	Site Address: Astbury Landfill (rossett), Burton, Wrexham, Wrexham, LL12 0AE Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: FP3894FP EPR reference: - Operator: W R G Environmental Ltd Waste Management licence No: 0 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: 17/08/1994 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -
Not shown	850	NW	332747 356798	Site Address: Astbury Landfill, Dark Lane, Burton, Wrexham, Clwyd, LL12 0AE Type: Household, Commercial & Industrial Waste Landfill Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CAI002 EPR reference: EA/EPR/FP3894FP/V008 Operator: W R G Environmental Ltd Waste Management licence No: 37116 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: - Modified: 03/03/2014 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Astbury Landfill (rossett) Correspondence Address: -
Not shown	850	NW	332747 356798	Site Address: Astbury Landfill, Dark Lane, Burton, Wrexham, Clwyd, LL12 0AE Type: Household, Commercial & Industrial Waste Landfill Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CAI002 EPR reference: - Operator: Wrg Environmental Ltd Waste Management licence No: 37116 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: - Modified: 01/10/2007 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Astbury Landfill (rossett) Correspondence Address: Wrg Waste Services Ltd, Ground Floor West, 900, Pavilion Drive, Northampton Business Park, Northampton, Northants, NN4 7RG
Not shown	850	NW	332747 356798	Site Address: Astbury Landfill, Dark Lane, Burton, Wrexham, Clwyd, LL12 0AE Type: Household, Commercial & Industrial Waste Landfill Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: CAI002 EPR reference: FP3894FP/V008 Operator: W R G Environmental Ltd Waste Management licence No: 37116 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: - Modified: 03/03/2014 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Astbury Landfill (rossett) Correspondence Address: -

ID	Distance (m)	Direction	NGR	Details	
Not shown	855	NW	332741 356798	Site Address: Dark Lane, Burton, Rossett, Wrexham, LL12 0AE Type: Household, Commercial & Industrial Waste Landfill Size: >= 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CAI002 EPR reference: - Operator: Caird Environmental Ltd Waste Management licence No: 37116 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: - Modified: 29/01/2003 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Astbury Landfill (rossett) Correspondence Address: Astbury Landfill (rossett), Dark Lane, Burton, Rossett, Wrexham, LL12 0AE
Not shown	855	NW	332741 356798	Site Address: Dark Lane, Burton, Rossett, Wrexham, LL12 0AE Type: Co-Disposal Landfill Site Size: >= 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CAI002 EPR reference: - Operator: Caird Environmental Ltd Waste Management licence No: 37116 Annual Tonnage: 0.0	Issue Date: 17/08/1994 Effective Date: - Modified: 09/07/2002 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: Astbury Quarry Correspondence Address: Deerplay, Bacup Road, Cliviger, Burnley, Lancashire, BB11 3RL
Not shown	977	W	332412 356413	Site Address: W H Chaloner & Son Ltd, Miners Road, Llay Industrial Estate, Wrexham, Clwyd, LL12 0PJ Type: Metal Recycling Site (mixed MRS's) Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: CHA002 EPR reference: ZP3594FN/V008 Operator: W H Chaloner & Son Limited Waste Management licence No: 37135 Annual Tonnage: 0.0	Issue Date: 20/07/1995 Effective Date: - Modified: 23/10/2012 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: W H Chaloner & Son Ltd Correspondence Address: -
Not shown	977	W	332412 356413	Site Address: W H Chaloner & Son Ltd, Llay Industrial Estate, Wrexham, Wrexham, LL12 0PJ Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: ZP3594FN EPR reference: - Operator: W H Chaloner & Son Limited Waste Management licence No: 0 Annual Tonnage: 24999.0	Issue Date: 20/07/1995 Effective Date: 20/07/1995 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -
Not shown	977	W	332412 356413	Site Address: W H Chaloner & Son Ltd, Miners Road, Llay Industrial Estate, Wrexham, Clwyd, LL12 0PJ Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CHA002 EPR reference: EA/EPR/ZP3594FN/V008 Operator: W H Chaloner & Son Limited Waste Management licence No: 37135 Annual Tonnage: 24999.0	Issue Date: 20/07/1995 Effective Date: - Modified: 23/10/2012 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: W H Chaloner & Son Ltd Correspondence Address: -
Not shown	977	W	332412 356413	Site Address: Miners Road, Llay Industrial Estate, Llay, Wrexham, LL12 0PJ Type: Metal Recycling Site (mixed MRS's) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: CHA002 EPR reference: - Operator: Chaloner W H & Son Ltd Waste Management licence No: 37135 Annual Tonnage: 0.0	Issue Date: 20/07/1995 Effective Date: - Modified: 29/11/2002 Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Modified Site Name: W H Chaloner & Sons Ltd Correspondence Address: Park House, Pulford, Chester, Cheshire, CH4 9DG

ID	Distance (m)	Direction	NGR	Details	
Not shown	1074	N	333200 357300	Site Address: Astbury Landfill Site, Dark Lane, Rossett, Wrexham, Clwyd, LL12 0AE Type: Landfill Gas Engine (<3 mW) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WRG014 EPR reference: - Operator: Wrg Environmental Ltd Waste Management licence No: 220007 Annual Tonnage: 0.0	Issue Date: 13/12/2006 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Rossett Landfill Gas Utilisation Plant Correspondence Address: -
Not shown	1074	N	333200 357300	Site Address: Astbury Landfill Site, Dark Lane, Rossett, Wrexham, Clwyd, LL12 0AE Type: Landfill Gas Engine (<3 mW) Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WRG014 EPR reference: - Operator: W R G Environmental Ltd Waste Management licence No: 220007 Annual Tonnage: 0.0	Issue Date: 13/12/2006 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Rossett Landfill Gas Utilisation Plant Correspondence Address: -
Not shown	1074	N	333200 357300	Site Address: Rossett Landfill Gas Utilisation Plant, Astbury Landfill Site, Dark Lane, Rossett, Wrexham, LL12 0AE Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: AB3096FL EPR reference: - Operator: W R G Environmental Ltd Waste Management licence No: 0 Annual Tonnage: 0.0	Issue Date: 13/12/2006 Effective Date: 13/12/2006 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -
Not shown	1074	N	333200 357300	Site Address: Astbury Landfill Site, Dark Lane, Rossett, Wrexham, Clwyd, LL12 0AE Type: Landfill Gas Engine (<3 mW) Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: WRG014 EPR reference: - Operator: W R G Environmental Ltd Waste Management licence No: 220007 Annual Tonnage: 0.0	Issue Date: 13/12/2006 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Rossett Landfill Gas Utilisation Plant Correspondence Address: -
Not shown	1093	E	334509 356207	Site Address: Gresford Road, Llay, Wrexham, Clwyd, LL12 0NU Type: Landfill taking other wastes Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: BOD001 EPR reference: EA/EPR/LP3594FP/S002 Operator: Bodfari (quarries) Limited Waste Management licence No: 37032 Annual Tonnage: 150000.0	Issue Date: 25/05/1992 Effective Date: - Modified: - Surrendered Date: 18/12/2003 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: Singret Quarry Correspondence Address: -
Not shown	1093	E	334509 356207	Site Address: Gresford Road, Llay, Wrexham, Clwyd, LL12 0NU Type: Landfill taking other wastes Size: >= 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: BOD001 EPR reference: LP3594FP/S002 Operator: Bodfari (quarries) Limited Waste Management licence No: 37032 Annual Tonnage: 150000.0	Issue Date: 25/05/1992 Effective Date: - Modified: - Surrendered Date: 18/12/2003 Expiry Date: - Cancelled Date: - Status: Surrendered Site Name: Singret Quarry Correspondence Address: -

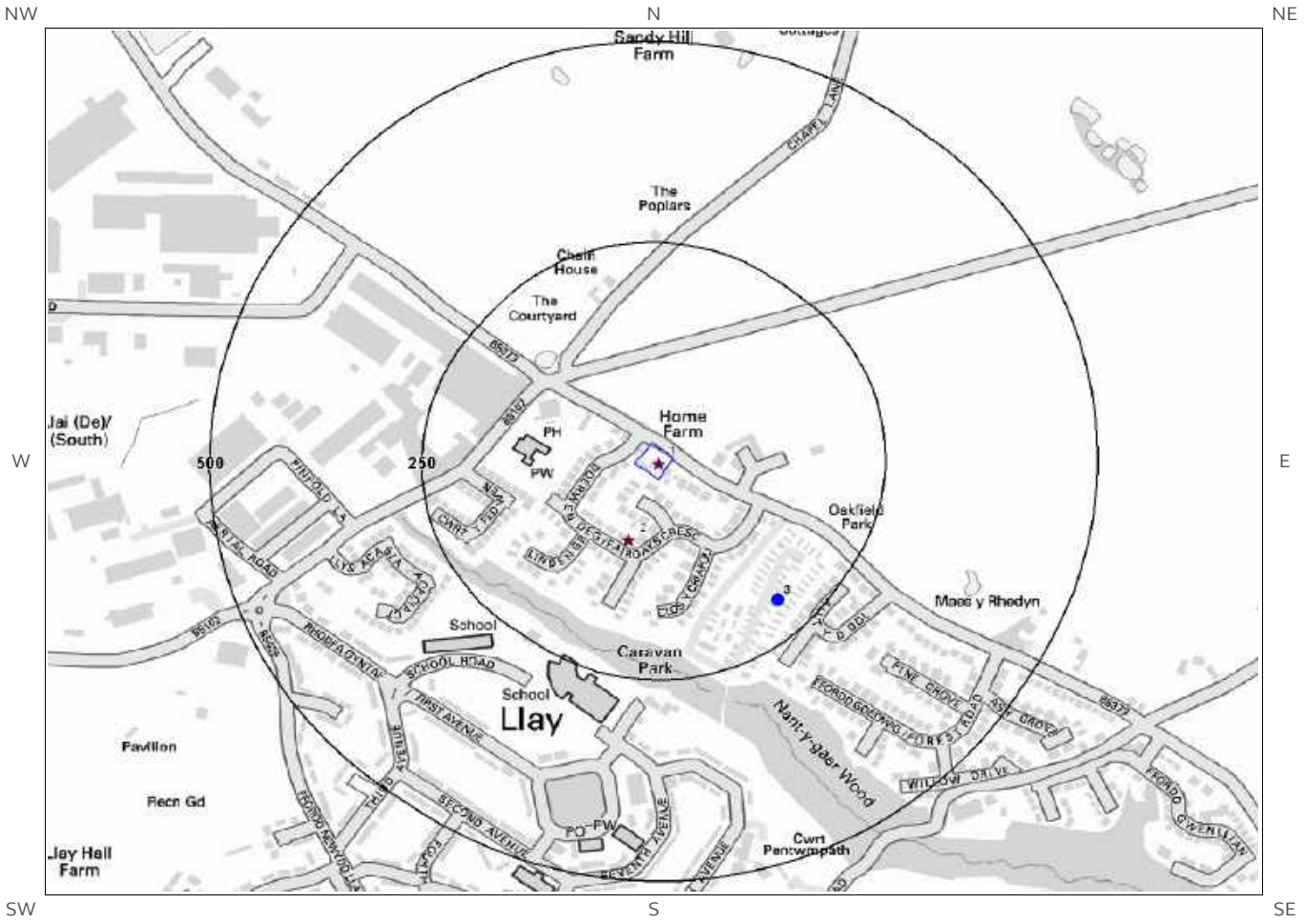
ID	Distance (m)	Direction	NGR	Details	
Not shown	1093	E	334509 356207	Site Address: Gresford Road, Llay, Wrexham, LL12 0NU Type: Landfill taking other wastes Size: >= 25000 tonnes < 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: BOD001 EPR reference: - Operator: Bodfari (quarries) Limited Waste Management licence No: 37032 Annual Tonnage: 0.0	Issue Date: 25/05/1992 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Closure Site Name: Singret Quarry Correspondence Address: Tunstead House, P O Box 25, Buxton, Derbyshire, SK17 8TG
Not shown	1204	E	334620 356235	Site Address: Ballswood Quarry, Gergin Lane, Llay, Nr Wrexham, LL12 0NU Type: Physical Treatment Facility Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: DPW005 EPR reference: EA/EPR/JB3237WU/A001 Operator: D P Williams Holdings Limited Waste Management licence No: 104698 Annual Tonnage: 74999.0	Issue Date: 08/01/2013 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Ballswood Quary Correspondence Address: -
Not shown	1204	E	334620 356235	Site Address: Inertia Recycling Limited, Ballswood Quary, Gergin Lane, Nr Wrexham, LL12 0NU Type: Physical Treatment Facility Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: JB3237WU EPR reference: - Operator: Inertia Recycling Limited Waste Management licence No: 104698 Annual Tonnage: 74999.0	Issue Date: 05/11/2015 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: Ballswood Quary Correspondence Address: -
Not shown	1204	E	334620 356235	Site Address: Ballswood Quary, Gergin Lane, Llay, Nr Wrexham, Wrexham, LL12 0NU Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: JB3237WU EPR reference: - Operator: Inertia Recycling Limited Waste Management licence No: 0 Annual Tonnage: 74999.0	Issue Date: 05/11/2015 Effective Date: 05/11/2015 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -
Not shown	1204	E	334620 356235	Site Address: Ballswood Quarry, Gergin Lane, Llay, Nr Wrexham, LL12 0NU Type: Physical Treatment Facility Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: DPW005 EPR reference: JB3237WU/A001 Operator: D P Williams Holdings Limited Waste Management licence No: 104698 Annual Tonnage: 0.0	Issue Date: 08/01/2013 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Ballswood Quary Correspondence Address: -
Not shown	1209	W	332163 356296	Site Address: Miner's Road Depot, Llay Industrial Estate, Wrexham, Wrexham, LL12 0PJ Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: RP3994FN EPR reference: - Operator: Wrexham Borough Council Waste Management licence No: 0 Annual Tonnage: 0.0	Issue Date: 09/05/2002 Effective Date: 09/05/2002 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -

ID	Distance (m)	Direction	NGR	Details	
Not shown	1209	W	332163 356296	Site Address: Wrexham Construction Services, Miners Road, Llay Industrial Estate, Wrexham, Clwyd, LL12 0PJ Type: Physical Treatment Facility Size: >= 25000 tonnes < 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WRE001 EPR reference: EA/EPR/RP3994FN/A001 Operator: Wrexham County Borough Council Waste Management licence No: 37235 Annual Tonnage: 60692.0	Issue Date: 5/9/2002 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Miner's Road Depot Correspondence Address: Ruthin Road Depot, Ruthin Road, Wrexham, Clwyd, LL13 7TU
Not shown	1209	W	332163 356296	Site Address: Wrexham Construction Services, Miners Road, Llay Industrial Estate, Wrexham, Clwyd, LL12 0PJ Type: Physical Treatment Facility Size: >= 25000 tonnes < 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WRE001 EPR reference: RP3994FN/A001 Operator: Wrexham Borough Council Waste Management licence No: 37235 Annual Tonnage: 60692.0	Issue Date: 09/05/2002 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Miner's Road Depot Correspondence Address: -
Not shown	1218	W	332152 356241	Site Address: Llay Depot, Llay Industrial Park, Llay, Wrexham, LL12 0PJ Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: NB3293HV EPR reference: - Operator: Roadway Civil Engineering & Surfacing Ltd Waste Management licence No: 0 Annual Tonnage: 75000.0	Issue Date: 12/12/2014 Effective Date: 12/12/2014 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -
Not shown	1218	W	332152 356241	Site Address: Unit 2, Miners Road, Llay Industrial Park, Llay, Wrexham, LL12 0PJ Type: Inert & excavation Waste TS + treatment Size: >= 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: ROA010 EPR reference: NB3293HV/A001 Operator: Roadway Civil Engineering & Surfacing Ltd Waste Management licence No: 900110 Annual Tonnage: 75000.0	Issue Date: 12/12/2014 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Llay Depot Correspondence Address: -
Not shown	1218	W	332152 356241	Site Address: Unit 2, Miners Road, Llay Industrial Park, Llay, Wrexham, LL12 0PJ Type: Inert & excavation Waste TS + treatment Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: ROA010 EPR reference: EA/EPR/NB3293HV/A001 Operator: Roadway Civil Engineering & Surfacing Ltd Waste Management licence No: 900110 Annual Tonnage: 75000.0	Issue Date: 12/12/2014 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Llay Depot Correspondence Address: -

ID	Distance (m)	Direction	NGR	Details	
Not shown	1232	W	332141 356302	Site Address: Miners Road, Llay Industrial Estate, Llay, Wrexham Type: Physical Treatment Facility Size: >= 25000 tonnes < 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: WRE001 EPR reference: - Operator: Wrexham County Borough Council Waste Management licence No: 37235 Annual Tonnage: 0.0	Issue Date: 09/05/2002 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Wrexham Construction Services / Llay Correspondence Address: Ruthin Road Depot, Ruthin Road, Wrexham, Wrexham, LL13 7TU
Not shown	1337	W	332035 356286	Site Address: P P S Skip Hire, Llay Industrial Estate, Wrexham, Wrexham, LL12 0PJ Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: RP3894FC EPR reference: - Operator: David Alan Darby Waste Management licence No: 0 Annual Tonnage: 0.0	Issue Date: 04/09/2003 Effective Date: 04/09/2003 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Expired Site Name: - Correspondence Address: -
Not shown	1337	W	332035 356286	Site Address: 12, Miners Road, Llay Industrial Estate, Wrexham, Clwyd, LL12 0PJ Type: Household, Commercial & Industrial Waste T Stn Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: DAR003 EPR reference: EA/EPR/RP3894FC/A001 Operator: Darby David Alan Waste Management licence No: 37239 Annual Tonnage: 9460.0	Issue Date: 04/09/2003 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Expired Site Name: P P S Skip Hire Correspondence Address: -
Not shown	1337	W	332035 356286	Site Address: 12, Miners Road, Llay Industrial Estate, Wrexham, Clwyd, LL12 0PJ Type: Household, Commercial & Industrial Waste T Stn Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: DAR003 EPR reference: RP3894FC/A001 Operator: Darby David Alan Waste Management licence No: 37239 Annual Tonnage: 9460.0	Issue Date: 04/09/2003 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Expired Site Name: P P S Skip Hire Correspondence Address: -
Not shown	1369	S	333204 354844	Site Address: Alyn Waters Country Park, Llay, Wrexham, Clwyd, LL12 0PW Type: Use of waste in construction <100,000 tps Size: < 25000 tonnes Environmental Permitting Regulations (Waste) Licence Number: FOR097 EPR reference: EA/EPR/QP3695VB/A001 Operator: Fore Golf Discount (Wrexham) Ltd Waste Management licence No: 102195 Annual Tonnage: 99999.0	Issue Date: 06/01/2011 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Foregolf Golf Course & Driving Range Correspondence Address: -

ID	Distance (m)	Direction	NGR	Details	
Not shown	1369	S	333204 354844	Site Address: Alyn Waters Country Park, Llay, Wrexham, Clwyd, LL12 0PW Type: Use of waste in construction <100,000 tps Size: >= 75000 tonnes Environmental Permitting Regulations (Waste) Licence Number: FOR097 EPR reference: QP3695VB/A001 Operator: Fore Golf Discount (Wrexham) Ltd Waste Management licence No: 102195 Annual Tonnage: 99999.0	Issue Date: 06/01/2011 Effective Date: - Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Issued Site Name: Foregolf Golf Course & Driving Range Correspondence Address: -
Not shown	1373	S	333219 354838	Site Address: Foregolf Golf Course & Driving Range, Llay, Wrexham, Wrexham, LL12 0PW Type: - Size: Unknown Environmental Permitting Regulations (Waste) Licence Number: QP3695VB EPR reference: - Operator: Fore Golf Discount (Wrexham) Ltd Waste Management licence No: 0 Annual Tonnage: 99999.0	Issue Date: 06/01/2011 Effective Date: 06/01/2011 Modified: - Surrendered Date: - Expiry Date: - Cancelled Date: - Status: Effective Site Name: - Correspondence Address: -

4. Current Land Use Map



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Site Outline

Search Buffers (m)

250

500

Current Industrial Sites

Petrol & Fuel Sites

Electricity Transmission Cables

Gas Transmission Pipelines

4. Current Land Uses

4.1 Current Industrial Data

Records of potentially contaminative industrial sites within 250m of the study site: 2

The following records are represented as points on the Current Land Uses map.

ID	Distance (m)	Direction	Company	NGR	Address	Activity	Category
1	0	On Site	Blackbrook Motors	333398 356218	Blackbrook Motors, Gresford Road, Llay, Wrexham, LL12 0NW	Vehicle Repair, Testing and Servicing	Repair and Servicing
2	84	SW	Electricity Sub Station	333363 356123	Electricity Sub Station, LL12	Electrical Features	Infrastructure and Facilities

4.2 Petrol and Fuel Sites

Records of petrol or fuel sites within 500m of the study site: 1

The following petrol or fuel site records provided by Catalist are represented as points on the Current Land Use map:

ID	Distance (m)	Direction	NGR	Company	Address	LPG	Status
3	205	SE	333539 356049	Obsolete	Black Brook Motors, B5373, B5373, Llay, Wrexham, Wrexham, LL12 0NW	Not Applicable	Obsolete

4.3 National Grid High Voltage Underground Electricity Transmission Cables

This dataset identifies the high voltage electricity transmission lines running between generating power plants and electricity substations. The dataset does not include the electricity distribution network (smaller, lower voltage cables distributing power from substations to the local user network). This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high voltage underground electricity transmission cables within 500m of the study site: 0

Database searched and no data found.

4.4 National Grid High Pressure Gas Transmission Pipelines

This dataset identifies high-pressure, large diameter pipelines which carry gas between gas terminals, power stations, compressors and storage facilities. The dataset does not include the Local Transmission System (LTS) which supplies gas directly into homes and businesses. This information has been extracted from databases held by National Grid and is provided for information only with no guarantee as to its completeness or accuracy. National Grid do not offer any warranty as to the accuracy of the available data and are excluded from any liability for any such inaccuracies or errors.

Records of National Grid high pressure gas transmission pipelines within 500m of the study site: 0

Database searched and no data found.

5. Geology

5.1 Artificial Ground and Made Ground

Database searched and no data found.

The database has been searched on site, including a 50m buffer.

5.2 Superficial Ground and Drift Geology

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
TILLD-DMTN	TILL, DEVENSIAN	DIAMICTON

5.3 Bedrock and Solid Geology

The database has been searched on site, including a 50m buffer.

Lex Code	Description	Rock Type
SAL-MDSC	SALOP FORMATION	MUDSTONE, SANDSTONE AND CONGLOMERATE

(Derived from the BGS 1:50,000 Digital Geological Map of Great Britain)

6 Hydrogeology and Hydrology

6a. Aquifer Within Superficial Geology



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Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

6b. Aquifer Within Bedrock Geology and Abstraction Licenses



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Site Outline

250
500
Search Buffers (m)

Principal Aquifer

Secondary (A) Aquifer - Permeable Layers

Secondary (B) Aquifer - Lower Permeability Layers

Groundwater Abstraction Licence

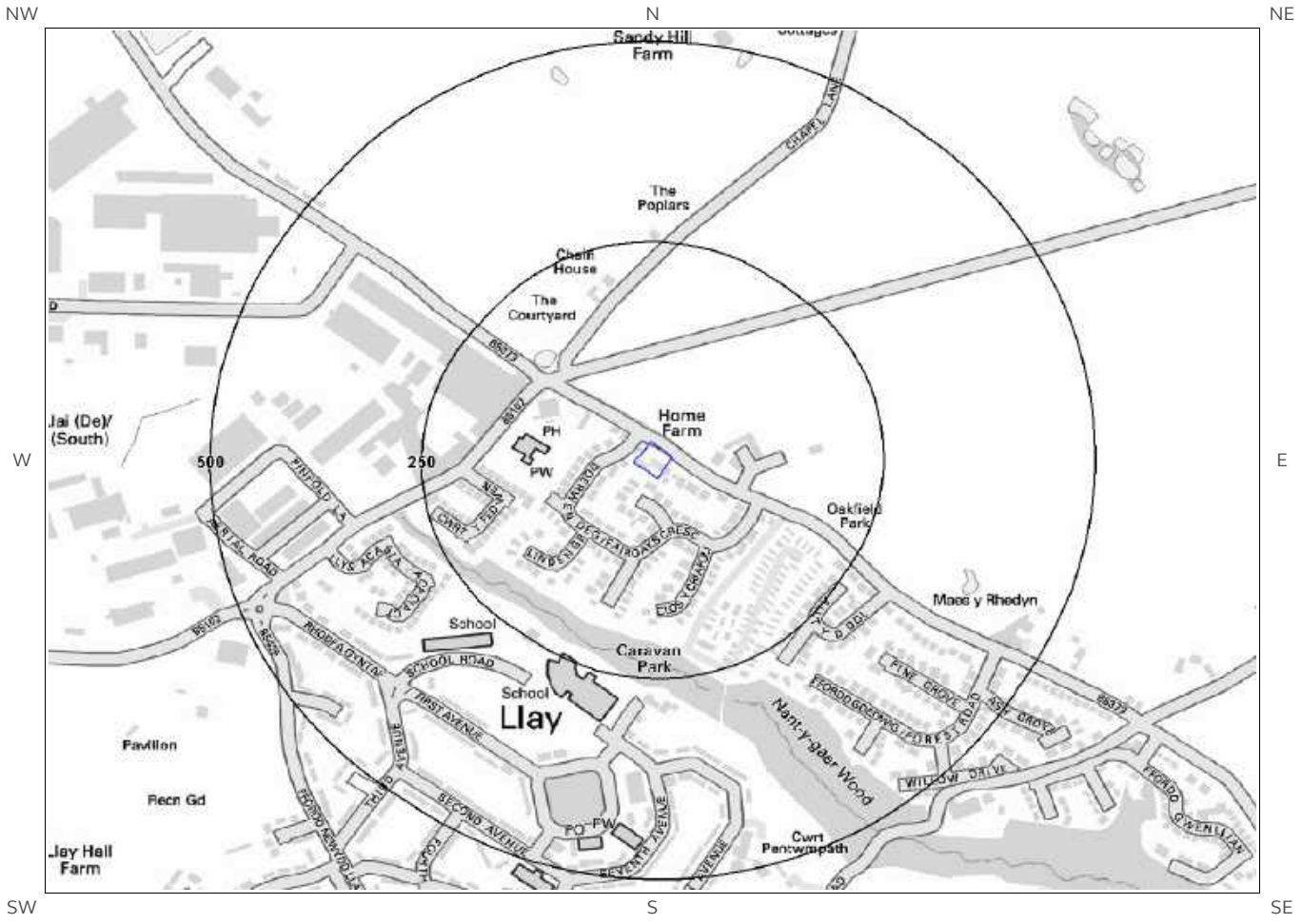
Secondary Aquifer - Undifferentiated Layers

Unproductive

Unknown (lakes and landslip)

Surface Water Abstraction Licence

6c. Hydrogeology – Source Protection Zones and Potable Water Abstraction Licenses



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Site Outline

250
500
Search Buffers (m)

Source Protection Zone 1 - Inner Catchment

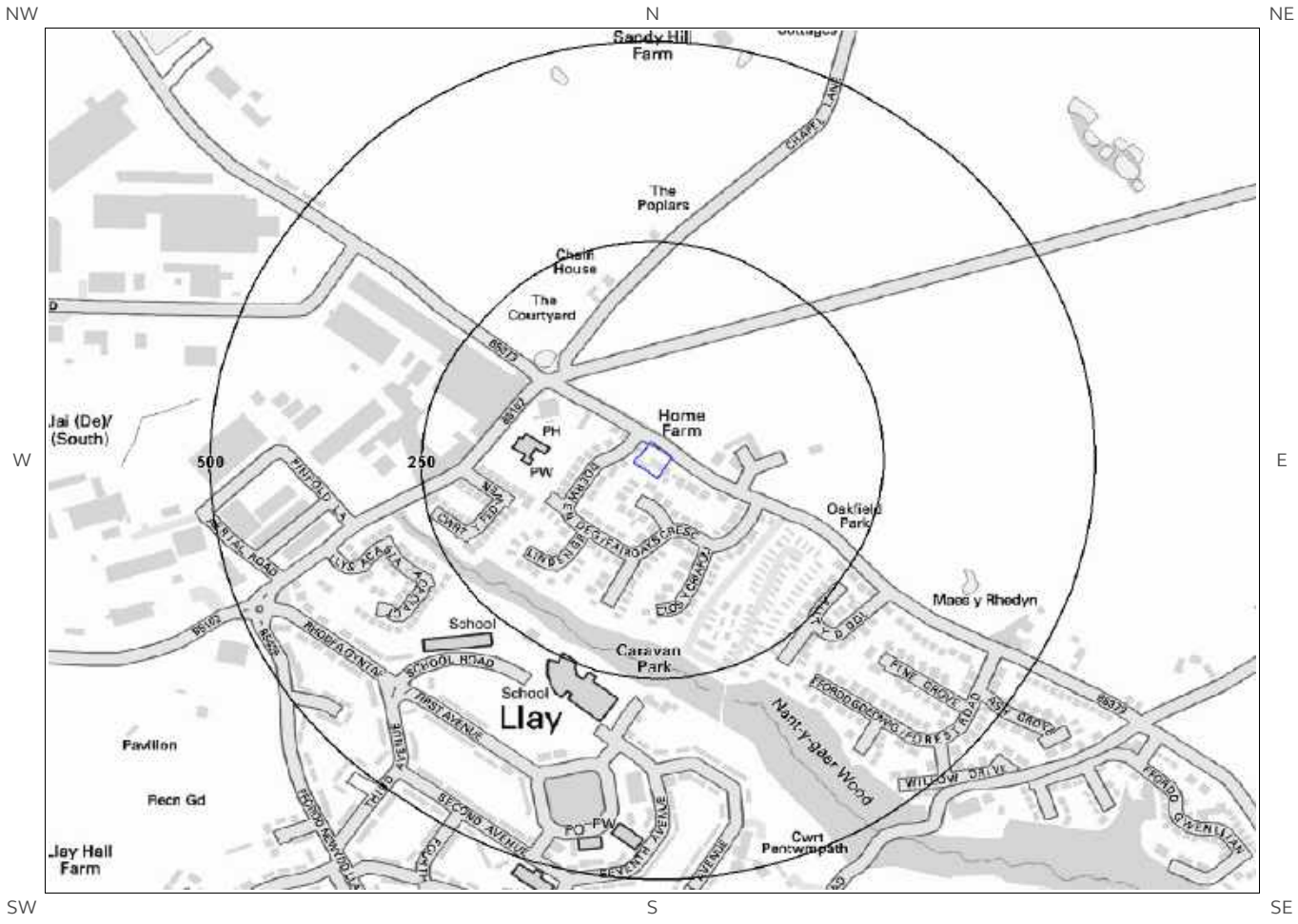
Source Protection Zone 2 - Outer Catchment

Source Protection Zone 3 - Total Catchment

Source Protection Zone 4 - Zone of Special Interest

Potable Water Abstraction Licence

6d. Hydrogeology – Source Protection Zones within confined aquifer



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Source Protection Zone 1 - Inner Catchment

Source Protection Zone 2C - Outer Catchment within Confined Aquifer

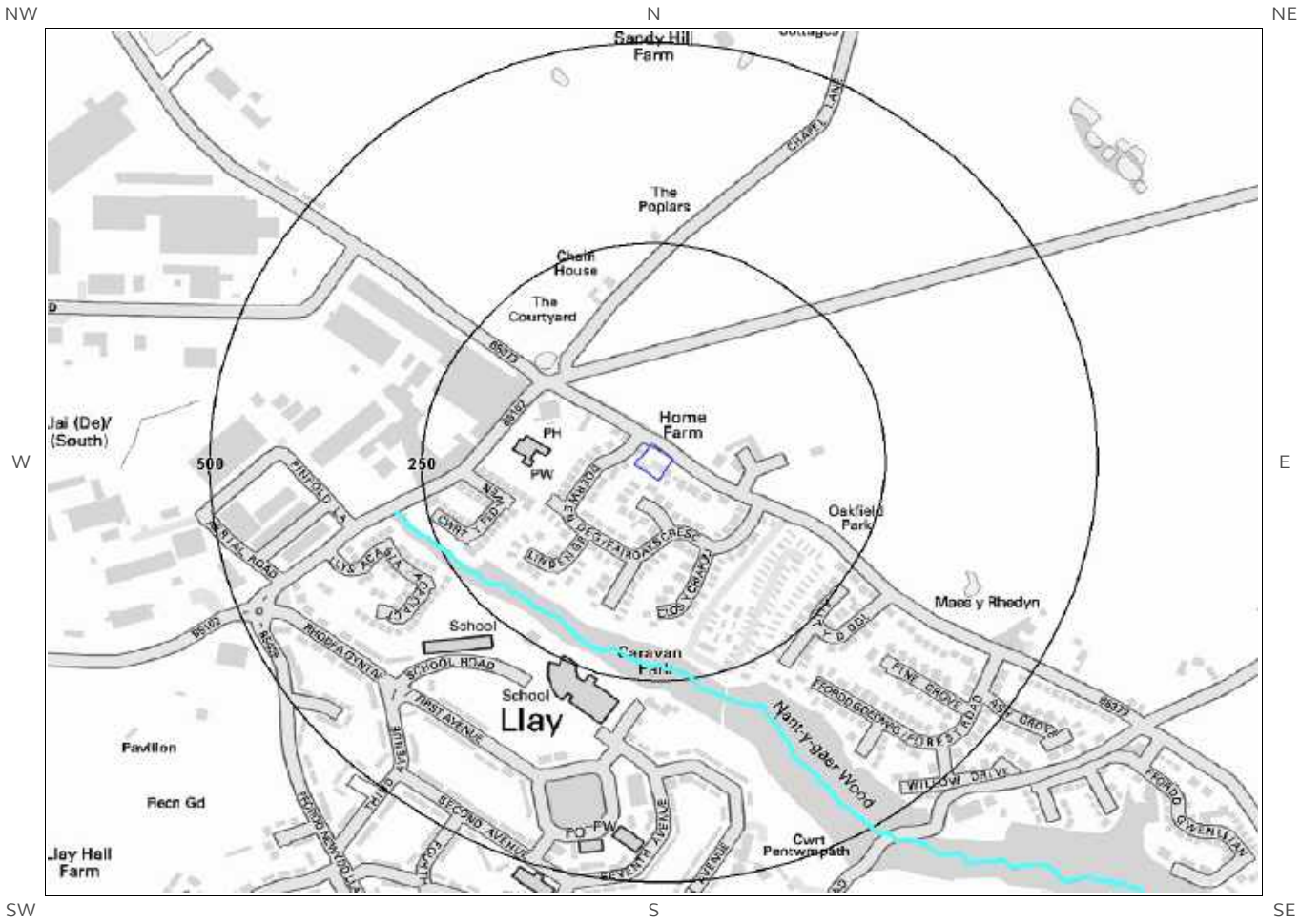
Source Protection Zone 3C - Total Catchment within Confined Aquifer

Potable Water Abstraction Licence

Site Outline

250 500 Search Buffers (m)

6e. Hydrology – Detailed River Network and River Quality



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Site Outline

250
500
Search Buffers (m)

Primary River
Secondary River
Tertiary River
Lake/Reservoir
Underground River (inferred)
General Quality Assessment: Biology
General Quality Assessment: Chemistry

Canal
Canal Tunnel
Culvert
Multiple Channel Culvert
Underground River (Potential Sewer)
Underground River (local knowledge)

6.Hydrogeology and Hydrology

6.1 Aquifer within Superficial Deposits

Are there records of strata classification within the superficial geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency/Natural Resources Wales's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the Groundsure Enviro Insight User Guide.

The following aquifer records are shown on the Aquifer within Superficial Geology Map (6a):

ID	Distance (m)	Direction	Designation	Description
2	0	On Site	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow
1	192	S	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers
3	387	SE	Unproductive	These are rock layers or drift deposits with low permeability that have negligible significance for water supply or river base flow

6.2 Aquifer within Bedrock Deposits

Are there records of strata classification within the bedrock geology at or in proximity to the property? Yes

From 1 April 2010, the Environment Agency/Natural Resources Wales's Groundwater Protection Policy has been using aquifer designations consistent with the Water Framework Directive. For further details on the designation and interpretation of this information, please refer to the Groundsure Enviro Insight User Guide.

The following aquifer records are shown on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	Designation	Description
2	0	On Site	Secondary A	Permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as minor aquifers

6.3 Groundwater Abstraction Licences

Are there any Groundwater Abstraction Licences within 2000m of the study site? Yes

The following Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	NGR	Details	
Not shown	1583	NE	334500 357380	Status: Historical Licence No: 24/67/9/0146 Details: General Farming & Domestic Direct Source: Eaw Groundwater Point: Borehole Data Type: Point Name: Lister	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: N142 Original Start Date: 7/10/1974 Expiry Date: - Issue No: 100 Version Start Date: 7/10/1974 Version End Date:
Not shown	1858	NE	334520 357720	Status: Historical Licence No: 24/67/9/0065 Details: General Farming & Domestic Direct Source: Eaw Groundwater Point: Borehole Data Type: Point Name: Walton	Annual Volume (m^3): - Max Daily Volume (m^3): - Original Application No: 535 Original Start Date: 25/10/1966 Expiry Date: - Issue No: 100 Version Start Date: 25/10/1966 Version End Date:

6.4 Surface Water Abstraction Licences

Are there any Surface Water Abstraction Licences within 2000m of the study site? Yes

The following Surface Water Abstraction Licences records are represented as points, lines and regions on the Aquifer within Bedrock Geology Map (6b):

ID	Distance (m)	Direction	NGR	Details	
Not shown	1344	SE	334480 355400	Status: Historical Licence No: 24/67/8/0052 Details: Mineral Washing Direct Source: Eaw Surface Water Point: River Alyn Data Type: Point Name: Tarmac Limited	Annual Volume (m^3): 166929 Max Daily Volume (m^3): 545.52 Application No: - Original Start Date: 14/6/1968 Expiry Date: - Issue No: 102 Version Start Date: 1/1/2008 Version End Date:
Not shown	1552	E	334961 356380	Status: Active Licence No: WA/067/0008/007 Details: Mineral Washing Direct Source: Eaw Surface Water Point: Lagoon At Ballswood Quarry Data Type: Point Name: DP Williams Holdings Ltd	Annual Volume (m^3): 0 Max Daily Volume (m^3): 0 Application No: WPCC3082 Original Start Date: 26/6/2015 Expiry Date: 31/3/2017 Issue No: 1 Version Start Date: 26/6/2015 Version End Date:
Not shown	1593	E	335000 356400	Status: Historical Licence No: 24/67/8/0108 Details: Mineral Washing Direct Source: Eaw Surface Water Point: Lagoon At Ballswood Quarry Wrexham Data Type: Point Name: DP Williams Holdings Ltd	Annual Volume (m^3): 3800 Max Daily Volume (m^3): 138 Application No: NPS/WR/011382 Original Start Date: 30/6/2006 Expiry Date: 31/3/2015 Issue No: 2 Version Start Date: 3/10/2012 Version End Date:

ID	Distance (m)	Direction	NGR	Details	
Not shown	1897	E	335530 356760	Status: Active Licence No: 24/67/8/0086 Details: Spray Irrigation - Direct Direct Source: Eaw Surface Water Point: River Alyn Data Type: Line Name: H E Jones And Son	Annual Volume (m^3): 0 Max Daily Volume (m^3): 0 Application No: N206 Original Start Date: 16/6/1980 Expiry Date: - Issue No: 100 Version Start Date: 1/4/2007 Version End Date:

6.5 Potable Water Abstraction Licences

Are there any Potable Water Abstraction Licences within 2000m of the study site? No

Database searched and no data found.

6.6 Source Protection Zones

Are there any Source Protection Zones within 500m of the study site? No

Database searched and no data found.

6.7 Source Protection Zones within Confined Aquifer

Are there any Source Protection Zones within the Confined Aquifer within 500m of the study site? No

Historically, Source Protection Zone maps have been focused on regulation of activities which occur at or near the ground surface, such as prevention of point source pollution and bacterial contamination of water supplies. Sources in confined aquifers were often considered to be protected from these surface pressures due to the presence of a low permeability confining layer (e.g. glacial till, clay). The increased interest in subsurface activities such as onshore oil and gas exploration, ground source heating and cooling requires protection zones for confined sources to be marked on SPZ maps where this has not already been done.

Database searched and no data found.

6.8 Groundwater Vulnerability and Soil Leaching Potential

Is there any Environment Agency/Natural Resources Wales information on groundwater vulnerability and soil leaching potential within 500m of the study site? Yes

Distance (m)	Direction	Classification	Soil Vulnerability Category	Description
0	On Site	Minor Aquifer/High Leaching Potential	HU	Soil information for urban areas and restored mineral workings. These soils are therefore assumed to be highly permeable in the absence of site-specific information.
17	NE	Minor Aquifer/Low Leaching Potential	L	Soils in which pollutants are unlikely to penetrate the soil layer because either water movement is largely horizontal, or they have the ability to attenuate diffuse pollutants.
354	SE	Minor Aquifer/High Leaching Potential	H2	Deep, permeable, coarse textured soils which readily transmit a wide range of pollutants because of their rapid drainage and low attenuation potential.

6.9 River Quality

Is there any Environment Agency/Natural Resources Wales information on river quality within 1500m of the study site? Yes

6.9.1 Biological Quality:

Biological Quality data describes water quality in terms of 83 groups of macroinvertebrates, some of which are pollution sensitive. The results are graded from A ('Very Good') to F ('Bad').

The following Biological Quality records are shown on the Hydrology Map (6e):

ID	Distance (m)	Direction	NGR	River Quality Grade	Biological Quality Grade				
					2005	2006	2007	2008	2009
Not shown	1280	SE	334200 355200	River Name: Alyn / Alun Reach: Rosset Weir - Gresford Lodge End/Start of Stretch: Start of Stretch NGR	C	C	C	C	C
Not shown	1280	SE	334200 355200	River Name: Alyn / Alun Reach: Gresford - Conf. Cegidog End/Start of Stretch: End of Stretch NGR	B	B	B	B	B

6.9.2 Chemical Quality:

Chemical quality data is based on the General Quality Assessment Headline Indicators scheme (GQAHI). In England, each chemical sample is measured for ammonia and dissolved oxygen. In Wales, the samples are measured for biological oxygen demand (BOD), ammonia and dissolved oxygen. The results are graded from A ('Very Good') to F ('Bad').

The following Chemical Quality records are shown on the Hydrology Map (6e):

					Chemical Quality Grade				
ID	Distance (m)	Direction	NGR	River Quality Grade	2005	2006	2007	2008	2009
Not shown	1280	SE	334200 355200	River Name: Alyn Reach: Gresford - Conf. Cegidog End/Start of Stretch: End of Stretch NGR	A	A	B	B	-
Not shown	1280	SE	334200 355200	River Name: Alyn Reach: Rosset Weir - Gresford Lodge End/Start of Stretch: Start of Stretch NGR	A	B	B	B	-

6.10 Detailed River Network

Are there any Detailed River Network entries within 500m of the study site? Yes

The following Detailed River Network records are represented on the Hydrology Map (6e):

ID	Distance (m)	Direction	Details	
1	208	SW	River Name: - Welsh River Name: - Alternative Name: -	River Type: Tertiary River Main River Status: Currently Undefined

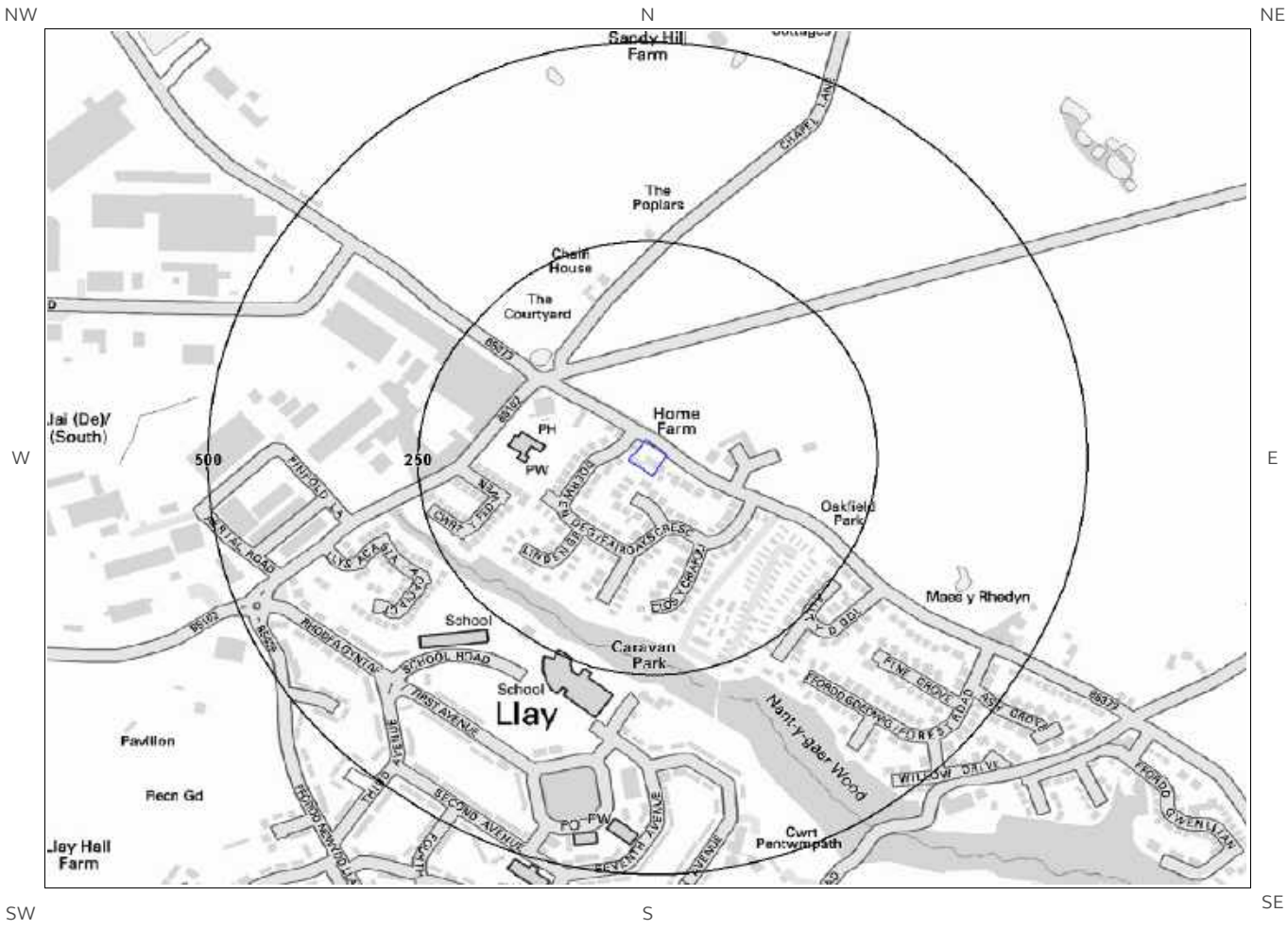
6.11 Surface Water Features

Are there any surface water features within 250m of the study site? Yes

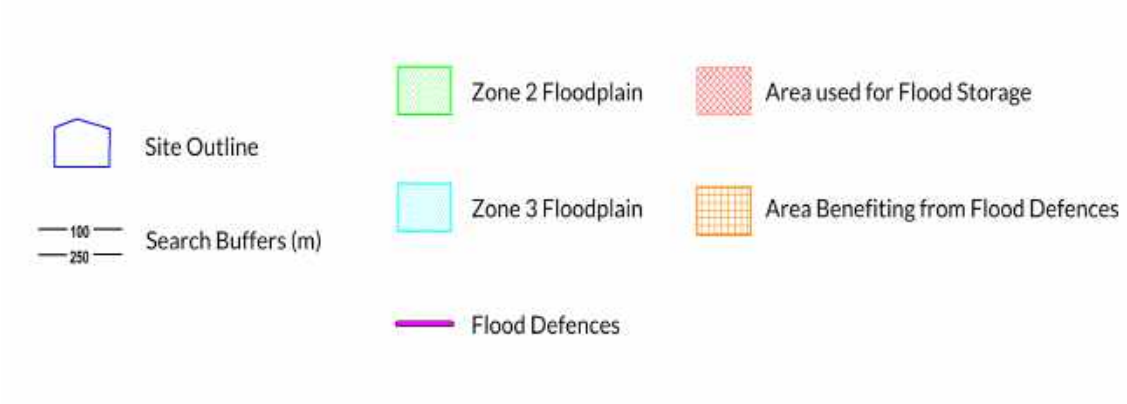
The following surface water records are not represented on mapping:

Distance (m)	Direction
208	SW

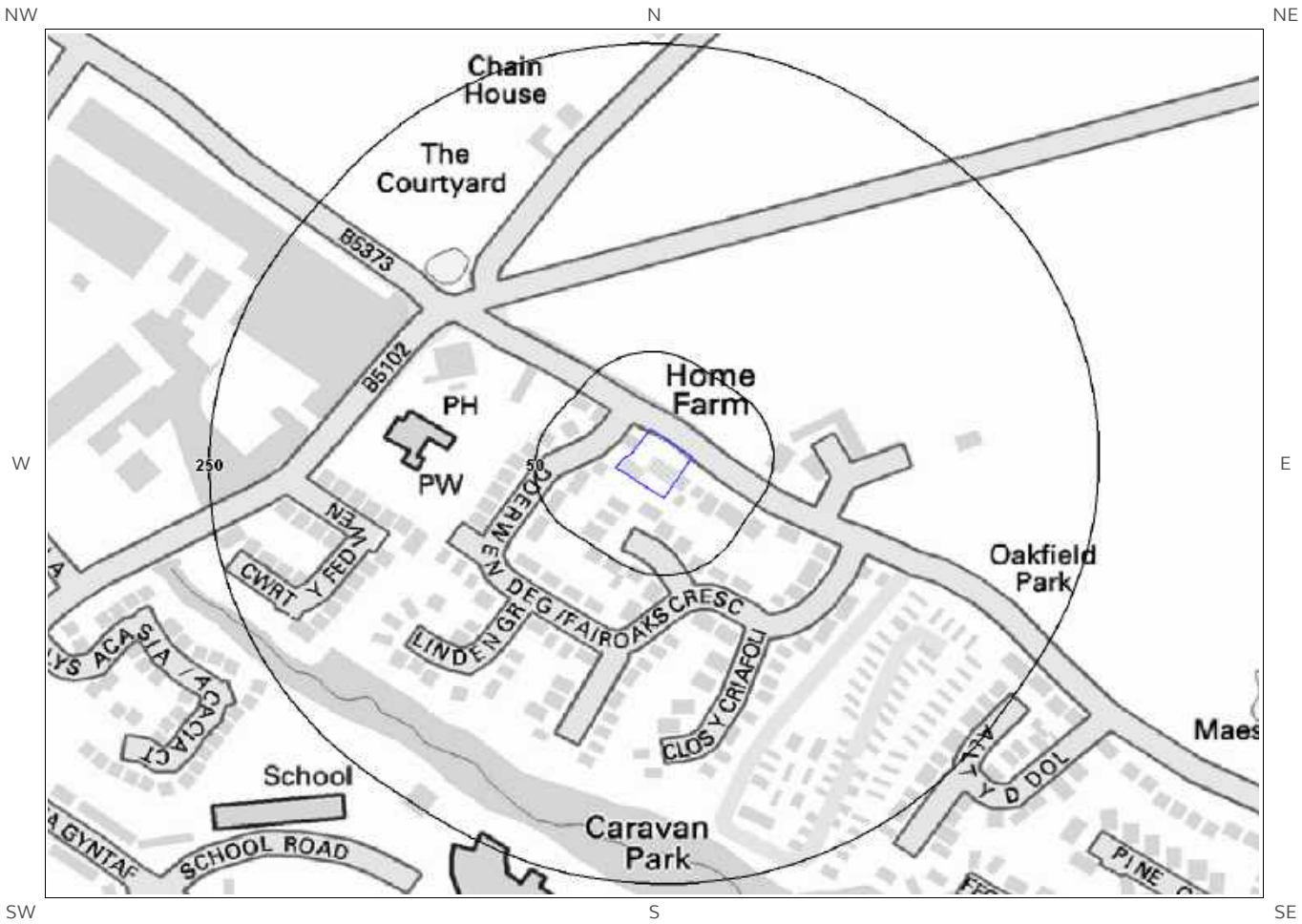
7a. Environment Agency/Natural Resources Wales Flood Map for Planning (from rivers and the sea)



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7b. Environment Agency/Natural Resources Wales Risk of Flooding from Rivers and the Sea (RoFRaS) Map



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Site Outline

100 250 Search Buffers (m)

RoFRaS Rating

- Very Low
- Low
- Medium
- High

7 Flooding

7.1 River and Coastal Zone 2 Flooding

Is the site within 250m of an Environment Agency/Natural Resources Wales Zone 2 floodplain? No

Environment Agency/Natural Resources Wales Zone 2 floodplains estimate the annual probability of flooding as between 1 in 1000 (0.1%) and 1 in 100 (1%) from rivers and between 1 in 1000 (0.1%) and 1 in 200 (0.5%) from the sea. Any relevant data is represented on Map 7a – Flood Map for Planning:

Database searched and no data found.

7.2 River and Coastal Zone 3 Flooding

Is the site within 250m of an Environment Agency/Natural Resources Wales Zone 3 floodplain? No

Zone 3 shows the extent of a river flood with a 1 in 100 (1%) or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year. Any relevant data is represented on Map 7a – Flood Map for Planning.

Database searched and no data found.

7.3 Risk of Flooding from Rivers and the Sea (RoFRaS) Flood Rating

What is the highest risk of flooding onsite? Very Low

The Environment Agency/Natural Resources Wales RoFRaS database provides an indication of river and coastal flood risk at a national level on a 50m grid with the flood rating at the centre of the grid calculated and given above. The data considers the probability that the flood defences will overtop or breach by considering their location, type, condition and standard of protection.

RoFRaS data for the study site indicates the property is in an area with a Very Low (less than 1 in 1000) chance of flooding in any given year.

7.4 Flood Defences

Are there any Flood Defences within 250m of the study site? No

Database searched and no data found.

7.5 Areas benefiting from Flood Defences

Are there any areas benefiting from Flood Defences within 250m of the study site? No

7.6 Areas benefiting from Flood Storage

Are there any areas used for Flood Storage within 250m of the study site? No

7.7 Groundwater Flooding Susceptibility Areas

7.7.1 Are there any British Geological Survey groundwater flooding susceptibility areas within 50m of the boundary of the study site? Yes

Does this relate to Clearwater Flooding or Superficial Deposits Flooding? Superficial Deposits Flooding

Notes: Groundwater flooding may either be associated with shallow unconsolidated sedimentary aquifers which overlie unproductive aquifers (Superficial Deposits Flooding), or with unconfined aquifers (Clearwater Flooding).

7.7.2 What is the highest susceptibility to groundwater flooding in the search area based on the underlying geological conditions?

Limited potential

Where limited potential for groundwater flooding to occur is indicated, this means that although given the geological conditions there may be a groundwater flooding hazard, unless other relevant information, e.g. records of previous flooding, suggests groundwater flooding has occurred before in this area, you need take no further action in relation to groundwater flooding hazard.

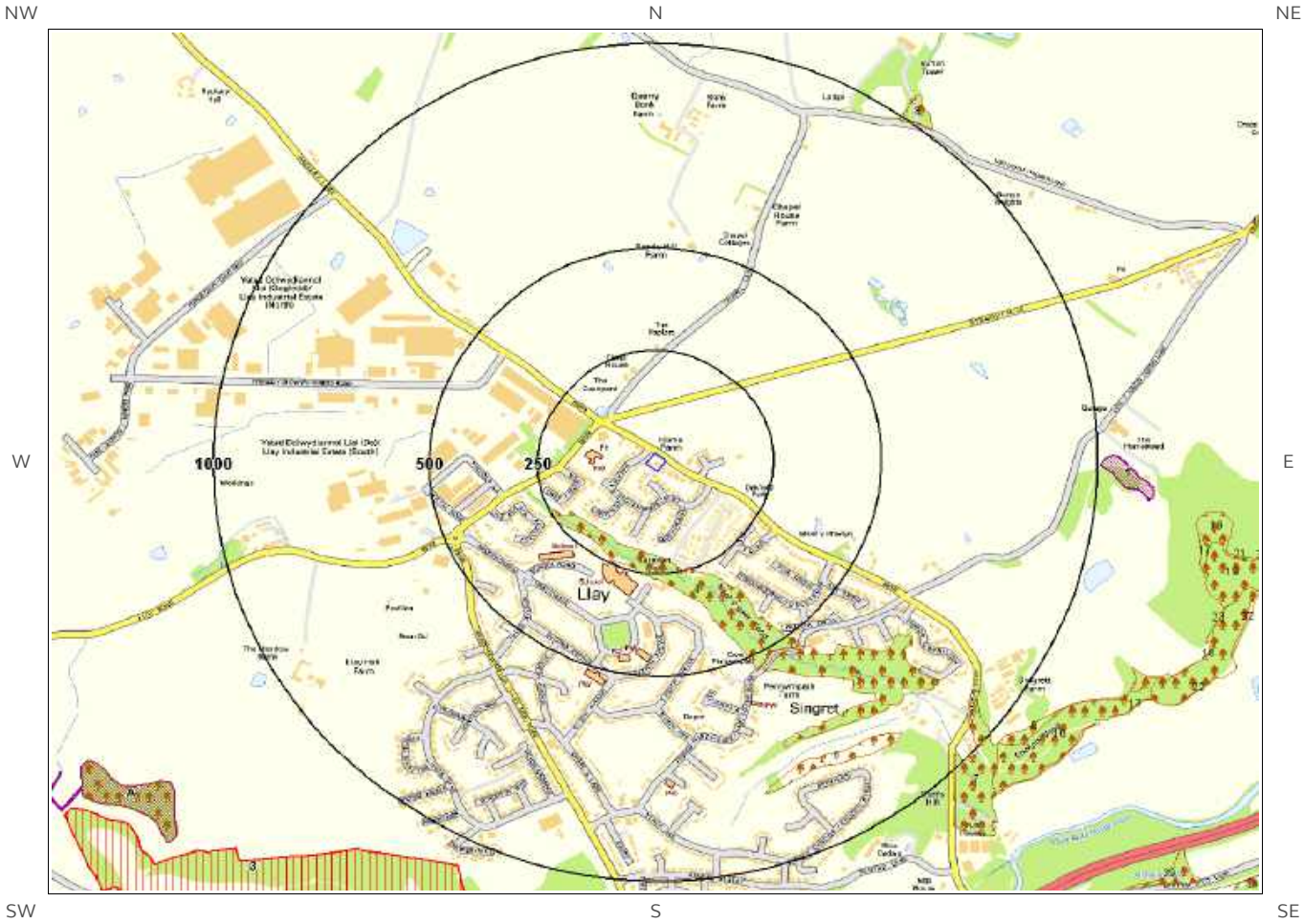
7.8 Groundwater Flooding Confidence Areas

What is the British Geological Survey confidence rating in this result? High

Notes: Groundwater flooding is defined as the emergence of groundwater at the ground surface or the rising of groundwater into man-made ground under conditions where the normal range of groundwater levels is exceeded.

The confidence rating is on a threefold scale - Low, Moderate and High. This provides a relative indication of the BGS confidence in the accuracy of the susceptibility result for groundwater flooding. This is based on the amount and precision of the information used in the assessment. In areas with a relatively lower level of confidence the susceptibility result should be treated with more caution. In other areas with higher levels of confidence the susceptibility result can be used with more confidence.

8. Designated Environmentally Sensitive Sites Map



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Site Outline

100 250 Search Buffers (m)

AONB

National Park

SSSI

Special Protection Areas

Nitrate Vulnerable Zones

Green Belt

Environmentally Sensitive Areas

Special Areas of Conservation

World Heritage Sites

Nitrate Sensitive Areas

Ancient Woodland

National Nature Reserve

Local Nature Reserves

Ramsar Sites

8. Designated Environmentally Sensitive Sites

Presence of Designated Environmentally Sensitive Sites within 2000m of the study site? Yes

8.1 Records of Sites of Special Scientific Interest (SSSI) within 2000m of the study site:

2

The following Site of Special Scientific Interest (SSSI) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	SSSI Name	Data Source
1	1007	E	CHWAREL SINGRET	Natural Resources Wales
2A	1347	SW	LLAY BOG	Natural Resources Wales

8.2 Records of National Nature Reserves (NNR) within 2000m of the study site:

0

Database searched and no data found.

8.3 Records of Special Areas of Conservation (SAC) within 2000m of the study site:

0

Database searched and no data found.

8.4 Records of Special Protection Areas (SPA) within 2000m of the study site:

0

Database searched and no data found.

8.5 Records of Ramsar sites within 2000m of the study site:

0

Database searched and no data found.

8.6 Records of Ancient Woodland within 2000m of the study site:

64

The following records of Designated Ancient Woodland provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
4	192	SW	Unknown	Ancient and Semi-Natural Woodland
5	522	SE	Unknown	Ancient and Semi-Natural Woodland
6	782	SE	Unknown	Ancient and Semi-Natural Woodland
7	921	SE	Unknown	Restored Ancient Woodland Site
8	988	NE	Unknown	Ancient and Semi-Natural Woodland
9	1028	SE	Unknown	Ancient and Semi-Natural Woodland
10	1028	SE	Unknown	Restored Ancient Woodland Site
11	1109	SE	Unknown	Ancient and Semi-Natural Woodland
12	1193	SE	Unknown	Restored Ancient Woodland Site
13	1202	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1230	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1231	S	Unknown	Restored Ancient Woodland Site
16	1235	E	Unknown	Ancient Replanted Woodland
17	1245	E	Unknown	Ancient and Semi-Natural Woodland
18	1250	SE	Unknown	Ancient and Semi-Natural Woodland
19	1271	E	Unknown	Restored Ancient Woodland Site
Not shown	1300	S	Unknown	Ancient and Semi-Natural Woodland
21	1308	E	Unknown	Ancient and Semi-Natural Woodland
22	1318	SE	Unknown	Ancient and Semi-Natural Woodland
23	1331	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1335	SE	Unknown	Ancient and Semi-Natural Woodland
25A	1347	SW	Unknown	Ancient and Semi-Natural Woodland
Not shown	1352	S	Unknown	Restored Ancient Woodland Site
Not shown	1364	SE	Unknown	Restored Ancient Woodland Site
Not shown	1375	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1383	S	Unknown	Ancient and Semi-Natural Woodland
30	1388	E	Unknown	Ancient and Semi-Natural Woodland

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
Not shown	1390	SE	Unknown	Restored Ancient Woodland Site
32	1390	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1397	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1418	SE	Unknown	Restored Ancient Woodland Site
Not shown	1437	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1438	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1441	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1459	S	Unknown	Ancient and Semi-Natural Woodland
39	1461	SE	Unknown	Ancient and Semi-Natural Woodland
40	1462	NE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1463	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1476	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1487	SE	Unknown	Restored Ancient Woodland Site
Not shown	1505	N	Unknown	Ancient and Semi-Natural Woodland
Not shown	1521	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1534	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1544	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1561	NE	Unknown	Restored Ancient Woodland Site
Not shown	1583	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1590	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1602	SW	Unknown	Ancient and Semi-Natural Woodland
Not shown	1640	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1666	S	Unknown	Ancient and Semi-Natural Woodland
54	1675	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1681	S	Unknown	Restored Ancient Woodland Site
Not shown	1696	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1713	SE	Unknown	Ancient and Semi-Natural Woodland

ID	Distance (m)	Direction	Ancient Woodland Name	Data Source
Not shown	1765	S	Unknown	Restored Ancient Woodland Site
Not shown	1786	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1792	SE	Unknown	Ancient and Semi-Natural Woodland
Not shown	1902	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1917	E	Unknown	Ancient and Semi-Natural Woodland
Not shown	1930	SE	Unknown	Ancient Replanted Woodland
Not shown	1934	S	Unknown	Ancient and Semi-Natural Woodland
Not shown	1959	W	Unknown	Ancient and Semi-Natural Woodland
Not shown	1966	W	Unknown	Ancient and Semi-Natural Woodland
Not shown	1967	S	Unknown	Ancient and Semi-Natural Woodland

8.7 Records of Local Nature Reserves (LNR) within 2000m of the study site:

1

The following Local Nature Reserve (LNR) records provided by Natural England/Natural Resources Wales are represented as polygons on the Designated Environmentally Sensitive Sites Map:

ID	Distance (m)	Direction	LNR Name	Data Source
3	1067	SW	ALYN WATERS	Natural Resources Wales

8.8 Records of World Heritage Sites within 2000m of the study site:

0

Database searched and no data found.

8.9 Records of Environmentally Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.10 Records of Areas of Outstanding Natural Beauty (AONB) within 2000m of the study site:

0

Database searched and no data found.

8.11 Records of National Parks (NP) within 2000m of the study site:

0

Database searched and no data found.

8.12 Records of Nitrate Sensitive Areas within 2000m of the study site:

0

Database searched and no data found.

8.13 Records of Nitrate Vulnerable Zones within 2000m of the study site:

0

Database searched and no data found.

8.14 Records of Green Belt land within 2000m of the study site:

0

Database searched and no data found.

9. Natural Hazards Findings

9.1 Detailed BGS GeoSure Data

BGS GeoSure Data has been searched to 50m. The data is included in tabular format. If you require further information on geology and ground stability, please obtain a Groundsure Geo Insight, available from our website. The following information has been found:

9.1.1 Shrink Swell

What is the maximum Shrink-Swell*[*] hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Ground conditions predominantly low plasticity. No special actions required to avoid problems due to shrink-swell clays. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with shrink-swell clays.

9.1.2 Landslides

What is the maximum Landslide* hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Slope instability problems are unlikely to be present. No special actions required to avoid problems due to landslides. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with landslides.

9.1.3 Soluble Rocks

What is the maximum Soluble Rocks* hazard rating identified on the study site? Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Soluble rocks are present, but unlikely to cause problems except under exceptional conditions. No special actions required to avoid problems due to soluble rocks. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with soluble rocks.

* This indicates an automatically generated 50m buffer and site.

9.1.4 Compressible Ground

What is the maximum Compressible Ground* hazard rating identified on the study site? Negligible

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
No indicators for compressible deposits identified. No special actions required to avoid problems due to compressible deposits. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with compressible deposits.

9.1.5 Collapsible Rocks

What is the maximum Collapsible Rocks* hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Deposits with potential to collapse when loaded and saturated are unlikely to be present. No special ground investigation required or increased construction costs or increased financial risk due to potential problems with collapsible deposits.

9.1.6 Running Sand

What is the maximum Running Sand*[*] hazard rating identified on the study site? Very Low

The following natural subsidence information provided by the British Geological Survey is not represented on mapping:

Hazard
Very low potential for running sand problems if water table rises or if sandy strata are exposed to water. No special actions required, to avoid problems due to running sand. No special ground investigation required, and increased construction costs or increased financial risks are unlikely due to potential problems with running sand.

9.2 Radon

9.2.1 Radon Affected Areas

Is the property in a Radon Affected Area as defined by the Health Protection Agency (HPA) and if so what percentage of homes are above the Action Level? The property is not in a Radon Affected Area, as less than 1% of properties are above the Action Level.

* This indicates an automatically generated 50m buffer and site.

9.2.2 Radon Protection

Is the property in an area where Radon Protection are required for new properties or extensions to existing
ones as described in publication BR211 by the Building Research Establishment? No radon protective measures are necessary.

10. Mining

10.1 Coal Mining

Are there any coal mining areas within 75m of the study site? Yes

The following coal mining information provided by the Coal Authority is not represented on Mapping:

Distance (m)	Direction	Details
0	On Site	The study site is located within the specified search distance of an identified mining area. Further details concerning this can be obtained from the Coal Authority Helpline on 0845 762 6848.

10.2 Non-Coal Mining

Are there any Non-Coal Mining areas within 50m of the study site boundary? No

Database searched and no data found.

10.3 Brine Affected Areas

Are there any brine affected areas within 75m of the study site? No
Guidance: No Guidance Required.

Contact Details

Groundsure Helpline
Telephone: 08444 159 000
info@groundsure.com

British Geological Survey Enquiries
Kingsley Dunham Centre
Keyworth, Nottingham NG12 5GG
Tel: 0115 936 3143.
Fax: 0115 936 3276.
Email:
Web:**www.bgs.ac.uk**
BGS Geological Hazards Reports and general geological enquiries:
enquiries@bgs.ac.uk

Natural Resources Wales
Ty Cambria
29 Newport Road
Cardiff
CF24 0TP
Tel: 0300 065 3000
Email: enquiries@naturalresourceswales.gov.uk

Public Health England
Public information access office
Public Health England, Wellington House
133-155 Waterloo Road, London, SE1 8UG
www.gov.uk/phe
Email:**enquiries@phe.gov.uk**
Main switchboard**: 020 7654 8000**

The Coal Authority
200 Lichfield Lane
Mansfield
Notts NG18 4RG
Tel: 0345 7626 848
DX 716176 Mansfield 5
www.coal.gov.uk

Ordnance Survey
Adanac Drive, Southampton
SO16 0AS
Tel: 08456 050505

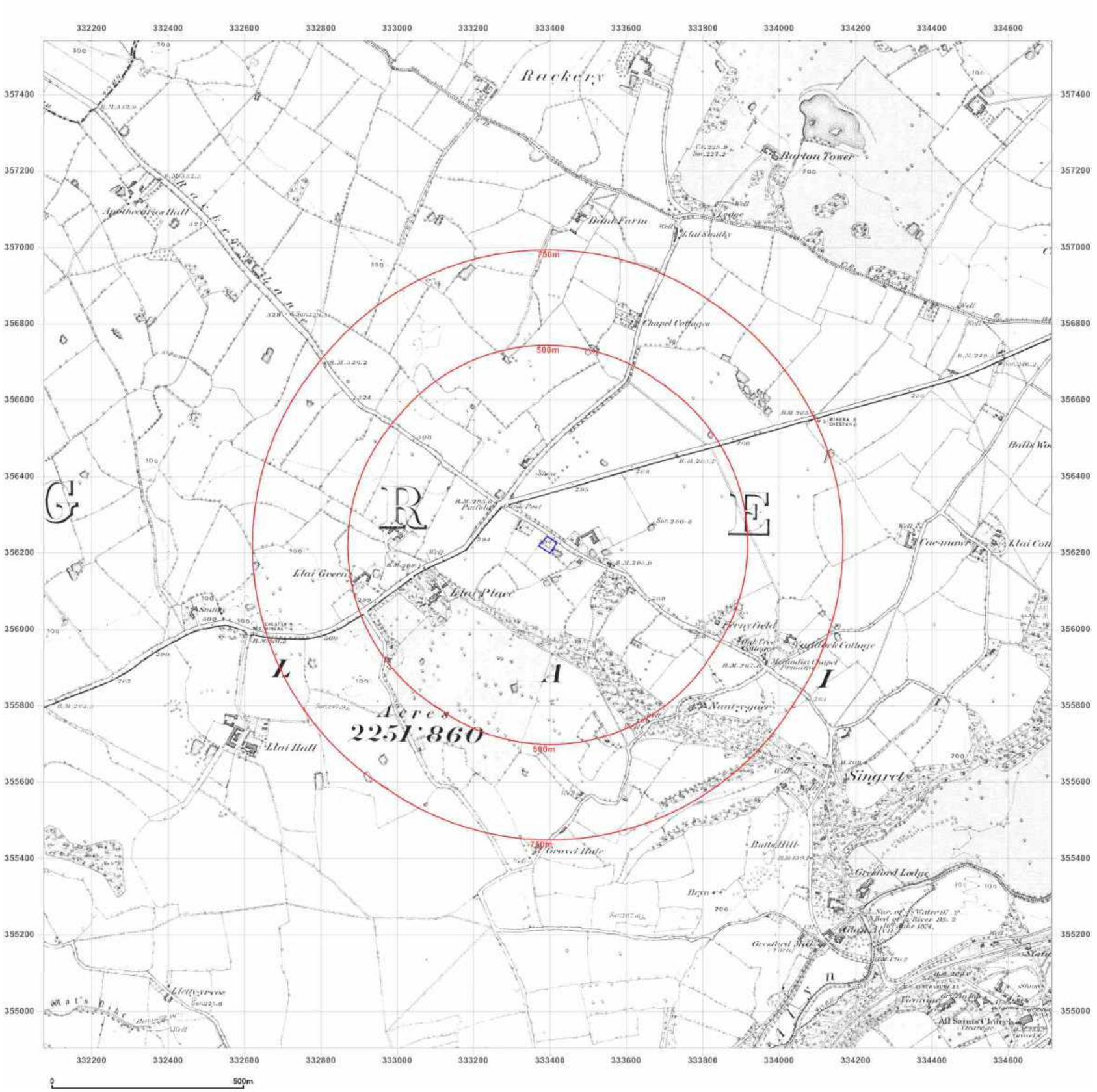
Local Authority
Authority: Wrecsam - Wrexham County Borough Council
Phone: 01978 292 000
Web: http://www.wrexham.gov.uk/
Address: The Guildhall, Wrexham, Wrexham, LL11 1AY

Gemapping PLC
Virginia Villas, High Street, Hartley Witney,
Hampshire RG27 8NW
Tel: 01252 845444

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Site Details:

22, GRESFORD ROAD,
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series

Map date: **1872**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1872
Revised 1872
Edition N/A
Copyright N/A
Levelled N/A

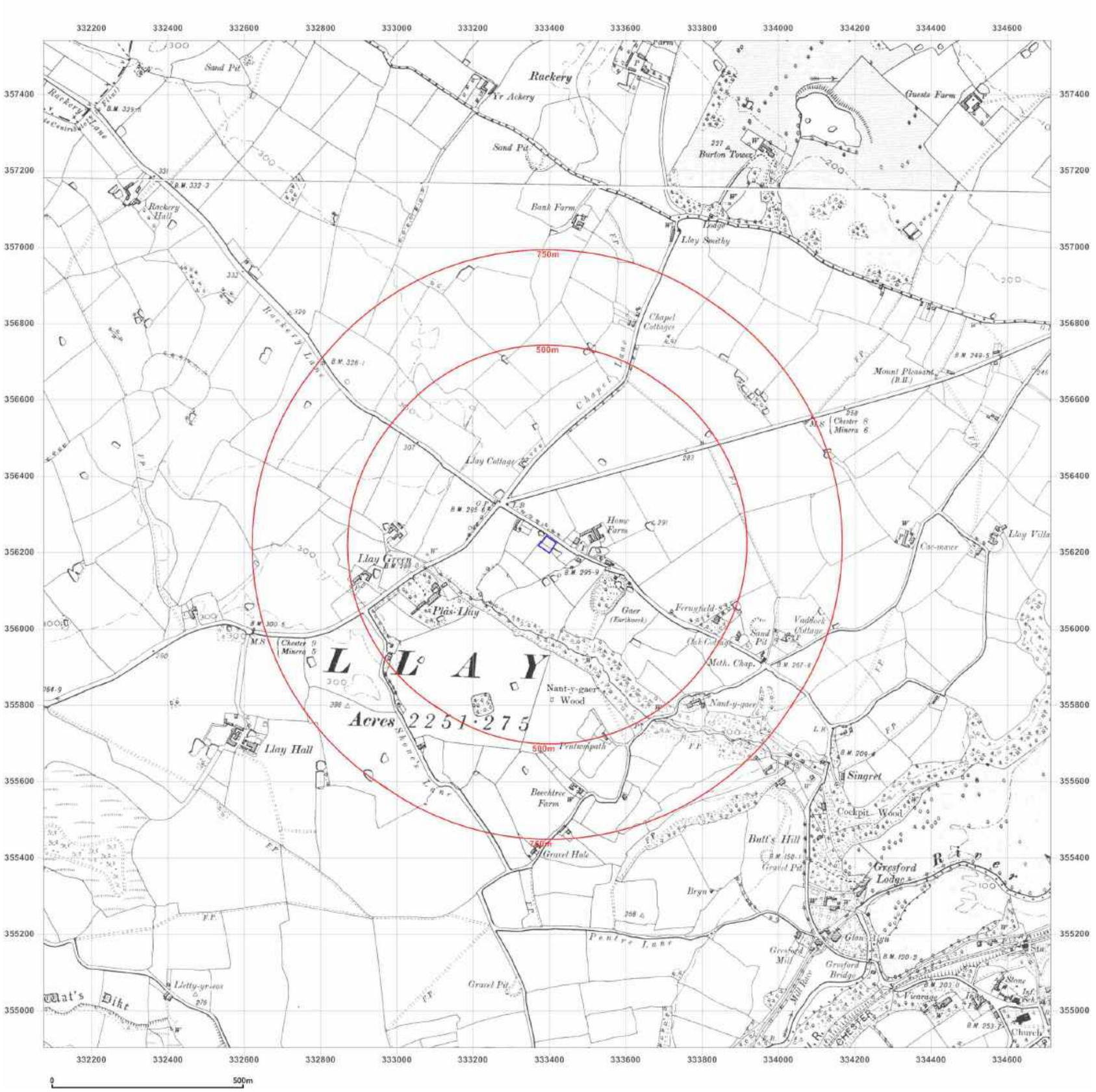
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series

Map date: **1900**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1872
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1871
Revised 1900
Edition N/A
Copyright N/A
Levelled N/A

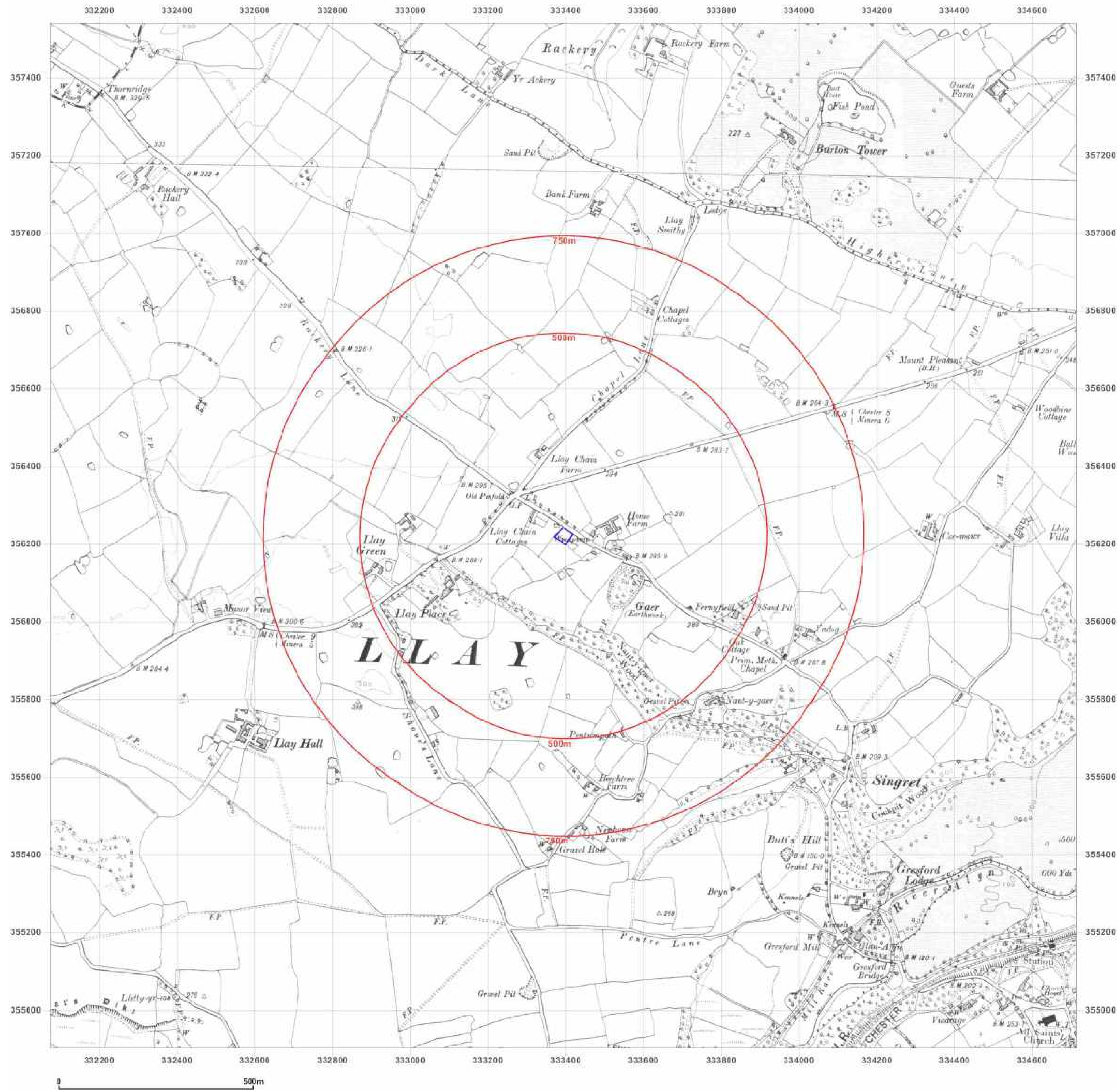
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series

Map date: **1909**

Scale: 1:10,560

Printed at: 1:10,560

N
W E
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Surveyed 1871
Revised 1909
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1871
Revised 1909
Edition N/A
Copyright N/A
Levelled N/A

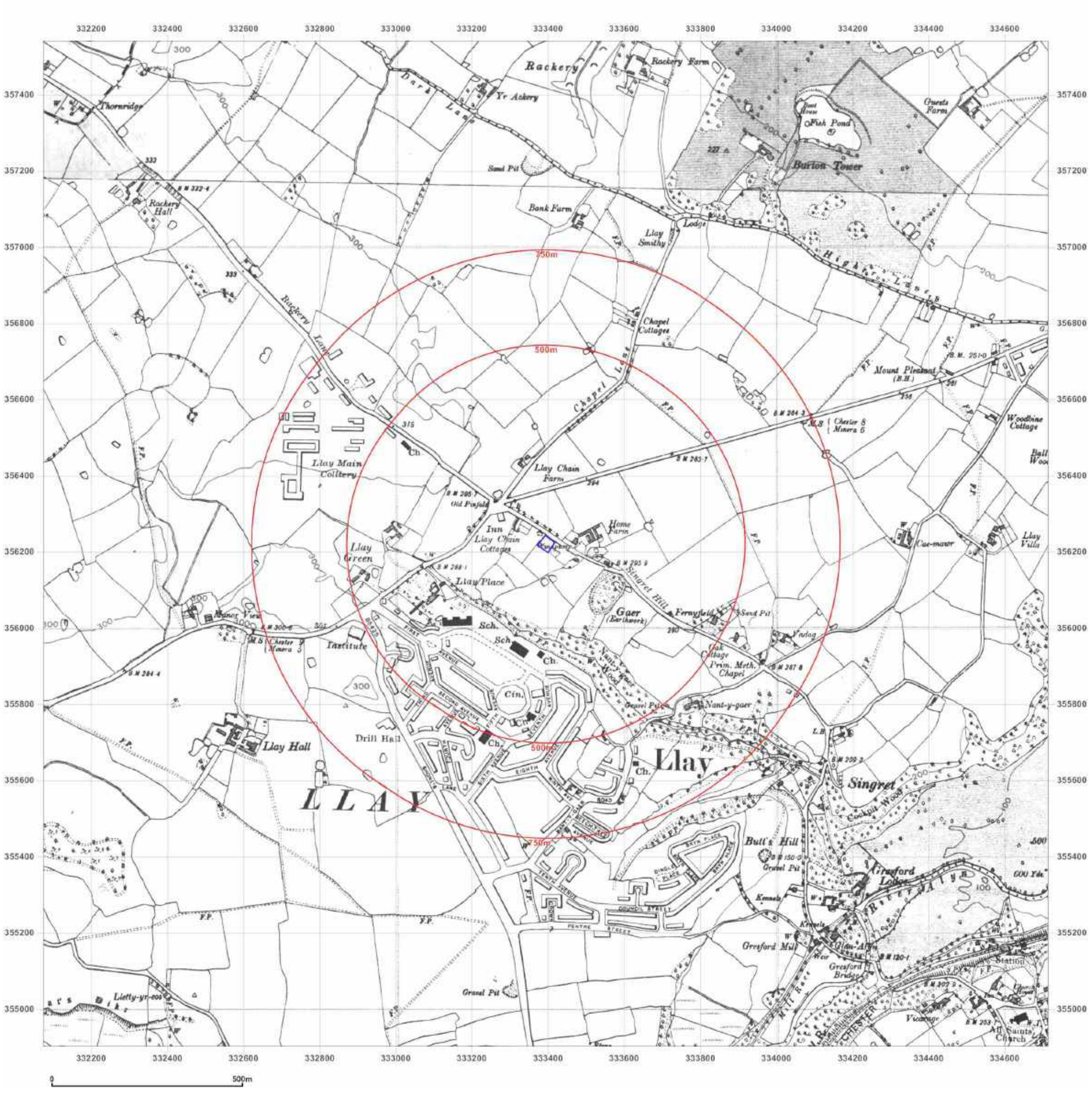
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series

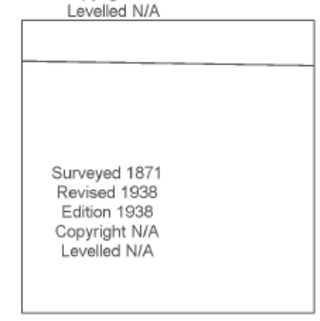
Map date: **1938**

Scale: 1:10,560

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N
W E
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Surveyed 1871
Revised 1938
Edition 1938
Copyright N/A
Levelled N/A



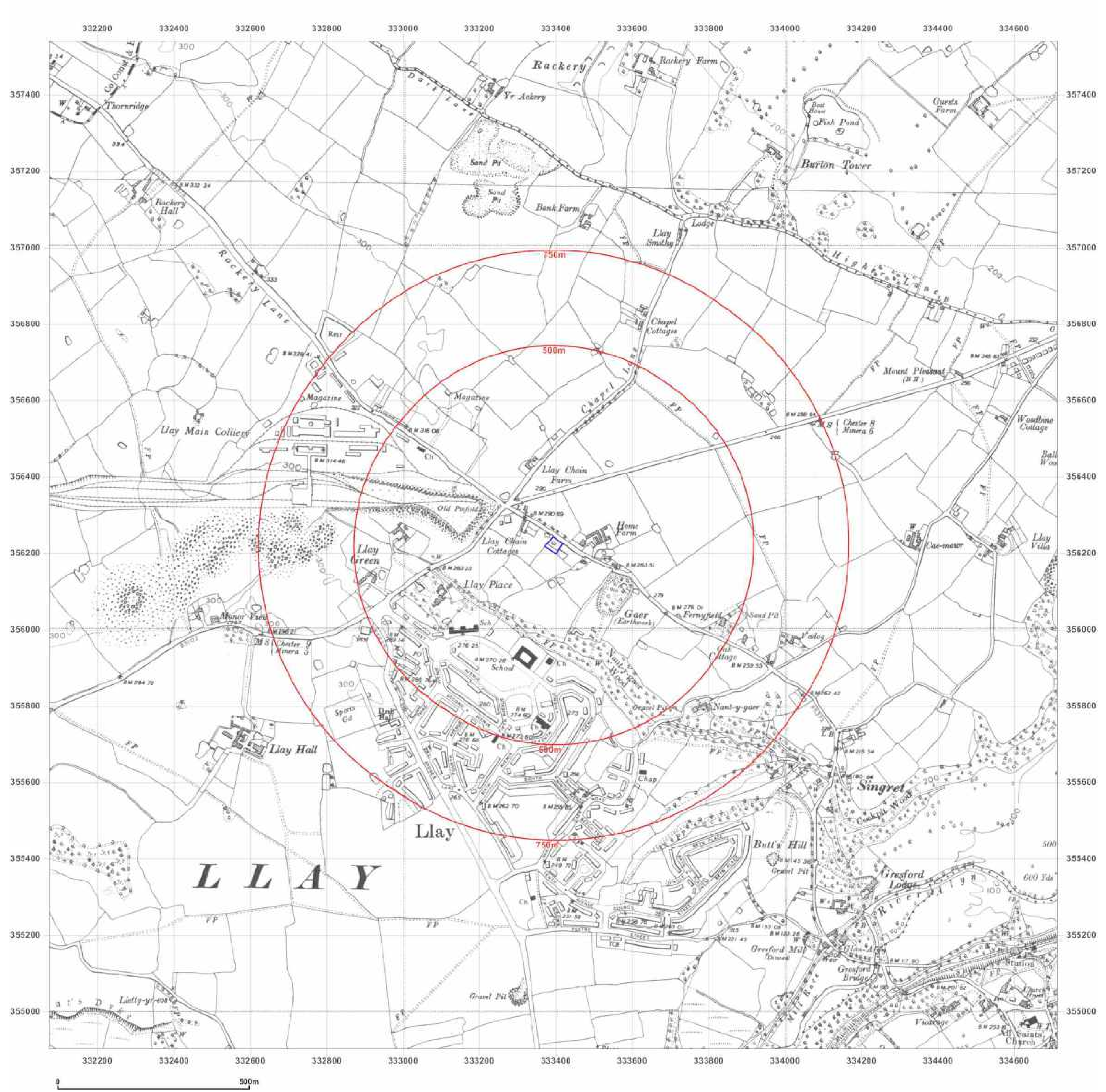
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Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series

Map date: 1949

Scale: 1:10,560

Printed at: 1:10,560

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Surveyed 1871
Revised 1949
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1871
Revised 1949
Edition N/A
Copyright N/A
Levelled N/A

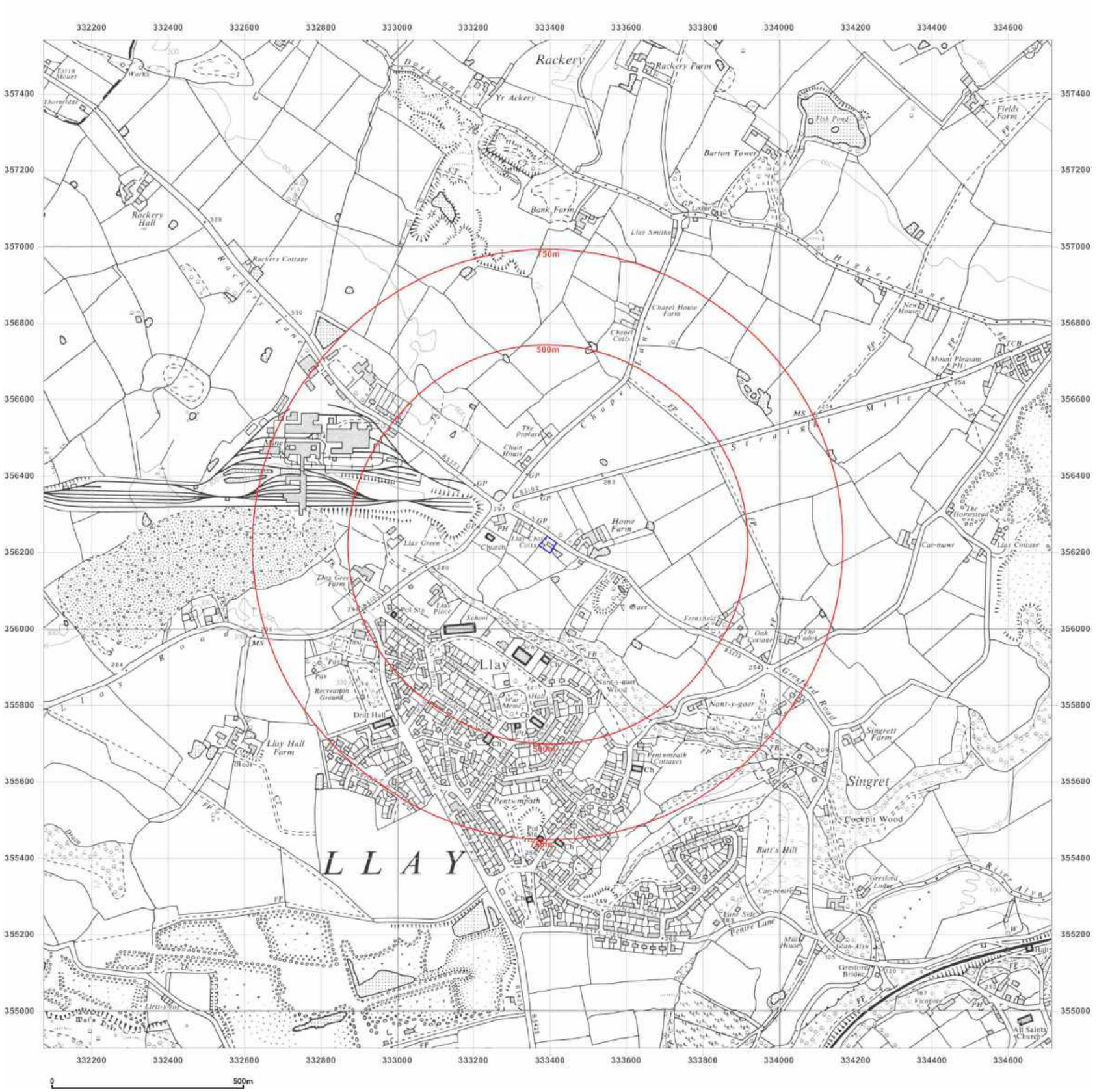
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: Provisional

Map date: **1960-1964**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1871
Revised 1960
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1964
Revised 1964
Edition N/A
Copyright N/A
Levelled N/A

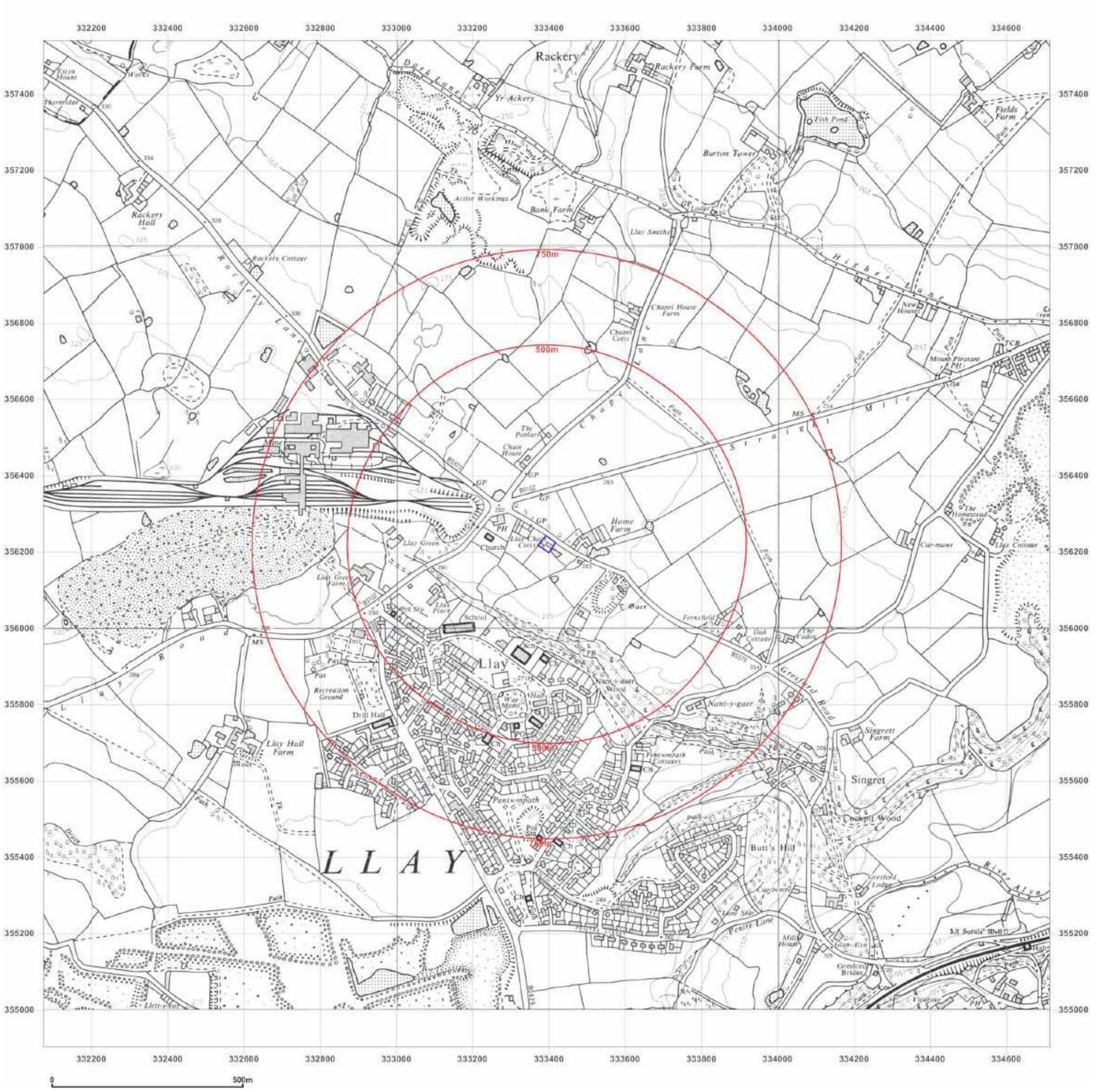
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: Provisional

Map date: **1968**

Scale: 1:10,560

Printed at: 1:10,560

N
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Surveyed 1968
Revised 1968
Edition N/A
Copyright N/A
Levelled N/A

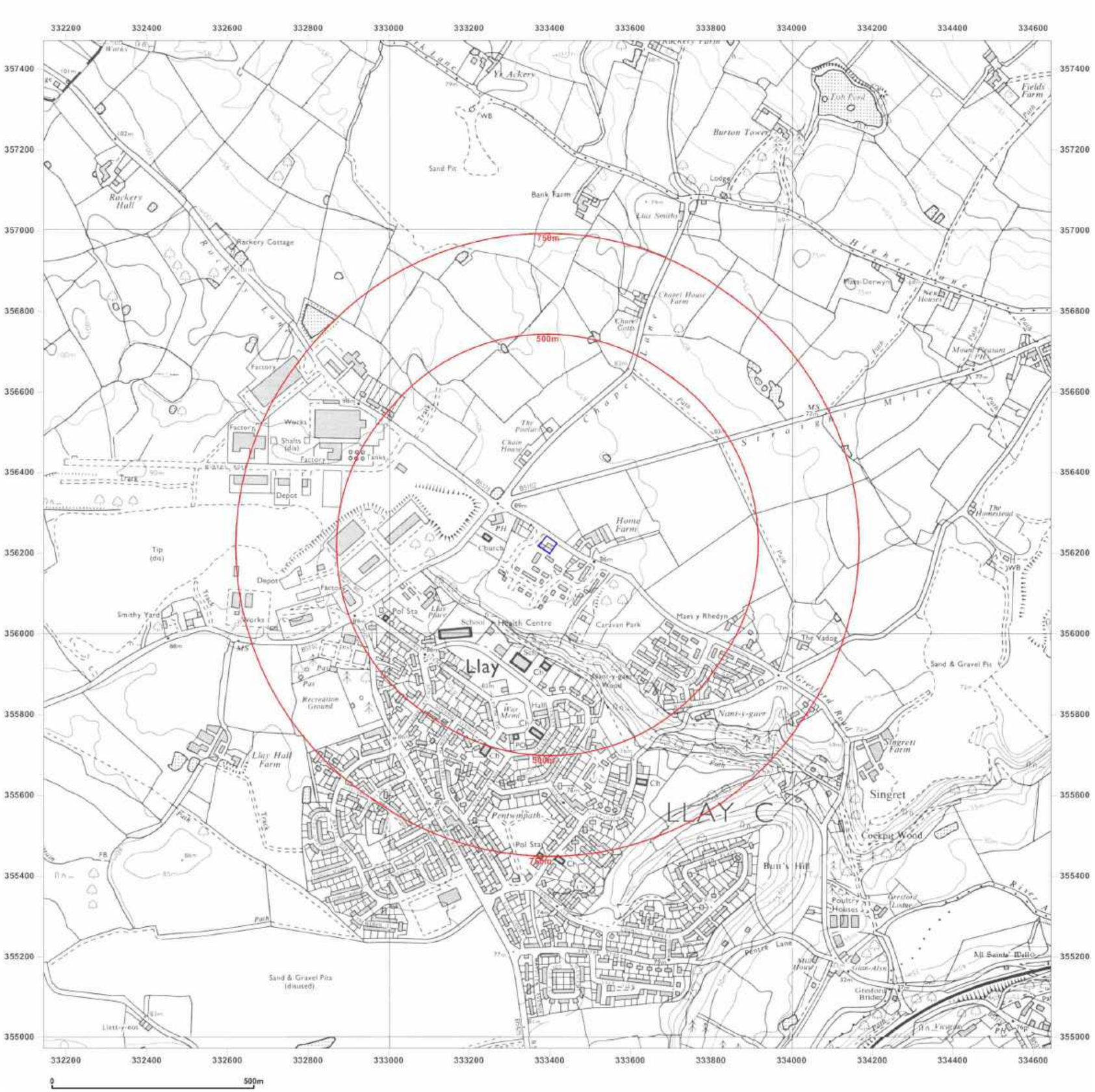
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Grid Ref: 333393, 356221

Map Name: National Grid

Map date: **1980-1981**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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Surveyed 1974
Revised 1981
Edition N/A
Copyright 1981
Levelled 1976

Surveyed 1980
Revised 1980
Edition N/A
Copyright N/A
Levelled N/A

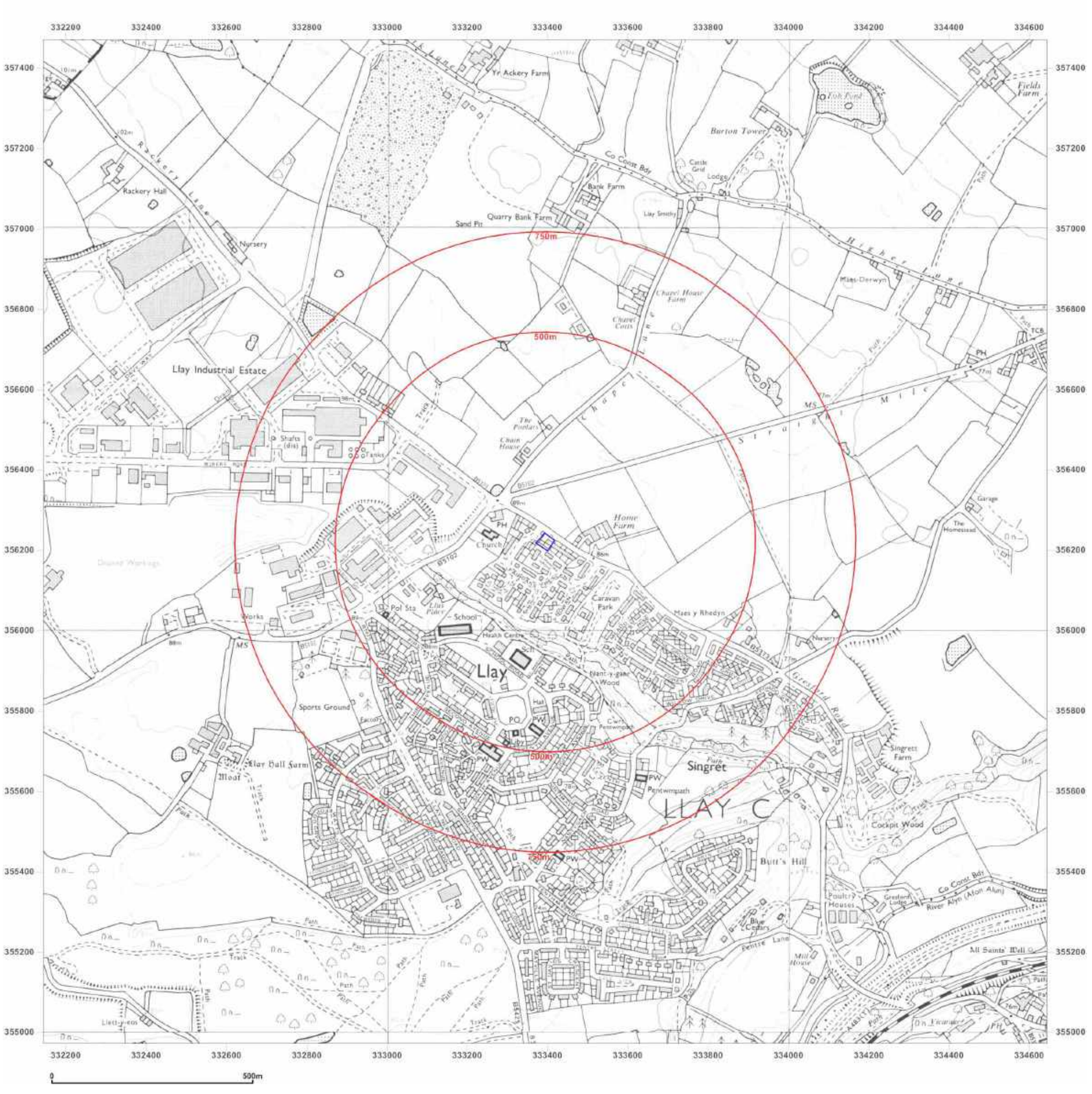
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Grid Ref: 333393, 356221

Map Name: National Grid

Map date: **1989-1992**

Scale: 1:10,000

Printed at: 1:10,000

N
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Surveyed 1990
Revised 1992
Edition N/A
Copyright N/A
Levelled N/A

Surveyed 1985
Revised 1989
Edition N/A
Copyright N/A
Levelled N/A

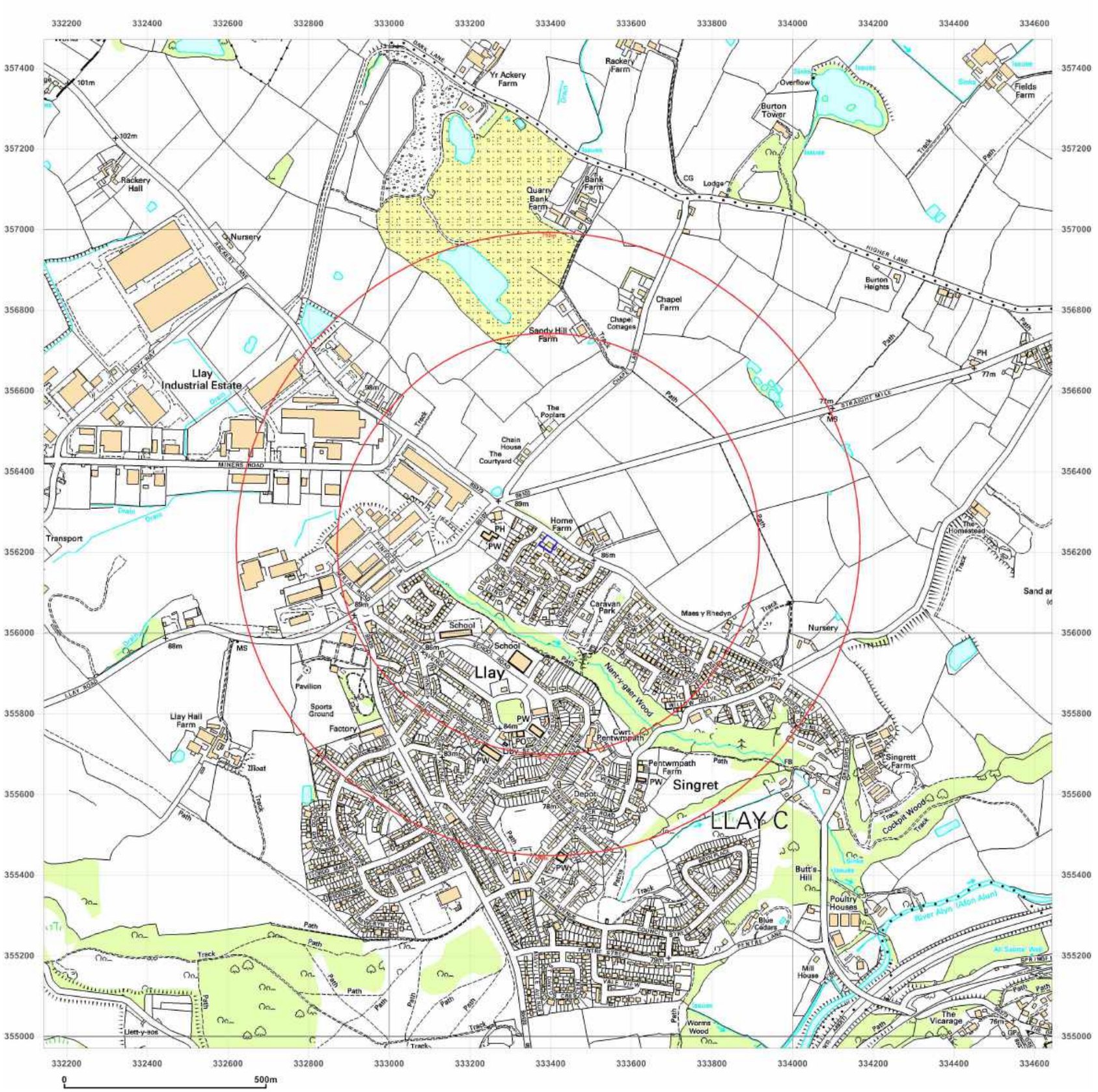
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: 1:10,000 Raster

Map date: **2002**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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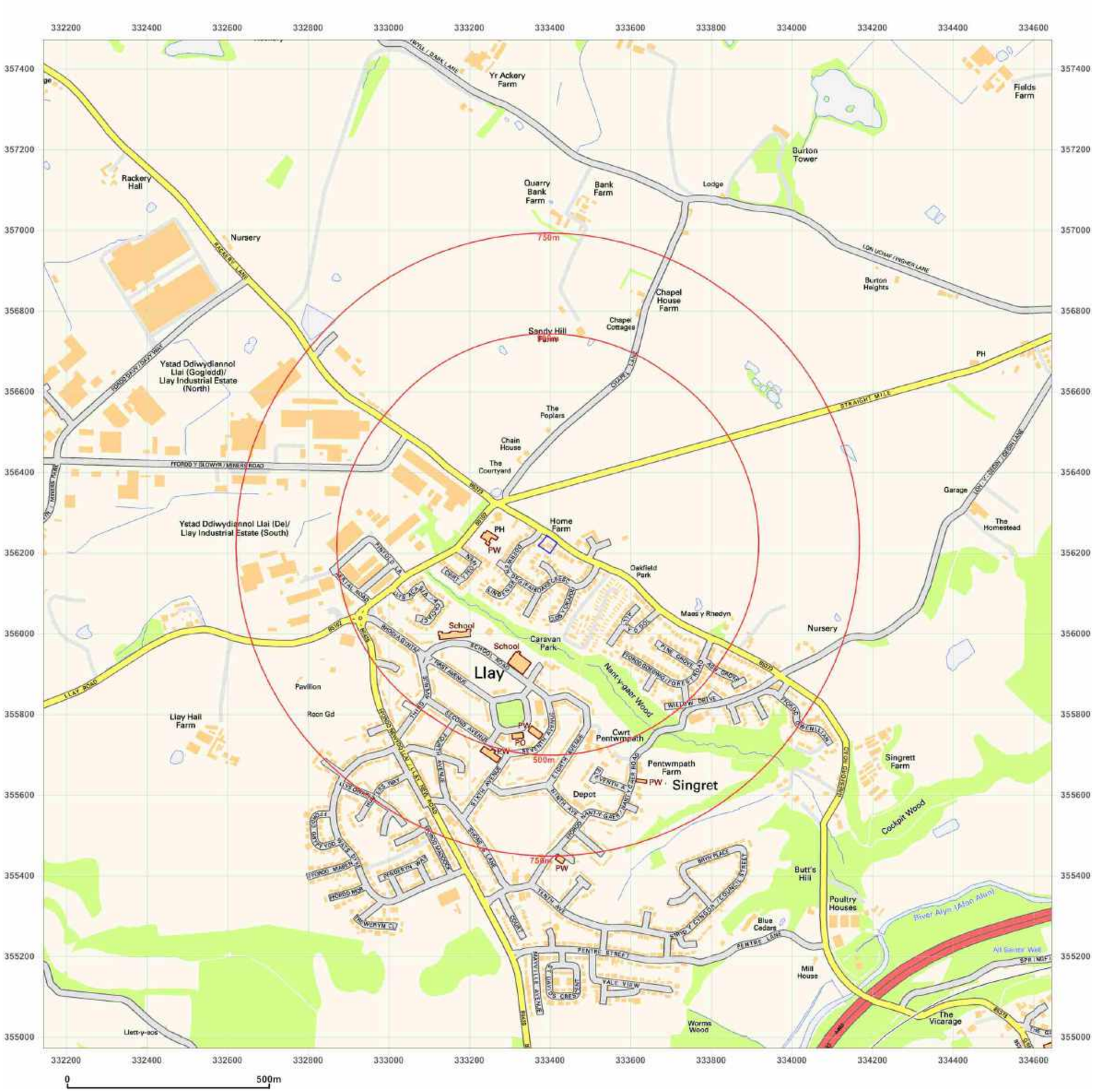
2002

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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid

Map date: **2010**

Scale: 1:10,000

Printed at: 1:10,000

N
W E
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2010

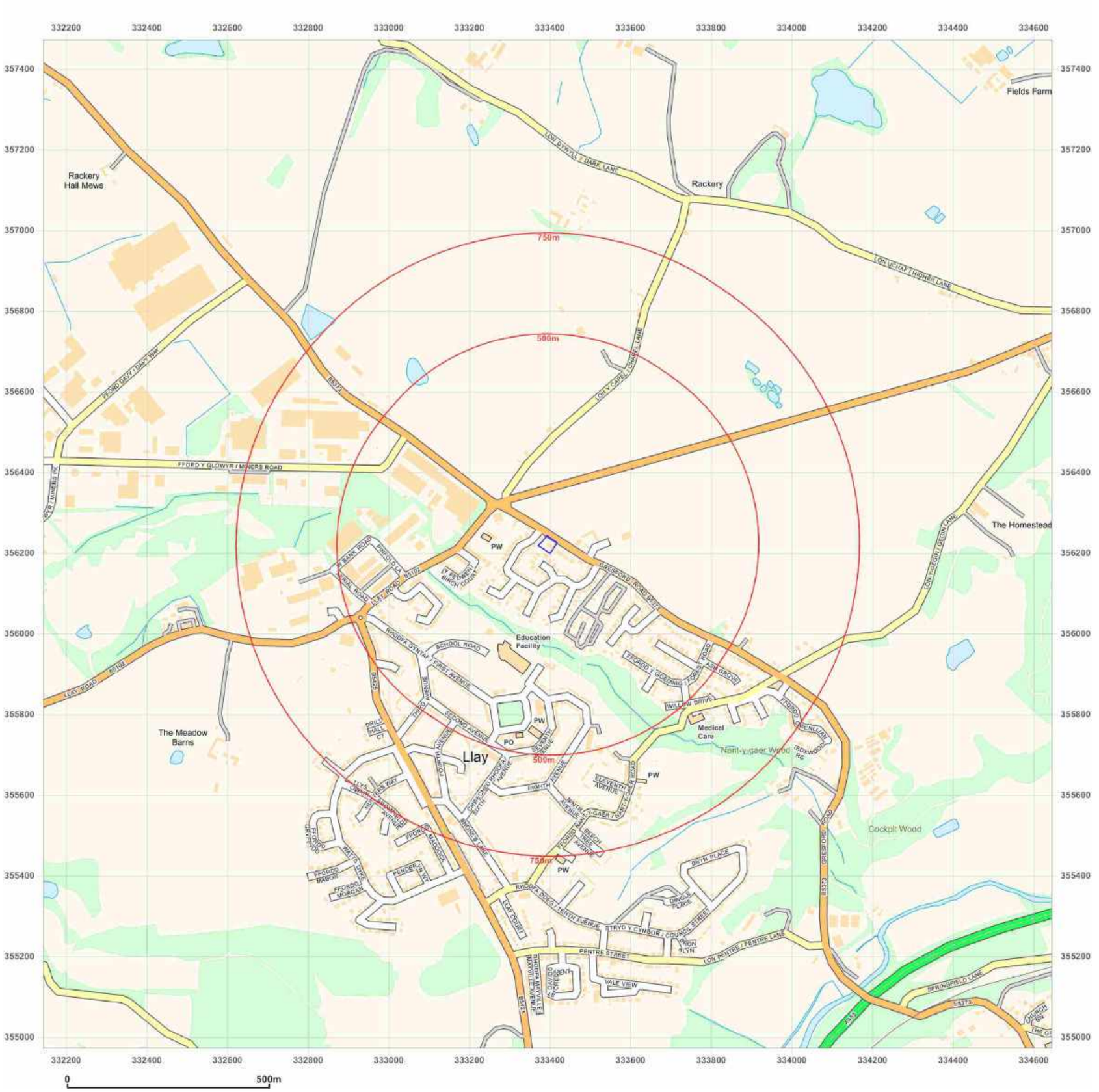
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid
Map date: **2014**
Scale: 1:10,000
Printed at: 1:10,000

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2014

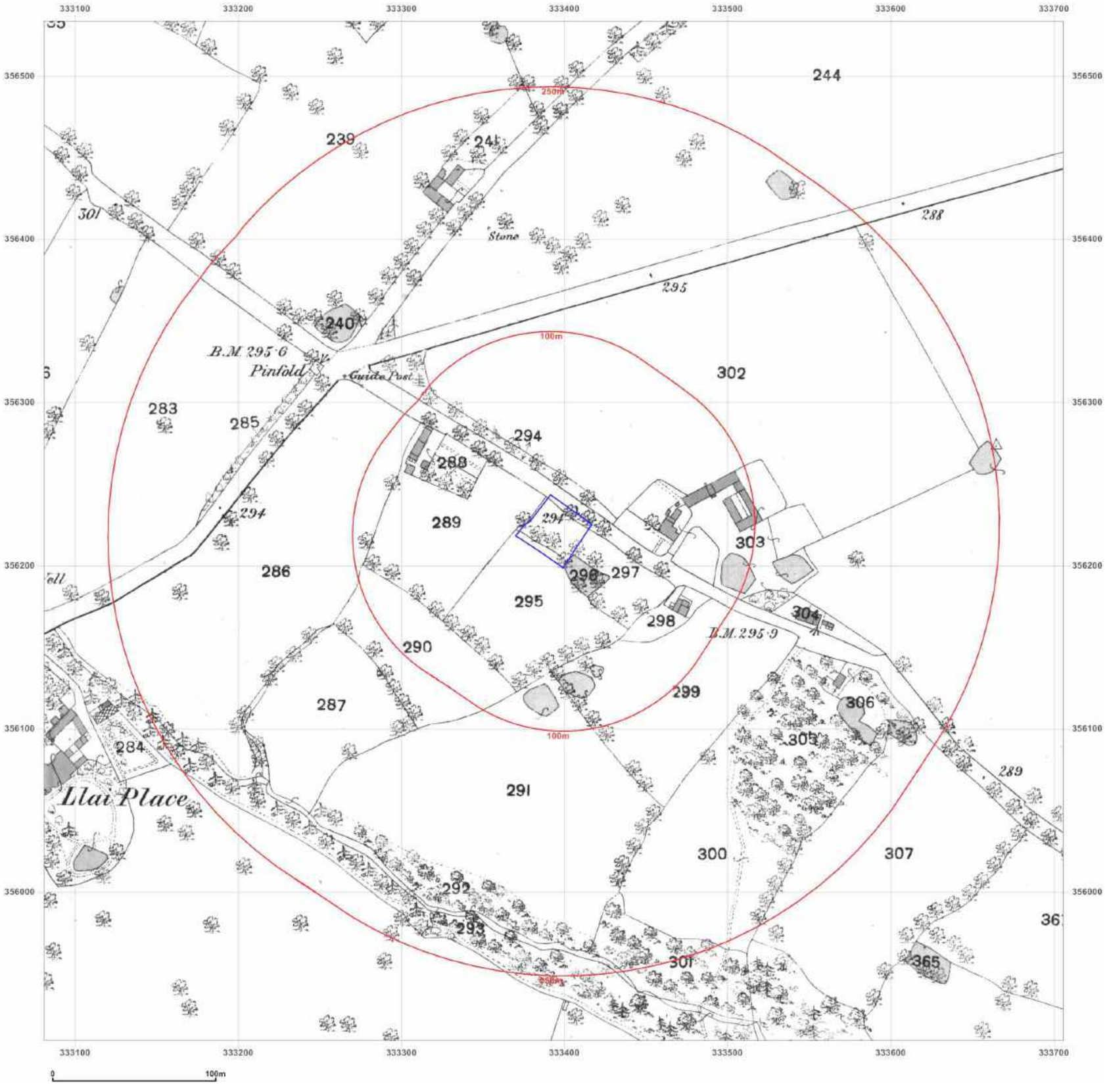
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series
Map date: **1875**
Scale: 1:2,500
Printed at: 1:2,500

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Surveyed 1875
Revised 1875
Edition N/A
Copyright N/A
Levelled N/A

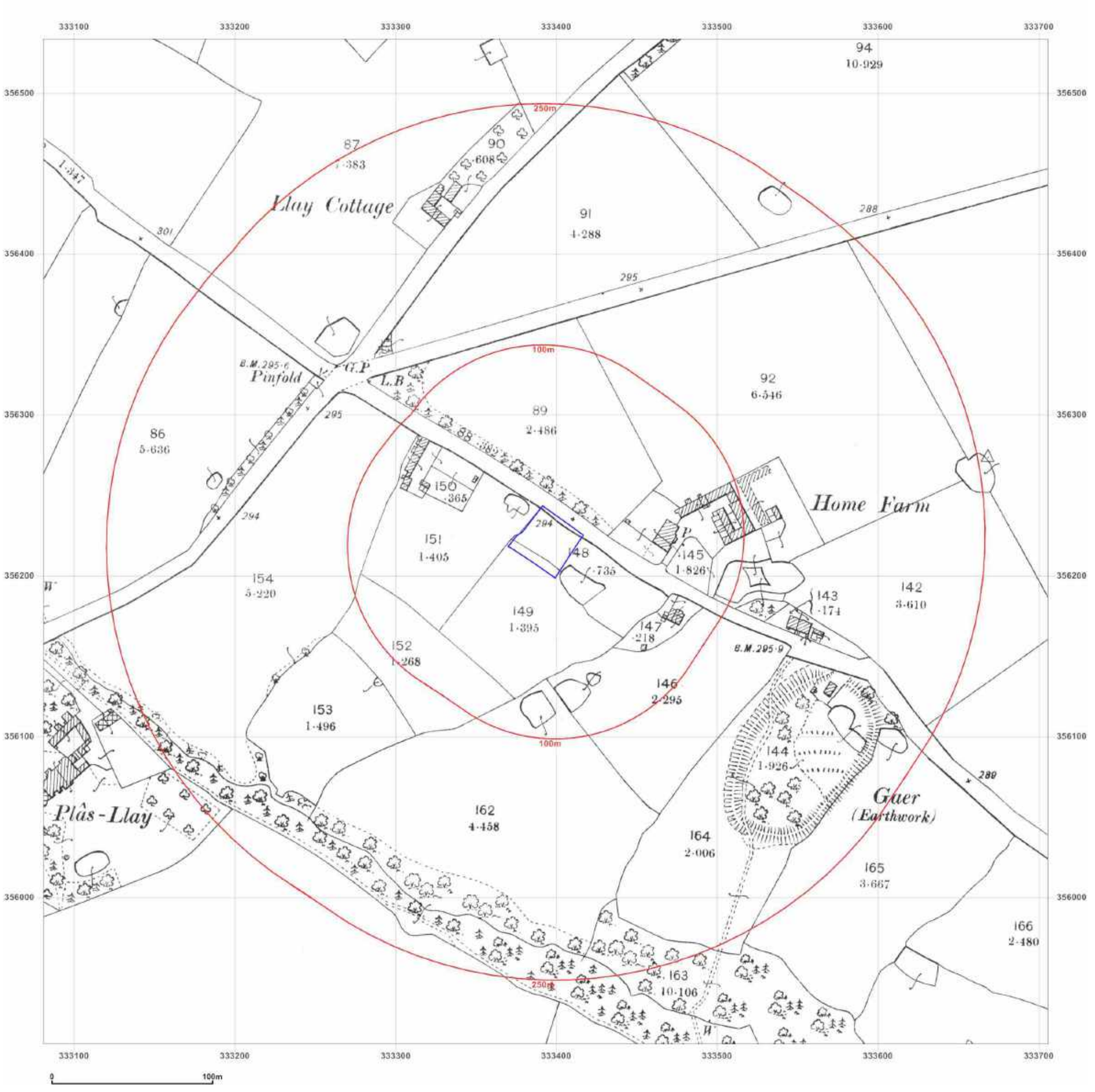
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series
Map date: **1899**
Scale: 1:2,500
Printed at: 1:2,500

N
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Surveyed 1899
Revised 1899
Edition N/A
Copyright N/A
Levelled N/A

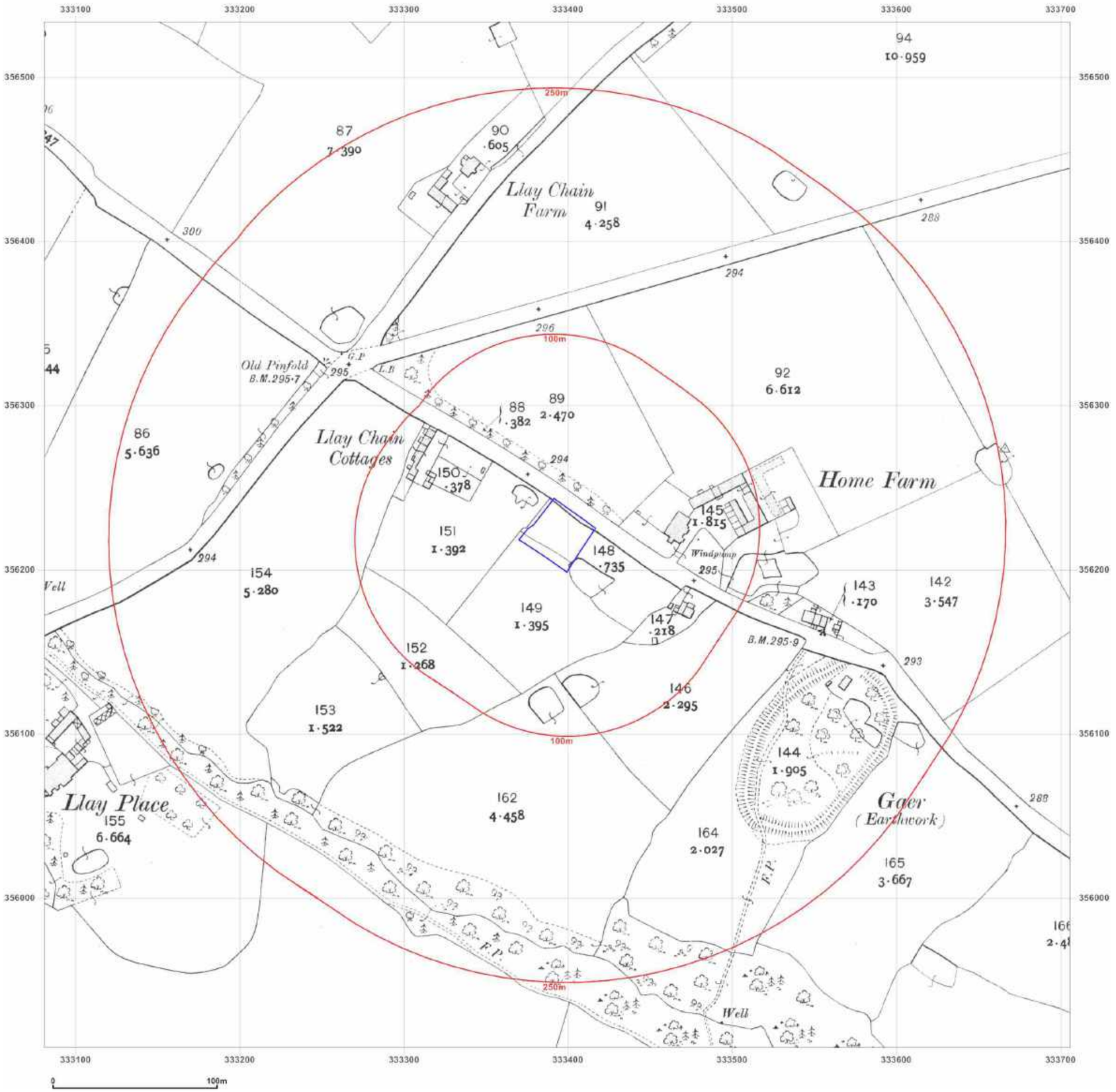
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: County Series

Map date: **1912**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1912
Revised 1912
Edition N/A
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Levelled N/A

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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid

Map date: **1959-1961**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed N/A
Revised N/A
Edition N/A
Copyright N/A
Levelled 1959

Surveyed 1961
Revised 1961
Edition N/A
Copyright 1962
Levelled 1959

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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid

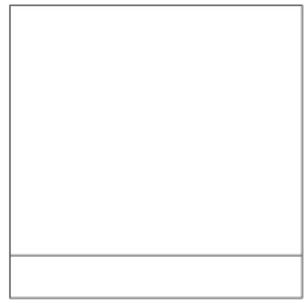
Map date: **1961**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1961
Revised 1961
Edition N/A
Copyright 1962
Levelled 1959



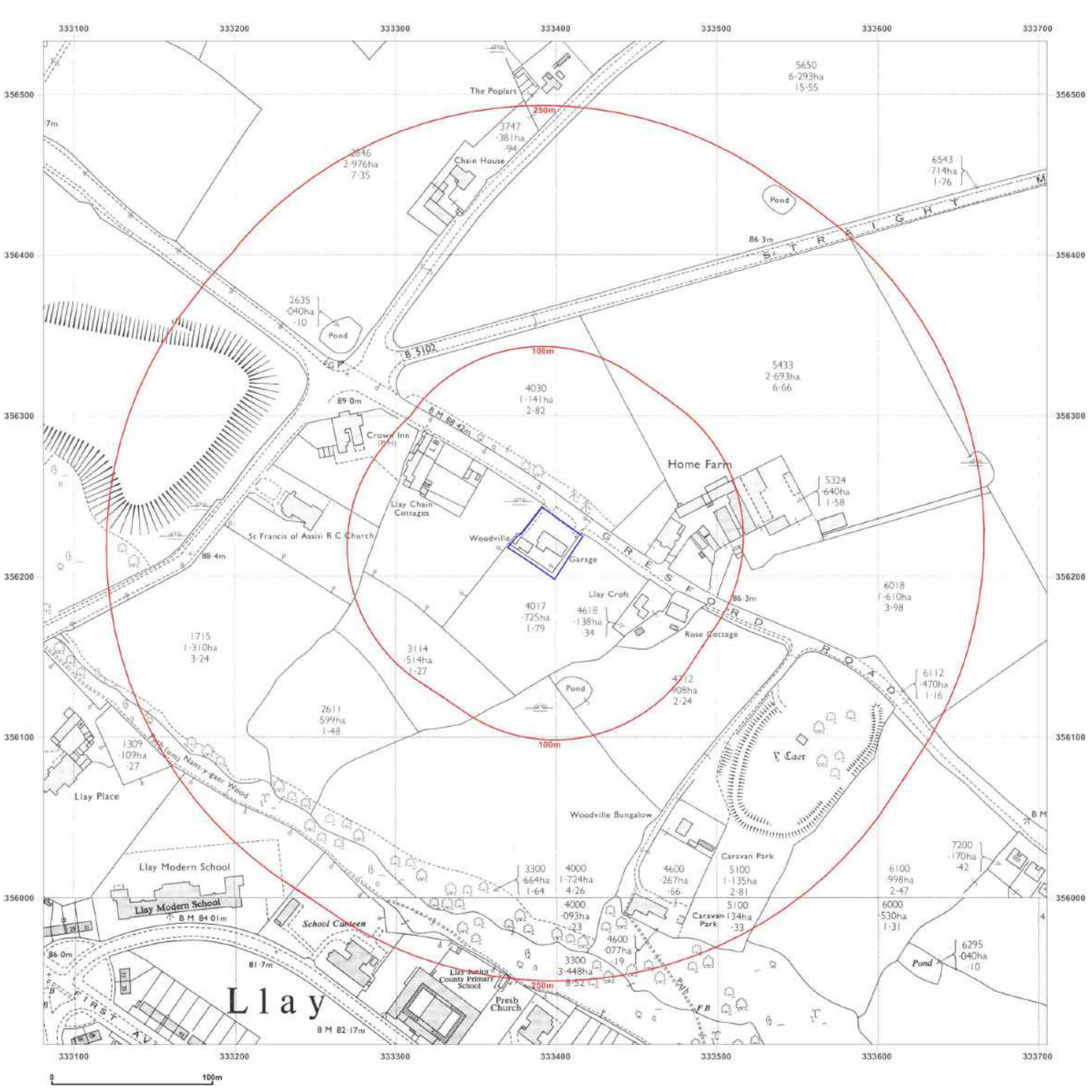
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Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid

Map date: **1969-1974**

Scale: 1:2,500

Printed at: 1:2,500

N
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Surveyed 1974
Revised 1974
Edition N/A
Copyright 1975
Levelled 1959

Surveyed 1969
Revised 1969
Edition N/A
Copyright 1970
Levelled 1959

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Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid

Map date: **1983-1984**

Scale: 1:2,500

Printed at: 1:2,500

N
W E
S

Surveyed 1959
Revised 1984
Edition N/A
Copyright 1984
Levelled 1959

Surveyed 1983
Revised 1983
Edition N/A
Copyright 1984
Levelled 1959

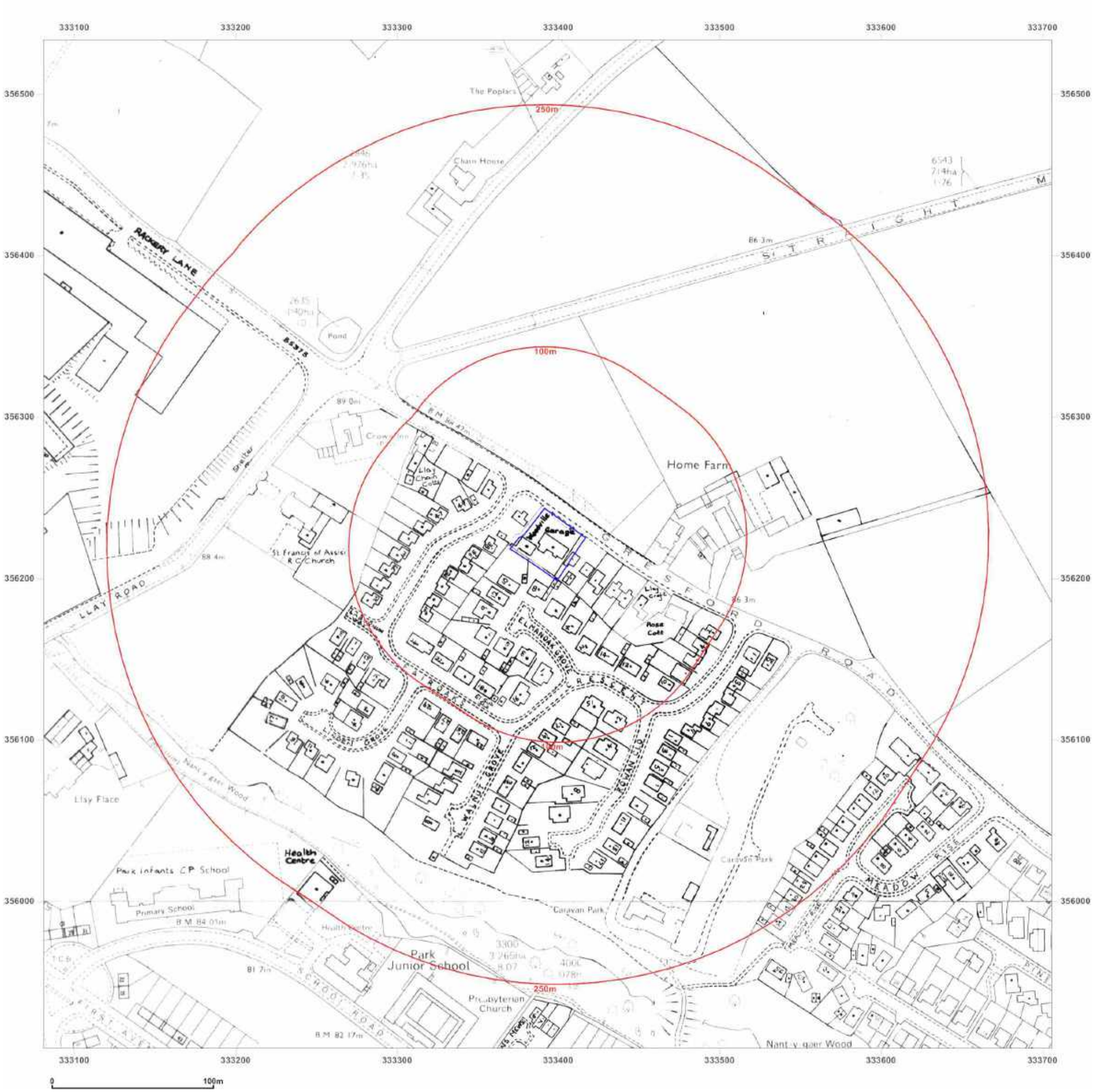
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Groundsure INSIGHTS

Site Details:

22, GRESFORD ROAD,
WREXHAM, LL12 0NW

Client Ref: TE1010_PE01394
Report Ref: GS-3880767
Grid Ref: 333393, 356221

Map Name: National Grid
Map date: **1990**
Scale: 1:2,500
Printed at: 1:2,500

N
W E
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Surveyed N/A
Revised N/A
Edition N/A
Copyright 1990
Levelled N/A

Surveyed N/A
Revised N/A
Edition N/A
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The Coal Authority

Resolving the impacts of mining

CON29M Non-Residential Mining Report







22 GRESFORD ROAD
LLAY
WREXHAM
LL12 0NW

Date of enquiry:	15 May 2017
Date enquiry received:	15 May 2017
Issue date:	15 May 2017
Our reference:	51001467266001
Your reference:	PE01395-TE1010

CON29M Non-Residential Mining Report

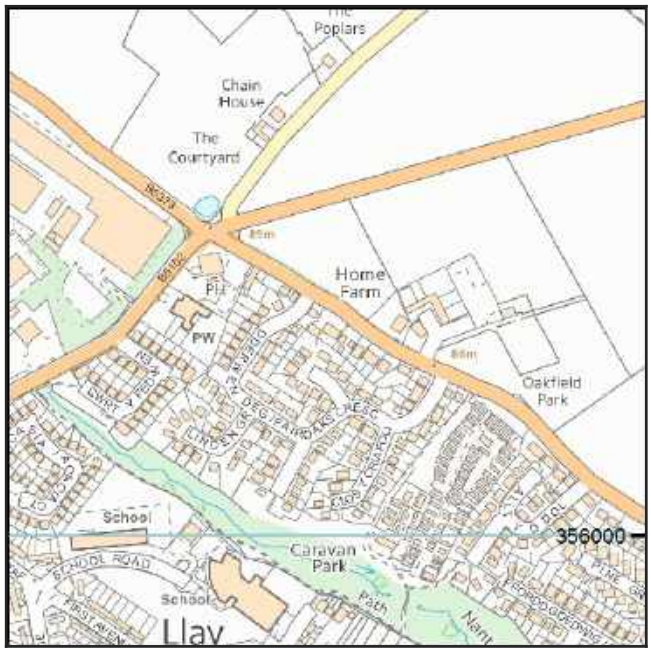
This report is based on, and limited to, the records held by the Coal Authority and the Cheshire Brine Subsidence Compensation Board's records, at the time we answer the search.

Client name

Tier Environmental

Enquiry address

22 GRESFORD ROAD, LLAY, WREXHAM, LL12 0NW



Approximate position of property

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How to contact us

0345 762 6848 (UK)
+44 (0)1623 637 000 (International)

200 Lichfield Lane
Mansfield
Nottinghamshire
NG18 4RG

www.groundstability.com

/company/the-coal-authority
/thecoalauthority
/coalauthority

Summary

Has the search report highlighted evidence or potential of		
1	Past underground coal mining	Yes
2	Present underground coal mining	No
3	Future underground coal mining	Yes
4	Mine entries	No
5	Coal mining geology	No
6	Past opencast coal mining	No
7	Present opencast coal mining	No
8	Future opencast coal mining	No
9	Coal mining subsidence	No
10	Mine gas	No
11	Hazards related to coal mining	No
12	Withdrawal of support	Yes
13	Working facilities order	No
14	Payments to owners of former copyhold land	No
15	Information from the Cheshire Brine Subsidence Compensation Board	No

For detailed findings, please go to page 4.

Detailed findings

1. Past underground coal mining

The property is in a surface area that could be affected by underground mining in 5 seams of coal at 660m to 940m depth, and last worked in 1966.

Any movement in the ground due to coal mining activity should have stopped.

2. Present underground coal mining

The property is not within a surface area that could be affected by present underground mining.

3. Future underground coal mining

The property is not in an area where the Coal Authority has plans to grant a licence to remove coal using underground methods.

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

The property is not in an area likely to be affected from any planned future underground coal mining.

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

No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

4. Mine entries

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

5. Coal mining geology

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

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

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

8. Future opencast coal mining
There are no licence requests outstanding to remove coal by opencast methods within 800 metres of the boundary.

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

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

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

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

10. Mine gas
The Coal Authority has no record of a mine gas emission requiring action.

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

12. Withdrawal of support
The property is in an area where a notice to withdraw support was given in 1959.

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

13. Working facilities order
The property is not in an area where an order has been made, under the provisions of the Mines (Working Facilities and Support) Acts 1923 and 1966 or any statutory modification or amendment thereof.

14. Payments to owners of former copyhold land

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

15. Information from the Cheshire Brine Subsidence Compensation Board

The property lies outside the Cheshire Brine Compensation District.

Additional remarks

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

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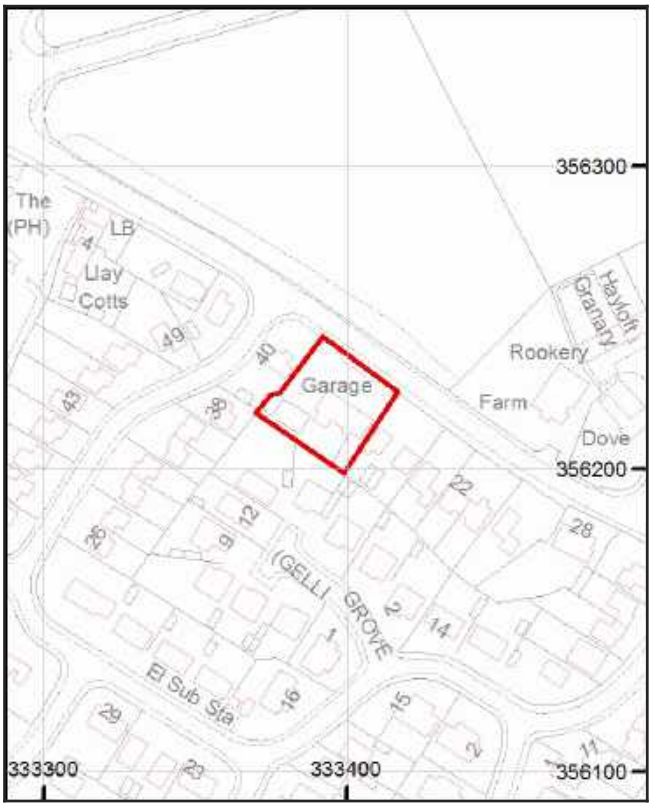
Alternative formats

If you would like this report in an alternative format, please contact our communications team.

Enquiry boundary

Key

Approximate position of enquiry boundary shown



Map data

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200 Lichfield Lane
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APPENDIX O – COMPLYING WITH CONTROL OF ASBESTOS REGULATION 2012

Complying with Control of Asbestos Regulations (CAR): Risk Assessments, Licensing and Training

This appendix outlines CAR risk assessments and where they should be applied in relation to assessing and remediating brownfield sites. The information below details the different classifications of work with asbestos under CAR, summarises the legal requirements for asbestos awareness training for all involved in the investigation and management of asbestos containing soil (ACS), and details the potential requirements for suitable proficiency training relating specifically to ACS.

CAR RISK ASSESSMENTS

A CAR Risk Assessment is required for any work which may expose employees to asbestos. It is recommended that a precautionary approach is adopted if there is any doubt about risks associated with asbestos.

There are three main activities for potential asbestos exposure during work on brownfield sites:

- Site reconnaissance visits;
- Site investigation works; and
- Site remediation.

CAR risk assessments are needed at each stage but may be incorporated during the site investigation stage into the overarching health and safety risk assessments.

The CAR risk assessment must:

- Identify the type of asbestos to which employees are liable to be exposed, where possible, or assume it is present in different forms;
- Determine the type and extent of exposures to asbestos that may occur during the work
- Identify the steps to be taken to prevent exposure or reduce it to the lowest level reasonably practicable; and,
- Consider the effects of control measures that have been or will be taken.

The CAR risk assessment should include any information used to inform the risk assessment such as asbestos reports or desk study information. In the event that this information is not available, the assessor should be assumed that all forms of asbestos may be present on Site.

For all investigation and remediation of ACSs, a detailed written work plan should he produced and followed as detailed on the HSE website and in the CAR.

The CAR risk assessments for specific investigations or remediation projects, will determine whether or not work is 'licensable work' (LW), notifiable non-licensable work' (NNLW) or 'non-licensed work' (NLW). In addition, training requirements are also defined by the CAR risk assessment.

Some examples of control measures that apply during site reconnaissance, site investigation works and site remediation are given below and should be applied depending on the asbestos risks identified for the Site at each stage of investigation:

- Avoiding stirring up dust;
- Cleaning footwear after site works;
- Removing and bagging any overalls for disposal/laundering;
- Respirators and hygiene facilities for high risk sites;
- Segregated welfare units;
- Wetting ground
- Minimising soil disturbances;
- Implementation or retention of capping/break layers;
- Implementation of awareness training;
- Air monitoring;
- Managing stockpiles;
- Area segregation;
- Wheel washing
- Road washing/cleaning

It is important to note that during Site reconnaissance visits, Site investigation works and Site remediation that asbestos should not be considered in isolation and control measures are likely to form part of a wider health and safety precautions.

Respiratory protective equipment (RPE)

RPE is the last line of defence and its requirement would be defined by the CAR risk assessment. HSE (2013b) advises that RPE should have an assigned protection factor of 20 or more for all work with asbestos. In certain instances, full face-piece, positive pressure respirators with a protection factor of 40 are necessary (to EN 12942:1998, TM3).

Suitable types of RPE for most *short* duration non-licensed asbestos work:

- Disposable respirator to standards EN149 (type FFP3) or EN1827 (type FMP3)
- Half mask respirator (to standard EN140) with P3 filter
- Semi-disposable respirator (to EN405) with P3 filter

These filters are not suitable for people with beards/stubble or for long or continuous use.

LICENSING

CAR defined certain types of activities involving asbestos as 'licensable work' (LW) or as 'notifiable non-licensable work' (NNLW). All other work would be 'non-licensable work' (NLW).

LW is defined as:

- work where exposure is not 'sporadic and low intensity'
- work where the risk assessment cannot demonstrate that the control limits (four hour and 10 minute limits) will not be exceeded
- work on asbestos coating
- work on AIB or insulation where risk assessment is either of first two points above or not of short duration (where short duration is defined for any work liable to disturb asbestos as taking less than two hours per week (including ancillary work) and no one person carries out that work for more than one hour').

NNLW includes work with:

- AIB or asbestos insulation of short duration that is not licensable
- fire-damaged asbestos cement or asbestos cement damaged so as to create significant dust and debris
- asbestos ropes, yarns, woven cloths in poor condition or handling cutting or breaking up the materials
- asbestos papers, felts and cardboard in poor condition, unencapsulated or not bound into another material.

Work with weathered asbestos cement, air monitoring and collecting samples of ACM in buildings would not normally be notifiable.

It is impossible to specify definitively what activities will and will not be licensable. This decision should be made as part of the CAR risk assessment. CAR is not primarily aimed at work with ACSs and there is little published information on airborne asbestos concentrations during work with ACSs. Nevertheless, CAR will require some remediation projects, and occasionally site investigations, to be LW. Investigations on other sites may involve NNLW. The decision as to whether work is LW or NNLW should be made during the CAR risk assessment by those in charge of the brownfield site investigations and remediation projects.

TRAINING REQUIREMENTS

Asbestos health and safety courses are offered by a number of providers in the UK. Training courses that include the problem of identifying ACMs in soil should be undertaken at regular intervals by those involved in the investigation, assessment and management of sites where ACs are known or suspected. It is the role of the employer to identify the level of training required for an employee based on their role, experience and duties. Reference to Regulation 10 of CAR should be referred to for more information on training requirements.

Recognising asbestos within soils is challenging due to the heterogeneity of such soils and the discolouration of asbestos by smeared soil. Specific training for ground workers should include understanding fibre release potential, potential control measures in the field, how to take representative ACSs safely, sample labelling and what analytical tests are available and when the y should be implemented.

Health and safety training required under CAR includes asbestos awareness, non-licensable work (including notifiable non-licensable work) and licensable work with asbestos.

In addition to health and safety training, some staff involved in the technical identification on site of ACMs, sampling and analysis may require technical proficiency training (competency training).

Training vs. Competence

HSE (2005) identifies that 'training alone does not make people competent. Training must be consolidated by practical experience so that the person becomes confident, skilful and knowledgeable in practice on the job'. It is critical that ACS surveyors demonstrate competency with details of relevant field experience alongside training and examples of previous works/references.