GroundSolve Ltd
Consulting Geotechnical Engineers

# IPSEN MULTI-STOREY CAR PARK- PHASE I PRELIMINARY RISK ASSESSMENT

**GSL3506R01**

**VERSION 3**

**25 JUNE 2026**

**Revision B**

Prepared for: Lovelock Mitchell Architects

Prepared by: E Rowland

GroundSolve Ltd
Consulting Geotechnical Engineers

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This report has been prepared by GroundSolve Ltd with all reasonable care and diligence, within the best practice and guidance current at the time of issue within the proposed redline boundary and proposed Site end use as presented by the Client.

This report is confidential to the Client and GroundSolve Ltd accepts no responsibility whatsoever to third parties to whom this report is presented.

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## EXECUTIVE SUMMARY

| | |
|---|---|
| **Introduction** | GroundSolve has been commissioned by Lovelock Mitchell architects to undertake a Phase I Preliminary Risk Assessment for the proposed redevelopment of the existing site into a Multi-Storey Car Park. |
| **Proposed land use** | The proposed land use on site will be commercial / industrial, with the site being redeveloped into a Multi-Storey Car Park. |
| **Site location and surrounding land uses** | The site is located off Ash Road South, Wrexham Industrial Estate, Wrexham, LL13 9UG. The site itself is situated within the wider Wrexham Industrial Estate. |
| **Site history** | The site has remained undeveloped land, likely agricultural until the mid-1970's when development occurred, understood to be the existing site layout as a hardstanding car parking area. The wider area has developed over time from primarily open agricultural land to large scale development of the Wrexham Industrial Estate. |
| **Geology, Hydrogeology and Hydrology** | The site is mapped to be underlain by artificial landscaped and Made Ground. Superficial deposits comprise Diamicton Glacial Till underlain primarily by bedrock of the Salop Formation (mudstone, sandstone, and conglomerate) with the very northwest of site being mapped as underlain by the Kinnerton Sandstone Formation, with the two rock types separated by an inferred fault of unknown displacement.<br>The superficial deposits are classified as a Secondary Undifferentiated Aquifer. The Salop formation which underlies the majority of the site is a Secondary A Aquifer, and the Kinnerton Sandstone Formation is classified as a Principal Aquifer. The site is within a Type 3 – total Catchment Source Protection Zone.<br>The nearest watercourse is 112m northeast and is an inland river not influenced by normal tidal action. |
| **Ground Gases** | There is no credible on site ground gas source unless deep and/or organic rich Made Ground is encountered. |
| **Radon Requirements** | The site is situated within an area where less than 1% of the properties are above the Radon Action Level and therefore no radon protection measures are required. |
| **Potential contaminative features** | On site Made Ground and off site Made Ground and industrial land uses/features. |
| **Mining and quarrying** | The site is situated within a coal mining reporting area but there is no evidence of historic mining taking place on the site or within the vicinity. |
| **Previous investigations** | GSL have produced a number of previous reports pertaining to the wider Ipsen facility and development. |
| **Preliminary Geotechnical Assessment** | Limited details regarding the current proposed development are available, however it is understood that unfactored column loads are likely to be in the region of 2200kN. Based on the anticipated ground conditions (Firm to stiff clay) it is expected that accommodating loads of this magnitude utilising conventional ground bearing foundations is unlikely to prove economic. Based on an allowable bearing capacity in the region of 150kN/m2 this would correspond to a 4.5 x 4.5m pad foundation consequently it is anticipated that a piled foundation will be required.<br>It is unlikely to be feasible to derive these sorts of capacities from pre-cast driven systems so the most likely suitable foundation solution will likely be continuous flight auger (CFA) or bored piles<br>As a guide, 500mm diameter CFA piles to a depth of 12.50m bgl should provide the required the capacity of 1800kN, but this will be confirmed during the detailed design. |
| **Further works or other issues potentially restricting work** | A Phase 2 Ground Investigation should be conducted to confirm the findings of the Phase I Preliminary Risk assessment. |

# 1 INTRODUCTION

GroundSolve Ltd (GSL) were commissioned by Lovelock Mitchell Architects to undertake a Land Contamination Risk Management (LCRM) Phase 1 Preliminary Risk Assessment for an area of land referred to as Ipsen Multi-Storey Car Park (MSCP) (the "Site").

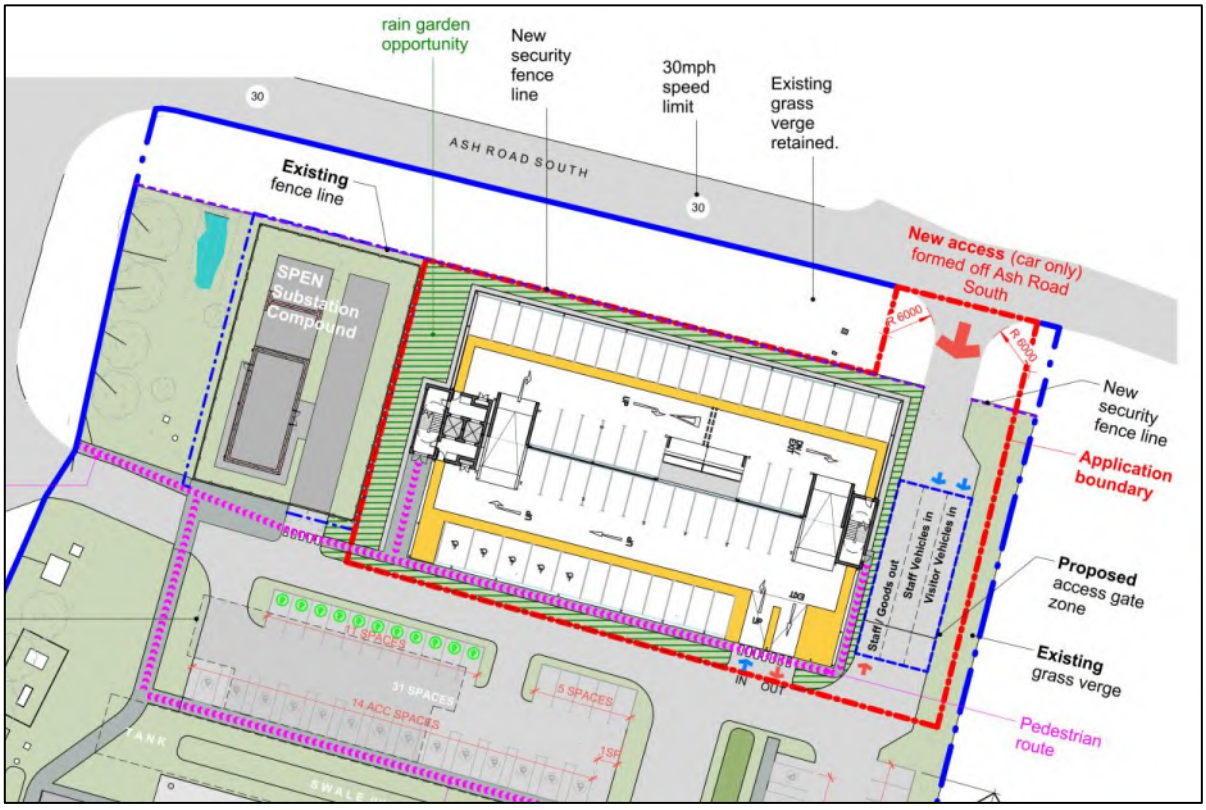
This report has been devised to generally comply with the relevant principles and requirements of a range of guidance including:

- Part IIA of the Environment Protection Act, 1990.
- BS5930:2015+A1:2020: "Code of practice for site investigations".
- BS10175: 2011 +A2:2017 "Investigation of Potentially Contaminated Sites - Code of Practice".
- The Building Regulations 2010. Part C (HM Government 2013).
- Environment Agency: Land Contamination Risk Management (LCRM), Version 3, October 2020.
- Environment Agency (2017) "The Environment Agency's Approach to Groundwater Protection" November 2018 Version 1.2.
- Welsh Local Government Assoc- Development of Land Affected By Contamination Guide for Developers 2017.

## 1.1 PROPOSED DEVELOPMENT

It is proposed to redevelop the existing Site into a Multi-Storey Car Park, the proposed development layout is included in **Figure 1.1** below, with relevant Site drawings provided to GSL included within **Appendix A**.

***Figure 1.1: Proposed development layout.***



The recommendations in this report are based on these assumptions, consequently, they should be reviewed, and if necessary revised during the detailed design.

As such, in accordance with the 'Updated technical background to the CLEA model' (Environment Agency, 2009) and 'Suitable 4 Use Levels' (LQM / CIEH 2015) the proposed generic land use for this development is commercial / industrial.

## 1.2 PREVIOUS REPORTS

GSL have previously produced a number of reports pertaining to the wider Ipsen Site which are summarised in Section 3.

## 1.3 OBJECTIVES

Taking into account the proposed development of the Site, the objectives of this appraisal were:

1. To determine the historical and current land use.
2. To establish the environmental setting of the Site.
3. To evaluate whether past mining or other extractive industries could have an influence on the Site.
4. To determine likely ground and groundwater conditions.
5. To determine the potential risks to human health and the wider environment.
6. To determine potential risks posed to the Site from hazardous ground gases and / or vapours.
7. To derive a Preliminary Conceptual Site Model.

## 1.4 ASSUMPTIONS

The following assumptions are made in this report:

1. It is assumed that ground levels will not change significantly from those described in this report or a shown on proposed development drawings. If this is not the case, then amendments to the recommendations made in this report may be required.
2. Any references to observations of suspected asbestos-containing materials are for information only and should be verified by a suitably qualified asbestos specialist and/or confirmed by laboratory analysis.
3. The use of the term 'Topsoil' within this report is based on a visual identification only and that these materials have not necessarily been classified in accordance with BS3882:2015.
4. The comments and opinions presented in this report are based on the findings of the desk study performed by GroundSolve Ltd. 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 at this stage.
5. 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 ground conditions should be undertaken if deemed necessary.
6. This report has been prepared for the sole use of the Client. No other third party may rely upon or reproduce the contents of this report without the written approval of GroundSolve Ltd. If any unauthorised third party comes into possession of this report, they rely on it entirely at their own risk.

# 2 SITE DETAILS AND DESCRIPTION

***Table 2.1: Current Site Overview***

| | |
|---|---|
| **Site name** | Ipsen MSCP. |
| **Site address** | Ash Road South, Wrexham Industrial Estate, Wrexham, LL13 9UG. |
| **National Grid Reference (NGR)** | 337610, 350202. |
| **Approximate Site area** | 0.28ha. |
| **Site shape** | Broadly rectangular. |
| **General topography and ground levels** | The Site is broadly level, situated at approx. 38mAOD. |

***Table 2.2: Summary of Description of the Site and its Environs***

| | |
|---|---|
| **Current Use:** | The Site is currently in use as a car park. |
| **Access** | The Site is currently accessed via the existing Ipsen facility, off Ash Road North. |
| **Existing Buildings& Structures** | There are no buildings or structures present on Site. |
| **Site Surface** | Asphalt hardstanding across the majority of the Site, with the small section protruding to the north currently scrub vegetation. |
| **Vegetation** | Vegetation in the north of Site is uncultivated roadside vegetation including tall grasses, wildflowers, herbaceous plants, and shrubs/bushes. |
| **Storage Tanks** | Below Ground Tanks: No evidence/none suspected.<br>Above Ground Tanks: None present. |
| **Services** | No service plans have been provided to GroundSolve. Satellite imagery indicates no above ground services, but it is anticipated that below ground services are present. |
| **Asbestos** | No potential Asbestos Containing Materials (ACMs) noted r on the ground surface. |
| **Waste Disposal/ Materials Storage** | No uncontrolled materials storage or waste disposal is evident on site. |
| **Surrounding Area** | The Site is situated within the wider Wrexham Industrial Estate. |
| **Local / Background Knowledge** | No local knowledge has been provided to GroundSolve. |

# 3 PREVIOUS INVESTIGATIONS

The proposed development Site sits adjacent, and in some cases, overlaps the wider Ipsen Site Facility which have previously investigated by GSL:

- "IPSEN Ash Road North, Wrexham East Site Development Geoenvironmental Report" dated March 2018 (report reference: 2053).
- "IPSEN Ash Road North, Wrexham, Proposed New Building Geoenvironmental Report" dated March 2021 (report reference: 2460).
- "IPSEN East Phase 1 & 2 Ground Investigation Report" dated March 2023 (report reference: 2867/01).
- "Factual Ground Investigation: IPSEN East" dated November 2023 (report reference: GSL3023R01).
- "Factual Ground Investigation for IPSEN East, Additional Boreholes" dated April 2024 (report reference: GSL3070R01)

Following these investigations and their reports, a subsequent feasibility study and gap analysis was produced by GSL for the east car park, dated November 2025 (report reference: GSL3387). The feasibility study & gap analysis is included within **Appendix D.**

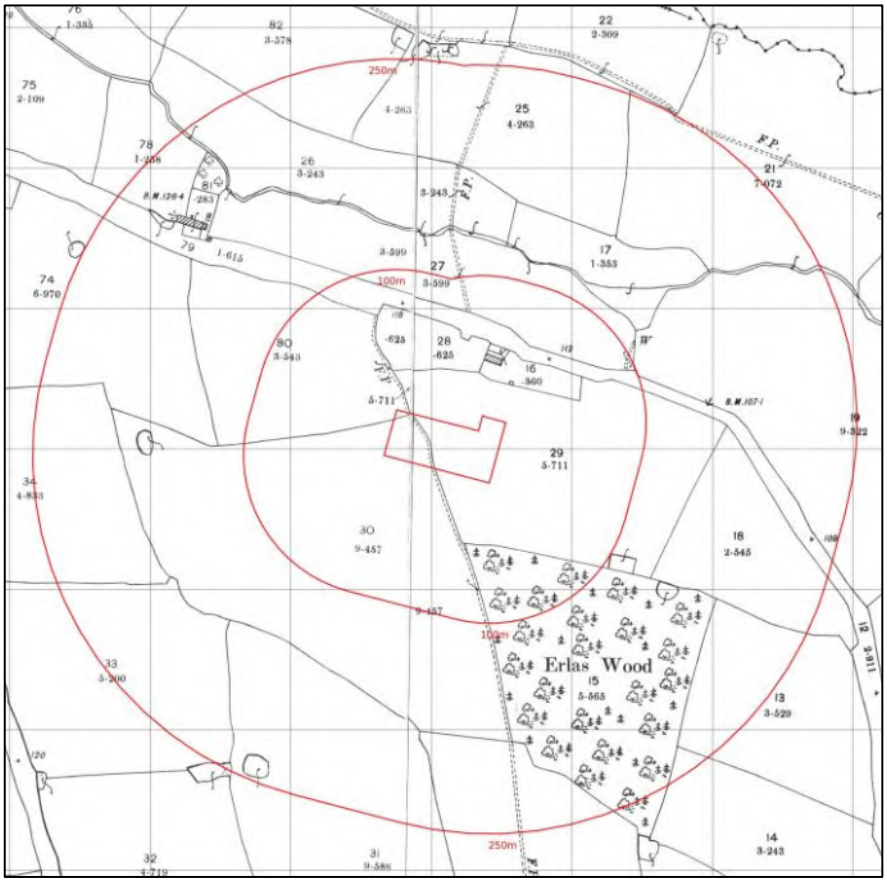
# 4 SITE HISTORY

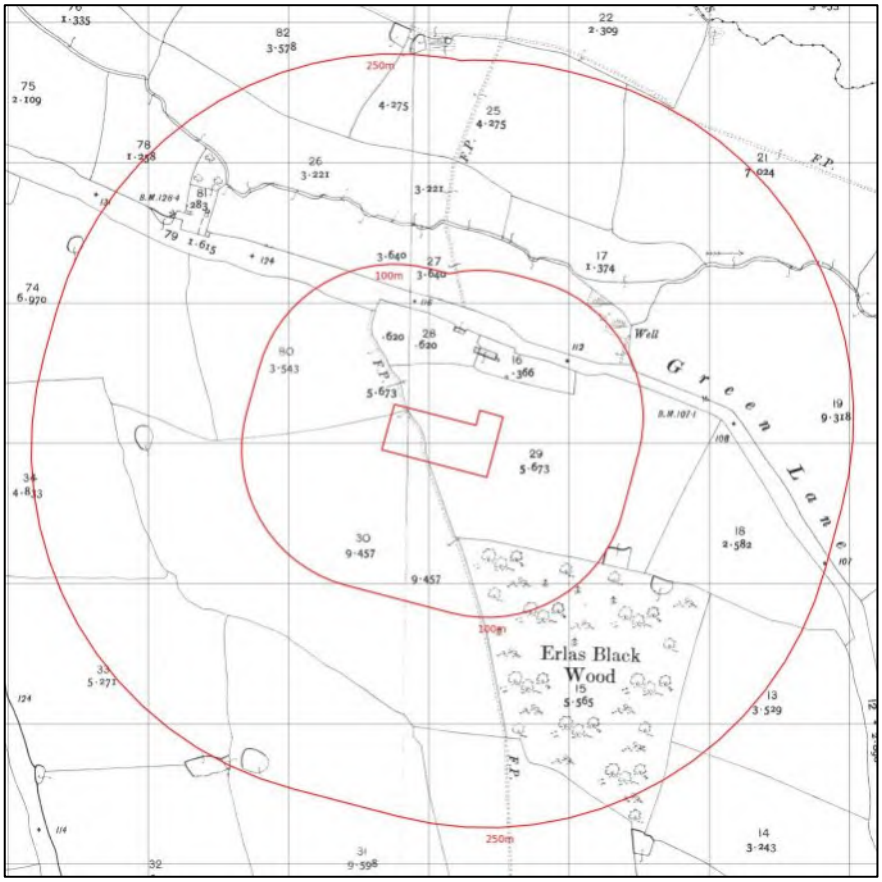
## 4.1 SITE HISTORY REVIEW

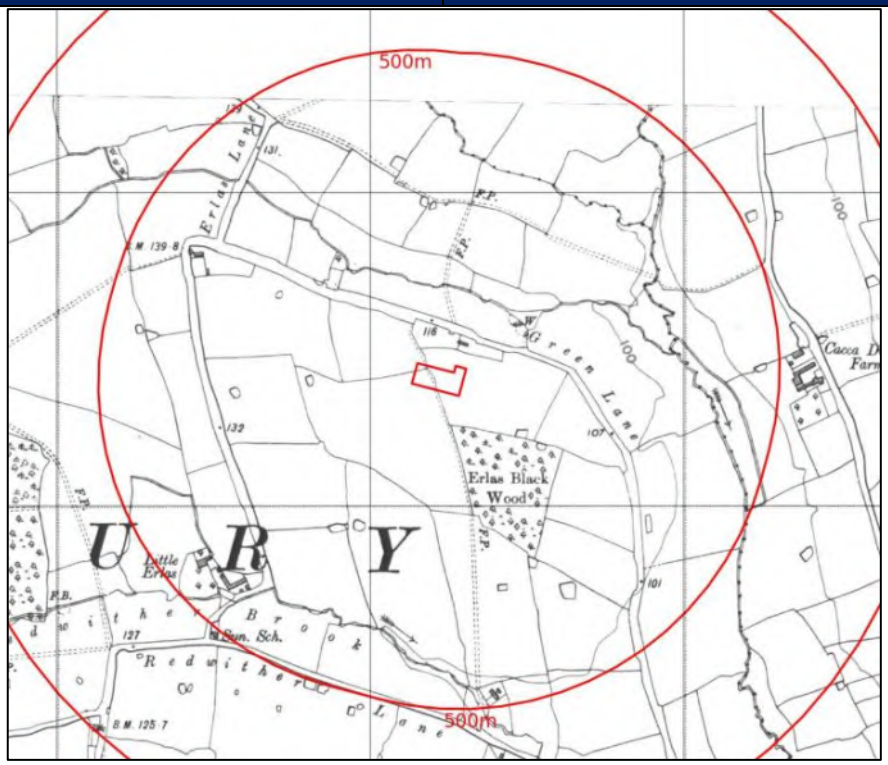
Extracts of Ordnance Survey (OS) plans dated from 1872 were reviewed. These were obtained as part of the Groundsure Report for the Site, which is presented in **Appendix B**.

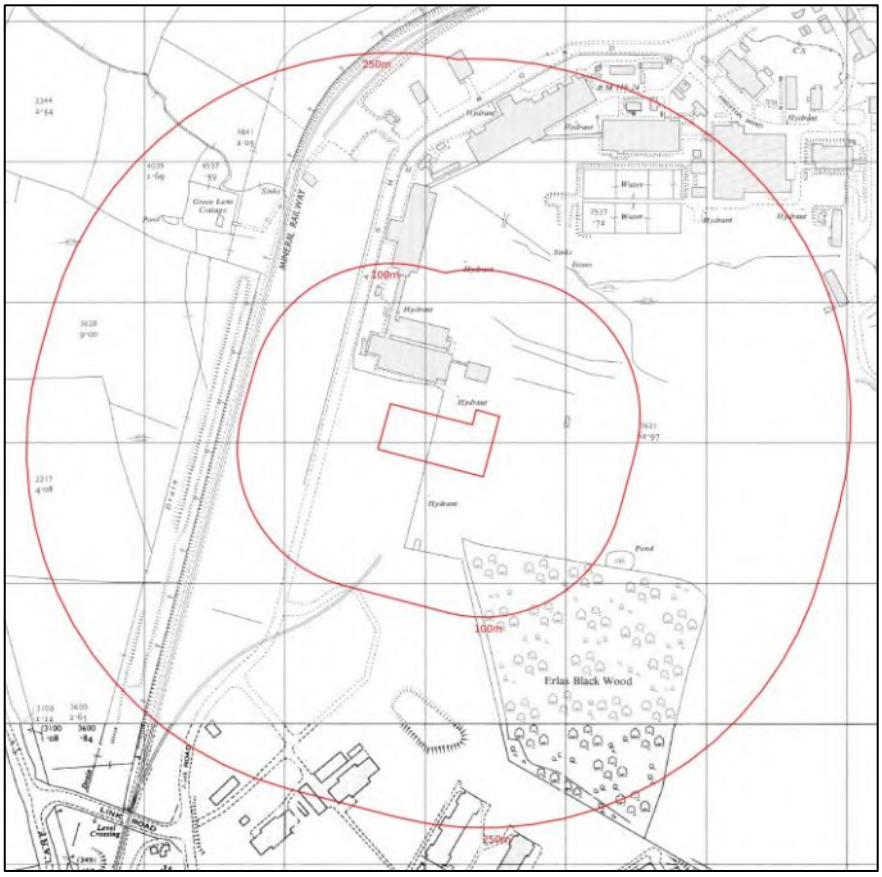
Table 4.1 below presents a summary of the main aspects of the Site relevant to the current and proposed future end uses. It is not the intention of this report to describe in detail all of the changes that have occurred on or adjacent to the Site, where these are not relevant to the land use.

***Table 4.1: Site History***

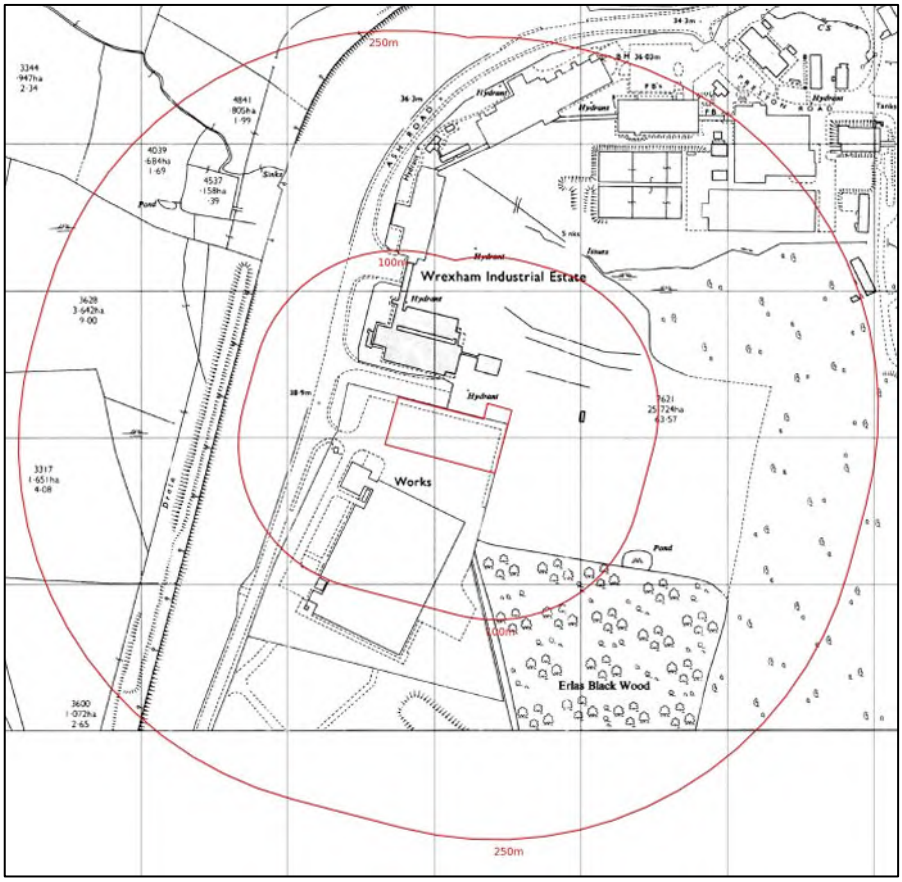
| Time Period | On-Site features | Off-Site features |
|---|---|---|
| Pre-1900 |  **1899 OS Map – 1:2,500** | |
| | The Site is undeveloped, likely agricultural fields, with a field boundary running through the centre of the Site. A second tree lined field boundary running east to west from the boundary shown above is recorded on the 1872/1873 mapping, but is no longer shown by 1899. | An unnamed brook is present approx. 120m north of the Site oriented broadly east-west.<br>Erlas Wood is present approx. 60m southeast of Site.<br>6 No. ponds are recorded between approx. 45m north and 245m southwest of the Site, with additional ponds mapped past a 250m radius.<br>1 No. well is shown approx. 100m northeast of Site.<br>1 No. small unnamed building is present approx. 55m north of Site.<br>An unnamed road is mapped running broadly east-west approx. 70m north of Site.<br>Redwither brook is mapped approx. 400m south of Site. |

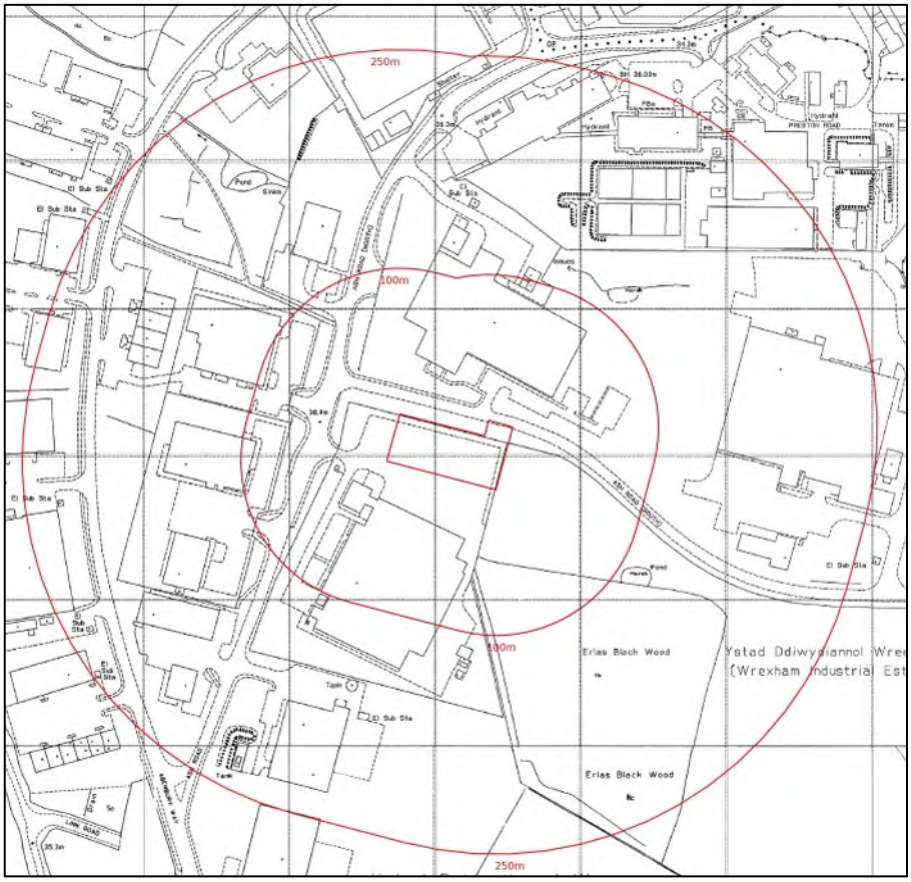
| Time Period | On-Site features | Off-Site features |
|---|---|---|
| 1901 – 1920 |  **1912 OS Map – 1:2,500** | |
| | No significant change. | Roadway to the north of Site now labelled as Green Lane.<br>The small building to the north of Site is no longer present.<br>The well is now shown to be situated in a small area of marsh land. |

<table>
<tr><th>Time Period</th><th>On-Site features</th><th>Off-Site features</th></tr>
<tr><td rowspan="2">Pre-World War II period (1920 – 1939)</td><td colspan="2">

1938 OS Map – 1:10,560</td></tr>
<tr><td>No significant changes.</td><td>No significant changes.</td></tr>
<tr><td>1945 – 1980 (Post war period)</td><td colspan="2">

1961 OS Map – 1:2,500</td></tr>
</table>

| Time Period | On-Site features | Off-Site features |
|---|---|---|
| | The field boundary running through the centre of the Site has changed orientation.<br>The pond is no longer present on Site. | Numerous ponds are no longer shown on mapping.<br>A Mineral railway is present approx. 100m west of Site.<br>Numerous buildings have been developed to the north of the Site between approx. 30m and 300m+ with numerous associated hydrants and water reservoirs.<br>A clay pit is present approx. 170m south of Site. |
| 1945 – 1980 (Post war period) | <br>**1976 OS Map – 1:2,500** | |
| | The Site no longer is shown as open land and is likely surfaced with hardstanding (as is the current layout) associated with the new Ash Road and Works to the south. | The railway is no longer present, with a drain now shown in its place.<br>Works have been constructed approx. 10m south of Site.<br>Increased industrial development. |

<table>
<tr><td rowspan="2">1980 – 2000 (Late 20th Century)</td><td colspan="2">

1993-1995 OS Map – 1:2,500</td></tr>
<tr><td>No significant changes.</td><td>Much wider scale industrial development surrounding the Site.<br>A tank is now shown approx. 130m south of Site.<br>Electricity substations are located approx. 150m north, 260m east, 145m south, 240m southwest, 245m southwest, 235m west, and 260m northwest.<br>Increase in roadways and industrial infrastructure.</td></tr>
</table>

<table>
<tr><td rowspan="2">2000 to 2025 (Modern day period)</td><td colspan="2">

2023 – Aerial Photograph</td></tr>
<tr><td>No significant change.</td><td>The works to the south of Site have been demolished.<br>No other significant changes.<br>The Ipsen NDP development located directly to the south begun in 2024 and has been recently been completed.</td></tr>
</table>

# 5 ENVIRONMENTAL SETTING

## 5.1 GEOLOGY

***Table 5.1: Geological Summary***

| | |
|---|---|
| **Maps and publications referenced** | BGS GeoIndex.<br>Groundsure.<br>BGs Geological Map Sheet No.: SJ35SE (1:10,000).<br>Mining Remediation Authority Interactive Map Viewer. |
| **Made ground / artificial ground** | The Site is mapped to be underlain by landscaped artificially modified ground across the majority of the Site as well as artificial Made Ground in the very east of Site. |
| **Drift geology** | The Site is mapped to be underlain by superficial deposits of Diamicton Till. |
| **Solid geology** | Bedrock geology primarily comprises the Salop Formation – Mudstone, Sandstone and Conglomerate, and the Kinnerton Sandstone Formation in the very northwest of Site. |
| **Faults** | 1 No. inferred fault (displacement unknown) is mapped to separate the Kinnerton Sandstone from the Salop Formation in the northwest of Site, with the fault orientated running northeast-southwest. |
| **Coal seams** | None recorded beneath Site. |

## 5.2 BGS EXPLORATORY HOLE RECORDS

There are 4 BGS exploratory hole records within a relevant distance of the Site (assumed as an approximate 100m radius).

A summary of the ground conditions is presented in Table 5.2 below.

***Table 5.2: Historical Borehole Records***

| Reference | Distance from site (m) and Direction | Depth Made Ground (m) | Depth Superficial Deposits (m) | Depth Solid Geology (m) |
|---|---|---|---|---|
| **SJ35SE229** | 63m northeast | 0.65 | 6.50 (base not encountered) | N/A |
| **SJ35SE79** | 77m east | 2.00 | 5.00 (base not encountered) | N/A |
| **SJ35SE80** | 79m northeast | 2.00 | 5.00 (base not encountered) | N/A |
| | 83m east | 1.90 | 24.00 (base not encountered) | N/A |

## 5.3 MINING AND QUARRYING

***Table 5.3: Coal Mining Activities***

| | Yes/No | Comments |
|---|---|---|
| **Is the Site in an area of potential shallow coal workings?** | No | The Site is situated within a coal mining reporting area but there is no evidence of historic mining taking place on the Site or within the vicinity. |
| **Is the Site in a high risk development area?** | No. | N/A |
| **Are there any known shafts, adits, tips, lagoons, or opencast workings likely to affect the Site?** | No | N/A |
| **Is exploratory work required to investigate the potential risk from shallow mining or quarrying?** | No | N/A |

*Table 5.4: Other Extractive Industries*

| | Yes/No | Comments |
|---|---|---|
| **Superficial drift deposits** | | |
| **Evidence of extraction on or within 250 m of the Site?** | Yes | 142m northeast – Water bodies.<br>233m – 235m south – ponds. |
| **Action required?** | No | N/A |
| **Solid Strata** | | |
| **Any evidence of mineral extraction on or within 250 m of the Site?** | No | N/A |
| **Action required?** | No | N/A |

## 5.4 HYDROGEOLOGY

*Table 5.5: Groundwater Occurrence and Abstraction*

| | Presence/location | Comments |
|---|---|---|
| **Environment Agency aquifer designation – Superficial Deposits** | On Site – Secondary Undifferentiated Aquifer. | Not possible to attribute category A or B to rock type. |
| **Environment Agency aquifer designation – Bedrock** | On Site – Secondary A Aquifer.<br>7m northwest – Principal Aquifer. | Secondary A consists of permeable layers capable of supporting water supplies at a local level. Principal Aquifers provide high level of water storage. |
| **Anticipated groundwater depth(s)** | On Site. | Within bedrock anticipated to be over 5m in depth. |
| **Direction of flow** | On Site. | Unknown. |
| **Current licensed abstractions – potable** | N/A. | None recorded within 250m of Site. |
| **Source Protection Zones** | On Site. | Type 3 – Total Catchment. |
| **Springs** | N/A. | Unknown if present. |

***NR - none recorded.***

## 5.5 HYDROLOGY

*Table 5.6: Surface Water Features*

| | Presence/location | Comments |
|---|---|---|
| **Nearest surface water feature** | 112m northeast. | Inland river not influenced by normal tidal action |
| **Other surface water features** | 114m northeast. | Inland river not influenced by normal tidal action. |
| | 155m northeast. | Inland river not influenced by normal tidal action |
| | 194m northwest. | Inland river not influenced by normal tidal action |
| **Canals, ponds, lakes, etc.** | 188m northwest. | Lake, loch, or reservoir. |
| **Water Framework Directive (WFD) Surface Water Bodies** | On Site. | Clywedog – Dee to Gwenfro catchment (ID: GB111067052110) |
| **Licensed surface water abstractions** | N/A. | None recorded within 250m of Site. |

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

Information obtained from the Natural Resources Wales Flood and Coastal Erosion Risk Map and Flood Risk Assessment Wales indicates that the risk from flooding across the Site is low, with the highest risk on Site being a 1 in 1000 year (0.1-0.3m) from

surface water and the risk from groundwater flooding low also. . No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regards to drainage and flooding.

## 5.6 ENVIRONMENTAL DESIGNATIONS

***Table 5.7: Summary of Environmental Designations***

| | Presence/location | Comments |
|---|---|---|
| **Sites of Special Scientific Interest (SSSI)** | On / Off Site. | None recorded within 250m of Site. |
| **Conserved wetland sites (Ramsar sites)** | On / Off Site. | None recorded within 250m of Site. |
| **Special Areas of Conservation (SAC)** | On / Off Site. | None recorded within 250m of Site. |
| **Special Protection Areas (SPA)** | On / Off Site. | None recorded within 250m of Site. |
| **National Nature Reserves (NNR)** | On / Off Site. | None recorded within 250m of Site. |
| **Local Nature Reserves (LNR)** | On / Off Site. | None recorded within 250m of Site. |
| **Designated Ancient Woodland** | 42m south and 51m south. | Restored ancient woodland Site, with further designated ancient woodlands at a distance greater than 250m from Site. |
| **Biosphere Reserves** | On / Off Site. | None recorded within 250m of Site. |
| **Forest Parks** | On / Off Site. | None recorded within 250m of Site. |
| **Marine Conservation Zones** | On / Off Site. | None recorded within 250m of Site. |
| **Green Belt** | On / Off Site. | None recorded within 250m of Site. |
| **Proposed Ramsar sites** | On / Off Site. | None recorded within 250m of Site. |
| **Possible Special Areas of Conservation (pSAC)** | On / Off Site. | None recorded within 250m of Site. |
| **Potential Special Protection Areas (pSPA)** | On / Off Site. | None recorded within 250m of Site. |
| **Nitrate Sensitive Areas** | On / Off Site. | None recorded within 250m of Site. |
| **Nitrate Vulnerable Zones** | On / Off Site. | None recorded within 250m of Site. |
| **SSSI Units** | On Site. | SSSI Impact Risk Zone – for infrastructure, air pollution, and combustion. |

## 5.7 LANDFILL AND WASTE MANAGEMENT ACTIVITY

***Table 5.8: Waste Management Activities***

| | Presence/location | Comments |
|---|---|---|
| **Active or recent landfill** | On / Off Site. | None recorded within 250m of Site. |
| **Historical landfill (BGS records)** | On / Off Site. | None recorded within 250m of Site. |
| **Historical landfill (LA/mapping records)** | On / Off Site. | None recorded within 250m of Site. |
| **Historical landfill (EA/NRW records)** | On / Off Site. | None recorded within 250m of Site. |
| **Historical waste sites** | On / Off Site. | None recorded within 250m of Site. |
| **Licensed waste sites** | On / Off Site. | None recorded within 250m of Site. |
| **Waste exemptions** | 180m northwest. | Use of waste to manufacture finished goods |
| | 204m east. | Preparatory treatments (baling, sorting, shredding etc). |
| | 219m northeast. | Storage of waste in a secure place and storage of waste in secure containers. |
| | 227m northeast. | Storage of waste in a secure place. |
| **Evidence of other landfilling or potential infilling on or within 250m of Site** | Off Site. | On historic mapping, numerous ponds were mapped within a 250m radius of the Site, and there is a potential for these to have been infilled. |
| **Evidence of fly-tipping on Site?** | On Site. | No evidence of fly-tipping. |
| **Is a landfill/ground gas risk assessment required?** | On Site. | Addressed in Section 7.9. |

## 5.8 LOCAL INDUSTRIAL LAND USES

Other potentially contaminative activities are shown in Table 5.9 below with those features considered pertinent to the conceptual Site model highlighted in **bold**. 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* 500m from the Site.

***Table 5.9: Other Potentially Contaminative Processes in the Locality***

| | Location | Comments |
|---|---|---|
| **Recent industrial land uses** | 67m southeast. | Business Park – Business Parks and Industrial Estates. |
| | 86m west. | Electricity substation – Electrical features. |
| | 134m southeast. | Clwyd Transport Services Ltd – Distribution and Haulage. |
| | 142m northwest. | Ipsen – Medical Equipment, supplies, and pharmaceuticals. |
| | 159m north. | Electricity substation – Electrical features. |
| | 166m southwest. | Sandstone brewery – Alcoholic drinks. |
| | 168m north. | Electricity substation – Electricity features. |
| | 171m north. | Enterprise park – Business Parks and Industrial estates. |
| | 174m south. | Electricity substation – Electrical features. |
| | 177m southwest. | Tyre Supplies – Vehicle parts and accessories. |
| | 187m north. | Electricity substation – Electrical features. |
| | 190m south. | Milner Engineering Services Ltd – Precision engineers |
| | 196m north. | Electricity substation – Electrical features. |
| | 197m south. | Proserve Ltd – Distribution and Haulage. |
| | 200m south. | Factory – Unspecified works and factories. |
| | 204m east. | Oscar Meyer – Catering and non-specific food products. |
| | 206m southeast. | Electricity substation – Electrical features. |
| | 207m southwest. | P J Garage Ltd – Vehicle repair, testing, and servicing. |

| | Location | Comments |
|---|---|---|
| | 233m southwest. | Electricity substation – Electrical features. |
| | 234m east. | Electricity substation – Electrical features. |
| | 238m north. | Playford Packaging – Packaging. |
| | 241m southwest. | Electricity substation – Electrical features. |
| | 247m northeast. | Mark Specialist Applications Ltd – Cleaning Equipment and Supplies. |
| | 247m northeast. | IPS – Packaging. |
| **Current or recent petrol stations** | On / Off Site. | None recorded within 250m of Site. |
| **Current or Historical Storage Tanks** | 91m north. | Roofed storage tank (from 27/02/2002). |
| | 211m northwest. | Roofed storage tank (from 02/07/2014). |
| | 216m north. | Roofed storage tank (from 20/10/2005). |
| **Electricity cables (High Voltage)** | On / Off Site. | None recorded within 250m of Site. |
| **Gas pipelines (High Pressure)** | On / Off Site. | None recorded within 250m of Site. |
| **Sites determined as Contaminated Land** | On / Off Site. | None recorded within 250m of Site. |
| **Control of Major Accident Hazards (COMAH)** | On / Off site. | None recorded within 500m of Site. |
| **Regulated explosive sites** | On / Off Site. | None recorded within 250m of Site. |
| **Hazardous substance storage/usage** | On / Off Site. | None recorded within 250m of Site. |
| **Historical licensed industrial activities (IPC)** | On / Off Site. | None recorded within 250m of Site. |
| **Licensed industrial activities (Part A(1))** | 187m north. | Operator – Gillette UK Ltd |
| **Licensed pollutant release (Part A(2)/B)** | 143m northwest. | Historical permit for Plant health and Biocide Products. |
| | 213m northwest. | Current permit for coating processes. |
| **Radioactive Substance Authorisations** | 187m north. | Operator: Specwood Ltd. Type: Disposal of radioactive waste and keeping and use of radioactive material. |
| **Licensed Discharges to controlled waters** | 168m northeast. | Unspecified effluent type (permit No.: CM0052201). |
| | 235m north. | Unspecified effluent type (permit No.: CM0207601). |
| **Pollutant release to surface waters (Red List)** | On / Off Site. | None recorded within 250m of Site. |
| **Pollutant release to public sewer** | On / Off Site. | None recorded within 250m of Site. |
| **List 1 Dangerous Substances** | On / Off Site. | None recorded within 250m of Site. |
| **List 2 Dangerous Substances** | On / Off Site. | None recorded within 250m of Site. |
| **Pollution Incidents (EA/NRW)** | 120m northeast. | Specific waste materials 09/01/2014 (ID 1192657) – category 4 land impact and category 3 air impact. |
| **Pollution inventory substances** | On / Off Site. | None recorded within 250m of Site. |
| **Pollution inventory waste transfers** | On / Off Site. | None recorded within 250m of Site. |
| **Pollution inventory radioactive waste** | On / Off Site. | None recorded within 250m of Site. |

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

## 5.9 UXO RISK

In accordance with CIRIA Report C681, we have reviewed non-specialist UXO data for the Site using the online Zetica Bomb Risk Mapping data. The map indicates the Site to be in an area where the bomb risk is low.

As the Site is at low risk, no further consideration of UXO is required at this stage. Should new evidence indicate that UXO may be an issue, it would be prudent to seek appropriate specialist advice.

## 5.10 RADON RISK

***Table 5.10: Radon Risk Status***

| | Comments |
|---|---|
| **Estimated properties affected** | Less than 1% of properties above the Radon Action Level. |
| **Radon Protection Measures required?** | No protection measures required. |

## 5.11 OTHER POTENTIAL DEVELOPMENT CONSTRAINTS

No invasive species have been noted during the walkover; however, it would be prudent to undertake a specialist survey prior to any works on Site.

## 5.12 WASTE CLASSIFICATION AND MATERIALS RE-USE

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

Based on the history of the Site and the anticipated potential contaminants of concern, it is considered unlikely that hazardous waste soil materials may be present beneath the majority of the Site; however, this will be subject to confirmatory investigation, sampling, laboratory analysis, and waste classification in accordance with the Guidance on the Classification and Assessment of Waste (WM3).

It will be necessary to register the Site in advance of the intended reclamation works with the Natural Resources Wales 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.

Subject to volumetric fill requirements and a future assessment of suitability of re-use (both chemically and geotechnically), some materials *may* be considered for potential re-use in line with an appropriate end-of-waste protocol such as WRAP Quality Protocol for Aggregates from Inert Waste, U1 Exemption or a Materials Management Plan in accordance with the CL:AIRE Definition of Waste Code of Practice (DoWCoP).

# 6 PRELIMINARY GEOTECHNICAL ASSESSMENT

## 6.1 ANTICIPATED GROUND CONDITIONS

In addition to the environmental hazards, there are also geotechnical hazards associated with the stability of the ground (including load bearing capacity, slope stability, and effects of ground (mining) cavities). Local Authorities follow NPPF (2018) which requires that "Site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining." A summary of the geotechnical considerations is provided below:

***Table 6.1: Summary of Geotechnical Hazards***

| **Geohazards:** | |
|---|---|
| Highly Compressible Ground | **Negligible Risk** – Compressible strata are not thought to occur. |
| Collapsible Soils | **Very Low Risk** – Deposits with the potential to collapse when loaded and saturated are unlikely to be present. |
| Swelling Clay | **Very Low Risk** – Ground conditions predominantly low plasticity. |
| Running Sand | **Negligible Risk** – Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on land use due to running conditions. |
| Ground Dissolution | **Negligible Risk** – Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present. |
| Landslip | **Very Low Risk** – Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the Site should always be considered. |
| Mining & Quarrying (see Section 5.3) | There is no evidence of mining or mineral extraction or quarrying at the Site. |
| **Geotechnical Design Considerations** | |
| Site Clearance | The Site is currently a car park with a small area of roadside vegetation in the north. The car park surface comprises asphalt hardstanding. It will be necessary to remove hardstanding and scrub vegetation prior to development. |
| Trees | Small trees are present in the north of Site associated with the roadside vegetation. |
| Existing Buildings / Obstructions | No buildings are currently present on Site. |
| Foundations | Limited details regarding the current proposed development are available, however it is understood that unfactored column loads are likely to be in the region of 2200kN. Based on the anticipated ground conditions (Firm to stiff clay) it is expected that accommodating loads of this magnitude utilising conventional ground bearing foundations is unlikely to prove economic. Based on an allowable bearing capacity in the region of 150kN/m2 this would correspond to a 4.5 x 4.5m pad foundation consequently it is anticipated that a piled foundation will be required.<br>Driven piled were used extensively for the recently completed adjacent development with piles extending into the Glacial Till Deposits to depths in the region of 16.00m bgl. Individual pile capacities were 300kN, and based on this and the anticipated loads, pile groups of up to 10 No. would be required. Construction of pile groups and the associated pile caps of this size is unlikely to be feasible and as such it is anticipated that larger and/or deeper piles will be required.<br>Based on the anticipated loads and assuming a group of 4 No. per column, ultimate pile capacities will need to be in the region of 1800kN/pile. It is unlikely to be feasible to derive these sorts of capacities from pre-cast driven systems so the most likely suitable foundation solution will likely be continuous flight auger (CFA) or bored piles. Exact pile lengths and diameters will be determined at the detailed design phase however the presence of sub-artesian/artesian pressures in the underlying fluvio-glacial deposits means that pile lengths will need to be restricted to within the Glacial Till, and therefore increased capacities will need to be derived from pile diameters rather than length.<br>As a guide, 500mm diameter CFA piles to a depth of 12.50m bgl should provide the required the capacity of 1800kN, but this will be confirmed during the detailed design. |
| Floor Slabs | Anticipated that a suspended floor slab will be appropriate. |
| Groundwater | It is not anticipated that significant shallow groundwater will be present within the Till. |
| Earthworks | It is considered that bulk earthworks may be required, subject to finalised designs. |

| | |
|---|---|
| Slopes | Slope stability considered to be a low risk. |
| Retaining Walls | Not considered to be relevant to the proposed development. |
| Chemically aggressive ground conditions | Possibility for low pH and high sulphate concentrations which could be detrimental to below ground concrete. |

# 7 PRELIMINARY CONCEPTUAL SITE MODEL

## 7.1 INTRODUCTION

Based on the information provided in the previous sections of this report a combined preliminary Conceptual Site Model and conceptual exposure 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. In assessing the likely contaminants of concern 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 in accordance with CIRIA C552.

The preliminary conceptual model is presented in schematic form in Section 7.9. The potential pollutant linkages identified and the qualitative risk assessment for these are presented in Conceptual Site Model.

The terms used in the preliminary qualitative risk assessment are defined in **Appendix C**.

The following sections discuss all the identified potential on and off- Site sources, pathways, and receptors in the context of the proposed development and plausible pollutant linkages which may represent a risk to identified receptors such as human health and/or controlled waters from the data gained from the desk study. At this stage, the assessment is qualitative and aimed to determine all pollutant linkages, irrespective of significance or allowing for uncertainty.

Three impact potentials exist for any given Site, these are:

- The Site impacting upon itself.
- The Site impacting on its surroundings.
- The surroundings impacting on the Site.

All three impacts need to be considered in a risk assessment.

- **Sources**: these are potential or known sources of contamination that may relate to a former land use or present Site feature or process (e.g., Made Ground, infilled ground etc).
- **Pathways**: a pathway is defined as a mechanism or route by which a contaminant encounters or otherwise affects a receptor. Pathways by which the identified receptors may be impacted upon in the context of the proposed development.
- **Receptors**: receptors are defined as people, living organisms, ecological systems, controlled waters, atmosphere, structures, and utilities that could be adversely affected by contaminant(s).

## 7.2 CONCEPTUAL SITE MODEL

Based on the data available the following Conceptual Site Model has been developed. The various components of the potential "source–pathway-receptor" pollutant linkages identified at the Site.

## 7.3 HAZARDS IDENTIFIED WITH THE PROPOSED DEVELOPMENT

The hazard identification is based on the assumptions presented below:

- the Site will be a commercial development.
- The potential Made Ground on Site being a source of contamination.

- Drinking water will be from mains supply.

## 7.4 POTENTIAL SOURCES OF CONTAMINATION

For the purpose of this assessment the potential contaminants of concern have been considered according to whether they are likely to have originated from on- Site or off- Site sources.

### Potential On- Site Sources of Contamination

From the information obtained, the following sources have been identified which may affect the redevelopment of the Site for commercial end use:

- Made Ground on Site.

### Potential Off- Site Sources of Contamination

The following off- Site sources have been identified which may affect the redevelopment of the Site:

- Off- Site Made Ground.
- Off- Site industrial land uses.

## 7.5 POTENTIAL RECEPTORS OF CONTAMINATION

Based on the data previously discussed, the following potential receptors to contamination have been identified:

***Table 7.1: Identified Potential Receptors***

| Sensitive Receptors | |
|---|---|
| A | Humans – Predevelopment completion, i.e. working on Site during demolition and construction. |
| B | Humans occupying the Site post construction. |
| C | Controlled waters – Surface Waters (rivers and streams) |
| D | Groundwater in the Secondary Undifferentiated and Secondary A Aquifer. |
| E | Local flora and fauna during and post construction. |
| F | Building structure and services. |

The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

The preliminary assessment of risks undertaken for the development considers potential risks to receptors A to F in Table 7.1 above. The receptors A to F incorporate each of the receptors normally required by the Local Authority to be considered in their planning conditions relating to land contamination:

- Human Health (A & B)
- Property (including buildings, crops, livestock, pets, woodland, service lines) (E & F)
- Adjoining land (D & F)
- Groundwater and surface water (C & D)

- Ecological systems (E)
- Buildings and structures (F)

It should be noted that there are no archaeological Sites or ancient monuments considered to be within the zone of influence of the Site. They are therefore not considered in the risk assessment.

The closest of each of the above receptor categories to the Site are considered to be:

**On-Site**

- Human Health, Property, Groundwater and Surface Water, Ecology, Building and Structures.

**Off-Site**

- Human Health, Property, Adjoining Land, Groundwater and Surface Water, Ecological Systems and Buildings and structures.

The possible contaminant linkages are discussed below. It should be noted not all may be formed between all sources and receptors.

## 7.6 IDENTIFICATION OF PATHWAYS

### Pathways to Human Health

There are various routes by which a potential contaminant may reach a receptor. For example, in areas where contaminated material is exposed, dermal contact with the material, inhalation or ingestion of dust may occur.

This Site is an existing car parking facility, which is set to be redeveloped into a Multi-Storey Car Park.

Inhalation or ingestion of dust and water could occur during the construction and development phase at the Site. Pathways from dermal contact with soil and groundwater may also arise. It is considered that the risk of short-term exposure for ground workers and other construction workers is low unless there are asbestos fibres are encountered.

Post construction, the surface of the development area will be occupied with the car park and hard standing, with smaller garden areas. This will effectively eliminate the persistence of potential pathways such as long-term direct contact and dust inhalation/ingestion as long as the soil in the garden areas has no significant concentrations of contaminants.

### Ground Gas

There is no credible on Site ground gas source unless deep organic rich Made Ground is encountered.

### Pathways to Controlled Waters

Groundwater levels at the Site are anticipated to be at a depth of more than 5m within the bedrock. However, there is the potential that perched groundwater may be present within any granular horizons. Lateral migration of potentially contaminated groundwater off Site (either via permeable Made Ground or the underlying aquifer) must be considered.

The vertical leaching of contaminants from any potential Made Ground into the groundwater is a potential pathway for contaminants to impact upon groundwater. Any Made Ground deposits are mapped to be underlain by Till (Clay) and therefore it is very unlikely for contaminants to make their way into the groundwater within the bedrock.

The Site is located within a groundwater source protection zone.

Surface run off from contaminated areas into surface watercourses must also be considered. Due to a lack of a hard standing Site surface, this will be uncontrolled prior to and during the groundworks phase when this must be carefully managed.

Post construction the majority of the Site and surface run-off will be limited and controlled through drains.

The nearest river source is 112m to the northeast. Overall GroundSolve consider that there is limited viable overland migration pathways for surface run off to reach this receptors.

### Other Pathways

Other potential pathways that are possibly less significant to the Site but still require consideration are: chemical attack on foundations and services and permeation of contaminants through domestic water pipes. The risk to buildings from ground gases has been discussed under human health above.

## 7.7 CONTAMINANT LINKAGES

For each contamination source there are potential contaminant linkages with all receptors. However, in the context of this Site, not all of the contaminant linkages are plausible, particularly those of potential groundwater contamination and lateral groundwater migration.

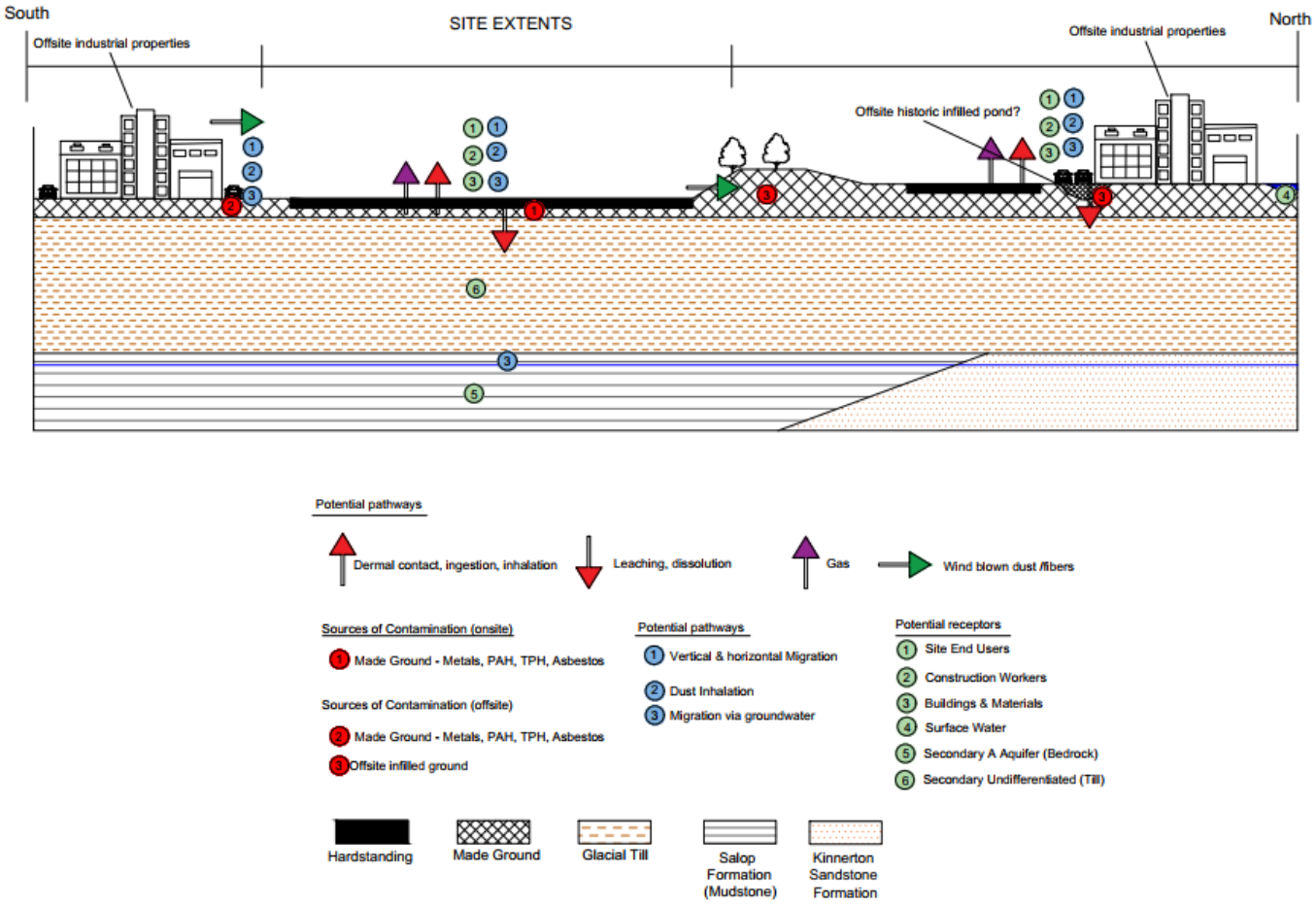
## 7.8 UNCERTAINTIES

The following uncertainties exist in the preliminary conceptual model:

- The presence of any features unrecorded by the historic maps.
- Any unrecorded geological features.
- Any unrecorded pollution events during the Site's history.

## 7.9 CONCEPTUAL SITE MODEL

In accordance with BS 10175, a schematic section has been developed for the Site based on the previously presented data and contaminant linkage assessment:




**Preliminary Conceptual Ground Model – Schematic Section (not to scale)**

The model shows the predicted geology and topography, the major on Site potential contamination sources and vulnerable receptors.

The information presented above represents the preliminary conceptual ground model that may need to be revised based on information obtained as part of any future intrusive investigation. A number of sensitive receptors and potential pathways and sources (in association with a list of likely contaminants) have been identified.

The ground model and proposed end use described above should be considered broadly representative of the commercial / industrial as defined in SR3 “Updated Technical Model to the CLEA Model” (SC050021/SR3, 2011) for the purpose of this report.

## 7.10 PRELIMINARY CONTAMINATION HAZARD ASSESSMENT

The preliminary hazard assessment is based on current available guidance published by a number of sources and is summarised in **Appendix C**. A preliminary Conceptual Site Model for this Site has been established using the desk study information and

has been used as a basis for the preliminary hazard assessment. The significant and possible potential pathways are only considered for the hazard assessment.

The preliminary hazard assessment is a qualitative assessment of the risks posed by each viable pollution link identified. The hazard assessment leads to a recommended subsequent activity that could be:

- Action Required (AR) in the short term to break existing contaminant-pathway-receptor (CPR) link.
- Site Investigation Required (SIR) with objectives for risk estimation, or
- No Action Required (NAR) at this stage.

## 7.11 PRELIMINARY ASSESSMENT OF POTENTIAL POLLUTANT LINKAGES

***Table 7.2: Preliminary Conceptual Site Model***

| Human Health and Controlled Waters | | | | | | |
|---|---|---|---|---|---|---|
| **Potential Source** | **Potential Pathway** | **Potential Receptor** | **Likelihood** | **Severity** | **Level of risk** | **Justification** |
| **On Site**<br>**Made Ground**<br>Metals, PAHs, asbestos | Root uptake, ingestion, direct contact, inhalation of dusts | End-users | Low likelihood | Medium | Moderate/ Low | The historical mapping details the Site remained undeveloped until the construction of the existing car park that currently occupies Site. Therefore, although Made Ground is likely to be present associated, it is not anticipated that it will be of any significant depth. Given the commercial / industrial nature of the proposed development and the likely shallow localised nature of any Made Ground, the likelihood of exposure to Site users is considered to be low and the and the overall risk is considered to be moderate/low. Further investigation and assessment will be required to confirm the risk from Made Ground. |
| **On Site**<br>**Made Ground**<br>Metals and organic contamination | Migration into/chemical attack of water supply pipelines | Water Pipelines / End users | Low likelihood | Medium | Moderate/ Low | Contaminants within the soil/groundwater could potentially attack the clean potable water supply pipe, although Made Ground is likely to be localised and shallow. Nevertheless, contaminants should be assessed to determine the correct pipe material and level of precautions required. |
| **On Site**<br>**Made Ground**<br>Ground Gas (carbon dioxide and methane) | Migration into confined spaces, inhalation, and asphyxiation/ explosion | End-users / property / structures | Unlikely | Medium | Low | Made ground is unlikely to be present in any significant thickness and no significant infilled ground is situated within reasonably close proximity to the Site. Made ground in this instance is likely to have a very low gas generation potential. CL:AIRE RB17 states that on Sites where natural soils with low organic content and there is less than 1m of made ground that comprises general infill and car park construction materials, this is not considered to represent a significant ground gas source, and therefore gas monitoring is not required, and the Site would fall into the definition of Characteristic Situation 1 (CS1), where no protection measures are required in construction. |
| **On Site**<br>**Made Ground**<br>Metals, PAHs, | Overland flow, / migration through saturated zone | Unnamed water course (112m northeast) | Unlikely | Medium | Low | Due to the lack of historical development across the Site, significant thickness or widespread Made Ground deposits are unlikely to be present. It is considered contaminants associated with the Made Ground are unlikely to impact the surface waters environment given the distance for contaminants to migrate and degradation is likely to occur over this distance. Therefore, the risk is considered to be low. |

| Human Health and Controlled Waters | | | | | | |
|---|---|---|---|---|---|---|
| **Potential Source** | **Potential Pathway** | **Potential Receptor** | **Likelihood** | **Severity** | **Level of risk** | **Justification** |
| | Overland flow, leaching through unsaturated zone / migration through saturated zone | Secondary (A) Aquifer (Groundwater) | Unlikely | Medium | Low | The Site is within a Source Protection Zone III, Total Catchment. However, there are no potable groundwater abstraction licences located within 2000m of the Site. As detailed above, any Made Ground is considered unlikely to be substantial in thickness. In addition, the development of the Site will likely result in a reduction in surface water infiltration with the installation of a new surface water drainage system, which will reduce any contaminant leaching and contribute to an overall betterment of groundwater quality. The overall risk is therefore considered to be low. If substantial thicknesses of Made Ground or gross contamination is encountered during intrusive investigations, the risk assessment will need to be revised. |
| | Leaching through unsaturated zone / Migration through saturated zone | Principal Aquifer (Groundwater) | Unlikely | Medium | Low | The Site is within a Source Protection Zone III, Total Catchment. However, there are no potable groundwater abstraction licences located within 2000m of the Site. The Site is mapped to be underlain by superficial deposits of Diamicton Till, which occurs primarily as very low permeability clay. Therefore, the potential for migration into the Principal Aquifer through these low permeability soils is considered to be low. As stated above any Made Ground is considered unlikely to be substantial in thickness. If substantial thicknesses of Made Ground or gross contamination is encountered during intrusive investigations, the risk assessment will need to be revised. |
| **Off Site**<br>Metals, PAHs, asbestos | Root uptake, ingestion, direct contact, inhalation of dusts | End-users | Unlikely | Medium | Low | Any significant off Site Made Ground Contaminations is considered to not be significantly mobile to the Site owing to the mapped significant thickness of low permeability Diamicton Till both on and off Site. |

From the Table above, a range of risk ranking from low - medium/low was established. Potentially medium and high risks require quantification and consideration prior to development. The Site investigation objectives described above should represent part of a detailed main stage investigation that should include overall characterisation of the ground in association with obtaining and analysing the information described above.

### Human Health Risk – Soils Contamination Summary

Based on the preliminary CSM and the current use of the Site, the overall risk from land contamination at the Site is considered to be **low to moderate** for a redeveloped Site. This would need to be confirmed by appropriate intrusive investigation, testing, and assessment.

### Human Health Risk – Ground Gas Summary

As stated within the CSM table, adopting the CL:AIRE RB17 approach, where natural soils with low organic content are present and there is generally less than 1m of Made Ground with no significant putrescible material, this is not considered to represent a significant ground gas source, therefore no gas monitoring is required and the Site would fall into the definition of Characteristic Situation 1 (CS1), with no protection measures required.

Aside from the Made Ground, there are no other viable sources of permanent ground gases. Should significant depths of Made Ground or putrescible material be encountered during any Site investigations then this assessment should be revised.

### Controlled Waters Risk - Summary

Based on the preliminary CSM, GSL believes the overall risk to controlled waters at the Site is **low.**

The above assessed level of risk will need to be confirmed by intrusive investigation and quantitative risk assessment.

# 8 CONCLUSIONS AND RECOMMENDATIONS

## 8.1 ENVIRONMENTAL RISK ASSESSMENT

A preliminary risk assessment has been carried out based on the contaminant-pathway-receptor model as defined in Statutory Guidance to Part IIA of the Environment Protection Act, 1990, and in accordance with BS 10175: 2011 +A1 2013 "Investigation of Potentially Contaminated Sites – Code of Practice". The characteristic ground conditions and elements of the surrounding environment and has been summarised and a risk assessment carried out.

The site has historically remained undeveloped from earliest mapping, as open agricultural land until the mid-1970s where it is understood that hardstanding was placed on site to construct the current layout of the existing car park on site. Off site there has been significant development associated with the wider Wrexham Industrial Estate. There is the potential for shallow Made Ground to be present on site, which may include metals, PAHs, and asbestos. There is no evidence of any hydrocarbon storage or spills on the site but cannot be ruled out. There is no credible ground gas source on site, and the site is located within an area where less than 1% of the properties are above the Radon Action Level.

The results of the risk assessments indicate that there is low potential source of contaminants present at the site and these present a moderate to low risk to receptors including humans, structures, controlled surface waters, and ecological receptors. The risk to the site from ground gases is considered low unless significantly deep and/or organic rich Made Ground is encountered.

In order to make a quantitative assessment of the potential risks and so any required remedial measures can be designed; we recommend that a ground investigation is carried out in accordance with BS 10175: 2011+A1 2013 with a suitably qualified geologist or engineer supervising all works. This should be combined with a geotechnical investigation carried out in accordance with BS 5930:2015 + A1:2020.

The objectives of the Ground Investigation will be:

- To determine shallow soil and groundwater (if encountered) conditions, including whether significant contamination has resulted from past or current land uses.
- To determine the risks posed by any ground contamination and provide recommendations on remedial measures to manage such risks.
- To determine the existence, and if applicable, the extent of contamination within local groundwater beneath the site.
- To provide advice relating to geotechnical issues associated with the site.

## 8.2 PROPOSED SCOPE OF WORKS

The following scope of works are proposed however these may be updated and further refined following the receipt of proposed development loading information:

- Cable Percussion boreholes to determine ground conditions, conduct in situ geotechnical testing and facilitate the retrieval of soil samples for both chemical and geotechnical laboratory assessment
- In situ and laboratory geotechnical testing to assist with foundation design and recommendations, which are anticipated to be piled foundations.
- Shallow Made Ground is anticipated, however to confirm to risk to the proposed development, geoenvironmental chemical testing on selected soil samples to include metals, pH, speciated PAH, sulphate, TOC, and asbestos screens in order to assess potential risks to human health based on historical land uses on the Site and to assist with basic waste characterisation.

# 9 REFERENCES

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BRE SD1 (2005). Concrete in Aggressive Ground. Special Digest 1 (revised edition). IHS BRE Press, Bracknell.

BRE 414 (2001) Protective measures for housing on gas-contaminated land. BRE.

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