

SP ASSOCIATES

**PHASE II GEOTECHNICAL ASSESSMENT
PROPOSED INDUSTRIAL DEVELOPMENT
R & R ENGINEERING
WREXHAM**

Client: R & R Engineering Ltd

Report Number: S1727

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**PHASE II GEOTECHNICAL ASSESSMENT
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R & R ENGINEERING
WREXHAM**

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- B Sitecheck Data Report
- C Initial CSM
- D Borehole Logs
- E Laboratory Test Results
- F Amended CSM

EXECUTIVE SUMMARY

The Site	The R & R Engineering facility is located off Oak Road to the east of Wrexham Industrial Estate at approximate National Grid Reference 339070 349200 (Figure 1). The industrial site comprises two sub-sites, one located to the north of Oak Road and one to the south which in total comprise about 0.8ha of land.
History	Both sub-sites comprised agricultural land before being incorporated into a peripheral area of ROF Wrexham. The sites were then occupied by a builders yard before being developed by R & R Engineering.
Geology	The site is underlain by superficial deposits of Glacial Till that overlie Kinnerton Sandstone.
Hydrogeology	The Kinnerton Sandstone is classified as a Principle aquifer whilst the overlying Till is classified as a Secondary Undifferentiated Aquifer.
Radon Gas	The site is in a Lower Probability radon area where less than 1% of properties are above the Radon action level. Radon protection will not be required for the proposed development.
Ground Investigation	Boreholes : A total of 3no boreholes were sunk on the site located to the south of Oak Road with a further 2no boreholes being sunk on the site located to the north of Oak Road, They were sunk on the 5th March 2021 and were each taken to 4.45m depth. Laboratory Testing: The following list of potential contaminants of concern has been specified for the laboratory testing program on selected soil samples: Asbestos, phenols, heavy metals, inorganic chemicals, Speciated Petroleum Hydrocarbons and PAHs. Five samples of the cohesive formation taken from the approximate foundation horizon have been tested for Index properties. Standpipe Monitoring: Concentrations of methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide gas have been measured within two borehole standpipes on three occasions within the period 16th March 2021 to the 14th April 2021. Groundwater levels within the standpipes were also measured at each monitoring visit.
Ground Conditions	Made Ground: Made Ground deposits were present within each of the boreholes to depths of between 0.2m and 0.6m below ground surface. The formation comprised loose, silty sand with shale in Boreholes 4 and 5 (northern development plot) and ashy, silty sand with brick, shale and concrete in Boreholes 1, 2 and 3 (southern development plot). Glacial Till: Glacial Till was encountered as a firm, firm to stiff and then stiff, brown and grey mottled clay. In Borehole 3, the cohesive formation encountered between 0.5m and 2m depth contained occasional fine, angular gravel. Groundwater: Stabilised groundwater levels were measured in the borehole standpipes at the following depth ranges: Borehole 1: 0.22 – 0.31 (mbgl); Borehole 5: 3.27 – 3.37 (mbgl)

Foundations	The natural firm to stiff Glacial Till formation that underlies the thin Made Ground deposits should be capable of supporting light to medium structural loads whilst maintaining total and differential settlements within accepted tolerances. Conventional strip or pad footings should therefore be suitable for the proposed development. Such foundations taken a minimum depth below finished grade of 900mm to found within the firm or firm to stiff Till may be designed using an allowable bearing capacity of 140kPa.
Ground Floor Slabs	The borehole investigation has revealed that the natural cohesive formation present beneath the thin, superficial Made Ground horizon is of Intermediate Plasticity and as such will potentially be susceptible to volume changes in response to variations in natural moisture content. If the proposed industrial units are sensitive to differential movements between the slab and the structural frame it is recommended that the Made Ground and natural formation beneath the slab are replaced with well compacted engineering fill to a depth that exceeds the zone of seasonal moisture content change which is conventionally about 1m below ground surface. This precaution will minimise the impact of any such volume changes on the integrity of the ground floor slab. The adoption of a suspended ground floor slab would eliminate this potential differential movement issue without the need for soil excavation and replacement, however; this option may require the construction of internal footings depending upon the dimensions of the slab and its working load bearing requirements. If the proposed units are relatively tolerant of minor differential movements between the frame and structural slab then conventional slab on grade techniques may be employed whereby the slab is constructed upon a 150mm thick sub-base of well compacted engineering fill.
Below Ground Concrete	The measured pH and water soluble sulphate values fall within concrete Class DS-1 as defined in BRE Special Digest 1, 'Concrete in aggressive ground', 2005', with a corresponding ACEC class of AC-1s.
Soil Remedial Measures	Soil remedial measures should not be required at the site.
Gas Membranes	Gas protection measures should not be required for the proposed development units.

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1. INTRODUCTION

SP Associates (SPA) have been appointed by R & R Engineering Ltd to carry out a Geotechnical Assessment at their industrial facility located on Oak Road, Wrexham Industrial Estate, Wrexham, LL13 9RG. We understand that the proposed development will comprise the construction of two steel portal frame industrial buildings, one to be located in the Company's property situated to the south of Oak Road, with the second to be constructed on land to the north of Oak Road.

The scope of the investigation that forms the basis of this Phase II Geotechnical Assessment is as follows:

- Acquisition of Phase I environmental and land use data;
- Boreholes sunk using a windowless sampler drilling rig;
- Borehole instrumentation comprising gas and groundwater monitoring standpipes;
- Standpipe monitoring for ground gas concentrations and groundwater levels;
- Testing of selected soil samples in the laboratory for chemical and geotechnical parameters;
- Analysis of data and reporting.

The investigation was implemented in order to assess the geotechnical and geo-environmental conditions at the site and to identify potential geotechnical and geo-environmental issues related to the construction of the proposed new industrial buildings. This report presents the factual data from the investigation and makes recommendations on foundations, ground floor slab and pavement design along with issues associated with soil and ground gas contamination.

2. THE SITE

2.1 LOCATION AND SURFACE CONDITIONS

The R & R Engineering facility is located off Oak Road to the east of Wrexham Industrial Estate at approximate National Grid Reference 339070 349200 (Figure 1). The industrial site comprises two sub-sites, one located to the north of Oak Road and one to the south which in total comprise about 0.8ha of land.

The southern plot, which is the larger of the two, is approximately rectangular in shape and bounded to the north by Oak Road from which it is accessed. The plot houses R & R Engineering's main manufacturing facility and offices along with an open area of storage land some of which will be utilised for the construction of one of the proposed new industrial units. The site surface comprises an amalgam of tarmac surfaced access and parking pavement along with concrete and hardcore surfaced storage areas. The plot effectively wraps around a garage business which is also accessed from Oak Road.

The smaller of the two plots located to the north of Oak Road is occupied by a second manufacturing unit along with offices housed in sectional buildings. External areas comprise hard surfaced access pavement along with some areas of open, rough ground.

Industrial units within the Wrexham Industrial Estate lie to the north of the site with small scale industrial and commercial businesses located to the west. A few residential properties lie to the east with wooded land to the south.

2.2 HISTORY

The site's historical land use has been assessed using Ordnance Survey maps dating from 1890 copies of which are enclosed within Appendix A. A summary of the site's history and that of immediately adjacent land is tabulated below:

Date	Site Features	Nearby Features of Note
173	The site comprised open, agricultural land bisected by Oak Road.	The area immediately surrounding the site comprised an agricultural field system. Ponds were present within some of the fields, and a residential property known as Lower Oak Cottage was located about 100m to the east.
1961	The northern part of the site was now occupied by a number of rectangular and 'L' shaped industrial buildings potentially associated with ROF (Royal Ordnance Factory) Wrexham which had been developed as part of the war effort on land to the south, west and north of the site. A track, part of which was raised on embankment, bisected the site from north to south and linked the industrial units located on the northern site area with storage bunkers located to the south and west. A hydrant was located in the southern site area.	Land to the south and west of the site comprised part of ROF Wrexham and was occupied predominantly by storage bunkers. Land immediately to the north remained in agricultural use with land to the north of that comprising part of the ROF facility. Land to the east was in agricultural use.

1972	The site remained as shown on the 1961 map edition.	Land to the south and west remained as part of the ROF facility but presumably now disused. Former ROF land to the north had been redeveloped with a Power Cables factory. Land to the east remained in agricultural use.
1988	The industrial units occupying the northern component of the site were now shown to be part of a Builders Yard.	The surrounding area remained as shown on the 1972 map.
1992	The south-western quadrant of the southern site area had been planted with trees as part of landscaping operations carried out on former ROF land to the south and west.	The surrounding area remained as shown on the 1972 map.
2006	The main R & R Engineering facility located in the southern site area had been constructed.	The former ROF land to the south and west is now shown as woodland.

In summary, the Ordnance Survey record shows that the site comprised agricultural land until some point prior to 1961 when it was incorporated into part of ROF Wrexham. The site comprised a peripheral element of that facility and was occupied by a pair of buildings, now comprising a garage, and a track that linked those buildings to storage bunkers located to the south.

2.3 GEOLOGY

The site is shown on British Geological Survey 1:50,000 scale geological maps as being underlain by Kinnerton Sandstone of Triassic age. This solid formation is overlain by Glacial Till which is predominantly cohesive in nature.

2.4 HYDROGEOLOGY AND HYDROLOGY

The nearest significant surface water feature is the Clywedog River that lies about 250m to the south.

The Kinnerton Sandstone is classified by the Environment Agency as a Principle Aquifer. These are formations that generally possess high intergranular and/or fracture permeability, with the result that they may provide a high level of water storage. They may be of regional importance for domestic, industrial and agricultural water supply.

The Till that overlies the Kinnerton Sandstone is classified as a Secondary Undifferentiated Aquifer.

The site lies within Zone III (Total Catchment) of a Source Protection Zone.

There are no groundwater or surface water abstraction licenses within 500m of the site.

2.5 POTENTIALLY CONTAMINATING ACTIVITIES

The Sitecheck Data report (Appendix B) has reported the following:

- There are no records relating to Licensed Waste Management Facilities within 250m of the site.
- There are no records of Registered Waste Transfer sites within 250m of the site.

- There are no records relating to Registered Landfill Sites within 250m of the study site.
- There are no records of Local Authority Pollution Prevention and Control Licences within 250m of the site.
- There are no COMAH sites located within 250m of the site.
- There are no Storage of Hazardous Substances consents within 250m of the property.
- There are records of one Integrated Pollution Prevention and Control within 250m of the site. The record relates to Hlc Waste Management Services Ltd located in the former Bloc 2 Building, Oak Road which lies about 50m to the east of the site.
- There are no records of Prosecutions Relating to Authorised Processes within 250m of the site.
- There are records of 19no Contemporary Trade Directory entry within 250m of the site only three of which are active. The active entries refer to the Bowling Bank Garage that occupies land immediately adjacent to the R & R Engineering site, a packing crates and packaging business that lies on Oak Road to the east and a distribution business that lies to the north-west within the Wrexham Industrial Estate.
- There are records of 2no discharge consents within 250m of the site one of which has expired. The active consent is held by Lower Oak Farm for sewage discharge.
- There are no records of BGS recorded Mineral Sites within 250m of the property.

2.6 FUEL STATION ENTRIES

There are no records of fuel station entries within 250m of the site.

2.7 HISTORICAL TANKS AND ENERGY FACILITIES AND POTENTIALLY CONTAMINATIVE PAST INDUSTRIAL USES

There are records of a 2no historical tanks and potential petroleum storage facilities within 250m of the site. Neither of these features are considered to have negatively impacted the study site.

There are records of one historical potentially contaminative industrial use for the site itself. The record refers to the site's historical use as part of ROF Wrexham. The historical Ordnance Survey map record has indicated that the site comprised a peripheral area to the military site and that it was not used for the manufacture or storage of Ordnance.

There are 10no records of infilled land within 250m of the site. The records all relate to small scale ponds and areas of marsh that were infilled to accommodate ROF Wrexham and the subsequent Wrexham Industrial Estate.

2.8 RADON GAS

The site lies in a lower probability radon area where less than 1% of homes are estimated to be at or above the action level. No radon protection measures should be required for the proposed new development.

2.9 GROUND STABILITY

The Phase I Assessment indicates that the risks associated with compressible ground, collapsible ground, ground dissolution, landslides, running sand and shrinking or swelling ground are very low or no hazard.

3 RISK SUMMARY AND CONCEPTUAL SITE MODELS

The following risk summary is predicated upon the findings of the Phase I site data.

3.1 HUMAN HEALTH RISKS

The land use database for the site has indicated that it has historically comprised a peripheral part of the former ROF Wrexham site that manufactured ordnance as part of the war effort. The historical map record shows that the site was not associated with the primary manufacturing facility but instead comprised an access area to storage bunkers that were located on land to the west and south. More recently, the two development plots have comprised open storage and temporary office land within the R & R Engineering site. The plots are considered to pose a low risk to human health. This risk category has been arrived at on the basis that widespread contamination is not anticipated to be present on site and the proposed site use is industrial and therefore low sensitivity in nature.

Construction workers are considered to be the most significant human health receptor and a moderate risk is envisaged as significant harm is possible in the short term. However, this increased risk can be mitigated by ensuring that appropriate work procedures are adhered to and that direct contact with potentially contaminated material is avoided through the wearing of appropriate PPE.

For future site occupants the majority of pathways between source and receptor are anticipated to be negated or significantly reduced resulting in betterment to the site. Consequently, a low risk is envisaged as it is improbable that significant harm would occur even in the long term.

3.2 GROUND GAS

The site is considered to be at a low level of risk from ground gases due to the apparent absence of localised significant areas of filled ground and the low potential for the presence on site of significant quantities of Made Ground. The risk of gas migration onto the site from any off-site sources is likely to be somewhat mitigated by the presence of cohesive Glacial Till.

3.3 CONTROLLED WATERS

A low risk is considered to be appropriate at this stage for controlled waters. The risk has been assigned on the basis that it is not anticipated that widespread contamination is present, the absence of on-site surface water features and the low permeability nature of the Glacial Till. Also, it is considered unlikely that any significant harm would occur, even in the very long term, due to the presence of low permeability superficial deposits that overlie the Principle Aquifer. It is also unlikely that any significant contamination would migrate to sensitive surface water receptors.

3.4 BUILDINGS AND SERVICES

The Phase I data indicates that the site is at low to moderate risk from aggressive contaminants within soil and groundwater that have the potential to attack building materials and services.

3.5 CONCEPTUAL SITE MODEL

The development of a Conceptual Model for the site involves the determination of potential pollutant linkages through the identification of likely sources of contamination from previous and current site uses and the identification of potential receptors such as site users and controlled waters. A Conceptual Site Model developed from the Phase I

site data for Human Health, Geotechnical Issues, Ground Gas and Controlled Waters is enclosed within Appendix C. A post-investigation amended version is enclosed within Appendix F

4 GROUND INVESTIGATION

4.1 GENERAL

The fieldwork was carried out generally where relevant in accordance with BS5930 (1999) 'Code of Practice for Site Investigations', BS10175 Investigation of Potentially Contaminated Sites, and the Association of Geotechnical and Geo-environmental Specialist Guidelines for Good Practice in Site Investigations (1998).

The exploratory boreholes were positioned within the footprints of the two proposed industrial units.

4.2 WINDOW SAMPLER BOREHOLES

A total of 5no boreholes were sunk across both plots on the 5th March 2021 using a window sampler drilling rig. Boreholes 1, 2 and 3 were sunk within the development plot to the south of Oak Road with Boreholes 4 and 5 sunk in the northerly plot. Access to the northerly plot was somewhat restricted as most of it was occupied by sectional office buildings.

The boreholes were each taken to 4.45m below ground surface where they were terminated within stiff formation. Standard Penetration Tests were carried out at 1m intervals within each borehole with full depth liner soil samples being recovered for soil description and testing requirements.

Borehole locations are shown on Figures 2 and 3 with borehole logs enclosed within Appendix D.

4.3 STANDPIPES

Groundwater and gas monitoring standpipes were installed within Borehole 1 and 5 upon the completion of drilling as detailed below:

Borehole	Depth to Base (m)	Response Zone (m bgl)	Pipe Diameter (mm)	Gas Valve/Lockable Cover
1	4.0	1.0 – 4.0 (firm to stiff clay)	50	Yes
5	4.0	1.0 – 4.0 (firm to stiff clay)	50	Yes

4.4 LABORATORY TESTING

The Phase I environmental database has indicated that the two plots have historically comprised a peripheral part of ROF Wrexham before being occupied by open storage and office land within the R & R Engineering facility. The risk assessment detailed in Chapter 3 has indicated that the risk to human health at both plots is considered to be low given that they comprised part of an access area, an area of open storage and an area of land occupied mostly by sectional office buildings. However, there may have been some Made Ground materials imported onto the site as a component of development works and consequently, the following list of potential contaminants of concern has been specified for the laboratory testing program:

Asbestos, phenols, heavy metals, inorganic chemicals, Speciated Petroleum Hydrocarbons and PAHs.

Selected soil samples from the borehole investigation have been tested in the laboratories of Chemtest for the above range of chemical determinants.

With regard to geotechnical testing, 5no samples of the cohesive Glacial formation taken from the approximate foundation horizon have been tested for Index properties in the laboratories of Socotec.

Chemical and Geotechnical test results are enclosed within Appendix E.

4.5 MONITORING

Concentrations of methane, carbon dioxide, oxygen, hydrogen sulphide and carbon monoxide gas have been measured within the borehole standpipes on three occasions within the period 16th March 2021 to the 14th April 2021. Total gas concentrations were taken using a GA2000 Plus meter with atmospheric pressure meter. The rate of gas flow from the standpipes was measured using a flow meter.

Groundwater levels within the standpipes were also measured at each monitoring visit.

The results obtained from the monitoring exercise are summarised on Table 1.