GEOENVIRONMENTAL DESK STUDY REPORT

M400 Heywood Distribution Park
Pilsworth Road
Heywood, Manchester

Reference	**5986-JPG-XX-XX-RP-G-0604-S2-P03**
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CONFIDENTIALITY STATEMENT

This report is addressed to and may be relied upon by the following:

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This report has been prepared for the sole use and reliance of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of JPG (Leeds) Limited. No responsibility will be accepted where this report is used, either in its entirety or in part, by any other party.

DOCUMENT HISTORY

Rev	Date	Revision Details	Status	Author(s)	Approved
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EXECUTIVE SUMMARY

Site Address	**M400 Heywood Distribution Park, Heywood, Manchester**
NGR	383819, 409515
Current Site Use & Proposed Development	The site has an area of approximately 11 hectares (ha) and comprises a roughly rectangular shaped parcel of land, measuring approximately 460m along its north to south axis and 310m along its east to west axis. The site currently comprises undeveloped land, predominantly used for the storage of container lorries, with an operational depot in the south-west. It is proposed to develop the site with a distribution centre, which will include two-storey offices, associated parking and ancillary infrastructure.
Site History	Prior to 1974, OS mapping indicates the site was used for agricultural purposes, associated with a farmstead located to the south-west (Upton's). However, anecdotal evidence suggests that parts of the site were used by the MOD from 1930 to 1960. During the late 1960s and 1970s the Heywood Distribution Park began to be built out. A depot was constructed in the south of the site and two small buildings in the east by the mid-1970s. By April 2013, aerial imagery indicates that only the depot in the south-west remained.
Site Setting	**Geology** – Landscaped ground is recorded on the majority of the site with the exception of the north-east. The superficial deposits are indicated to comprise glacial till. The bedrock geology comprises mudstone, siltstone and sandstone of the Pennine Lower Coal Measures Formation, with a band of Helpet Edge Rock Sandstone, trending north-west to south-east across the site. There are two linear features on the site also trending north-west to south-east, corresponding to the Upper Foot Coal seam and an overlying marine band horizon. **Mining** - The site is not affected by coal mine workings. **Quarrying and Surface Mineral Workings** – There is one record of a former British Pit within 500m of the site, located 408m south of the site. There is no evidence of quarrying on the site. **Hydrogeology** - The majority of the superficial deposits (relating to glacial till) are classified as a Secondary Undifferentiated Aquifer with the exception of the northern edge of the site where the superficial deposits classified as a Secondary A Aquifer (relating to the glaciofluvial deposits). The bedrock geology on the site is classified as a Secondary A Aquifer. The vulnerability of both the superficial and bedrock geology is classed as low, based on low infiltration rate. There is one active groundwater abstraction license area located approximately 307m to the south-west of the site. There are no potable water abstraction licences within 2km of the site. There are no source protection zones within 500m of the site. **Hydrology** - The site is located within the Water Framework Directive (WFD) surface water body catchment area for Whittle Brook (Irwell). The nearest WFD surface water body is Whittle Brook (Irwell), located 1.58km from the site. There are ten records of surface water features within 250m of the site. These surface water features relate to Brightley Brook, either at ground level or underground, i.e. culverted. Brightley Brook is located approximately 200m to the south of the site and is described as an inland river not influenced by normal tidal action. On OS mapping, its flow is indicated to be generally from east to west in the vicinity of the site. There are three records of active discharge consents (of treated or untreated effluent) to surface water within 500m of the site, two of which are presumed to be active. The site lies within a Zone 1 floodplain. **Environmental Permits and Registers** – There are three records of Control of Major Accidents Hazard (COMAH) sites within 500m of the site. The records relate to sites located immediately to the north-west of the site, approximately 49m to the west and approximately 425m to the north-west. The Eddie Stobart site, located immediately to the south of the site, has consent for storage of hazardous substances. **Landfill and Waste** – There are two records of active (or recent) landfill sites, located approximately 283m to the south-west and approximately 380m to the west of the site. Both are operated by Viridor Waste Management Limited. **Radon Risks** - The site is not in a radon affected area.
Environmental Risk Assessment	Based on the history of the site and adjacent area, the information provided to date, the following potentially contaminative sources may be present: • Potentially contaminated made ground/groundwater and hazardous ground gases/vapours associated with the site's former uses. • Potentially contaminated made ground/groundwater associated with former ponds. • Potentially contaminated made ground/groundwater and hazardous ground gases/vapours associated with the active and historical tanks located on the site. • Potential ground gas associated with the active landfill sites operated by Viridor Waste Management Limited located approximately 283m to the south-west and approximately 380m to the west of the site. Based on the end use and history of the site, the following potential pollutant linkages may be present: • Development and maintenance workers and site end users (future employees) could come into contact with soils and groundwater containing elevated concentrations of potential

	contaminants and hazardous ground gases/soil vapours. • The underlying Secondary Aquifers could become contaminated due to the leaching and migration of potential contaminants from the made ground; and, • Buildings and services could be affected by potential contaminants in any made ground. These are based on current site conditions and do not consider exposure pathways following any remediation of the site.
Preliminary Engineering Assessment	**Mining & Quarrying** - Based on the geological setting, the probability of shallow unrecorded coal workings is considered to be very low and not warranting further assessment. There are no recorded mine entries on the site or within 20m of the site boundary. The risk of unrecorded mine entries on the site is considered to be very low. **Foundations** - It is anticipated that a shallow foundation solution would be appropriate for lightly loaded buildings and structures on the site. However, if the shallow natural strata is proven to be unsuitable for shallow foundations, i.e. too weak or compressible, or greater bearing capacity is required, then consideration could be given to ground improvement or the adoption of deeper foundations such as piles. In relation to the proposed van deck parking, it is likely that foundations will be required to extend through the glacial till to bear onto the underlying bedrock. **Ground Floor Construction** - The properties of the underlying natural soils will need to be investigated to determine if ground bearing floor slabs can be used. The requirements of any ground gas protection measures will also need to be taken into consideration in relation to ground floor design and construction. **Groundwater** - The presence of groundwater will need to be assessed as part of any ground investigation. **Obstructions** - The presence of obstructions including existing services should be anticipated given the previous developments on and adjacent to the site. **Earthworks** - Based on the proposed development and ground levels, some cut and fill earthworks will is required. Testing of materials on site will be carried out as part of the further investigation to confirm suitability of materials to be incorporated into the earthworks. **Chemical Attach on Buried Ground** - Samples of made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity and hence the concrete class required for buried concrete to the latest standard.
Further Work Required	In order to further assess the potential geotechnical and environmental constraints to the proposed development, it is recommended that the following investigative works be carried out: • Dynamic sample boreholes with rotary cored follow-on, complete with in-situ tests to provide geotechnical information in order to assess the nature of the made ground, superficial deposits and bedrock geology. These boreholes will also facilitate the installation of gas and groundwater monitoring wells and allow soil samples to be obtained from depth. • Window sample boreholes to assess the shallow ground conditions at the site and confirm the composition, extent, depth and nature of the made ground and natural strata. Samples will be obtained to submit for laboratory testing. These boreholes will also facilitate the installation of gas and groundwater monitoring wells where required. • Trial pitting in order to assess the shallow ground conditions at the site and confirm the composition, extent, depth and nature of the underlying made ground. Samples will also be obtained to submit for laboratory testing. • Chemical analysis of soil, leachate and water samples in order to determine the concentrations of potential contamination on the site. • An assessment of the classification of materials for disposal off-site (not including WAC testing). • Geotechnical testing to classify materials and inform foundation design and chemical testing to determine the Aggressive Chemical Environment for Concrete classification. • Monitoring of gas and groundwater wells for groundwater level and hazardous ground gases, including methane, carbon dioxide, oxygen and flow rate. On completion of the above, a Phase 2 geoenvironmental ground investigation report, to include a Tier 2 Generic Quantitative Risk Assessment, will be prepared.
This sheet is intended as a summary only of the assessment of the site in relation to ground condition. It does not provide a definitive engineering analysis.	

1.0 INTRODUCTION

1.1 Instruction

JPG (Leeds) Limited (JPG) has been instructed by Black Cat Building Consultancy Limited to provide a geoenvironmental desk study report for a proposed commercial development at M400 Heywood Distribution Park, Pilsworth Road, Heywood.

1.2 Objectives

The main objective of the geoenvironmental desk study is to identify potential geotechnical and environmental issues that may represent constraints to the proposed development of the site.

1.3 Scope of Works

The scope of works for the desk study includes the following:

- Site description.
- Review of contemporary and historical Ordnance Survey publications and available aerial photographs.
- Consultations with regulatory authorities, where appropriate.
- Review of geological publications (including hydrology, hydrogeology, and soil survey publications, where appropriate).
- Review of the radon status of the site.
- An environmental database search.
- Outline environmental risk assessment.
- Preliminary recommendations with respect to foundations, ground floor and pavement design.
- Recommendations for further work, where appropriate; and,
- Presentation of the findings in a tabular non-technical summary.

1.4 Location

The site is situated approximately 1.7km to the south-west of Heywood town centre and approximately 12km to the north of Manchester city centre. The approximate centre of the site is located at NGR 383819 409515.

A site location plan is provided as Figure 1 in Appendix A.

1.5 Site Description and Topography

The site has an area of approximately 11 hectares (ha) and comprises a roughly rectangular shaped parcel of land, measuring approximately 460m along its north to south axis and 310m along its east to west axis. The site can be accessed from the internal access road network associated with Heywood Distribution Park.

The site currently comprises undeveloped land, predominantly used for the storage of container lorries, with an office building/depot in the south-west. Steel palisade fencing bisects the site, separating the northern area from the southern area. Access roads extend approximately east to west along the southern boundary and east to west in the north.

The north of the site includes a concrete hardstanding area, which is used for car parking. The north-east of the site is primarily concrete surfaced with some areas of compacted gravel at the surface and utilised for storing refrigerator containers and lorries. There are peripheral areas of landscaping including some mature trees and shrubbery. The north-west of the site comprises an area of scrubland, which is raised above the surrounding landform and encompassed by concrete access roads. Headworks associated with recently installed monitoring wells are evident at ground level. The south-east comprises concrete hardstanding used for the storage of container lorries. The south-west also comprises concrete hardstanding used as a depot.

The landform is generally level and flat with the exception of the scrubland in the north-west, which is raised approximately 1m above the rest of the site.

The site's boundaries are formed by access roads along the two northern boundaries, steel post and mesh fencing along the western boundary, landscaping along the eastern boundary and another access road along the southern boundary. The south-east of the site is bordered by an industrial building.

Adjacent land use consists of commercial development associated with Heywood Distribution Park with small industrial buildings to the north and south of the site and large industrial units to the east and west.

An aerial photograph of the site is included as Figure 2 in Appendix A and selected photographs of the site are provided in Appendix B.

1.6 Development Proposals

It is proposed to develop the site with a distribution centre, which will include two-storey offices, associated parking and ancillary infrastructure.

A proposed site layout plan has been provided. This is referenced below and included in Appendix A.

- AshtonSmith. Heywood Distribution Park – External Works. Proposed Site Plan, Drawing No. HDP1-ASA-30-EX.SI-D-A-3001_(S0. Dated 30 September 2021.

1.7 Limitations

The general limitations to the nature of the investigation are outlined in Appendix E.

2.0 SITE HISTORY

2.1 Ordnance Survey Mapping

Historical maps for the site were obtained from GroundSure (GS). These have been reviewed in order to establish any former uses of the site and identify any potentially contaminative historical uses or potential geotechnical constraints to the proposed development.

A summary of the relevant map information is provided in Table 2.1 and copies of the Ordnance Survey (OS) maps are provided in Appendix C.

Table 2.1 – Summary of Relevant Historical Map Information

Date(s) & Scale	Feature
1851 1:10,560	**The site comprises agricultural fields and includes three ponds near the western boundary. There is a track entering the site from the south-east and extending to the north-west, following the field boundaries.** The surrounding area generally comprises open fields. The Lancashire and Yorkshire railway extends east to west within a cutting approximately 50m to the north of the site. There is a pump approximately 100m to the south-east. 'Upton's', presumably a farmstead, is located approximately 200m to the south-west. Brightley Brook, aligned north-east to south-west, approximately 200m south of the site. An old sandstone quarry is located approximately 350m to the south of the site and Barlow's Coal Pits are located approximately 400m to the south.
1890-1891 1:10,560 **1890 1:1,250, 1:2,500**	**Two further ponds are located in the north-west.** A further pond is discernible immediately beyond the western boundary. This pond appears to be connected to the three ponds referenced above.
1908-1909 1:10,560	**No significant changes are shown on or adjacent to the site.**
1910 1:1,250	**No significant changes are shown on or adjacent to the site.**
1928 1:10,560 **1930 1:2,500**	**No significant changes are shown on or adjacent to the site.**
1938 1:10,560 **1937-1939 1:2,500**	**No significant changes are shown on or adjacent to the site.**
1955-1956 1:10,560 **1957 - 1958 1:1,250** **1956- 1957 1:2,500**	**No significant changes are shown on or adjacent to the site.**
1965-1968 1:10,560 **1966-1970 1:2,500** **1966 1:1,250**	**Four buildings are indicated in the south of the site, two large and two small, all rectangular in shape. There is a tank in the south of the site adjacent to the building in the south-west.** There is industrial/commercial development immediately to the north, east and south of the site. There is residential development 100m north of the site which includes a school with a large playing field. There is a depot immediately to the east of the site. A works building, later annotated as a sewage works, is indicated approximately 500m to the south-west.
1974-1975 1:10,000 **1973-1978 1:1,250** **1978-1984 1:1,250**	**The site is annotated as a depot. The ponds in the west are no longer present, presumed to have been infilled. Industrial/commercial development, comprising a large unit and a small unit with a small rectangular pond, is shown in the east.** A large industrial unit is shown approximately 50m to the west of the site. Brightley Brook is annotated approximately 200m to the east.
1981-1983 1:10,000	**The large building in the south-east has been extended. The pond in the east appears further to the west than its former location. Access roads have been built across the site.** The general area is annotated as 'Heywood Industrial Estate'. There are new buildings to the north-west and also units to the south-east. There is a reservoir 400m to the north-east.
1992 1:1,250 **1992-1995 1:1,250**	**No significant changes are shown on the site.** There is a further electricity substation approximately 150m to the west.
2001 1:10,000	**No significant changes are shown on the site.** The railway to the north is indicated to be disused.
2010 1:10,000	**No significant changes are shown on the site.** Buildings located near the former coal pits to the south-west of the site are annotated as 'Coal Pits Farm'. The works and sewage works south of the site are no longer present. The reservoir north-east of the site is no longer present.
2021 1:10,000	All buildings except the depot in the south-west are no longer shown and are assumed to have been demolished.

2.2 Historical Aerial Imagery

Available aerial photographs dating from 1985 to 2021 have been reviewed on Google Earth Pro along with imagery provided in the GS report.

Aerial photos dating from June 2000 show the four large industrial buildings located on the site. By April 2013, only the depot in the south-west is present. By this date, the area immediately west of the western boundary has been developed for parking and it is apparent that the scrubland in the north-west has been relandscaped. Since 2013, It appears that the site has been used to store container lorries with no further significant development.

2.3 Other Sources of Information

Previous site investigation reports relating to the site and surrounding land (see Section 3.12) state that Heywood Distribution Park was first established during the 1970s, prior to which large areas of the site were occupied by the Ministry of Defence (MOD) between 1930 and 1960 for aircraft maintenance works, with associated railway sidings. Land to the east was reportedly used by ICI from the 1960s for the storage of agrochemicals and later used by Zeneca Colours (dyes) in the 1990s.

2.4 Summary of Site History

Prior to 1974, OS mapping indicates the site was used for agricultural purposes, associated with a farmstead located to the south-west (Upton's). However, anecdotal evidence suggests that parts of the site were used by the MOD from 1930 to 1960. During the late 1960s and 1970s, Heywood Distribution Park began to be built out. A depot was constructed in the south of the site and two small buildings in the east by the mid-1970s. By April 2013, aerial imagery indicates that only the depot in the south-west remained.

Evidence of coal mining and sand/sandstone quarrying is noted to the south but not within 250m of the site.

3.0 SITE SETTING

3.1 Geology

The GS Report and the following geological publications have been consulted:

- British Geological Survey (BGS). Sheet 85. Manchester. Drift. Scale 1:50,000. 2011.
- British Geological Survey. Sheet 85. Manchester. Bedrock. Scale 1:50,000. 2010.
- British Geological Survey. Sheet SD80NW. Lancashire. Scale 1:10,000.
- Geological Survey of England & Wales. County Series Sheet 88SW Lancashire. 1928.
- BGS, Geology of Britain viewer. Onshore GeoIndex.
- BGS Onshore GeoIndex (http://mapapps2.bgs.ac.uk/geoindex/home.html).
- BGS. The BGS Lexicon of Named Rock Units. BGS Lexicon of Named Rock Units. Details.

The GS report and geological mapping indicates there is landscaped ground (undivided) recorded on the majority of the site with the exception of the north-east. The landscaped ground is presumed to be associated with earthworks operations relating to the development of the distribution park.

The superficial deposits are indicated to comprise glacial till. Superficial deposits consisting of glaciofluvial deposits are indicated approximately 53m to the north-west.

The bedrock geology comprises mudstone, siltstone and sandstone of the Pennine Lower Coal Measures Formation. A band of Helpet Edge Rock Sandstone, a coarse-grained sandstone, trends north-west to south-east across the site.

The site is located between two north-west to south-east trending faults, both with downthrown strata to the north-east. In addition, there are two linear features on the site also trending north-west to south-east, corresponding to the Upper Foot Coal seam and an overlying marine band horizon.

Historical borehole information has been obtained from the BGS GeoIndex. There are nine BGS boreholes recorded on the site, referenced SD80NW202, SD80NW203, SD80NW206, SD80NW207, SD80NW208. SD80NW398, SD80NW410, SD80NW411 and SD80NW437. These are summarised in Tables 3.1.1 to 3.1.9.

Table 3.1.1 – Summary of BGS Borehole Record SD80NW202 (Ground level not known) NGR 383870, 409690 – In North-east of Site.

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Soil	0.46	0.46
Firm brown and grey sandy mottled clay	1.37	1.83
Firm brown boulder clay	1.07	2.90
Hard brown boulder clay	3.51	6.41
Grey shale	>0.15	>6.56

No groundwater recorded.

Table 3.1.2 – Summary of BGS Borehole Record SD80NW203 (Ground level not known) NGR 383910, 409570 – In North-east of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	0.38	0.38
Soft brown and grey sandy mottled clay	1.30	1.68
Stiff brown boulder clay	1.37	3.05
Hard brown sandy boulder clay	3.35	6.40
Sandstone	Not proven	Not Proven

No groundwater recorded.

Table 3.1.3 – Summary of BGS Borehole Record SD80NW206 (Ground level not known) NGR 383860, 409550 – In North-east of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	0.25	0.25
Firm dark brown mottled clay	1.65	1.90
Soft dark grey sandy clay	0.53	2.43
Hard brown boulder clay	5.03	7.46
Hard black weathered shale	1.07	8.53
Very hard black shale	>0.30	>8.83

Groundwater strikes at 2.13m and 8.53m bgl.

Table 3.1.4 – Summary of BGS Borehole Record SD80NW207 (Ground level not known) NGR 383800, 409650 – In North-east of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	0.30	0.30
Firm light brown mottled clay	1.14	1.44
Soft dark grey sandy clay	0.38	1.82
Hard dark brown boulder clay	3.81	5.63
Hard dark grey boulder clay	0.91	6.54
Weathered sandstone	>0.46	>7.00

Groundwater strike at 6.55m bgl.

Table 3.1.5 – Summary of BGS Borehole Record SD80NW208 (Ground level not known) NGR 383720, 409570 – In North-west of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	0.28	0.28
Soft light brown sandy stoney clay	0.41	0.69
Firm light brown mottled clay	0.69	1.38
Firm dark brown boulder clay	1.75	3.13
Hard dark brown boulder clay	5.56	8.69
Firm dark grey stoney clay	0.30	8.99
Sandstone	>0.46	>9.45

Groundwater strike at 8.69m bgl.

Table 3.1.6 – Summary of BGS Borehole Record SD80NW398 (Ground level: 115m)
NGR 383890, 409410 – In Southern Half of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	1.30	1.30
Firm to stiff grey and brown sandy mottled clay	1.60	2.90
Firm to stiff grey/brown sandy clay	3.20	6.10
Hard dark grey shale	2.90	9.00
Black shale	>1.22	>5.33

Groundwater strikes at 4.00m and 5.80m bgl respectively.
Maximum groundwater standing level of 3.0m bgl.

Table 3.1.7 – Summary of BGS Borehole Record SD80NW410 (Ground level: 119.8m)
NGR 383750, 409720 – In Northern Half of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	1.40	1.40
Firm light grey and brown sandy mottled clay	0.60	2.00
Firm grey/brown sandy clay	0.80	2.80
Firm to stiff grey/brown sandy clay	2.20	5.00
Soft to firm grey/brown sandy clay	2.90	7.90
Hard dark grey shale	>1.10	>9.00

Groundwater strikes at 2.00m and 6.00m bgl respectively.
Maximum groundwater standing level of 3.60m bgl.

Table 3.1.8 – Summary of BGS Borehole Record SD80NW411 (Ground level: 118.7m)
NGR 383520, 409270 – In Northern Half of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	1.00	1.00
Soft brown sandy clay	1.50	2.50
Soft to firm grey/brown sandy clay	4.90	7.40
Hard dark grey shale	>6.00	>13.40

Groundwater strikes recorded at 2.50m bgl.
Maximum groundwater standing level of 2.00m bgl.

Table 3.1.9 – Summary of BGS Borehole Record SD80NW437 (Ground level: 118m)
NGR 383520, 409270 – In Southern Half of Site

Strata Description	Thickness of Stata (m)	Depth to Base of Stata (m bgl)
Topsoil	2.30	2.30
Stiff light grey and brown sandy clay	1.40	3.70
Soft to firm brown sandy mottled clay	1.30	5.00
Soft grey and brown very sandy clay	2.60	7.60
Very stiff grey/brown sandy clay	2.20	9.80
Hard dark grey shale	>0.20	>10.00

Groundwater strikes recorded at 8.90m bgl.
Maximum groundwater standing level of 4.00m bgl.

3.2 Coal Mining

A Mining Report and Consultants Report have been obtained from the Coal Authority (CA). These are presented in Appendix D and pertinent information is detailed below.

'The property is not within a surface area that could be affected by any past recorded underground coal mining.'

'The property is not within a surface area that could be affected by present underground mining.'

'The property is not in an area where the Coal Authority has received an application for, and is currently considering whether to grant a licence to remove or work coal by underground methods. However, reserves of coal exist in the local area which could be worked at some time in the future.'

'There are no recorded coal mine entries known to the Coal Authority within, or within 20 metres, of the boundary of the property.'

'The property is not within the boundary of an opencast site from which coal has been removed by opencast methods.'

3.3 Quarrying and Surface Mineral Workings

The GS Report provides information from the British Pits (BritPits) database. This includes records of former sand and gravel pits. There is one record of a former British Pit within 500m of the site. This is summarised in Table 3.3 below.

Table 3.3 - Summary Surface Mineral Workings/Quarrying (Within 500m of the Site)

Distance & Direction	Name	Address	Commodity	Status	Comment
408m S	Three Lane Ends	Darn Hill Heywood	Sandstone	Ceased	Included on OS mapping

The GS report also indicates 32 historical surface ground workings within 250m of the site. 12 records are labelled as ponds, nine of which are located on the site, and 16 records are labelled as cuttings. There are three records of unspecified heaps 197m east of the site and one record of an unspecified hole 94m east of the site.

The GS report indicates seven historical underground workings within 1km of the site. All records relate to coal pits located between 392m and 449m to the south of the site.

The GS report indicates one record of non-coal mining areas within 1km of the site. This record relates to a vein mineral which is located 23m to the south-west of the site. The likelihood for difficult ground conditions has been described as 'unlikely and localised and are at a level where they need not be considered'.

3.4 Hydrogeology

The GS report indicates that the majority of the superficial deposits (relating to glacial till) are classified as a Secondary Undifferentiated Aquifer with the exception of the northern edge of the site where the superficial deposits classified as a Secondary A Aquifer (relating to the glaciofluvial deposits). A Secondary Undifferentiated Aquifer is 'assigned where it is not possible to attribute either category Secondary A or B'. In general, these layers have previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type. A Secondary A Aquifer is described as having 'permeable layers capable of supporting water supplies on 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'.

The GS report indicates that the bedrock geology on the site is classified as a Secondary A Aquifer, described as 'permeable layers capable of supporting water supplies on 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'.

The GS report indicates that the vulnerability of both the superficial and bedrock geology is classed as low, based on low infiltration rate.

There is one active groundwater abstraction license area located approximately 307m to the south-west of the site. The record relates to a dewatering well associated with the Viridor Waste Management Ltd landfill site, off Pilsworth Road, Bury. The licence started in March 2021 and expires in March 2027. There are no other records of groundwater abstraction licences within 1km of the site. There are a further eight records of groundwater abstraction licences (both active and historical) located between 1km and 2km of the site.

There are no potable water abstraction licences within 2km of the site.

There are no source protection zones within 500m of the site.

The GS report indicates that the risk of groundwater flooding occurring on the site and adjacent land is low. However, the risk of groundwater flooding occurring at the site should be assessed based on site specific information.

3.5 Hydrology

The site is located within the Water Framework Directive (WFD) surface water body catchment area for Whittle Brook (Irwell). The nearest WFD surface water body is Whittle Brook (Irwell), located 1.58km from the site.

The GS report indicates there are ten records of surface water features within 250m of the site. These surface water features relate to Brightley Brook, either at ground level or underground, i.e. culverted. Brightley Brook is located approximately 200m to the south of the site and is described as an inland river not influenced by normal tidal action. On OS mapping, its flow is indicated to be generally from east to west in the vicinity of the site.

The latest Environment Agency EA data (2016) provided within the GS Report indicates an ecological quality grade of 'moderate' and a chemical quality grade of 'good' for Whittle Brook at approximately 1,575m to the south-west.

There are three records of active discharge consents (of treated or untreated effluent) to surface water within 500m of the site, two of which are presumed to be active. The active consents are detailed in Table 3.5.1, below.

Table 3.5.1 Records of Licensed Discharge Consents within 500m of the study site

Distance (m) and direction from the site	Site Address	Effluent type	Receiving Water	Status
248m S	Three Arrows Inn, Pilsworth Road, Heywood	Sewage and trade	Brightley Brook	Permit version 2, issued April 2000
460m S	The Boskins Stp, Moss Hall Road, Pilsworth	Sewage Discharges - Final/Treated Effluent - Not Water Company	Tributary of Brightley Brook	Permit effective from February 1997

There are no records of active Red List discharge consents (potentially harmful discharges to surface waters) within 500m.

There is one active surface water abstraction license within 2km of the site. This record relates to surface water from a single abstraction point, a stretch of watercourse or a larger area located 1.46km to the north-west. The water is used for hydroelectric power generation. There are six records relating to historical surface water abstraction licenses within 2km of the site.

Information on the gov.uk website and provided in the GS report indicates that the site lies within a Zone 1 floodplain, i.e. less than 1 in 1,000 (<0.1%) annual probability of river or sea flooding. There are no records of historical flood events since records began in 1946. There are no flood defences within 250m of the site.

The GS report indicates that the highest risk of surface water flooding on site and adjacent is a depth 0.30m to 1.00m for a 1 in 30-year return.

The GS report indicates that the risk of groundwater flooding occurring on the site and within 50m is low.

3.6 Pollution Incidents

There are 13 records of pollution incidents within 500m of the site, 12 of which relate to a landfill site located 489m to the north-west of the site. The other record relates to an incident that occurred approximately 211m to the north-east of the site in April 2001 which had a minor air impact.

3.7 Environmental Permits and Registers

There are no recorded Integrated Pollution Control (IPC) authorisations within 500m of the site.

There are no recorded active Part A (1) licensed industrial activities within 500m of the site.

There are no recorded active Part A (2) licensed pollutant releases within 500m of the site.

There is one active Part B licensed pollutant release within 500m of the site, located 42m east of the site.

There are no recorded active radioactive substance authorisations within 500m of the site.

There are no records of discharges of special category effluents to the public sewer within 500m of the site.

There are no active List 1 or List 2 Dangerous Substances Inventory Sites within 500m of the site.

There are no pollution inventory substances, waste transfer or radioactive waste records within 500m of the site.

There are three records of Control of Major Accidents Hazard (COMAH) sites within 500m of the site. These records include upper and lower tier sites, and also historical COMAH sites and Notification of Installations Handling Hazardous Substances (NIHHS) records. The records relate to sites located immediately to the north-west of the site, approximately 49m to the west and approximately 425m to the north-west. They are summarised in Table 3.7 below.

Table 3.7 Records of COMAH Sites and NIHHS Records within 500m of the study site

Distance (m) and direction from the site	Company	Address	Operation Status	Tier
0m NW (located immediately to the south of site)	Eddie Stobart Logistics Limited	Unit M2 Heywood Distribution Park, Pilsworth Road, Heywood	Current COMAH Site	COMAH Upper Tier Operator
49m W	Beck & Pollitzer Ltd	Mosshall Road, Bury	Historical NIHHS Site	NA
425m NW	Baerlocher UK Ltd	Moss Hall Road, Bury	Historical NIHHS Site	NA

The Eddie Stobart site, located immediately to the south of the site, has consent for storage of hazardous substances. However, no details are included in the GS report.

There are no sites determined as Contaminated Land under Part 2A of the Environmental Protection Act (EPA) 1990 within 500m of the site.

3.8 Landfills and Waste

The GS report includes information on active and former landfill sites supplied by the EA, Local Authority and the BGS.

There are two records of active (or recent) landfill sites, located approximately 283m to the south-west and approximately 380m to the west of the site. Both are operated by Viridor Waste Management Limited. These are summarised in Table 3.8 below.

Table 3.8 - Summary of Historical Environment Agency Landfill Sites (Within 1.5km of the Site)

Distance & Direction	Site Address	Site Reference	Licence Holder	Landfill Type	Status
283m SW	Pilsworth South Landfill, Pilsworth Road, Lancashire, BL9 8QZ	-	Viridor Waste Management Limited	Waste Landfilling; >10 tonnes/ day; Capacity >25,000 tonnes (Excluding Inert Waste)	Effective
380m W	Pilsworth North Landfill Site, Pilsworth Road, Lancashire, BL9 8QZ	-	Viridor Waste Management Limited	Waste Landfilling; >10 tonnes/ day; Capacity >25,000 tonnes (Excluding Inert Waste)	Effective

There are no records relating to historical landfill sites within 500m of the site.

3.9 Current Land Use

The Current Industrial Data, included in the GS report, indicates 19 records of potentially contaminative industrial sites within 250m of the site. One record relates to a tank which is on the site. Other land uses within 250m of the site include tanks, electricity substations, vehicle parts and accessories, electrical features, telecommunications, industrial repairs, published goods and construction completion services.

There are no records of current or recent petrol stations within 500m of the site.

3.10 Historical Land Use

The Past Land Use Data, included in the GS report and based on OS mapping, indicates 37 records of historical industrial land uses within 500m of the site, two records of which are recorded onsite. The historical industrial land uses on site include an industrial estate recorded in 1981 and an unspecified depot recorded between 1974 and 1981. Nearby industrial land uses, within 200m, include cuttings, a pump and unspecified work.

There is one record of an electricity substation on the site, present during 1978 and 1997.

3.11 Radon Risks

The site is not in a radon affected area as defined by Public Health England with less than 1% of properties above the action level. In accordance with the Building Research Establishment (BRE) publication BR211, no radon protective measures are required for new properties constructed on the site.

3.12 Previous Reports

SKM Enviros. Ground Investigation Report. Plots M5, M6 and M400, Heywood Distribution Park. Final V1. Dated April 2011.

The report provides a summary of ground investigation works carried out by SKM Enviros in 2011 to assist in an enquiry to construct a warehouse across Plots M5, M6 and M400.

The following relevant intrusive works were undertaken on-site:

- 12 No. trial pits were excavated across the site to depth of between 2.00m below ground level (m bgl) and 3.20m bgl.
- 10 No. cable percussive boreholes were drilled to depths of between 2.33m bgl and 11.50m bgl.
- 19 No. window sample boreholes were drilled to depths of between 2.00m bgl and 5.30m bgl.

Site Overview
M400 can be split into three areas; the western area, raised through the filling of material generated from the wider development, the eastern area generally covered by hardstanding and the northern entrance area comprising areas of hardstanding and informal soft landscaping. M5 and M6 described as an area of hardstanding and industrial buildings/ storage areas.

Ground Conditions
SKM enviros generally encountered made ground across the whole site to a maximum recorded depth of >3.20m bgl (TP412), though typically this was encountered to an average depth of 1.36m bgl within the western area and 0.90m bgl within the eastern area of plot M400. Made ground was encountered to variable depths of between 0.69m bgl and 2.1m bgl within plot M5 and M6.

Within plot M400, typically the made ground comprised cohesive reworked Devensian Till with varied inclusions of brick, metal, concrete, roots, plastic and organic matter. Sand and gravel were encountered beneath concrete hardstanding within the eastern area of M400. Within the northern and western areas of M400, topsoil from surface to depths of between 0.1m bgl and 1.8m bgl, but to an average of 0.67m bgl. Buried topsoil was also encountered in the western area of M400with an average thickness of 0.47m. Two historical ponds are recorded within plot M400 and were recorded to comprise clay made ground and topsoil in the eastern pond and clay made ground within the western pond.

Within plot M5 and M6, the made ground comprised variable material including sand, gravel, clay or silty topsoil. cohesive reworked Devensian Till with varied inclusions of brick, metal, concrete, roots, plastic and organic matter.

Generally, the made ground (where penetrated) was underlain by natural strata recovered as firm to stiff grey mottled sandy clay with gravel and cobbles in plot M400, and soft to stiff silts/ slightly organic silts within plot M5 and M6. The unit was interpreted by SKM Enviros to comprise 'Devensian Till'. Natural strata was proven at depths between 0.40m and 3.20 bgl, ranging in thicknesses between 0.50m and 7.85m. Bedrock of mudstone and occasionally sandstone was encountered to underly the Devensian till, encountered between 1.4m bgl and 9.2m bgl and were attributed by SKM Enviros to the 'Pennine Lower Coal Measures'.

Ground Gas
SKM Enviros carried out ground-gas monitoring across plot M400 on six occasions between April and May 2007 and on six occasions between January and April 2011. Some wells were unable to be monitored during the 2011 round due to boreholes being flooded or unable to be located. The maximum steady carbon dioxide concentration encountered was 9.8% v/v (WS305) and the maximum elevated methane concentration encountered was 8.4% v/v (BH103). The minimum recorded oxygen concentration was 0% v/v; however, the minimum steady oxygen concentration was 3% v/v (BH101). The maximum peak flow rate recorded was 24.5 l/hr (WS304); however, the maximum steady flow recorded was 4.6 l/hr (BH103).

SKM Enviros recommend Characteristic Situation (CS) 3 protection measures should be implemented for the building, in line with CIRIA C665 (1999).

Groundwater
Limited groundwater was identified during the 2007 ground investigation. Groundwater encountered within installations was interpreted by SKM Enviro to be shallow perched groundwater. Groundwater was identified in three cable percussive boreholes drilled during the 2010 ground investigation. Groundwater was then encountered within all monitored boreholes during subsequent monitoring rounds at depths of between 0m bgl and 1.80m bgl.

No groundwater samples were obtained.

Risks to Human Health
A total of 42 No. disturbed soil samples were collected during the 2007 investigation and a total of 18 No. disturbed soil samples were collected during the 2010/2011 investigation, including samples from trial pits and boreholes.

The 42 No. soil samples collected during 2007 were submitted to ALcontrol Geochem Analytical Services and 18 No. soil samples collected during 2010 were submitted to Chemtest for a range of chemical analysis.

Samples were assessed by SKM Enviros against values equivalent to CLEA Soil Guideline Values (SGVs), called Enviros Screening Values (ESVs) for a commercial/industrial land use and against Environment Agency mixture-specific toxicity thresholds for Total Petroleum Hydrocarbons (TPH).

SKM Enviros recorded no elevated concentrations (above ESVs) of heavy metals, volatile organic compounds (VOCs), BTEX compounds, PCBs or Total Petroleum Hydrocarbons (TPHs) within soil samples collected. No asbestos fibres were recorded in any of the 38No. soil samples collected.

No significant visual or olfactory evidence of organic contamination was recorded in any of the exploratory locations. Gravel within the made ground at BH501 was recorded to contain slag and ashy black gravel was recorded at WS605.

Three site investigation reports (the full reports of which are not available to JPG) have been summarised by SKM Enviros within their April 2011 report. The reports include the following and are summarised below.

- WSP Environmental Limited. Phase I and II Environmental Assessment. Dated 2003.
- Peter Brett Associates. Due Diligence Ground Investigation. Dated 2005.
- Sub Surface. Ground Investigation. Dated 2006

WSP Environmental Limited. Phase I and II Environmental Assessment. Dated 2003.
The investigation has been summarised to comprise a Phase I and Phase II Environmental Assessment across the wider Heywood Distribution Park, which includes plot M400, M5 and M6.

The following relevant intrusive works were undertaken on-site:

- 2 No. trial pits were excavated.
- 10 No. boreholes (cable percussive or window sample) were drilled.
- 10 No. cone penetration tests (CPTs) were advanced.

Background
SKM Enviros summarised pertinent pieces of historical information which may be relevant. Much of the site was occupied by the MOD between 1930 and 1960 for aircraft maintenance works and railway sidings. The area to the east of plot M400 was occupied by ICI from the 1960s for the storage of agrochemicals and by Zeneca Colours (dyes) in the 1990s, yet no contamination had been identified in previous ground investigations. One small area classed as a former sand and/or clay pit is present within plot M400. A large sand pit was located to the west of Heywood Distribution Park, which is now classed as a landfill. It is suspected that an underground heating oil tank is present in the central area of M5 and M6. Four above ground diesel/ heating oil tanks are present to the north of the unit within M5.

Ground Conditions
Made ground was encountered across the whole site to a maximum recorded depth of 1.90m bgl (BH1210), though typically this was encountered to an average depth of approximately 0.30m bgl. Devensian Till was encountered to a maximum depth of 5.6m bgl. Bedrock of weathered mudstone or sandstone was encountered to underly the Devensian till, encountered between 3.85m bgl to 5.6m bgl.

Risks to Human Health
Hydrocarbon odours were noted in the made ground within two discrete locations in the southern site area (BH4220, maximum PID of 14.7ppm and BH4218, maximum PID of 0.6ppm); chemical analysis indicated slightly elevated TPH concentrations relative to other locations. The concentration of lead recorded in BH4218 exceeded the relevant guideline.

Peter Brett Associates. Due Diligence Ground Investigation. Dated 2005.
The investigation has been summarised to comprise a due diligence ground investigation across the wider Heywood Distribution Park, which includes plot M400.

The following relevant intrusive works were undertaken on-site:

- 25 No. trial pits were excavated across the site to depth of between 2.00m below ground level (m bgl) and 3.20m bgl.

Ground Conditions
It is summarised that ground conditions encountered comprised inert demolition waste within brown to black organic clay, with variable inclusions of brick, tile, concrete, stones, plastic, slate, wood, cloth and metal within a clay matrix within the raised area. Natural ground, described as glacial till, was encountered at depths between 0.20m bgl and 2.2m bgl. Topsoil was encountered to overly the glacial till in some locations, interpreted by SKM to represent the original surface level prior to filling. PBA estimated that the volume of fill within the raised area is between 40,000m^3 to 45,000m^3.

Sub Surface. Ground Investigation. Dated 2006.
SKM Enviros commissioned four cable percussive boreholes within the eastern area of plot M400 for geotechnical data purposes. Ground conditions encountered comprises cohesive and granular made ground between 0.60m and 1.50m thickness, underlain by glacial till to between 5.10m bgl and 7.0m bgl. Bedrock of mudstone or sandstone was encountered at 5.1m bgl and between 6.5m bgl and 7.0m bgl.

Waterman. Remediation Strategy. MN400 Heywood Distribution Park, Heywood, Greater Manchester. Dated December 2013.
The report provides a summary works required to remediate the site to an acceptable level for a commercial development.

The report recommends the following remedial activities:

- Application of required environmental permitting and consents for material and waste management, notably relating to the cut/fill required to form a level site.
- Completion of an asbestos risk management plan due to the presence of demolition type materials within the western raised area.
- Decommissioning of all boreholes prior to remedial works.
- Site clearance.
- Application of remedial target values for topsoil in landscaped areas, material reused as fill beneath access roads and material reused as fill beneath buildings.

- Suitable methods for the disposal of contaminated or unsuitable material offsite.
- Method for unidentified contamination.
- Removal of underground obstructions which are not to be re-used as part of the development.
- Excavation, inspection, screening and re-engineering of made ground.
- Installation of CS3 gas protection measures.
- Verification reporting.

E3p. Supplementary Site Investigating and Remediation & Enabling Works Strategy. mediation Strategy. M400 Heywood Distribution Park. Dated November 2016.
The report provides a summary of supplementary ground investigation works carried out to inform the sites remediation strategy and enabling works specification.

The following relevant supplementary intrusive works were undertaken on-site:

- 17 No. trial pits were excavated across the site to a maximum depth of 3.90m bgl.
- 3 No. cable percussive and rotary boreholes were drilled to a maximum depth of 9.40m bgl.
- 9 No. window sample dynamic probe boreholes were drilled to a maximum depth of 5.45m bgl.

Ground Conditions
SKM enviros generally encountered made ground across the whole site at less than 2.00m thickness. Made ground topsoil was encountered in the raised western area of the site, described as soft brown gravelly clay with occasional gravel of brick, coal, porcelain and wood at depths between 0.25m bgl and 1.30m bgl.

Sub-base of grey sandy grave of fine to medium angular to sub-angular limestone pieces, and brown gravelly sand with fine to medium angular to sub-angular gravel of sandstone, limestone and occasionally brick were encountered beneath hardstanding in the eastern and south-eastern areas.

A hydrocarbon odour was encountered within TP101 at a depth between 0.40m bgl and 0.60m bgl.

Typically, the made ground was underlain by natural strata recovered as firm to stiff brown mottled grey sandy gravelly clay, with a gravel of coal, mudstone and sandstone generally underlain by firm to stiff dark brown slightly sandy gravely clays with a gravel of coal, mudstone and sandstone. Within the western area, very soft to stiff dark brown sandy gravelly clays were encountered at depths between 1.60m bgl and 3.90m bgl, and soft clay was encountered at the northern boundary. Occasional very low to low strength clays were encountered at shallower depths in several locations.

Bedrock, interpreted as grey mudstone by e3p, was encountered in all cable percussive/rotary and window sample dynamic probe exploratory holes at depths of between 4.7m bgl (north-west area) and 8.00m bgl (south-eastern area).

Groundwater
'Damp strata' described as moderate to fast seepages, were encountered within some trial pits and some window sample boreholes, at depths of between 2.00m bgl and 3.50m bgl.

No groundwater samples were obtained.

Geotechnical
Chemical analysis for pH and water-soluble sulphate was carried out on three samples. E3p characterised the soils to meet DS-1 SC-1 in accordance with BRE Special Digest 1 (2005).

E3p established the clay soils could be classified as having a low volume change potential.

E3p established the clay soils are of moderate compressibility under a loading of 120kN/m^2 and are wet of optimum at depth.

E3p measured undrained shear strength values through both field and laboratory methods and confirmed material to be of firm to very stiff consistency with undrained shear strengths recorded between 19kN/m^2 (field measurement) and 369kN/m^2 (laboratory measurement).

Ground Gas
E3p carried out ground-gas monitoring across plot M400 on two occasions during November 2016. The maximum steady carbon dioxide concentration encountered was 7.5% v/v (DP104) and no methane was encountered within any of the exploratory locations. The minimum recorded oxygen concentration was 14.2% v/v (DP104). No positive flow rates were recorded, flow rates ranged from -0.26 l.hr to -8.47 l/hr. The monitoring was carried out at atmospheric pressures ranging between 1005ppm to 1009ppm.

E3p recommend Characteristic Situation (CS) 2 protection measures should be implemented for the building, in line with CIRIA C665 and BS8485.

Risks to Human Health
A total of 12 No. disturbed soil samples were collected during the 2016 investigation and submitted to i2 Analytical for a range of chemical analysis.

Samples were assessed by against Soil Guideline Values (SGVs) for a commercial/industrial land use.

SKM Enviros recorded no elevated concentrations of heavy metals, PAHs, or Total Petroleum Hydrocarbons (TPHs) within soil samples collected. Chrysotile asbestos fibres were recorded in 6No. of soil samples collected and crocidolite asbestos fibres were recorded in 1No. of soil samples. Quantification results were 0.001% for three samples and 0.043% within TP118.

Remediation Recommendations
The report provides a summary works required to remediate the site to an acceptable level, such that is would be suitable for use as an industrial unit.

The report recommends the following pertinent remedial activities:

- Delineation, excavation, treatment of historically infilled ponds and asbestos impacted soils.
- Suitable methods for the disposal of contaminated or unsuitable material offsite and importation of materials (where required).
- Cut and fill exercise of made ground to development levels.
- Verification reporting.

4.0 ENVIRONMENTAL RISK ASSESSMENT

4.1 Introduction

The statutory definition of contaminated land is given in the Environmental Protection Act, Part 2A, Section 78, 1990, which was introduced by the Environment Act, Section 57, Department of Environment, 1995 and is defined as:

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:

- Significant harm is being caused or there is a significant possibility of such harm being caused (where harm is defined as harm to health of living organisms or other interference with the ecological systems of which they form a part and, in the case of man, includes harm to his property); and/or
- Significant pollution of controlled waters is being caused, or there is a significant possibility of such pollution being caused (by the land).

The presence of contaminated materials on a site is generally only of concern if an actual or potentially unacceptable risk exists. The potential for harm to occur requires three conditions to be satisfied:

- Sources – The presence of substances (potential contaminants/pollutants), in or under the ground, that may cause harm or pollution.
- Receptors - The presence of a receptor which may be harmed, e.g. the water environment or humans, buildings, fauna and flora; and,
- Pathway - The existence of a linkage between the Source and the Receptor.

In summary, the presence of measurable concentrations of contaminants within the ground and subsurface environment does not automatically imply that a contamination problem exists, since contamination must be defined in terms of pollutant linkages and an unacceptable risk of harm to available receptors.

The nature and importance of both pathways and receptors, which are relevant to a particular site, will vary according to the sensitivity of the intended end use of the site and the site's characteristics and environmental setting.

Legislation and guidance on the assessment of contaminated sites acknowledges the need for a tiered risk-based approach. This is set out in the Environment Agency's manual Land contamination: risk management (LCRM), published in June 2019 and last updated on 19 April 2021. The LCRM outlines the following stages of risk assessment:

Tier 1: Preliminary risk assessment (PRA)	As part of this assessment, the overall site objectives are defined. Current and historical information about the site and the potential contaminants expected to be present are assessed and an outline conceptual model (CM) is developed. The risks are assessed qualitatively, and the findings reported in the PRA (or desk study). The report recommends what further works would be required in order to assess whether the site is suitable for its proposed use.
Tier 2: Generic quantitative risk assessment (GQRA)	The GQRA uses Generic Assessment Criteria and a standard set of generic assumptions based on specific end uses in order to assess the risks to receptors. It includes the collection of more detailed information including laboratory analysis of soil and water samples in order to inform and assess the risks.
Tier 3: Detailed quantitative risk assessment (DQRA)	If pollutant linkages are confirmed as part of the GQRA, these are known as relevant pollutant linkages (RPLs) and further detailed assessment is required. At this tier, detailed site-specific information is collected to estimate the risk or to develop site-specific assessment criteria (SSAC). This may include collecting information about the receptor.

This desk study report represents a Tier 1 Preliminary Risk Assessment.

4.2 Potential Sources

Based on the history of the site and adjacent area, the information provided to date, the following potentially contaminative sources may be present:

- Potentially contaminated made ground/groundwater and hazardous ground gases/vapours associated with the site's former uses.
- Potentially contaminated made ground/groundwater associated with former ponds.
- Potentially contaminated made ground/groundwater and hazardous ground gases/vapours associated with the active and historical tanks located on the site.
- Potential ground gas associated with the active landfill sites operated by Viridor Waste Management Limited located approximately 283m to the south-west and approximately 380m to the west of the site.

Potential contaminants which could be present on the site are listed below:

- Metals, metalloids and their compounds.
- Inorganic compounds, e.g. arsenic.
- Hazardous gases/soil vapours; and
- Asbestos.

4.3 Potential Pathways

Based on the available information and the proposed development on the site of a distribution centre, offices, associated parking including multi-storey and ancillary infrastructure, and an AR mezzanine, the following potential exposure pathways will require consideration, both during the redevelopment works and on completion of construction:

- Ingestion, inhalation and/or dermal contact with contaminated soil and groundwater.
- Inhalation of hazardous ground gases/soil vapours.
- Leaching/migration of potential contaminants from soil into groundwater via infiltration and groundwater flow; and,
- Leaching/migration of potential contaminants from soil into surface water via surface infiltration, drainage and/or groundwater flow.

4.4 Potential Receptors

The potential receptors considered are:

- Development workers and future maintenance workers involved in excavations, e.g. foundations or where services are being installed or repaired following development.
- Adjacent site users, i.e. adjacent buildings on the Heywood Industrial Park.
- Future end users of the site, i.e. employees.
- Buildings and infrastructure.
- Surface water features, i.e. Brightley Brook.

4.5 Pollutant Linkage Assessment

A potential pollutant linkage assessment has been completed and is summarised in the Conceptual Site Model, which is provided in Section 4.6. This is based on the proposed development of the site for proposed commercial use.

Based on the end use and history of the site, the following potential pollutant linkages may be present:

- Development and maintenance workers and site end users (future employees) could come into contact with soils and groundwater containing elevated concentrations of potential contaminants and hazardous ground gases/soil vapours.
- The underlying Secondary Aquifers could become contaminated due to the leaching and migration of potential contaminants from the made ground; and
- Buildings and services could be affected by potential contaminants in any made ground.

These are based on current site conditions and do not consider exposure pathways following any remediation of the site.

4.6 Conceptual Site Model & Risk Rating

The preliminary conceptual model and risk rating is summarised in Table 4.6 below.

Table 4.6 Preliminary Conceptual Model

Source	Pathway	Receptor	Risk Rating	Comments
Contamination in Soil, Rock and/or Groundwater • Localised made ground associated with the past development and current use of the site. • Contamination from active and historical tanks located on site.	• Inhalation. • Ingestion. • Dermal contact.	**Future Site Users** • Future employees • Maintenance workers.	Low to Moderate	Ground investigation and sampling to establish levels of contamination present.
		Users During Development • Development workers.	Low to Moderate	Ground investigation and sampling to establish levels of contamination present.
	• Inhalation	**Users of surrounding sites** • Adjacent buildings	Low	Ground investigation and sampling to establish levels of contamination present.
	• Leaching of mobilised contaminants	**Groundwater** • Secondary A Aquifers. **Surface water features** • Brightley Brook	Low to Moderate	Ground investigation and sampling to establish levels of contamination present.
Hazardous Ground Gases/Soil Vapours • Potential for limited made ground below site and adjacent to the site e.g., active and historical tanks located on site. • Landfill sites located 283m to SW and 380m to W. • Surface ground workings within 250m of the site e.g. ponds. • Underground coal workings within 500m of the site.	**Ground Gas Migration** • Migration through permeable soils/ fractured rock. • Inhalation.	**Future Site Users** • Future employees/ visitors. • Maintenance workers. **Built Environment** • Buildings. • Infrastructure.	Moderate	Underlying strata likely to be of low permeability. Gas monitoring to be undertaken as part of ground investigation to confirm risk.
		Users During Development • Development Workers.	Moderate	Appropriate health and safety procedures to be in place during the construction phase of the development.
Aggressive Contaminants in Soil/Water	• **Direct contact.**	**Construction Materials/ Services**	Low to Moderate	Samples of made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity.

4.7 Risk Classification

Based on the conceptual site model, the site should be considered to be a **low to moderate risk** with respect to contamination. This designation will be largely dependent on the nature of the made ground and hazardous ground gases present on or adjacent to the site.

In order to assess further and classify the risks to human health, groundwater, surface water and buildings/services, a Phase 2 geoenvironmental ground investigation, to include a Tier 2 Generic Quantitative Risk Assessment, will be required. The Phase 2 geoenvironmental ground investigation will include chemical testing of soils, soil leachate and ground gas monitoring.

5.0 PRELIMINARY ENGINEERING ASSESSMENT

5.1 Development Proposals

It is proposed to develop the site with a distribution centre, which will include two-storey offices, associated parking and ancillary infrastructure.

A proposed site layout plan has been provided. This is referenced below and included in Appendix A.

- AshtonSmith. Heywood Distribution Park – External Works. Proposed Site Plan, Drawing No. HDP1-ASA-30-EX.SI-D-A-3001_(S0. Dated 30 September 2021.

5.2 Mining & Quarrying

The Coal Authority Mining Report states that the site is not within a surface area that could be affected by past recorded underground coal workings. Based on the geological setting, the probability of shallow unrecorded coal workings is considered to be very low and not warranting further assessment. There are no recorded mine entries on the site or within 20m of the site boundary. The risk of unrecorded mine entries on the site is considered to be very low. No further coal mining investigation is considered necessary.

Former sandstone and sand pits are present to the south of the site. However, there is no evidence of quarrying on the site.

5.3 Foundations

Based on the information provided in the GS report and geological maps, ground conditions below the site are likely to comprise made ground underlain by glacial till, underlain by mudstone, siltstone and/or sandstone of the Lower Pennine Coal Measures.

The selection of foundation type for the proposed development will be governed by the thickness of any made ground and the strength and settlement characteristics of the underlying natural strata.

It is anticipated that a shallow foundation solution would be appropriate for lightly loaded buildings and structures on the site. However, if the shallow natural strata is proven to be unsuitable for shallow foundations, i.e. too weak or compressible, or greater bearing capacity is required, then consideration could be given to ground improvement or the adoption of deeper foundations such as piles. In relation to the proposed van deck parking, it is likely that foundations will be required to extend through the glacial till to bear onto the underlying bedrock.

5.4 Ground Floor Construction

The properties of the underlying natural soils will need to be investigated to determine if ground bearing floor slabs can be used.

The requirements of any ground gas protection measures will also need to be taken into consideration in relation to ground floor design and construction.

5.5 Groundwater

The presence of groundwater will need to be assessed as part of any ground investigation.

5.6 Obstructions

The presence of obstructions including existing services should be anticipated given the previous developments on and adjacent to the site.

5.7 Earthworks

Based on the proposed development and ground levels, some cut and fill earthworks will is required. Testing of materials on site will be carried out as part of the further investigation to confirm suitability of materials to be incorporated into the earthworks.

5.8 Chemical Attack on Buried Ground

Samples of made and natural ground should be obtained and submitted to the laboratory for testing in order to assess the sulphate content and acidity and hence the concrete class required for buried concrete to the latest standard.

6.0 FURTHER INVESTIGATIONS

In order to further assess the potential geotechnical and environmental constraints to the proposed development, it is recommended that the following investigative works be carried out:

- Dynamic sample boreholes with rotary cored follow-on, complete with in-situ tests to provide geotechnical information in order to assess the nature of the made ground, superficial deposits and bedrock geology. These boreholes will also facilitate the installation of gas and groundwater monitoring wells and allow soil samples to be obtained from depth.
- Window sample boreholes to assess the shallow ground conditions at the site and confirm the composition, extent, depth and nature of the made ground and natural strata. Samples will be obtained to submit for laboratory testing. These boreholes will also facilitate the installation of gas and groundwater monitoring wells where required.
- Trial pitting in order to assess the shallow ground conditions at the site and confirm the composition, extent, depth and nature of the underlying made ground. Samples will also be obtained to submit for laboratory testing.
- Chemical analysis of soil, leachate and water samples in order to determine the concentrations of potential contamination on the site.
- An assessment of the classification of materials for disposal off-site (not including WAC testing).
- Geotechnical testing to classify materials and inform foundation design and chemical testing to determine the Aggressive Chemical Environment for Concrete classification.
- Monitoring of gas and groundwater wells for groundwater level and hazardous ground gases, including methane, carbon dioxide, oxygen and flow rate.

On completion of the above, a Phase 2 geoenvironmental ground investigation report, to include a Tier 2 Generic Quantitative Risk Assessment, will be prepared.