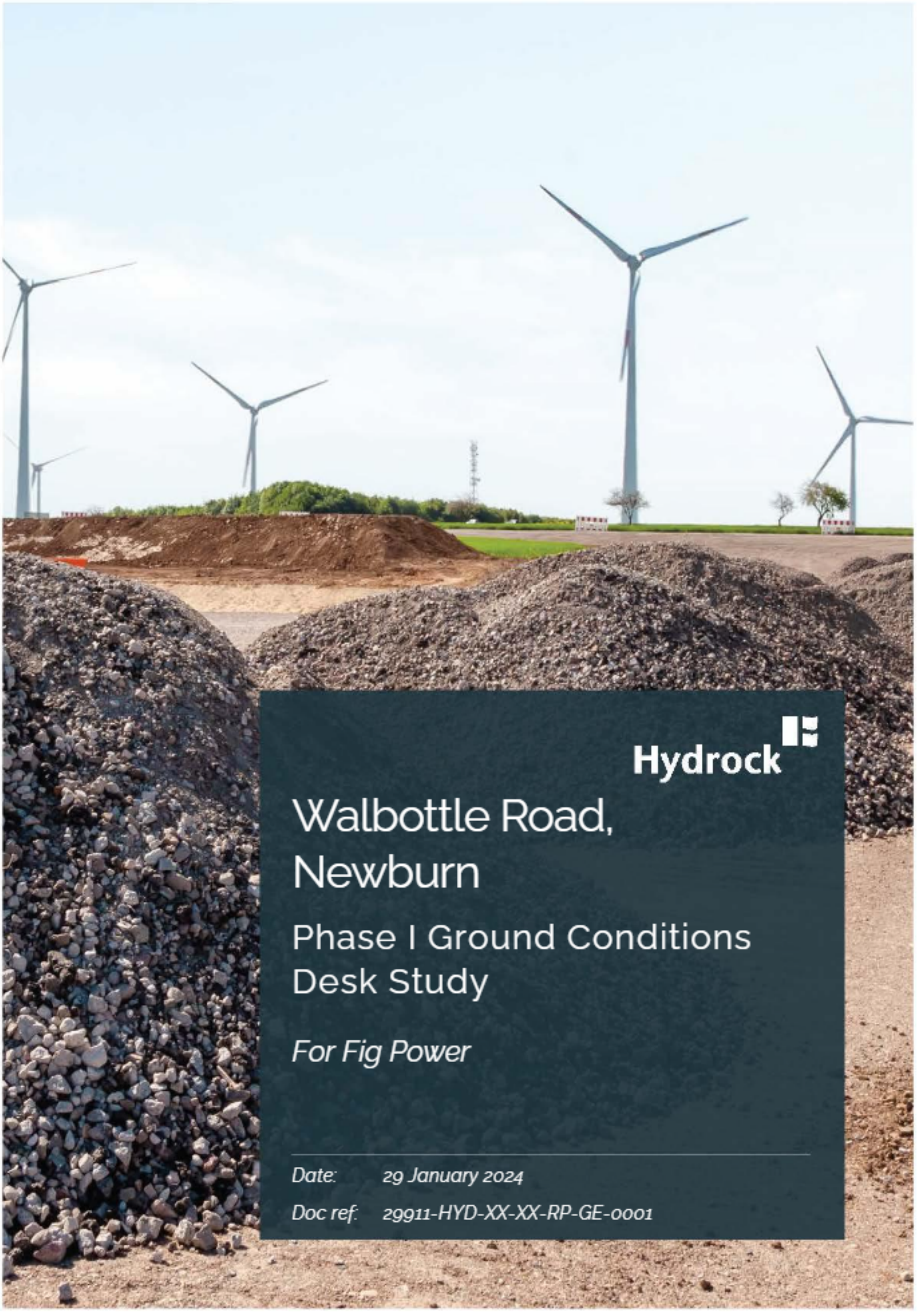

Hydrock

Walbottle Road, Newburn

Phase I Ground Conditions Desk Study

For Fig Power

Date: *29 January 2024*

Doc ref: *29911-HYD-XX-XX-RP-GE-0001*

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Issued by	Hydrock Consultants Limited Northern Assurance Buildings 9-21 Princess Street Albert Square Manchester M2 4DN United Kingdom	T +44 (0)161 804 5550 E manchestercentral@hydrock.com W hydrock.com
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Executive summary

Site information and setting	
Objectives	The objectives of the Phase 1 Ground Conditions Desk Study is to support the planning application and to assist with the design of the development.
Client	Fig Power
Site name and location	Walbottle Road, Newburn, Newcastle Upon Tyne, NE15 8HH.
Proposed development	The proposed development is to comprise a 90MW battery storage facility, substation and associated infrastructure.
Site description	The site is split primarily into two sections, north and south, with a proposed access road joining the two sections. The present land use is predominately commercial with commercial units occupying the southern section of the site and a concrete works with associated stockpiles and fuelling yard along the proposed access road. The northern section of the site is currently a parking facility for cars, storage including general waste such as pallets, tyres, machinery parts etc.
Desk study summary	
Topography	The site and local area are formed on sidelong ground, with the land falling to the south-west (with steeper slopes and retaining walls to the east and west of the site). The site is fairly level with a slight slope to the south-west. However, the northern section of the site is at a slightly higher elevation (16m AOD), with a gentle slope down along the proposed access road leading to the southern section of the site (14m AOD). The northern section of the site is at a lower elevation than the surrounding area with general slopes (between 8.0m in the north-east and 5.0m in the south east) and retaining walls (between 1.5m and 2.0m) present along the north and eastern boundaries.
Hydrology	The River Tyne is approximately 350m to the south and the culverted New Burn River is approximately 35m west.
Site History	1856 – 1858 Earliest mapping shows the northern section of the site is undeveloped grass land sloping down from the north-east to the New Burn river to the south-west (which flows below the site). The south-eastern section of the site is part of a larger orchard. From 1895 Newburn Steel works and associated rail infrastructure has been constructed across the site, with the New Burn river partly culverted to the west and has been presumably infilled. To accommodate the Steel works and rail infrastructure, it is inferred that earthworks have been undertaken to level the site, presumably land has been cut from the east and filled in the west, resulting in steeped slopes and retaining walls along the eastern and western boundaries. By 1936 Newburn Steel works have been demolished however rail tracks remain. A small refuse tip was recorded in the south east of the site. During the middle 20th century and early 21st century minor changes on site occurred, with demolition and then subsequent reconstruction of various smaller buildings along with removal of rail infrastructure. Off-site – Mapping from the late 19th century onwards shows the site to be situated within an industrial area with various works, such as steel, sawmills and

	brick with mining and quarries for minerals such as coal and sand. Relict sand pits were utilised as refuse pits/ heaps from the 1950s until the late 1970's.
Geology	Made Ground and Infilled ground will be present across the site. Superficial: Till Solid: Lower Pennine Coal Measures
Natural geological hazards	Mature and semi-mature trees present on-site and adjacent to the north, west and eastern boundaries of the northern section of the site and along the eastern boundary of the southern section of the site. The environmental data report lists the onsite risk of natural ground instability from landslides as low for the majority of the site with the exception of a small portion along the northern boundary of the southern section of the site which is listed as moderate.
Anthropomorphic geotechnical hazards	Made Ground is expected to be present which is likely to be heterogenous, possibly placed in an uncontrolled manner. The site lies within a Coal Mining Reporting Area and Development High Risk Area due to presence of a coal seam which sub-crops beneath the site. There are seven worked coal seams beneath the site between 20m and 89m bgl with two recorded mine entries within the boundary and eight recorded mine entries in the surrounding area. Made Ground and waste from mining related waste/ colliery spoil may contain elevated concentrations of sulfates and sulfides.
Hydrogeology	The Till is a Secondary Undifferentiated aquifer and the Pennine Lower Coal Measures formation is a Secondary A Aquifer.
UXO risk	A non-specialist UXO assessment indicates a low bomb risk.
Radon	The site lies within an area where less than 1% of homes are affected by radon. Therefore no radon protection measures are required.
Other	A local nature reserve, Walbottle Brickworks, and Green Belt land is located 27m north of the site. There are no Sites of Special Scientific Interest (SSSI) within 1km of the site. However, the site is located in a SSSI impact risk zone.
Preliminary conceptual site model based on desk study	
Preliminary Geotechnical Hazards	The following plausible geotechnical risks are identified: » Uncontrolled Made Ground (variable strength and compressibility). » Soft / loose compressible Made Ground (low strength and high settlement potential). » Shrinkage / swelling of the shallow clays within the Till, cohesive fraction of soils under the influence of vegetation. » Variable lateral and vertical changes in ground conditions. » Attack of buried concrete by aggressive ground conditions, associated with the Made Ground. » Slope and retaining wall stability issues – the site is formed on sidelong ground with steepened slopes and retaining walls along the eastern and western boundaries. » Earthworks – low bearing capacity or settlement of new fill and impact on foundations, floor slabs, roads and infrastructure and construction plant / settlement (due to placement of fill on soft / loose ground) / unsuitability of site won material to be reused as fill. » Adverse chemical ground conditions, (e.g. expansive slag from former on-site steel works). » Obstructions from concrete/ asphalt hardstanding.

	» Seasonal variations in the depths to groundwater. » Running sands or loose Made Ground, leading to difficulty with excavation and collapse of side walls. » Instability from landslides, particularly along the north-eastern boundary of the southern section of the site. » Problematic soils e.g. alluvium and subsequent infilled ground along the historical New Burn river. » Shallow mine workings beneath the site and the immediate vicinity including on and off-site shafts.
Preliminary Geoenvironmental Conclusions.	It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990. The overall risk from land contamination at the site is considered to be low for the current development, as it is covered by hard standing or buildings limiting the possibility of contact with the soils, as well as the risk of significant rainwater infiltration leading to leaching. The overall risk for a redeveloped site is assessed to be moderate, but this would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation. The possible pollutant linkages (for risk levels of moderate or greater) on an unremediated redeveloped site, as determined by the desk study and walkover are summarised below:

Source(s)	◄ potential Impact on ►	Receptor(s)
Historical and current land use (from the operation of the former Steel works, brick works, rail lines, garage infilled ground, refuse heap, concrete factory, depot, car park and substation): including asbestos containing materials (ACM), metal, slag, ash, hydrocarbon fuels, lubricants, BTEX/ MTBE and solvents including leakage from Underground Storage Tanks (USTs), Above Ground Storage Tanks (ASTs), the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles.		People Development end use Groundwater and surface water
Hydrocarbon vapours from potential VOC and petroleum hydrocarbon spillages/leaks		People Development end use Groundwater
Mine gas emissions from coal seams in the Pennine Lower Coal Measures Ground gases (carbon dioxide and methane) from organic materials in the Made Ground/Infilled Ground, potential alluvial deposits along the historical course of the New Burn and historical refuse tip in the south-eastern section of the site		People Development end use
Calcium oxide, calcium hydroxide, calcium carbonate, hydrated calcium sulphate, manganese dioxide and alkalinity associated with ready mix concrete works on site		People Development end use Groundwater
Coal tar potentially present in the bituminous bound roads and carparks		People Development end use

	Hydrocarbon fuels and oils from the unspecified works bounding the site 4m north including leakage from Underground Storage Tanks (USTs), the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles	People Development end use
	Off – site: Methane and ground gas migration from landfilled waste of unknown materials located beyond the northern and eastern boundaries	People Development end use
Future considerations		
Further work	Following the work undertaken to date, the following further works will be required: » undertake a survey of the site and local area (and topographical survey) and record any evidence of slope instability that may affect future proposed developments; » determine the depth and distribution of Made Ground and natural strata across the site; » determine the soil strength/density profile beneath the site; » determine the depth/level of groundwater beneath the site; » determine the ground gas concentrations beneath the site; » assess trench stability, over break potential and 'diggability'; » determine the stability of the retaining walls and slopes associated with the sidelong ground, and specifically the slopes along the northern and eastern site boundaries. » determine the depth and extent of mine workings and mine entries below the site; » allow sampling for chemical and geotechnical laboratory testing; » obtain information in terms of Aggressive Chemical Environment for Concrete Class (ACEC class) » determine CBRs to assist with pavement design; » determine the frequency of slag deposits from the Steel works to ensure further detailed investigation is not required; and » assessment of tree influence on foundations and design of foundations. Following investigation, assessment will be required to: » update the ground model; » update the geotechnical register; » provide geotechnical design recommendations; » update the Conceptual Site Model (CSM), including identification of plausible pollution linkages; » undertake generic quantitative risk assessment of potential chemical contaminants to establish 'suitability for use' under the current planning regime; » discuss potential environmental liabilities associated with land contamination (soil, water and gas); and » provide outline mitigation recommendations to ensure the site is 'suitable for use'.	

This Executive Summary forms part of Hydrock Consultants Limited report number 29911-HYD-XX-XX-RP-GE-0001 and should not be used as a separate document.

1. Introduction

1.1 Terms of reference

In November 2023, Hydrock Consultants Limited (Hydrock) was commissioned by Fig Power (the Client) to undertake site investigation, comprising a Phase 1 ground conditions desk study at a site off Walbottle Road, Newburn, Newcastle Upon Tyne, NE15 8HH.

The site is currently split into two sections with an adjoining access road. The northern section comprises of a car park/ storage yard with excavators and tyres. The south-eastern section of the site comprises of commercial units and associated car park.

Hydrock understands that the proposed development is to comprise a 90MW battery storage facility in the northern section and a substation in the southern section, along with associated infrastructure. A proposed development layout (Fig Power Drawing 2991-FIG-DR-0006), is presented in Appendix A.

The investigation works have been undertaken in accordance with Hydrock's proposal (referenced 29911-FP-GE-0001, 14th November 2023) and the Client's instructions to proceed via email, dated 15th November 2023.

1.2 Objectives

The works have been commissioned to support the planning application and to assist with the design of the development.

The objectives of the Phase 1 Desk Study is to formulate a preliminary Ground Model and an Initial Conceptual Site Model of the site to identify and make a preliminary assessment of any potential geo-environmental and geotechnical risks to the proposed development.

1.3 Scope

The scope of the Phase 1 Desk Study comprises:

- a field reconnaissance (walkover) to determine the nature of the site and its surroundings including current and former land uses, topography and hydrology;
- acquisition and review of:
  - historical Ordnance Survey maps, to identify any; former potentially contaminative uses shown at the site and immediately surrounding it, and an assessment of the associated contamination risks;
  - a third-party environmental report to identify any; flooding warning areas, local landfills, pollution incidents, abstractions, environmental permits etc. All of which may have had the potential to have environmental impact on the site;
  - topographical, geological and hydrogeological maps;
  - British Geological Survey (BGS) archive records;
  - regional UXB risk maps;
  - a site-specific Coal Authority 'Consultants Coal Mining Report';
  - the Coal Authority's Interactive Viewer;
- a review of previous investigations carried out at the site;
- development of a preliminary Ground Model representing ground conditions at the site;
- development of an initial Conceptual Site Model (iCSM), including identification of potential contaminant linkages;
- a qualitative assessment of any geo-environmental risks identified; and

- identification of any plausible geotechnical hazards.

1.4 Available information

The following drawings have been provided to Hydrock by Fig Power for use in the preparation of this report:

- Fig Power. November 2023. 'Location Plan, Newburn Battery Energy Storage System'. Ref: 29911-FIG-DR-0004-S2-P01.
- Fig Power. January 2024. 'Site Layout For Operation, Newburn Battery Energy Storage System'. Ref: 29911-FIG-DR-0006-S2-P01.

It is understood that the Client defined in Section 1.1 commissioned or has obtained assignment of the above documents and Hydrock has assumed full reliance can be placed upon their contents. Should this not be the case, Hydrock should be informed at the earliest opportunity.

1.5 Regulatory context and guidance

The investigation work has been carried out in general compliance with recognised best practice, including (but not limited to) BS 5930:2015, BS 10175:2011+A2:2017 and the AGS (2006) 'Good Practice Guidelines for Site Investigations'.

The geo-environmental section of this report is written in broad accordance with BS 10175:2011+A2:2017, EA LCRM (2023) and the AGS (2006) 'Good Practice Guidelines for Site Investigations'.

The methods used follow a risk-based approach, the first stage of which is a Phase 1 desk study and field reconnaissance, with any potential geo-environmental risks assessed qualitatively. This is done using the 'source-pathway-receptor contaminant linkage' concept to assess risk as introduced in the Environmental Protection Act 1990 (EPA, 1990). Any potential geotechnical risks are also assessed from the Phase 1 desk study and site reconnaissance stage.

The geo-environmental and geotechnical aspects are discussed in separate sections. Throughout the report the term 'geotechnical' is used to describe aspects relating to the physical nature of the site (such as foundation requirements). The term 'geo-environmental' is used to describe aspects relating to ground-related environmental issues (such as potential contamination). However, it should be appreciated that this is an integrated investigation and these two main aspects are inter-related. Designers should take all aspects of the investigation into account.

Remaining uncertainties and recommendations for further work are listed in Section 5 and Section 6.

2. Desk study (and field reconnaissance)

2.1 Data

A number of desk study sources have been used to assemble the following information. These are presented in Appendix D and include:

- Third-party environmental report (Groundsure report, reference HYD-9ML-MJ2-CD8-TX8);
- BGS Onshore GeoIndex (GeoIndex - British Geological Survey (bgs.ac.uk);
- BGS borehole records (Borehole records - British Geological Survey (bgs.ac.uk);
- BGS maps portal (BGS maps portal - British Geological Survey);
- Historical Ordnance Survey mapping;
- BGS Archive Records;
- BGS Open-loop ground source heat pump viability screening map (GSHP (bgs.ac.uk))
- Zetica UXB Risk Maps (https://zeticauxo.com/downloads-and-resources/risk-maps/);
- Coal Authority 'CON29 Consultants Coal Mining Report' (Ref: HYD-6HT-A7V-A2S-ENT);
- Coal Authority's Interactive Viewer (http://mapapps2.bgs.ac.uk/coalauthority/home.html);
- Environment Agency River catchment data (England | Catchment Data Explorer);
- Environment Agency flood data (https://flood-map-for-planning.service.gov.uk/); and
- DEFRA Magic Map Application https://magic.defra.gov.uk/magicmap.aspx.

2.2 Site referencing

Table 2.1: Site referencing information

Item	Brief Description
Site name	Walbottle Road, Newburn.
Site address	Walbottle Road, Newburn, Newcastle Upon Tyne, NE15 8HH.
Site location and grid reference	The site is located between Walbottle Road to the north-east and High Street to the south-west. 1.3km south of the A69, 2.4km west of the A1 and 7.6km west of Newcastle upon Tyne city centre. The National Grid Reference of the approximate centre of the site is 217063E, 565240N. The site is approximately 0.66Ha in area.
Site boundaries	An approximately 2m high metal palisade fence, along with brick walls and chain link fences surrounds the southern and northern sections of the site. Residential housing is present beyond the northern boundary with residential units/ warehouses to the west. Walbottle Road is present beyond the eastern boundary and the High Street/ A6085 is present beyond the southern boundary. Along the eastern boundary there are a mixture of retaining walls (between 1.5m and 2.0m) and steep slopes above (between 8.0m in the north-east and 5.0m in the south east.)

Figure 2.1: Site location
(Reproduced with permission from Groundsure)

Figure 2.2: Site Layout Plan
(Reproduced with permission from Groundsure)

A site location plan (Hydrock Drawing 29911-HYD-XX-XX-DR-GE-0001) is presented in Appendix A.

2.3 Site description and field reconnaissance survey

A field reconnaissance survey was undertaken on 30th November 2023 to visually identify potential geotechnical hazards, contaminant sources for future investigation and identification of possible source-pathway-receptor linkages. The weather during the field reconnaissance survey was snowing and cold.

A description of the site is presented in Table 2.2 and selected photographs are presented in Figure 2.3 to Figure 2.6. Additional photographs are presented in Appendix B.

Table 2.2: Site description

Item	Brief Description
Site access	The site is accessed from the High Street (A6085). There are no other access points to the site.
Site area	The site is irregular in shape and has an area of approximately 0.66ha.
Elevation, topography and any geomorphic features	The site and local area are formed on sidelong ground, with the land falling to the south-west (with steeper slopes and retaining walls to the east and west of the site). The site is fairly level with a slight slope to the south-west. However, the northern section of the site is at a slightly higher elevation (16m AOD), with a gentle slope down along the proposed access road leading to the southern section of the site (14m AOD). The northern section of the site is at a lower elevation than the surrounding area with general slopes (between 8.0m in the north-east and 5.0m in the south east) and retaining walls (between 1.5m and 2.0m) present along the north and eastern boundaries. The retaining walls and slopes along the eastern boundary show signs of instability, with movement of soils, vegetation and fencing panels. In addition, there is evidence of a landslip in the north eastern section of the site associated with the steep slopes and former railway line.
Present land use	The present land use is predominately commercial, with commercial units occupying the southern section of the site. A concrete works with associated stockpiles and fuelling yard along are present along the proposed access

Item	Brief Description
	road. The northern section of the site is currently a parking facility for cars, and storage for the concrete works plant and general waste such as pallets, tyres, machinery parts etc. The buildings present on site are in generally good condition with no evidence of structural issues. Overhead telecommunication cables are present in the north-east of the southern section of the site running north-west to south-east. An electricity substation is also present along the southern boundary situated behind the industrial units.
Vegetation	Mature and semi-mature trees are present surrounding the north, east and western site boundaries (along the slopes) in the northern section of the site and the east and south boundaries of the southern section of the site. Invasive buddleia is present within the northern section of the site.
General site sensitivity	The site is within a generally a commercial area with commercial units to the south, east, and west. However, a residential housing estate lies to the north of the site.

A site features plan (Hydrock Drawing 29911-HYD-XX-XX-DR-GE-0002) is presented in Appendix A.

Figure 2.3: Electricity substation present in the southern section of the site.

Figure 2.4: Potential landslip and instability of steep slopes in north-eastern section of the site.

Figure 2.5: Storage of machinery and general waste in the northern section of the site.

Figure 2.6: Live concrete works with stockpiles and infrastructure along the proposed access road.

2.4 Site history

A study of historical Ordnance Survey maps (Appendix C) has been undertaken to identify any former land uses at the site and surrounding areas which may have geotechnical or geo-environmental implications for the proposed development. The key findings are summarised in Table 2.3.

Table 2.3: Site history review

Reference	Key features on site	Key features off-site
County Series 1856-1860 1:10,560 1858 1:2,500	The northern section of the site is primarily agricultural fields with a slope in the north-east leading down to a river in the north-west corner. The southern section forms part a larger orchard. The land in the local area generally falls to the south-west.	Mapping shows the area to the east as agricultural fields, the village of Newburn to the west, marshland and bogs to the south with industrial works to the north; Walbottle Brick works and Newburn Steel Works (approximately. 120m – 250m). Rail tracks are present approximately 20m to the east and 50m to the south. A sand pit is shown approximately 100m south-east. Mapping shows evidence of coal mining, with Wallbottle Collieries located approximately 800m north (Duke Pit) and north-east (Blucher Pit) with three old Coal Pits/ Shafts between approximately 0.8km and 1km south-west.
County Series 1894-1895 1:10,560 1897 1:2,500	The stream is no longer present on site (presumed infilled), and appears to have been diverted around the western boundary of the northern section. The entire site has been developed with a large building labelled as the 'Newburn Steel Works' and associated infrastructure including rail tracks in the eastern section of the site. To accommodate the Steel works and rail infrastructure, it is assumed that earthworks has been undertaken to level the site; presumably land has been cut from the east and filled in the west, resulting in steeped slopes along the eastern and western boundaries.	Wallbottle road has been constructed to the east of the site, parallel to the railway lines. The sand pit to the south-east has increased in size (now approximately 50m to the south-east). Walbottle Brick works and Newburn Steel Works are shown to have expanded. With the steel works extending approximately 100m beyond the southern boundary. A large unnamed building with rail lines and Gasometer, labelled as 'Disused', is present between approximately 100m and 250m south respectively. 800m south at the old coal shaft's location Addison Colliery is labelled with rail lines and reservoirs. Wallbottle Collieries (Duke Pit) is no longer present.
County Series 1921 1:10,560 1920 1:2,500	Two chimneys are labelled in the northern section of the site.	Three chimneys are adjacent to the southern boundary of the northern section of the site, The sand pit to the south-east and has more than tripled in

Reference	Key features on site	Key features off-site
		size and now labelled 'Newburn Hills Sand Pit'. Several chimneys are labelled at the large unnamed building beyond the southern boundary. A new Colliery labelled 'Wallbottle Colliery' is present approximately 500m to the south-east.
County Series 1938 1:10,560 1936 1:2,500	The Newburn Steel Works has been demolished. Although, the rail tracks remain.	Kilns, chimneys, tanks and clay pit are shown at Wallbottle Brick Works. The large unnamed building beyond the southern boundary has been demolished with only three chimneys remaining. 'Newburn Cordage Works' is shown approximately 30m beyond the southern boundary. Approximately 50m and 80m to the west of the site respectively a county laboratory is present and a fire station are present.
Provisional 1950-1952 1:10,560 National Grid 1950-1951 1:1250 Provisional 1957 1:10,560	Two new buildings are present in the centre and east of the northern section the site. A 'Refuse Heap' in the eastern corner and part of a 'Track' occupy the southern section.	A 'Sawmill and Joinery Works', are shown approximately 10m beyond the eastern boundary. Newburn Hills Sand Pit is now labelled as 'Refuse Pit' with several buildings now constructed, one of which labelled 'Garage'. A chemical works is present approximately 50m beyond the western boundary. By 1957 Walbottle Colliery is no longer present.
Provisional 1967 1:10,560 National Grid 1963-1970 1:1250	The building the east of the northern section and rail tracks are no longer present. The track and refuse heap in the southern section of the site are also no longer present. The railway tracks in the northern section of the site are no longer present.	A works is labelled at the former Newburn Hills Sand Pit refuse pit/tip (approximately 50m) beyond the eastern boundary. Blucher Pit is labelled as disused. County Laboratory is now described as an Employment Exchange.
National Grid 1974-1976 1:10,000 National Grid 1976 1:1,250	No significant change.	There is an electricity substation approximately 10-20m east of the site. The former Newburn Hills Sand Pit refuse pit/tip to the east are labelled as disused. Tanks are labelled at the now disused tip approximately 75m east. Newburn industrial estate constructed

Reference	Key features on site	Key features off-site
		along the River Tyne approximately 150m to the south-east.
National Grid 1982-1985 1:10,000 National Grid 1979-1982 1:1,250	Slight reconfiguration to the building the northern section of the site. 1979 - New building construction in the south-eastern section of the site.	The Fire station and chemical works are no longer present. The site is part of a larger area described as a depot. Approximately 5m north of the southern section of the site a tank is labelled.
1986-1993 1:1,250	The building in the northern section of the site has been reconfigured again and is labelled as 'Works'.	By 1993 a new building has been built approximately 10m west of the proposed access road. The woks approximately 10m beyond the eastern boundary is now labelled as 'Clayton House'.
Landline 2003 1:1,250 Google Earth© Imagery 2008[1].	Demolition of the previous buildings in both sections of the site and construction of the commercial buildings as seen present today.	Newcastle city waste department is present at former Newburn Hills Sand Pit refuse pit/tip. The works approximately 10m – 250m beyond the northern boundary has been demolished and a housing estate has been built.

2.5 Geology

The geology of the site area is shown on the British Geological Survey (BGS) 1:50,000 geological map of Newcastle upon Tyne (Sheet 20), the 1:10,560 BGS map (NZ16NE 1984) and the 1:10,000 British Geological Survey (BGS) map extract reproduced as part of the Groundsure and is summarised below:

Table 2.4: Geology

Ref. for Figures	Location	Stratigraphic Name	Description
Superficial Deposits (Figure 2.7)			
1	On site	Till - Diamicton	Heterogeneous mixture of clay, sand, gravel and boulders varying widely in shape and sizes
Solid Geology (Figure 2.8)			
1	On site.	Pennine Lower Coal Measures Formation (Sandstone)	Predominantly pale grey sandstone and common coal seams
2	On site.	Pennine Lower Coal Measures Formation (Mudstone, Siltstone and Sandstone)	Interbedded grey mudstone, siltstone and pale grey sandstone, commonly with mudstones containing marine fossils in the lower part, and more numerous and thicker coal seams in the upper part.

[1] ©Infoterra Ltd & Bluesky, image date: 8/4/2003; ©Digital Globe, image date: 10/5/2005.

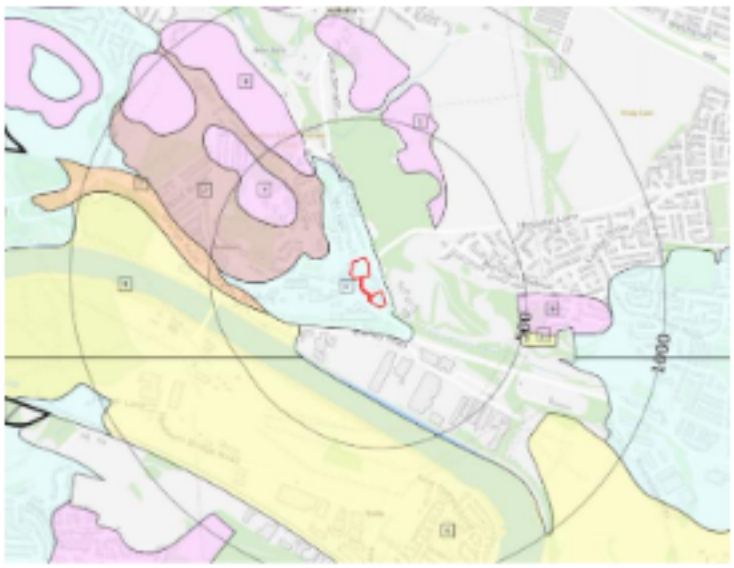


Figure 2.7: Superficial deposits.
(Reproduced with permission from Groundsure)

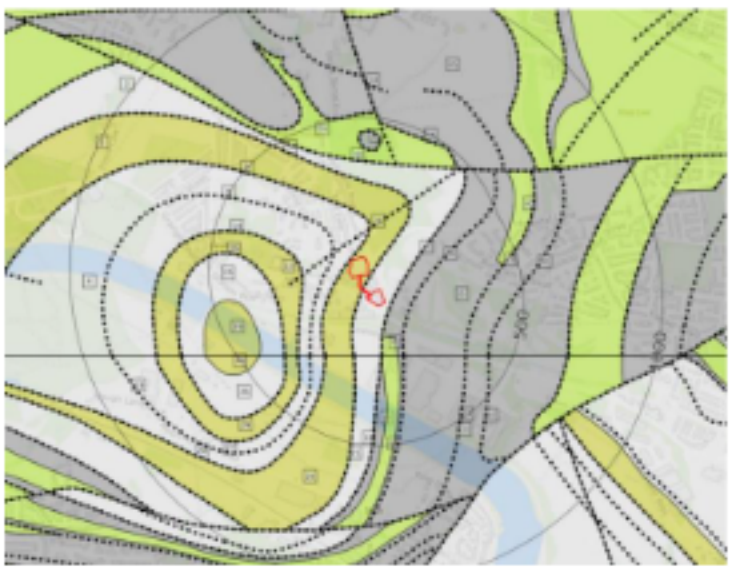


Figure 2.8: Solid geology.
(Reproduced with permission from Groundsure)

A coal seam is present on site, with frequent faults, coal seams and marine bands of the Pennine Lower Coal Measure Formation are listed in the vicinity of the site. Further detail is given in the Coal Mining Risk Assessment (Hydrock ref: 27789-HYD-XX-XX-RP-GE-0002).

A number of borehole logs from the BGS archive have been reviewed. Selected records are summarised below:

- NZ16NE620 located adjacent to the northern boundary, between 0m – 10m, excavated to a depth of 4.00m and recorded:
  - dark brown clay with gravels of man-made constituents between ground level and 0.80m below ground level (bgl) (Made Ground);
  - dark reddish brown organic subsoil with gravels of man-made constituents (including asbestos containing materials (ACM), metal, slag, ash and household wastes) between 0.80m and 2.00m bgl (Made Ground); and
  - Light to medium brown silty fine grained sand between 2.00m and 4.00m bgl (probable Fluvial Deposits).
  - No ground water was encountered.
- NZ16NE619 located adjacent to the northern boundary between 0m – 10m, drilled to a depth of 5.00m and recorded:
  - Loose soily clay with gravels of man-made constituents and cobbles between ground level and 1.55m bgl. (Made Ground);
  - Slag, clinker, ash. rubble and sand between 1.55m and 4.40m bgl (Made Ground); and
  - Dark grey shaley mudstone between 4.40m and 5.50m bgl (probable Pennine Lower Coal Measures Formation).
  - No ground water was encountered.

2.6 Ground source heat pump (GSHP) viability

The BGS ground source heat pump viability screening map indicates that the site in in an area that is favourable for open-loop ground source heat pumps.

This report does not constitute a Thermogeological Assessment (TGA). For site specific GSHP viability a full TGA to characterise the geological and thermogeological properties beneath the site is required.

2.7 Hydrogeology

2.7.1 Aquifer designations

Based on the inferred geological sequence presented in Section 2.5 and the Environment Agency's interactive aquifer designation map, the aquifer system presented in Table 2.5 applies.

Table 2.5: Aquifer system

Stratum	Aquifer Designation	Comments
Superficial Deposits		
Till	Secondary undifferentiated Aquifer	Predominantly clay of low permeability, interbedded with occasional pockets of sand, gravel, cobbles and boulders, of moderate to high permeability which are limited in area and not found to be interconnected. Overall, this unit is likely to be anisotropic in nature with horizontal permeability greater than vertical permeability (i.e. kh>kv).
Solid Geology		
Pennine Lower Coal Measures Formation	Secondary A Aquifer	Other than in respect of worked coal seams, likely to be generally characterised by low permeability and isotropic. Stratification suggests kh is likely to be greater than kv in the unmined parts of the sequence, except where highly fractured. Coal workings are likely to have created a significant secondary porosity and permeability and large volumes of groundwater can be present in abandoned workings, with associated potentially high rates of flow.

2.7.2 Groundwater abstraction

There are no active licensed groundwater abstractions within 1km of the site.

2.7.3 Groundwater source protection zones and groundwater vulnerability

The site is not within a groundwater Source Protection Zone (SPZ).

2.7.4 Groundwater levels, recharge, and flow

The historical exploratory holes completed in close proximity to the site did not encounter groundwater between ground level and 5.00m bgl.

Until a ground investigation is completed on site the possibility of shallow perched groundwater on cohesive layers of Made Ground cannot be discounted.

The topography of the site and surrounding area falls gently towards the southwards towards the River Tyne approximately 0.35km to the south; consequently groundwater is likely to flow towards the south.

Recharge to shallow groundwater is likely to be restricted on site due to the presence of hardstanding. There will be recharge opportunity limited to the localised soft landscaping areas within the agricultural fields beyond the north-eastern and western site boundaries. Recharge to

the Glacial Till and Made Ground could occur through any permeable layers. A Ground Investigation is required to confirm the nature of the soils.

2.7.5 *Groundwater quality*

The groundwater body beneath the site (Tyne Carboniferous Limestone and Coal Measures Operational Catchment) is currently (2019 Cycle 3) classified under the Water Framework Directive as 'poor overall'.

The water body is currently given a 'poor' status due to 'chemical dependant surface water body' and 'General chemical test' conditions. The objective is for chemical dependant surface water body status to be 'good' by 2027, while the 'general chemical test' is to likely remain as 'poor'.

2.7.6 *Groundwater flooding*

The environmental data report indicates a low risk of groundwater flooding.

2.8 Hydrology

2.8.1 *Surface water system and drainage*

The surface water features within 1km of the site are listed in Table 2.6. There are no surface water features located on site; although there is a culvert located 35m to the west.

Table 2.6: Surface water features

Feature	Location Relative to Site
New Burn	35m west
The River Tyne	Approximately 350m south

2.8.2 *Surface water abstractions and discharges*

There are no recorded active licensed surface water abstractions within 1km of the site.

There are four active licensed surface water discharges within 1km of the site. They are listed in Table 2.7.

Table 2.7: Active surface water discharges

Location Relative to Site	Details
302m south-west	Effluent Type: Sewer discharges final/ treated. Receiving Water: River Tyne saline estuary.
363m south	Effluent Type: Sewer discharges pumping station/ storm overflow. Receiving Water: River Tyne saline estuary.
375m west	Effluent Type: Sewer discharges pumping station/ storm overflow. Receiving Water: River Tyne saline estuary
469m north	Effluent Type: Sewer discharges storm overflow. Receiving Water: Newburn.

There are three records of historical licenced discharges to controlled waters within 250m of the site. One record, 32m west, relates to sewer discharges of storm water to the New Burn River and was revoked 1994. The other two relate to the River Tyne, one 211m south and 231m south-west relating to sewer discharges – final/ treated (revoked 1997) and trade discharges – process effluent (revoked 1992) respectively.

2.8.3 Surface water quality

Reference to the Environment Agency web site shows the site is located within the catchment known as the Tyne Lower and Estuary Operational Catchment. The specific river water body being the New Burn (Trib of Tyne). The current (2019 cycle 3) overall status under the Water Framework Directive is described as 'moderate ecological'.

The reason for the water body currently having a 'moderate' status is due to Biological Quality Elements such as vertebrates, Physio-chemical quality elements including phosphate levels and chemical status including Mercury and Its Compounds and Polybrominated diphenyl ethers (PBDE). The objective is for phosphate levels and invertebrate to be 'good' by 2017, mercury and its compounds to be good by 2040 and (PBDE) to be good by 2063.

2.8.4 Surface water flooding

The desk study information indicates the proposed development is in Flood Zone 1 with a low probability of flooding from rivers or the sea. Although, Flood Zone 2 and 3 areas are present within 50m of the western site boundary.

While the majority of the site has a very low risk of surface water flooding from rainfall events, are shown to be at risk from a flood with depth between 0.1m-0.3m from a 1 in 100-year return period in the centre of the site (along the proposed access road).

No further consideration of flood risk is undertaken in this report. Specialist flood risk advice should be sought with regard to drainage and flooding.

2.9 Coastal / Tidal Waters

The River Tyne, which is located 0.35km to the south, is a tidal river. The New Burn, 32m west of the site is not a tidal river.

2.10 Mining and mineral extraction

2.10.1 Coal mining

The site is within an area defined by the Coal Authority (CA) as a Development High Risk Area, an area of probable coal mine workings, and a Coal Mining Reporting Area.

As the site is within a Development High Risk Area, a Coal Mining Risk Assessment (CMRA) will need to be submitted to the Planning Authority as part of any planning application. The CA states that the CMRA must be undertaken by a chartered engineer or geologist with at least 3 years' experience in ground investigation, and it must follow the CA's required format.

As there is a potential for past mine workings being present in coal seams beneath the site, a 'Consultants Coal Mining Report' was obtained from the Coal Authority and is included in Appendix D. Key statements within the report are that:

- There are seven worked coal seams beneath the site at depth of between 20m and 89m bgl. The nearest worked coal seam located close to the surface is the Top Busty (20m), Harvey (21m) and Brockwell (52m).
- "the site is in an area where the Coal Authority believe there is coal at or close to the surface, this coal may have been worked at some time in the past";

- "there are two known coal mine entries within the site, with a further eight located outside of the site boundary";
- The Coal Authority has not received a damage notice or claim for the subject property, or any property within 50 metres of the enquiry boundary, since 31 October 1994; and
- No notices have been given, under section 46 of the Coal Mining Subsidence Act 1991, stating that the land is at risk of subsidence.

British Geological Survey (BGS) 1:50,000 geological map of Newcastle upon Tyne (Sheet 20) shows one coal seam to sub-crop beneath the site, the Harvey Seam (previously known as the Beaumont seam), below the proposed access road in the centre of the site and is between 0.90m and 1.25m thick. The Tilley Coal Seam sub crops 9.1m to the north-west of the site and again 14.1m to the west of the site and is between 0.10m and 1.00m thick. Both seams have a north-east to south-west orientation and are dipping from west to east. No faults are recorded on site or within close proximity to the site.

There are two mine entries recorded within the site boundary, neither of which are shown on historical maps. There is no information regarding if or how the mine entries were treated or capped. A further eight mine entries are recorded outside of the boundary, one of which reference 417565-020 is approximately 30m beyond the southern boundary of the proposed access road. There is no record of any treatment having been afforded to this mine entry.

In conclusion, shallow coal seams are likely to be present beneath the site, some of which have been worked. In addition, there are two recorded mine entries on site and one located close to the site boundary. There is also the possibility that additional unrecorded mine entries may be present within the site boundary. Therefore, a Coal Mining Risk Assessment is required for the site, as well as a further works to investigate the mine entries and assess for worked coal seams.

2.10.2 Non-coal mining

The historical mapping indicates several local mineral excavations within the area such as clay pits (between 150m and 250m north), sand pits (between 50m and 450m east) and quarrying, potentially sandstone (1km east). However there is no evidence on the historical plans of any mineral excavation such as clay/ sand pits present on site since 1856 (the earlies available historical OS map), as such, Hydrock does not believe that surface ground working for mineral excavation has occurred on site.

2.11 Natural ground instability

The environmental data report lists the onsite risk from shrink swell clays as low. However sporadic trees and other vegetation are present around the site boundaries, with dense thickets of mature trees present encircling the majority of the boundaries in the northern section of the site. Shallow cohesive deposits of Glacial Till and weathered Pennine Lower Coal Measures Formation may be affected by potential for shrink-swell ground movements in clays as a result of changes in moisture content from removal or growth of trees.

The environmental data report lists the onsite risk of natural ground movement from landslides as low for the majority of the site with the exception of a small portion along the northern boundary of the southern section of the site which is listed as moderate associated with the steep slopes present on-site. As noted in section 2.3 evidence of slope instability/landslips have been noted along the eastern boundary and in the north eastern part of the site. A site investigation should consider specifically the slope stability of the sidelong ground on which the site sits and the earthworks to the east and west.

The environmental data report lists the onsite risk from running sands, compressible deposits, collapsible deposits, and ground dissolution of soluble rocks as very low or negligible.

2.12 Waste management

Details of waste related records within 500m of the site are presented in Table 2.8 below

Table 2.8: Waste management sites

Site Name and Location	Details
43m – 131m	Type: Refuse Tips Date: 1962 - 1970 mapping
26m north Address: Old Walbottle Brickworks, Newburn	Waste licence: Yes Waste type: Inert Licence issue: 26/03/1980 Licence surrender: 28/04/1980
80m – 87m north- east Address: Sandy Banks, Lemington Road, Newburn	Type of site: Waste disposal depot Date: 1993
23m north-east Address: Walbottle Road, Newburn, NE15 8HY	Type of site: Household Waste Amenity Site Annual Tonnage: 24,999 Issue Date: 30/09/2003 Status: Issued/ Active
122m - 127m south-west Address: Old Neolith Works, High Street, Newburn, NE15 8LN	Type of site: 75kte HCI Waste TS +treatment Annual Tonnage: 74,999 Issue Date: 04/12/2019 Status: Active
164m east Address: Newcastle City Council, Sandhills, Walbottle Road, Newburn, NE15 9RU	Type of site: Composting facility Annual Tonnage: 29,999 Issue Date: 15/09/2005 Status: Issued/ Active
178m south Address: Norman Marshall Limited, Unit 12, Shelley Road, Newburn Industrial Estate, NE15 9RT	Type of site: Metal recycling site (vehicle dismantler) Annual Tonnage: 5200 Issue Date: 03/11/1994 Status: Issued/ Active
Waste Exemptions	
322m south-east	Category: Treating waste exemption Sub category: Non-agricultural waste only Description: Treatment of waste toner cartridges by sorting, dismantling, cleaning, or refilling
391m west	Category: Using waste exemption Sub category: Non-agricultural waste only Description: Use of waste in construction
451m west.	Category: Treating waste exemption Sub category: Not on a farm Description: Sorting and de-naturing of controlled drugs for disposal

2.13 Regulatory Information

Information in the GroundSure Report (Appendix D), relating to various regulatory controls has been reviewed, with a summary presented below in Table 2.9.

Table 2.9: Regulatory information within 500m of the site

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
Discharge Consents	302m - 469m (four active)	Effluent Type: Sewer discharges final/ treated, pumping station/ storm overflow. Receiving Water: River Tyne saline estuary.	No	Due to the distance from the site and nature of the contents. They are also down hydraulic gradient of the site.
Historical licenced industrial activities	189m east	Operator: Aes K2 Ltd Process: Combustion processes. Status: Revoked	No	Due to the distance from the site and historical status
Pollution incidents	71m – 488m (8 no.)	Date: 2001 – 2009 Pollutant: Crewde sewage and atmospheric pollution, atmospheric pollutants and other specific wastes. Impact: Category 3 to 4 (minor to no impact)	No	Due to the distance from the site, time elapsed since the incident and the minor to no impact status.
	323m north-east	Date: 27/05/1997 Pollutant: Atmospheric pollutants Impact: Category 2 (Significant)	No	Due to the distance from the site and the time elapsed since the incident.
Licenced Discharges to controlled waters	302m – 469m bgl. (4 no. active)	Effluent type: Sewer discharges - final/ treated, storm overflow, pumping station. Receiving water: New Burn and River Tyne Saline Estuary Issue date: 1999 - 2019	No	Due to the distance from the site, the nature of the discharges and the culverted nature of the New Burn severing a pathway onto the site and the River Tyne down hydraulic gradient.
Licenced pollutant release (Part A(2)/B	12m south	Process: Use of bulk cement	Yes	Due to the close proximity to the site and the

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
		Status: Current permit Permit type: Part B		nature of the substance.
Historical licenced industrial activities (IPC)	189m east	Operator: Aes K2 Ltd Process: Combustion processes Effective Date: 1997 – 1998 (Revoked)	No	Due to its proximity to the site and the time elapsed.
Recent industrial land uses	On site	Newburn Garage Electricity Substation Enterprise Park	Yes	Due to the proximity on site
	6m – 126m	Electricity substation Tank Chimney Gas meter house Chimney Works	No	Due to the presence of relatively impermeable Till in the intervening distance
Historical industrial land uses	On site	Steel works Railway sidings Unspecified ground workings Unspecified depot Brick works	Yes	Due to the presence in site and the nature of the industrial activities
	4m – 498m	Including but not limited to; Railway sidings Unspecified works Fire station Sand pit Refuse heap Unspecified pit Colliery Disused gasometer Unspecified tank Grave yard	Yes	Due to the nature of the activities and close proximity of some industrial activities
Control of major accident hazards sites (COMAH)	N/A	No entries on (COMAH) sites were recorded within 500m of the site.	No	-
Registered radioactive substances	N/A	No entries on registered radioactive substances were recorded within 500m of the site.	No	-
Notification of installations	N/A	No entries on notification of	No	-

Regulatory Data	Distance from Site	Details	Potential Risk	Comment
handling hazardous substances		installations handling hazardous substances were recorded within 500m of the site.		

2.14 Natural soil chemistry

Information contained within the environmental report (Appendix D) gives indicative (estimated) concentration values for the natural soils at the site for a selection of Contaminants of Potential Concern (CoPC). These have been reproduced in Table 2.9.

Table 2.9: Natural soil chemistry

Element	Arsenic	Cadmium	Chromium	Lead	Nickel
Concentration (mg/kg)	15	1.8	60 - 90	100	15 - 45

The data in Table 2.9 appear to be below generic assessment criteria for residential end use therefore concentrations of natural soil chemistry are not considered to pose a risk to future receptors.

2.15 Radon

The site lies within an area where less than 1% of homes are affected by radon. Therefore, no radon protection measures are required within new builds.

2.16 Unexploded ordnance (UXO)

In general accordance with CIRIA Report C681 (Stone et al 2009) a non-specialist UXO screening exercise has been undertaken for the purposes of ground investigation and is presented in

Table 2.10.

Table 2.10: Non-specialist UXO screening (for the purposes of ground investigation)

Data	Comment	Further Assessment Required
Site History	There is no indication of former military use from the desk study.	No
Post War Development	No areas of missing housing, ruins or other indicators of bomb damage are noted.	No
Geology Type	The ground conditions comprise Made Ground overlying a thin covering of superficial deposits (sand), over shaley mudstone of Pennine Lower Coal Measures. There is the potential that UXO, if present, would remain undetected.	Yes
Surface Cover during WWI	The surface cover during WWII comprised a significant proportion of bituminous bound pavement, concrete and buildings. It is unlikely UXO would remain undetected.	No

Data	Comment	Further Assessment Required
Indicator of Aerial Delivered UXO	Screening against the regional bomb risk map (Tyne and Wear) Appendix D indicates the site to be in an area where the bomb risk is low	No

The non-specialist UXO screening exercise has indicated no further assessment is required with regard to UXO in relation to ground investigation. Further assessment may be considered prudent for construction activities.

3. Initial conceptual site model

3.1 Introduction

The initial Conceptual Site Model (CSM) incorporates evidence from the site walkover and the Desk Study. The formulation of an initial CSM is a key component of the LCRM methodology, and incorporates: a ground model of the site physical conditions; and an exposure model of the possible contaminant linkages. It forms the basis for Generic Quantitative Risk Assessment (GQRA) in accordance with current guidelines.

3.2 Ground model

The preliminary ground model presented in Section 2 provides an understanding of the ground conditions and is the basis for preparing the preliminary geotechnical hazard assessment (Section 3.3) and the preliminary geo-environmental exposure model (Section 3.4)

3.3 Geotechnical hazard identification

3.3.1 Context

The preliminary geotechnical hazard identification has been undertaken in accordance with the general requirements of ICE/DETR Document 'Managing Geotechnical Risk' and the HE documents HD 41/15 and CD 622.

The following section sets out the identified geotechnical hazards and the development elements potentially affected (see Table E.1 in Appendix E for further information).

3.3.2 Plausible geotechnical hazards

Plausible geotechnical hazards identified at the site are:

- Uncontrolled Made Ground (variable strength and compressibility).
- Soft / loose compressible Made Ground (low strength and high settlement potential).
- Shrinkage / swelling of the shallow clays within the Till, cohesive fraction of soils under the influence of vegetation.
- Variable lateral and vertical changes in ground conditions.
- Attack of buried concrete by aggressive ground conditions, associated with Made Ground.
- Slope stability issues – general slopes.
- Retaining walls/ stability issues along the eastern boundary.
- Earthworks – low bearing capacity or settlement of new fill and impact on foundations, floor slabs, roads and infrastructure and construction plant / settlement (due to placement of fill on soft / loose ground) / unsuitability of site won material to be reused as fill.
- Adverse chemical ground conditions, (e.g. expansive slag from former on-site steel works).
- Obstructions from concrete/ asphalt hardstanding.
- Seasonal variations in the depths to groundwater.
- Running sands or loose Made Ground, leading to difficulty with excavation and collapse of side walls.
- Instability of slopes and retaining walls associated with sidelong ground and slopes particularly along the north-eastern boundary of the southern section of the site.
- Problematic soils e.g. alluvium and subsequent infilled ground along the historical New Burn River.

- Shallow mine workings beneath the site and the immediate vicinity including on and off-site shafts.

3.3.3 *Potential development elements affected*

Development elements potentially affected by geotechnical hazards are:

- Structures – foundations.
- Structures – floor slabs.
- Roads and pavements.
- Services.
- Construction staff, vehicles and plant operators.
- Concrete below ground.

Health and safety risks to site Contractors and maintenance workers have not been assessed during these works and will need to be considered separately during design.

The above plausible geotechnical hazards and development elements affected have been carried forward for investigation and assessment. presented in Appendix E.

3.4 Geo-environmental exposure model

3.4.1 *Context*

The preliminary exposure model is used to identify geo-environmental hazards and to establish potential contaminant linkages, based on the source-pathway-receptor (SPR) approach.

A viable contaminant linkage requires all the components of an SPR to be present. If only one or two are present, there is no linkage and no further assessment is required.

3.4.2 *Potential contaminants*

For the purpose of this assessment the potential contaminants have been separated according to whether they are likely to have originated from an on-site or off-site source.

3.4.2.1 *Potential on-site sources of contamination*

- Historical and current land use (from the operation of the former Steel works, brick works, rail lines, garage infilled ground, refuse heap, concrete factory, depot, car park and substation): including asbestos containing materials (ACM), metal, slag, ash, hydrocarbon fuels, lubricants, BTEX/ MTBE and solvents including leakage from Underground Storage Tanks (USTs), Above Ground Storage Tanks (ASTs), the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles. (S01).
- Hydrocarbon fuels, lubricants, BTEX/ MTBE and solvents from the operation of the former Iron works, brick works and garage on the site. Including leakage from Underground Storage Tanks (USTs), Above Ground Storage Tanks (ASTs), the pipework between tanks and pumps, and general spillages, together with uncontrolled disposal and spillage from waste receptacles (S02).
- Hydrocarbon vapours from potential VOC and petroleum hydrocarbon spillages/leaks (S03).
- Mine gas emissions from coal seams in the Pennine Lower Coal Measures Formations (S04).
- Calcium oxide, calcium hydroxide, calcium carbonate, hydrated calcium sulphate, manganese dioxide and alkalinity associated with ready mix concrete works on site (S05).
- Ground gases (carbon dioxide and methane) from organic materials in the Made Ground, potential alluvial deposits along the historical course of the New Burn and historical refuse tip in the south-eastern section of the site (S06).

- Coal tar potentially present in the bituminous bound roads and carparks (S07).

3.4.2.2 *Potential off-site sources of contamination*

- Leachate from landfilled waste of unknown materials which potentially include, commercial and industrial, asbestos, animal processing wastes located beyond the northern and eastern boundaries (S08).
- PFAS (Per-and Polyfluroalkyl Substances) in AFFF (Aqueous Film-Forming Foams) in firefighting foams from the former fire station 24m west (S09).
- Hydrocarbon fuels and oils from the unspecified works 4m north including leakage from Underground Storage Tanks (USTs), the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles (S10).
- Methane and ground gas migration from landfilled waste of unknown materials located beyond the northern and eastern boundaries (S11).
- PCBs and oils from transformers in the electricity sub-station approximately 10m east of the site (S12).

3.4.3 *Potential receptors*

The following potential receptors in relation to the proposed land use have been identified.

- People (neighbours, site end users) (R01).
- Development end use (buildings, utilities) (R02).
- Groundwater: Secondary Undifferentiated Aquifer status of the Till Deposits and Secondary A Aquifer status of the Pennine Lower Coal Measures Formation (R03).
- Surface water: New Burn River and the River Tyne (R04).
- Plant life: on-site and off-site (Local Nature Reserve 27m north) (R05).

3.4.4 *Potential pathways*

The following potential pathways have been identified.

- Ingestion, skin contact, inhalation of dust and outdoor air by people (P01).
- Migration, build-up of methane and carbon dioxide via permeable soils and/ or construction gaps (P02).
- Migration of contaminant via leachate migration through the unsaturated zone in the Made Ground or Till Deposits (P03).
- Migration of contaminant from the perched groundwater within the Till Deposits to the groundwater within the Pennine Lower Coal Measure Formation Aquifer (P04).
- Root uptake by plants (P05).
- Surface run off (P06).
- Base flow from contaminated groundwater (P07).

Health and safety risks to site development contractors and maintenance workers have not been assessed as part of this study and will need to be considered separately.

The above sources, pathways and receptors have been considered as part of the Preliminary Risk Assessment in accordance with LCRM (2023), are considered to be plausible in the context of this site and have been carried forward for investigation and assessment. An assessment of the Source – Pathway – Receptor linkages is undertaken following the assessment and is presented in Appendix F (Table F.2).

3.4.5 *Potential implications of climate change*

Climate change has the potential to change the risk profile for conceptual site models and associated contaminant linkages. The impact of climate change on the CSM is site-specific, and a qualitative assessment of the potential impact of climate change on the CSM for this site is summarised below. The assessment has primarily utilised the guidance in Environment Agency (2010)[2] and SoBRA (2022)[3] which set out the UK context to climate change and land contamination. Both guidance documents advocate a "what if" scenario approach in the context of changes in ambient temperatures, an increase in the frequency of extreme rainfall/storm events and heatwaves/droughts, and long-term changes in groundwater and sea levels.

Those "what if" scenarios that are relevant to this CSM are:

- Increased long-term rainfall leading to increased infiltration and seasonally higher groundwater and water levels in surface waters.
- Rising sea-level leading to rise in groundwater levels and/or saline intrusion.
- Increased frequency and/or magnitude of extreme rainfall events leading to short-term surface flooding, surface water run-off, groundwater flooding, and/or land-based erosion.
- Increased frequency and/or magnitude of storm events leading to short-term drops in barometric pressure and/or high winds.
- Occurrence of extreme cold and hot weather events leading to changes in ground conditions such as soil temperature, evapo(trans)piration, and soil moisture (for example freeze-thaw effects and desiccation), decreased infiltration and fall in groundwater and surface water levels.
- Long-term decrease in rainfall leading to lower infiltration and fall in groundwater and surface water levels.

[2] *Environment Agency, 2010. Guiding Principles for Land Contamination. Part 2. FAQs, technical information, detailed advice and references, March 2010.*

[3] *SoBRA, 2022. Guidance on Assessing Risk to Controlled Waters from UK Land Contamination Under Conditions of Future Climate Change, Society of Brownfield Risk Assessment, August 2022.*

4. Desk study conclusions

4.1 Geotechnical conclusions

The following plausible geotechnical risks are identified:

- Variable Made Ground – (variable strength and compressibility).
- Soft/ loose compressible ground (low strength and high settlement potential).
- Attack of buried concrete by aggressive ground conditions – the development site may contain deposits of expansive slag material and general Made Ground which are potentially sulphate bearing soils.
- Shrinkage/swelling of clay – settlement/heave of foundations, especially where located within the influence of trees and vegetation.
- Running sands or loose Made Ground and shallow groundwater, leading to difficulty with excavation due to trench instability.
- Slope and retaining wall instability associated with the sidelong ground, and specifically the slopes along the northern and eastern site boundaries.
- Potential earthworks – low bearing capacity or settlement of new fill and impact on foundations, floor slabs, roads and infrastructure and construction plant / settlement (due to placement of fill on soft / loose ground) / unsuitability of site won material to be reused as fill.
- Potential for obstructions and the risk of instability of excavations with the impact on construction staff, vehicles and plant operators.
- Shallow coal mining activity and shafts – worked shallow coal seams resulting in broken ground/ ground stability, recorded and potentially unrecorded mine entries. Further assessment is made in the Hydrock Coal Mining Risk Assessment.
- Potential for unforeseen ground conditions and the risks associated with limited data.
- Problematic soils e.g. alluvium and subsequent infilled ground along the historical New Burn river.

These plausible risks require further investigation and assessment (see Section 6).

4.2 Geo-environmental conclusions

Based on historical and current land uses:

- It is considered that it is unlikely that the site would be classified as Contaminated Land under Part 2A of the EPA 1990.
- The overall risk from land contamination at the site is considered to be low for the current development, as it is covered by hard standing or buildings limiting the possibility of contact with the soils, as well as the risk of significant rainwater infiltration leading to leaching.
- The overall risk for a redeveloped site is assessed to be low to moderate, but this would need to be confirmed by appropriate intrusive investigation, testing and assessment of the results of the investigation.

The possible pollutant linkages (for risk levels of moderate or greater) on an unremediated redeveloped site, as determined by the desk study and walk-over, are summarised in Table 4.1:

Table 4.1: Possible Pollutant Linkages (for Risk Levels of Moderate or Greater)

Source(s)	◄ potential Impact on ►	Receptor(s)
Historical and current land use (from the operation of the former Steel works, brick works, rail lines, garage infilled ground, refuse heap, concrete factory, depot, car park and substation): including asbestos containing materials		People Development end use

Source(s)	◄ potential Impact on ►	Receptor(s)
(ACM), metal, slag, ash, hydrocarbon fuels, lubricants, BTEX/ MTBE and solvents including leakage from Underground Storage Tanks (USTs), Above Ground Storage Tanks (ASTs), the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles .		Groundwater and surface water
Hydrocarbon vapours from potential VOC and petroleum hydrocarbon spillages/leaks		People Development end use Groundwater
Mine gas emissions from coal seams in the Pennine Lower Coal Measures Ground gases (carbon dioxide and methane) from organic materials in the Made Ground, infilled ground, potential alluvial deposits along the historical course of the New Burn and historical refuse tip in the south-eastern section of the site		People Development end use
Calcium oxide, calcium hydroxide, calcium carbonate, hydrated calcium sulphate, manganese dioxide and alkalinity associated with ready mix concrete works on site		People Development end use Groundwater
Coal tar potentially present in the bituminous bound roads and carparks		People Development end use
Hydrocarbon fuels and oils from the unspecified works 4m north including leakage from Underground Storage Tanks (USTs), the pipework between tanks and pumps, and general spillage, together with uncontrolled disposal and spillage from waste receptacles		People Development end use
Methane and ground gas migration from landfilled waste of unknown materials located beyond the northern and eastern boundaries		People Development end use

These possible pollutant linkages require further investigation and assessment (see Section 6).

5. Uncertainties and limitations

5.1 General comments

Hydrock Consultants Limited (Hydrock) has prepared this report in accordance with the instructions of Fig Power (the Client), by e-mail dated November 2023 under the terms of appointment for Hydrock, for the sole and specific use of the Client and parties commissioned by them to undertake work where reliance is placed on this report. Any third parties who use the information contained herein do so at their own risk. Hydrock shall not be responsible for any use of the report or its contents for any purpose other than that for which it was prepared or for use of the report by any parties not defined in Hydrock's appointment.

Information provided by third parties has been used in good faith and is taken at face value; however, Hydrock cannot guarantee its accuracy or completeness.

Where the existing report(s) prepared by others have been provided by the Client, it is assumed that these have been either commissioned by the Client, or can be assigned to the Client, and can be relied upon by Hydrock. Should this not be the case Hydrock should be informed immediately as additional work may be required. Hydrock is not responsible for any factual errors or omissions in the supplied data, or for the opinions and recommendations of others. It is possible that the conditions described may have since changed through natural processes or later activities.

The work has been carried out in general accordance with recognised best practice. Unless otherwise stated, no assessment has been made for the presence of radioactive substances or unexploded ordnance. Where the phrase 'suitable for use' is used in this report, it is in keeping with the terminology used in planning control and does not imply any specific warranty or guarantee offered by Hydrock.

The non-specialist UXO screening has been undertaken for the purposes of ground investigation only (i.e. low risk activity in accordance with CIRIA Report C681). Further assessment should be undertaken with regards to other higher risk activities e.g. construction.

Please note that notwithstanding any site observations concerning the presence or otherwise of archaeological sites, asbestos-containing materials or invasive weeds, this report does not constitute a formal survey of these potential constraints and specialist advice should be sought.

Any site boundary line depicted on plans does not imply legal ownership of land.

6. Recommendations for further work

6.1 Additional Work

Following completion of the Phase I Desk Study the following additional work is recommended:

6.1.1 Coal mining risk assessment

A Coal Mining Risk Assessment is required for the proposed development.

6.1.2 Ground investigation

In order to confirm the actual risks to receptors and confirm the ground conditions with respect to potential geotechnical and geo-environmental risks, an appropriate intrusive investigation will need to be undertaken once the stockpiles located on the site have been removed. This investigation will need to:

- undertake a survey of the site and local area (and topographical survey) and record any evidence of slope instability that may affect future proposed developments;
- determine the depth and distribution of Made Ground and natural strata across the site;
- determine the soil strength/density profile beneath the site;
- determine the depth/level of groundwater beneath the site;
- determine the ground gas concentrations beneath the site;
- assess trench stability, over break potential and 'diggability';
- determine the stability of the retaining walls and slopes across the site associated with the sidelong ground, and specifically the slopes along the northern and eastern site boundaries.
- determine the depth and extent of mine workings and mine entries below the site;
- allow sampling for chemical and geotechnical laboratory testing;
- obtain information in terms of Aggressive Chemical Environment for Concrete Class (ACEC class)
- determine CBRs to assist with pavement design;
- determine the frequency of slag deposits from the Steel works to ensure further detailed investigation is not required; and
- assessment of tree influence on foundations and design of foundations.

Following investigation, assessment will be required to:

- update the ground model;
- update the geotechnical register;
- provide geotechnical design recommendations;
- update the Conceptual Site Model (CSM), including identification of plausible pollution linkages;
- undertake generic quantitative risk assessment of potential chemical contaminants to establish 'suitability for use' under the current planning regime;
- discuss potential environmental liabilities associated with land contamination (soil, water and gas); and
- provide outline mitigation recommendations to ensure the site is 'suitable for use'.

7. References

ASSOCIATION OF GROUND INVESTIGATION SPECIALISTS. 2006. Guidelines for Good Practice in Site Investigation. Issue 2. AGS, Beckenham.

BRITISH STANDARDS INSTITUTION. 2007. Eurocode 7 – Geotechnical design - Part 2: Geotechnical investigation and testing. BS EN 1997-2. BSI, London.

BRITISH STANDARDS INSTITUTION. 2004+A1 2013. Eurocode 7 – Geotechnical design - Part 1: General rules. BS EN 1997-1+A1. Incorporating Corrigendum February 2009. BSI, London.

BRITISH STANDARDS INSTITUTION. 2015+A1 2020. Code of practice for foundations. BS 8004 Incorporating Amendment No. 1. BSI, London.

BRITISH STANDARDS INSTITUTION. 2011. Code of Practice for Investigation of Potentially Contaminated sites. BS 10175 Incorporating Amendment No. 2:2017. BSI, London.

BRITISH STANDARDS INSTITUTION. 2015. Code of practice for ground investigations. BS 5930. BSI, London.

CLAYTON, C. R. I. 2001. Managing Geotechnical Risk. Improving productivity in UK building and construction. Thomas Telford, London.

DCLG. February 2019. National Planning Policy Framework. DCLG, London.

ENVIRONMENT AGENCY. 2019. Land Contamination: Risk Management (LCRM). The Environment Agency.

THE HIGHWAYS AGENCY. 2019. Design Manual for Roads and Bridges. Managing Geotechnical Risk. CD 622 Rev 0. Highway Agency, London.

THE HIGHWAYS AGENCY. 2015. Design Manual, Road and Bridges: Volume 4, Geotechnics and Drainage; Section 1, Earthworks; Part 3, HD 41/15, Maintenance of highway geotechnical assets. HD 41/15.

MILES, J. C. H., APPLETON, J. D., REES, D. M., GREEN, B. M. R., ADLAM. K. A. M. and MYRES. A. H. 2007. Indicative Atlas of Radon in England and Wales. Health Protection Agency and British Geological Survey. Report HPA-RPD-033.

MINISTRY OF HOUSING, COMMUNITIES and LOCAL GOVERNMENT (MHCLG). Internet published Planning practice guidance https://www.gov.uk/government/collections/planning-practice-guidance. MHCLG. London.

NHBC. 2021. NHBC Standards. NHBC, Milton Keynes.

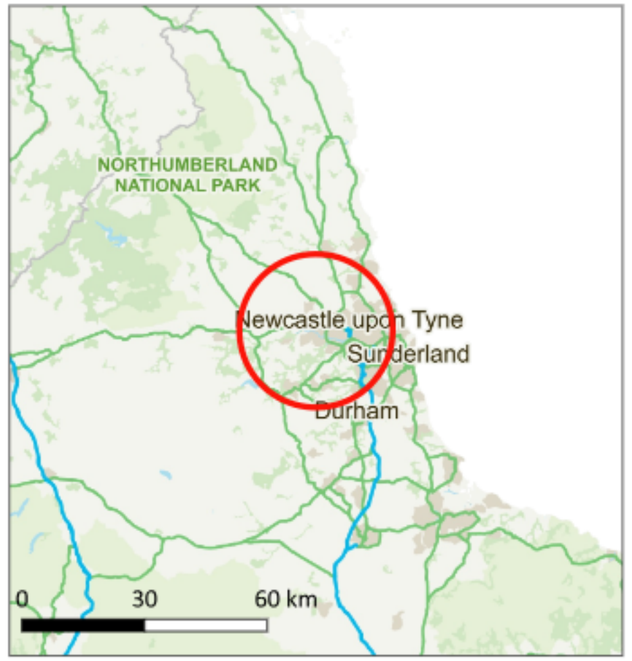
RAWLINS, B. G., McGRATH, S. P., SCHEIB, A. J., CAVE, N., LISTER, T. R., INGHAM, M., GOWING, C. and CARTER, S. 2012. The advanced geochemical atlas of England and Wales. British Geological Survey, Keyworth.

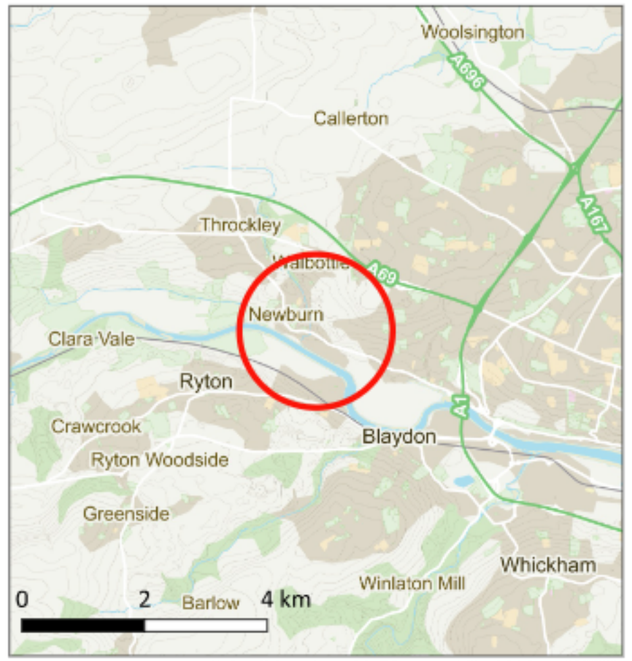
SCIVYER, C. 2015. Radon: Guidance on protective measures for new buildings. Building Research Establishment Report BR 211. BRE, Garston.

STONE, K., MURRAY, A., COOKE, S., FORAN, J. and GOODERHAM, L. 2009. Unexploded ordnance (UXO), a guide to the construction industry. CIRIA Report C681. Contaminated Land: Applications in Real Environments, London.

WATER UK HBF. January 2014. Contaminated Land Assessment Guidance. Water UK and the Home Builders Federation.

Appendix A Drawings





KEY PLAN

Site Boundary

NOTES

1. Contains OS data © Crown copyright and database right (2022)

REVISIONS

REV.	DRAWN BY INITIALS	CHECKED BY INITIALS	DATE	REVISION NOTES/COMMENTS
P01	JH	WS	01/12/23	First Issue
P02	JH	WS	29/01/24	Second Issue

Hydrock

TITLE
SITE LOCATION PLAN

HYDROCK PROJECT NO.
29911

SCALE @ A3
1:2,000

CLIENT
Fig Power

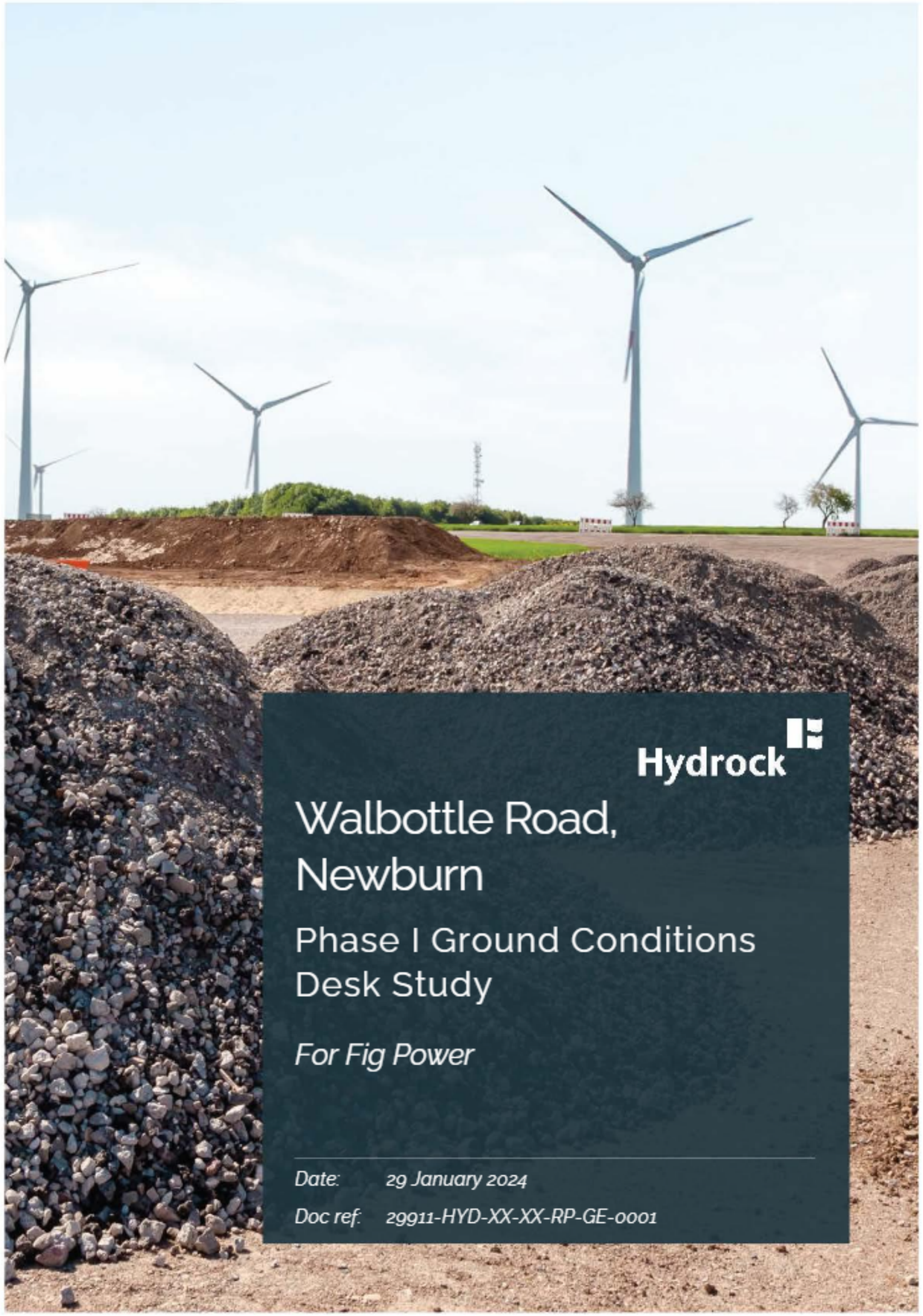
PURPOSE OF ISSUE
SUITABLE FOR INFORMATION

STATUS
S2

PROJECT
Walbottle Road, Newburn

DRAWING NO.
29911-HYD-XX-XX-DR-GE-0001

REVISION
P02



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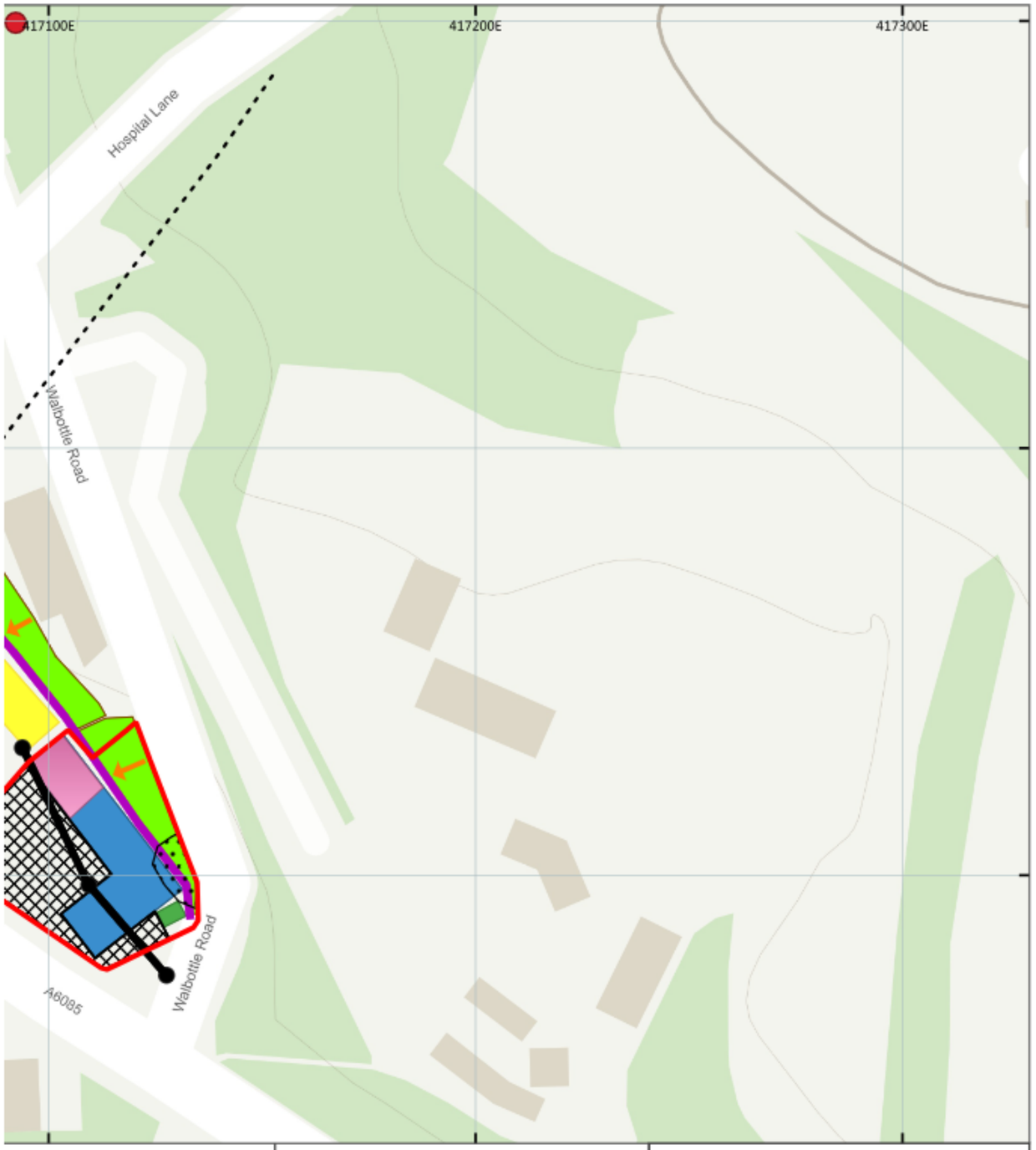
Walbottle Road, Newburn

Phase I Ground Conditions Desk Study

For Fig Power

Date: *29 January 2024*

Doc ref: *29911-HYD-XX-XX-RP-GE-0001*



CHECKED BY	INITIALS	DATE	REVISION NOTES/COMMENTS
	S	04/12/23	First issue
	S	29/01/24	Second issue

Hydrock

TITLE: SITE FEATURES PLAN		
HYDROCK PROJECT NO.: 29911	SCALE @ A3: 1:1,200	
CLIENT: Fig Power	PURPOSE OF ISSUE: SUITABLE FOR INFORMATION	STATUS: S2
PROJECT: Walbottle Road, Newburn	DRAWING NO.: 29911-HYD-XX-XX-DR-GE-0002	REVISION: P02