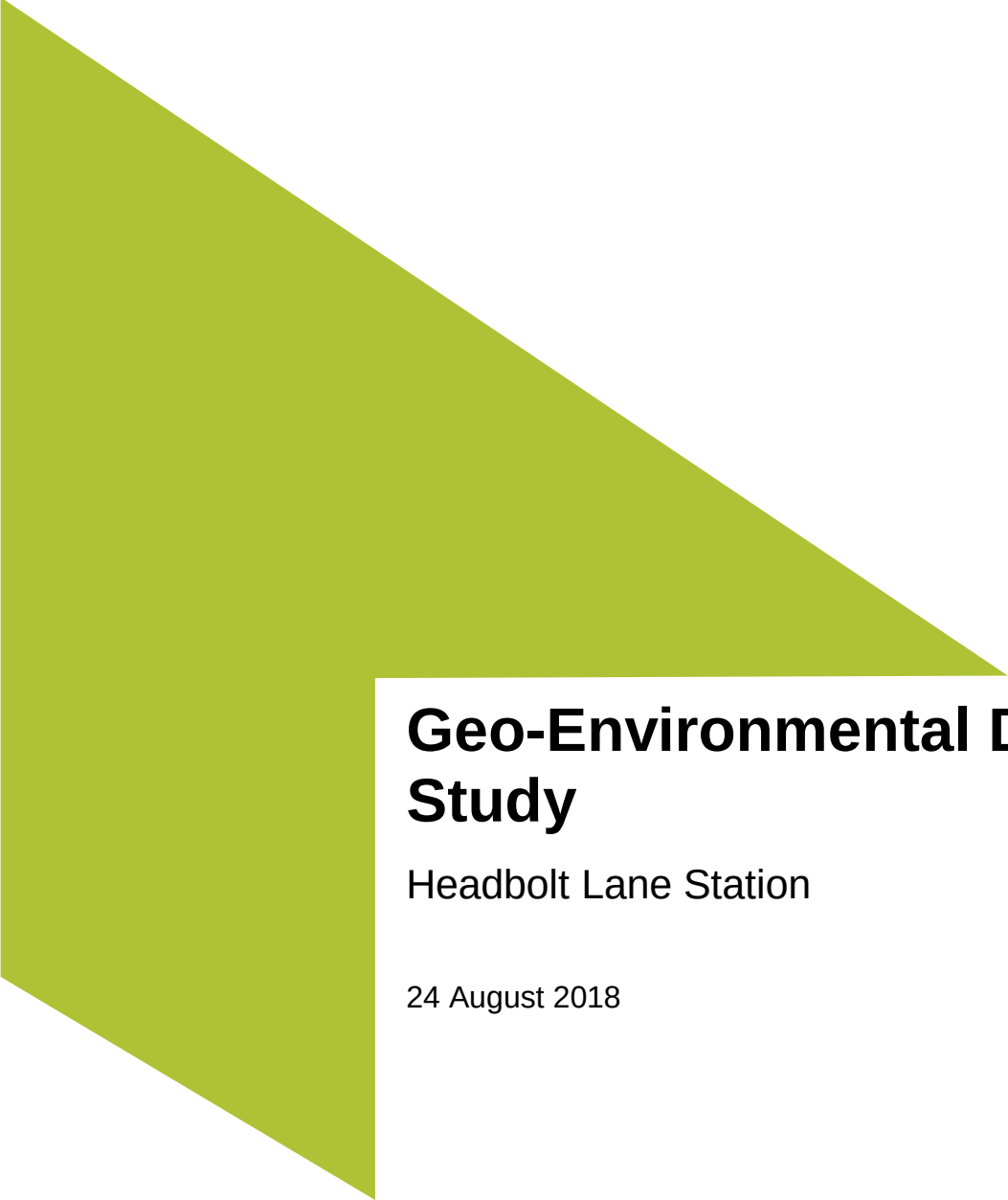


Appendix 10B

Geo-environmental Desk Study



Geo-Environmental Desk Study

Headbolt Lane Station

24 August 2018

Mott MacDonald
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33 Stamford Street
Altrincham WA14 1ES
United Kingdom

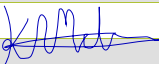
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Geo-Environmental Desk Study

Headbolt Lane Station

24 August 2018

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Executive Summary

Mott MacDonald Limited has been commissioned by Network Rail to develop the Skelmersdale Rail Link to GRIP 3A and Track AIP. As part of this work a Geo-environmental Desk Study and this report covers the proposed Headbolt Lane Station site. This site is situated 1.2km north east of Kirby Station, on a section of open land between Headbolt Lane, Country Road and the existing Liverpool to Wigan railway line.

The overall aim of this desk study is to define and reduce risks to the project with the objective of ensuring that critical issues specific to the site including nature and geotechnical properties of the ground are addressed. The desk study will inform the ground investigations (GI) to be undertaken as part of the works. This will allow project risks to be efficiently managed at an early stage. The proposed works comprise a new station which includes a station building, car and bicycles parking areas, bus stops and a pedestrian bridge over the railway.

The existing railway line has been present along the southern boundary of the site since the earliest map in 1850, with the majority of the surrounding area being agricultural land. A small sandstone quarry was present to the north of the site at the end of the 1800's, next to the property called Tanpit House. The property was no longer present after the 1990s. Rigby Brook flows through the middle of the site and appears to have been realigned in 1960s away from the foot of the railway embankment. The detailed review of the historical mapping has indicated the possibility for the presence of made ground and alluvium on the site associated with the historical quarry, house and realignment of Rigby Brook.

The BGS mapping indicate that there are no superficial deposits over the majority of the site with wind blown sands of the Shirdley Hill Sand Formation present in the extreme east of the site. However, as mentioned above there is an indication that alluvium and made ground could be present. The nearest historical boreholes were 50m to the south of the site and indicated the bedrock of the Wilmslow Sandstone Formation is anticipated to be within 2m of the ground level.

A preliminary qualitative contaminated land risk assessment has determined that for the majority of source-pathway-receptor scenarios the risk is low to moderate to human health and controlled waters. The most significant risk is considered to apply to human health and controlled waters through human health pathways, overland flow of surface water, and horizontal and vertical migration of contaminants in the soil.

The key geo-environmental risks relate to potential variability of and potential contamination within the Made Ground, possibility of subsurface obstructions and the variability of the topography of the site leading to significant cut/fill works across the site. The site is outside of a High-Risk Coal Mining Area.

To mitigate the risks highlighted in this report, an intrusive ground investigation is recommended to:

- define the ground conditions across the site for foundation design,
- assess the suitability of the near surface strata for reuse in earthworks, cut/fill design; and
- assess the extent of the geotechnical constraints highlighted in this desk study; and
- understand and define the presence of contamination and the geo-environmental risks at the site.

1 Introduction

1.1 Scope of Work

Mott MacDonald Limited has been commissioned by Network Rail to develop the Skelmersdale Rail Link to GRIP 3A and Track AIP. This report is to inform the design as part of the GRIP 3A activities.

1.2 Proposed Scheme

The Skelmersdale Rail Link Project will create new transport hub within the town to provide a direct rail link between Skelmersdale, Wigan and Liverpool. A study commissioned by Lancashire County Council has found that improved transportation links to Wigan and Liverpool will provide job opportunities for Skelmersdale residents and this will create further employment in the area.

The scheme comprises of new tracks for about 3km over land from new junctions on WLK2 (Liverpool to Wigan Railway line) to the proposed station site at the former Glenburn Sports College site, a new station at Skelmersdale and at Headbolt Lane with modifications required to the existing stations at Rainford and Kirby.

The proposed works at Headbolt Lane will require geotechnical input related to but not limited to the following:

- Station building foundations and earthworks to create level carpark area;
- Foundations for new pedestrian bridges to cross the railway line; and
- Some modification to the track layout to allow the additional train services to operate through the station.

1.3 Report Objectives

The purpose of this geo-environmental desk study is to provide information on the ground conditions that are likely to be encountered during the proposed works at Headbolt Lane, where a new station is proposed. A site location plan is provided in Figure 1.

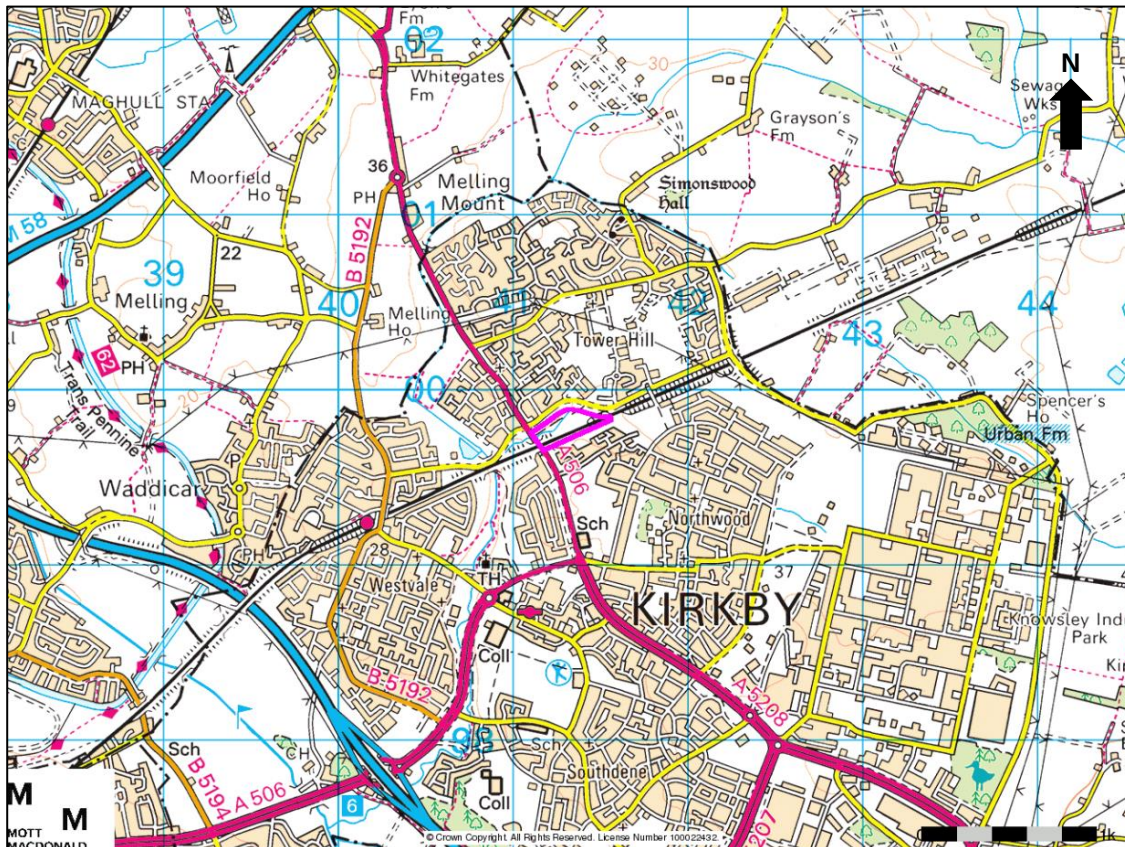
Designs for the Headbolt Lane Station are still to be developed but it is understood that the station is to have a capacity for 400,000 passengers a year, a carpark with space for at least 250 cars within 200m of the station, 4 bus stops within 25m of the station, and provision for at least 100 bicycles to be parked. There should also be an allowance for 500 parking spaces within 2minutes of the station, and passive provision for at least 300 bicycles to be parked.

This desk study reviews and summarises information for the site obtained from several sources, as detailed in Section 1.4 of this report. The objectives of this Geo-environmental Desk Study are to:

- Establish the geological and hydrogeological conditions for the site using existing available information;
- Summarise available information and identify site specific geotechnical and/or geo-environmental hazards which may place a constraint or risk upon the proposed development;

- Produce a preliminary Conceptual Site Model and preliminary qualitative contamination risk assessment identifying plausible potential linkages between contamination sources, pathways and receptors and,
- Provide objectives and recommendations with regards to an intrusive ground investigation (GI) and other further assessments that may be required.

Figure 1: Study Area shown in Pink



Source: Envirocheck, (2018)

1.4 Sources of Information

The following sources of information were used in the preparation of this report:

- Envirocheck, (2018). Envirocheck Report Order number: 167815730_1_1 including site sensitivity data, 1:10,000 scale geological mapping, Historical Land Use Database and historical maps (Appendix C)
- NERC. (2017). BGS Open Geoscience Borehole Scans. Available from <http://mapapps.bgs.ac.uk/geologyofbritain/home.html> Last accessed June 2018. (Appendix D)
- British Geological Survey (1970). Geological Survey of England and Wales 1:63,360 Wigan Sheet 84, Drift (Keyworth, Nottingham: British Geological Survey).
- British Geological Survey (1977). Geological Survey of England and Wales 1:50,000 Wigan Sheet 84, Solid (Keyworth, Nottingham: British Geological Survey).

- NERC. (2017). The BGS Lexicon of Named Rock Units. Available from <https://www.bgs.ac.uk/lexicon/home.cfm> Last accessed June 2018.
- Geological Memoir (Jones, R.C.B.; Tonks, L.H.; Wright, W.B, (1038). Wigan district. Explanation of sheet 84. HMSO; London.)
- Coal Authority, (2017). Coal Authority Interactive Map Viewer. Available from <http://mapapps2.bgs.ac.uk/coalauthority/home.html>. Last accessed May 2018.
- Network Rail, 2018. Stage 1 Preliminary Mining Assessment. Report Reference: LM-MISC-2448, dated 17/07/2018.
- Zetica, (2018). Unexploded Bomb Risk maps (Available from <https://zeticauxo.com/downloads-and-resources/risk-maps/> Last accessed May 2018)
- Zetica, (2018). Pre-Desk Study Assessment for Skelmersdale Rail Link and Headbolt Lane, Kirkby dated 1 June 2018.
- NERC. (2018). GeoIndex Onshore. Available: <http://mapapps2.bgs.ac.uk/geoindex/home.html>. Last accessed 6 June 2018
- JBA Consulting, (2018). Network Rail Earthworks Asset Database. Available from <http://www.jbamap.co.uk/map/NetworkRail/Examinations> Last accessed June 2018.
- WLBC-Walter, Barry, (2018) Barry.Walters@westlancs.gov.uk Contaminated land enquiry. 20/06/2018

2 Geo-Environmental Baseline Summary

2.1 Site Location

The site is located approximately 1.3km northeast of the existing Kirby Railway Station, immediately adjacent to the Liverpool to Wigan Railway line (WLK2, 28m 1000yds to 28m 1570yds), and is centred on approximate National Grid Reference (NGR) 341330, 399790. A detailed site located plan is provided in Figure A1 (Appendix A).

2.2 Site Description and Topography

The 5 Ha site is roughly rectangular in shape and is bounded to the south by the Liverpool to Wigan Railway Line (WKL2), the east and north by Headbolt Lane, and to the west by the A506, Bank Lane. A stream, the Kirkby Brook, is indicated to enter the east of the site from the south, via a culvert beneath the railway, flow north-west to the centre of the site, before flowing south-west through the middle of the site to exit beneath the A506.

The land is undulating and slopes down from the northern and southern boundaries to the stream in the centre of the site forming a valley. Headbolt Lane is at an approximately elevation of 30 m AOD on the northern boundary of the site, reducing to 25m AOD on the eastern boundary of the site, although the road appears to be located on an approximately 2m high embankment at this eastern edge.

The stream in the centre of the site is at an elevation of approximately 23m AOD in the east of the site, reducing to 20m AOD in the west of the site. The railway along the southern boundary of the site is indicated to be at grade (approximately 30m AOD) between 28m 1000yds and 28m 1430 yds (eastern part of the site) and on embankment on the approach to the crossing of the A506 at 28m 1570yds. The embankment has a maximum height of 5m, approximately 35m AOD.

2.3 Site History

The historical maps at 1:10,560, 1:10,000 and 1:2500 scales from between 1850-2018 (Envirocheck, 2018) have been reviewed to understand the development of the study area. A detailed review of the site history is presented in Table 10 in Appendix B.

In summary in the earliest available map from 1850, the site is shown to comprise agricultural land with a stream, the Rigby Brook, flowing through the centre of the site east-west. A building, Tanpit House, located in the centre north of the site, and a sandstone quarry, Mercer's Delf, is located in the centre of the site north of the Rigby Brook. The southern boundary of the site comprises a railway line that is indicated to be on embankment in the west of the site. The site is indicated to be bounded to the north and west by roads, with the surrounding area comprising agricultural land with occasional houses and cottages.

In the map from 1893 the quarry on site is no longer present, and a pumping station is shown to 50m south of the site. No significant changes are noted until 1966 where housing developments are shown to have been constructed to the north and east of the site, and Headbolt Lane has been re-aligned around the northern and eastern boundaries of the site. On site the stream is indicated to have been re-aligned away from the railway embankment in the west of the site, and a footpath is indicated to cross the site east-west.

Tanpit House is no longer indicated to be present by 1990, and the crest of hill on northern site boundary has moved southwards indicating a change in ground levels. No other significant changes are noted on any of the maps to present day with the exception of the pumping station shown to be absent from 1999.

2.4 Geology

The geology underlying the study area has been summarised from the BGS geological maps, Envirocheck report and Geological Memoir of Wigan District as detailed in Section 1.4. A conceptual cross section N-S through the centre of the site is presented in Figure 4.

2.4.1 Made Ground

No Made Ground is indicated to be present on the site from the geological mapping, although Made Ground is expected on the site associated with the following:

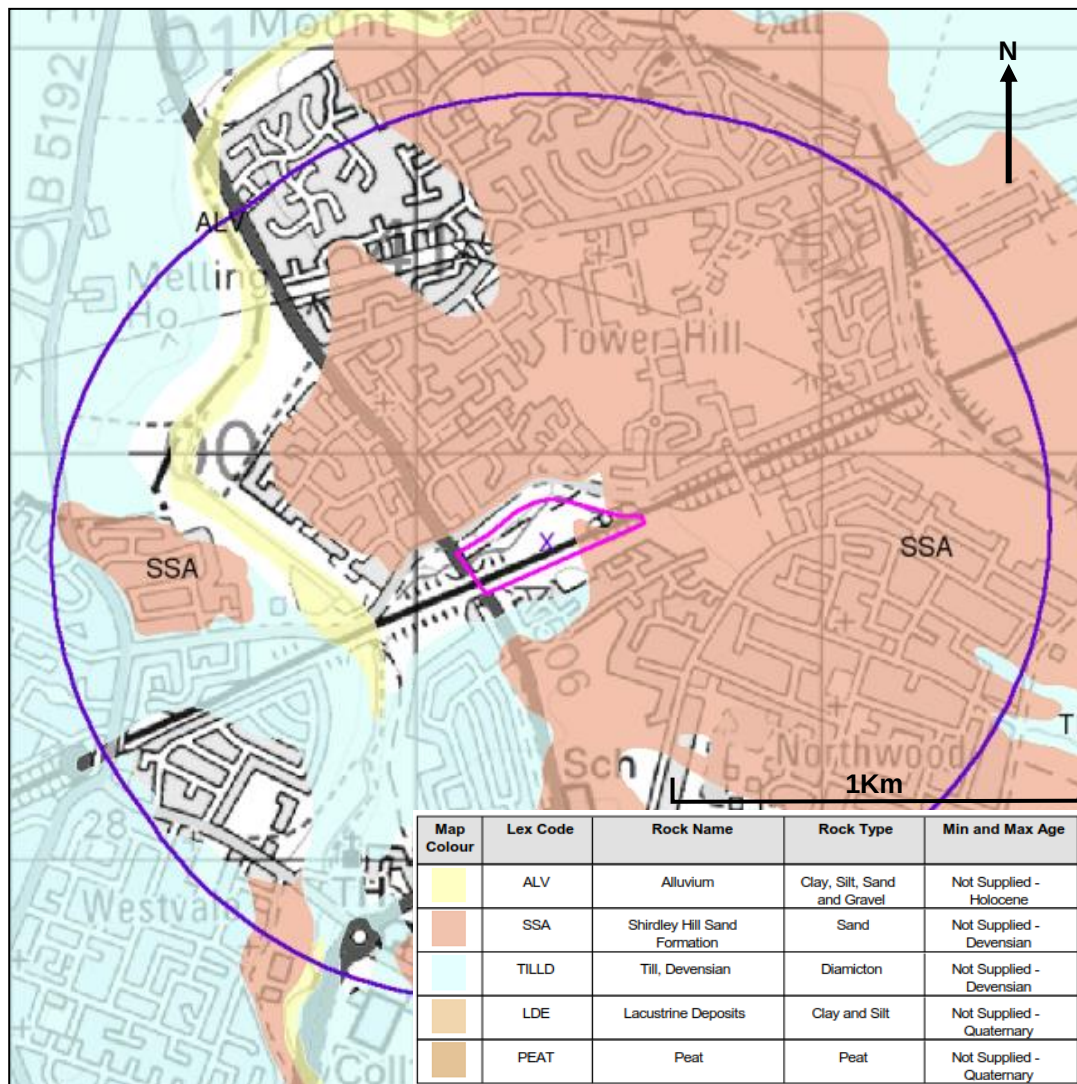
- railway line;
- embankment on the western boundary of the site associated with Headbolt Lane;
- former sandstone quarry;
- backfilling of the former stream channel, adjacent to the railway line where it crosses the A506; and
- former Tanpit House in the north of the site.

Made Ground is also expected to be present in the northern half of the site as the 30m AOD elevation line on the northern boundary of the site is indicated to move southwards between the historical 1:10,000 scale maps from 1974-1978 and 1990 (Figure A.2, Appendix A). This coincides with the demolition of Tanpit House and may be associated with the spreading of demolition waste across the site, or with construction with the residential housing to the north and west of the site. The areas of expected Made Ground are presented in Drawing 394359-HBL-GEO-01 (Appendix A).

2.4.2 Superficial Deposits

No superficial deposits are indicated to be present over the majority of the site, however wind blown sands of Shirdley Hill Sand Formation are indicated to be present in the extreme east of the site. These post glacial deposits are indicated to comprise moderately to well-sorted, fine grained sand with peat layers in the lower part. An extract of a map of the superficial geology is provided in Figure 2. Whilst it is not indicated on the geological mapping, Alluvium could be expected along the alignment of the stream/brook and beneath the backfilled stream channel.

Figure 2: Superficial Geology Extract



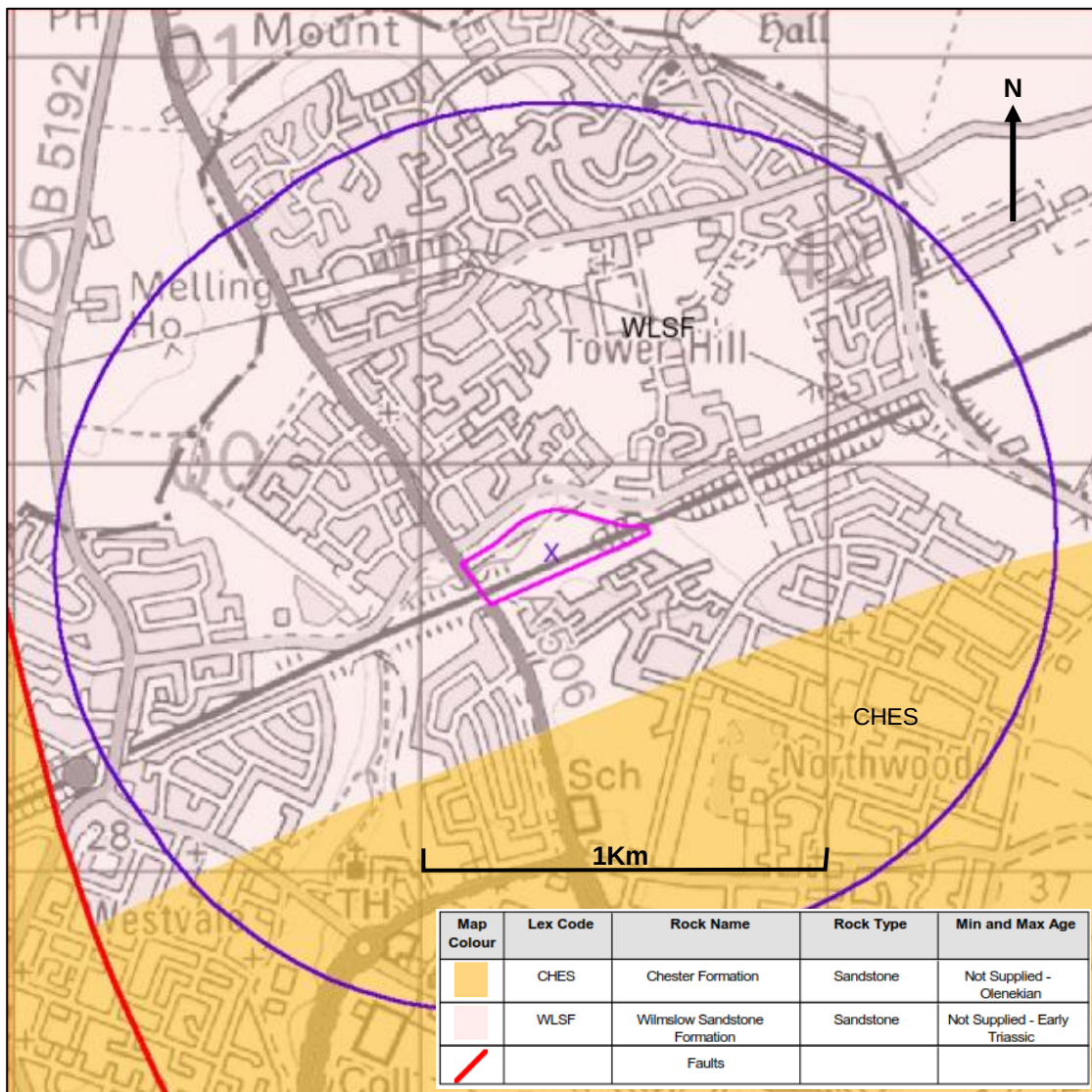
Source: Envirocheck, (2018)

2.4.3 Solid Geology

The bedrock Geology beneath the site is indicated to comprise Wilmslow Sandstone Formation of the Sherwood Sandstone Group. The underlying Chester Formation is indicated to subcrop 400m south of the site. An extract of the solid geology map is provided in Figure 3.

The Wilmslow Sandstone is indicated to comprise a red-brown to brick-red fine to medium grained generally pebble-free cross-bedded sandstone, whilst the underlying Chester Formation is indicated to comprise conglomerates and reddish brown, cross-bedded, pebbly sandstones with subordinate beds of red-brown mudstone.

Figure 3: Solid Geology Map Extract



Source: Envirocheck, (2018)

2.4.4 Structural Geology

A northeast – southwest trending fault is indicated to be present 1.1km west of the site (Figure 3). The bedrock geology is indicated to dip gently at 5° to the northwest.

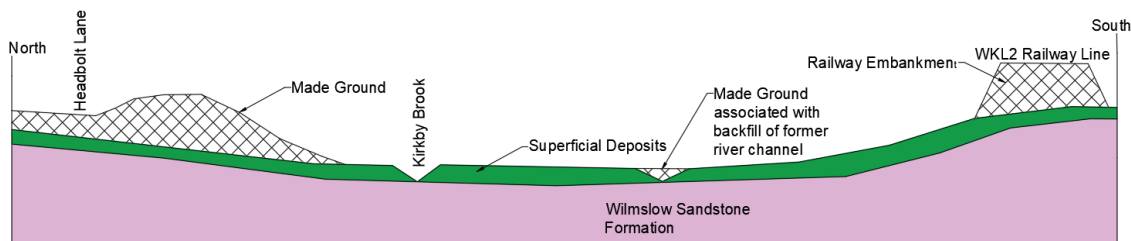
2.4.5 BGS Historical Boreholes

Two BGS publicly available borehole logs (SJ49NW1, SJNW10) are located 50m south of the site that were drilled in the 1950s at the St Helens Corporation Water Works (Pumping Station). These encountered 0.45m – 0.6m of topsoil, over 0.6m to 1m of clay. Sandstone is encountered at depths of 1.2m to 1.5m bgl and is weathered to sand in its upper 0.5m. The sandstone is proven to a maximum depth of 150m bgl. A conceptual cross section is shown in Figure 4.

A further borehole record is located 270m north of the site (SD40SW12) where the ground conditions were found to comprise topsoil to 0.46m bgl, sand to 1.68m bgl, clay to 1.83m bgl and weathered rock to 3.05m. Competent rock is proven to 19.81m bgl.

The BGS borehole logs are provided in Appendix C. The location of these holes is shown on drawing 394359-HBL-GEO-01 in Appendix A.

Figure 4: Conceptual Cross Section



2.5 Hydrology and Flooding

The Envirocheck report indicates the closest surface water is the Kirkby Brook which is indicated the flow through the centre of the site. This joins the Simonswood Brook 300m west of the site before flowing south.

The site is not indicated to be at risk of flooding from rivers or sea.

A strip of land in the middle the site, orientated along the Kirkby Brook at the lowest elevation point on the site is indicated to be at risk from fluvial and surface water flooding.

2.6 Hydrogeology

The Environment Agency classify the Shirdley Hill Sand Formation as a Secondary A Aquifer. This classification is assigned to permeable layers capable of supporting water supplies at a local scale, and in some cases can supply an important base flow to rivers.

The Wilmslow Sandstone Formation is classified as a Principle Aquifer due to its high intergranular and/or fracture permeability, meaning it can provide a high level of water storage and may provide water supply and/or base river flow on a strategic scale.

The site is indicated to be within a Source Protection Zone (SPZ) 3. A Zone 3 status covers the entire catchment area for a protected groundwater abstraction source. The nearest source is located over 1.5km to the northwest of the site.

2.7 Water Abstractions and Discharge Consents

A discharge consent is located 11m south east of the site. This was for the discharge of process water to a freshwater stream, and the consent was held by Suez Recycling & Recovery Limited. This consent was revoked in 2010.

A groundwater abstraction is located 55m south of the site and is operated by United Utilities of public water supply. It is not known if this is still active. However, the historical maps indicate that the pumping station has not been present since 1999.

2.8 Mining

The site is not reported to be within a Coal Mining Area.

A Stage 1 Preliminary Mining Assessment has been undertaken which states no further action is required (Network Rail, 2018).

2.9 BGS Recorded Mineral Sites

There is one BGS recorded mineral site located within the site boundary. This is reported to be Mercer's Delf which mined sandstone from an opencast quarry and is indicated to have ceased operation by the late 1800's. There are two other sandstone quarries, Old Rough Delf and Dearbolt Delf reported 760m and 890m to the south and the west of the site respectively.

2.10 Network Rail Earthwork Records

Network rails Earthwork inspection records have been interrogated from the Network Rail JBA Earthworks Examinations Portal. The railway earthworks within the site boundary comprise embankments on the approach to the crossing of the A506. These increase in height from 1m to 5m by the crossing A506, with slope angles of 32° and a cess width of 2m. They are indicated to comprise fine granular and ash material, and show little evidence of distress. The available earthwork records results are summarised in Table 1 and copies of the earthwork record reports are included in Appendix E. Typically, these earthworks classify as Earthwork Hazard Category (EHC) A (good condition) and of Low Risk

Table 1: Earthwork Condition Summary

ELR	Start	End	Side	Type	Risk Category	EHC
WKL2	28.1430	28.1540	D	Soil Embankment	Low	A
WKL2	28.1430	28.1540	U	Soil Embankment	Average	A
WKL2	28.1540	28.1650	D	Soil Embankment	Low	A
WKL2	28.1540	28.1650	U	Soil Embankment	Low	A

Source: Network Rail JBA Examinations Portal

2.11 BGS Geotechnical Hazards

The Envirocheck report states the following potential risk level for the following geotechnical hazards:

- Collapsible Ground Stability Hazard – Very Low
- Compressible Ground Stability Hazard – Very Low
- Ground Dissolution Stability Hazard – No risk
- Landslide Ground Stability Hazard – Very Low
- Running Sand Ground Stability Hazard – Low in areas of the Shirdley Hill Sands Formation, no risk across the rest of the site.
- Shrinking or Swelling Clay – No risk

An area of potentially infilled land is indicated to be present in the north of the site. This is likely associated with the former Mercer's Delf sandstone quarry.

The site is indicated to be in a Lower Probability Radon area (less than 1% of homes are estimated to be at or above the Action level). No radon protection measures are necessary in the construction of station.

2.12 UXO

A Pre-Desk Study Assessment obtained from Zetica Limited on the 1 June 2018 indicates that the site has a low risk potential from UXO and a detailed desk study for the site is not considered essential.

2.13 Pollution Incidents to Controlled Waters

There is 1No. pollution incident to controlled waters within the site boundary, and a further 11No. pollution incidents to controlled waters within 500m of the site as detailed Table 2 and in the Envirocheck Report.

Table 2: Pollution Incidents to Controlled Waters

Distance from Site	Receiving Water	Date	Pollutant	Category
0m	Kirkby Brook	04/11/1994	Miscellaneous – Other (Leak from Underground Pipe)	Cat 3 - Minor
20m (NE)	Kirkby Brook	16/07/97	Miscellaneous – Other	Cat 3 - Minor
245m (W)	Not Given	14/05/92	Not Given	Cat 3 – Minor
305m (W)	Kirkby Mill Dam Pond	08/04/94	Oils – unknown	Cat 2 - Significant
310m (W)	Simonswood Brook	07/07/92	Miscellaneous – Other	Cat 2 - Significant
340 (W)	Not Given	09/09/92	Not Given	Cat 3 - Minor
400 (W)	Mill Dam Pond	12/05/95	Unknown	Cat 3 – Minor
405 (W)	Not Given	23/09/94	Crude Sewage (Leak from underground pipe)	Cat 2 - Significant
400 (W)	Kirkby Brook	18/04/95	Rubble/Litter or Solids	Cat 3 - Minor
430 (W)	Simonswood Brook	31/03/93	Not Given	Cat 3 – Minor
430 (W)	Simonswood Brook	19/09/93	Rubble/Litter or Solids (Burnt out cars)	Cat 3 – Minor
430 (W)	Mill Dam Pond	29/06/94	Miscellaneous – Unknown	Cat 3 – Minor

Source: Envirocheck, (2018)

2.14 Local Authority Pollution Prevention Controls

There are no Local Authority Pollution Prevention Controls within 950m of the site.

2.15 Integrated Pollution Prevention and Control

There are no Integrated Pollution Prevention and Control measures within 500m of the site.

2.16 Contemporary Trade Entries

There are only two Contemporary Trade Entries within 500m of the site. One of which is active and related to a carpet, curtain and upholstery cleaners located 170m west of the site. The inactive entry related to a recycling centre that was located 470m to the southeast.

2.17 Fuel Entries

There is one active fuel entry located 885m southeast of the site, Essar Bigdale Service Station. An inactive fuel station, Kirkby Service Station, was located 775m south of the site.

2.18 Landfills

A historical landfill is located 540m northwest of the site, that is also a recorded Local Authority Recorded Landfill Site, and a Registered Landfill Site. This was operated by Nico Trading Limited and stopped receiving waste in December 1993. It was authorised to receive brick, stone, concrete, inert spoil, soils and clays.

A Licenced Waste Management Facility is located 900m northeast of the site. This is operated by William Bros Industry Limited and involves treating waste to produce soil. The licence was surrendered in 2013.

2.19 Hazardous Substances

No hazardous substances are reported within 1000m of the site boundary.

2.20 Consultation with Contaminated Land Officer

The site is not on the councils list of potentially contaminated sites and has no other information on the site (WLBC, 2018).

2.21 Past Land Use, Contamination Potential

As the land use on site only comprises a railway, a quarry that stopped operating in the late 1800s, a house, and agricultural and park land, no significant contamination is expected on site.

However, localised contamination may be expected in the areas of the former development and alongside the railway line in the south of the site.

2.22 Sensitive Land Use and Statutory Designations

The only sensitive land uses within 1000m of the site are areas of adopted green belt, the closest of which is located 675m northwest of the site.

2.23 Services/Utilities

A detailed utility search for the site is still to be undertaken, therefore no information on utilities is currently available.

2.24 Network Rail Hazard Directory

An extract from Network Rail Hazard Directory relevant to section of affected track is shown in Table 3. The comments given in Table 3 are as given in the directory, no further details are provided.

Table 3: Extract from Network Rail Hazard Directory

ELR Start	ELR End	Type	Name	Track	Comment
28.1174	28.1194	Buried Foul Water Service	Kirkby Brook	All/Multiple Tracks	45 x 36 inch Sewer laid by Whiston RDC Agmt. 23/3/1956. LP 618.
28.1309	28.1309	Buried & Overhead Electric Cable	Kirkby	Rev Single	not shown on LP 618.
28.132	28.132	Buried & Overhead Electric Cable	Kirkby	Unknown	North East of Station. Line 1 Pole. not shown on LP 618.

ELR Start	ELR End	Type	Name	Track	Comment
28.1587	28.1587	Buried Service	School Lane (Country Road A506)	All/Multiple Tracks	18 inch Trunk main laid by St. Helens Corp. Corres 2771/64. LP 618.
28.159	28.159	Buried & Overhead Electric Cable	School Lane (Country Road A506)	All/Multiple Tracks	Voltage: 33000 <> School Lane Bridge 55. Elec. Cable laid by MANWEB Corres. 631/65. LP 618.
28.1593	28.1593	Buried Water Main	School Lane (Country Road A506)	All/Multiple Tracks	18 inch water main. LP 618.

Source: Network Rail Hazard Directory

3 Qualitative Contaminated Land Risk Assessment

3.1 Regulatory Context

The primary legislative regime under which historic contaminated land is managed in the UK is Part IIA of the Environmental Protection Act (EPA), 1990. The framework for the assessment of potential land contamination adopted in this report is based on current guidance documents regarding the implementation of Part IIA of the EPA and the assessment of potentially contaminated land, with particular reference to:

- Department of the Environment Food and Rural Affairs (DEFRA) (2012): “Environmental Protection Act 1990: Part 2A, Contaminated Land Statutory Guidance”, April 2012;
- Environment Agency (2009): Human Health Toxicological Assessment of Contaminants in Soil”, Science Report – SC050021/SR2;
- Environment Agency (2009): “Updated Technical Background to the CLEA Model” , Science Report - SC050021/SR3;
- British Standard (BS) 10175: 2011, “Investigation of Potentially Contaminated Sites” ;
- Environment Agency (2012): “Groundwater Protection Policy and Practice, GP3” ;
- NHBC, EA, CIEH (2008): “Guidance for the Safe Development of Housing on Land Affected by Contamination”, R&D Publication 66: 2008
- Department for Communities and Local Government (2012): “National Planning Policy Framework”.

Elimination of liability under Part IIA is not always achievable largely because of the inherent risk basis of the statutory regime, the technical difficulty in establishing levels of contamination that are likely to represent Significant Potential of Significant Harm (SPOSH), and the variable distribution of contamination at many sites. Statutory guidance on Part IIA (DEFRA, 2012) recognises that sites require prioritisation by Local Authorities under the statutory Part IIA site inspection programme to ensure that only those sites likely to present the greatest risks are identified. However, it should be recognised that considerable investigation is often required to establish whether sites are likely to meet the definition of contaminated land under Part IIA.

Such investigation may be beyond the scope of project budgets for nominally “low risk sites” necessitating judgement on an acceptable level of investigation. Since the designation of Contaminated Land is the responsibility of the local Authority, it is advised that consensus is sought on any recommendations regarding the significance of contaminated land risks and remedial measures through consultation with the Regulator(s).

Section 161 of the Water Resources Act 1991 states that the Environment Agency can recover clean-up costs on person(s) who caused or knowingly permitted the entry or presence of any poisonous, noxious or polluting matter or any solid waste into controlled waters. Contamination and environmental considerations are studied by developing a conceptual model of the site that describes the environmental features of the site together with the expected interaction of potential contamination sources and the wider environment.

3.2 Planning Context

The National Planning Policy Framework (Department for Communities and Local Government, 2012) includes the following policies in relation to contaminated land:

Policy 109: “The planning system should contribute to and enhance the natural and local environment by:

- preventing both new and existing development from contributing to or being put at unacceptable risk from, or being adversely affected by unacceptable levels of soil, air, water or noise pollution or land instability; and
- remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate”

Policy 120: “To prevent unacceptable risks from pollution and land instability, planning policies and decisions should ensure that new development is appropriate for its location. The effects (including cumulative effects) of pollution on health, the natural environment or general amenity, and the potential sensitivity of the area or proposed development to adverse effects from pollution, should be taken into account. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.”

Policy 121: “Planning policies and decisions should also ensure that:

- the site is suitable for its new use taking account of ground conditions and land instability, including from natural hazards or former activities such as mining, pollution arising from previous uses and any proposals for mitigation including land remediation or impacts on the natural environment arising from that remediation;
- after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part IIA of the Environmental Protection Act 1990; and
- adequate site investigation information, prepared by a competent person, is presented.”

The glossary states the following relation to “site investigation information”:

- “Site investigation information: Includes a risk assessment of land potentially affected by contamination, or ground stability and slope stability reports, as appropriate. All investigations of land potentially affected by contamination should be carried out in accordance with established procedures [such as BS10175 (2011) Code of Practice for the Investigation of Potentially Contaminated Sites]. The minimum information that should be provided by an applicant is the report of a desk study and site reconnaissance.”

3.3 Qualitative Contaminated Land Risk Assessment

A qualitative risk assessment in accordance with NHBC, EA, CIEH (2008) has been undertaken. This is described below:

3.3.1 Conceptual Model

A key element of an environmental risk assessment is the development of a conceptual model which is done undertaking a Source-Pathway-Receptor analysis of the site:

- Sources (S) are potential or known contaminant sources e.g. a former land use;
- Pathways (P) are environmental systems thorough which a contaminant could migrate e.g. air, groundwater;

- Receptors (R) are sensitive environmental receptors that could be adversely affected by a contaminant. e.g. Site occupiers, groundwater resources.

Where a source, relevant pathway and receptor are present, a pollutant linkage is considered to exist whereby there is a circumstance through which environmental harm could occur and a potential environmental liability is considered to exist. The sources, pathways and receptors expected on the site are summarised below:

3.3.1.1 Sources

- **S1: Made Ground** - Potential for contaminated soil in Made Ground associated with the Liverpool to Wigan Railway Line, the former Tanpit House, the former Quarry, and the infilled stream channel.
- **S2: Ground Gas** - Potential for ground gas associated with the infilled quarry, peat within the Shirdley Hill Sand Formation and Made Ground across the northern extent of the site.

3.3.1.2 Pathways

- **P1:** Human uptake pathways;
 - Ingestion of exposed soils;
 - Inhalation of soil/dust/volatilised compounds via migration through permeable strata and conduits; and
 - Dermal contact with exposed soils.
- **P2:** Overland flow of surface water
- **P3:** Vertical and horizontal percolation within the unsaturated zone
- **P4:** Vertical and lateral migration of ground gases
- **P5:** Wind blown dust
- **P6:** Horizontal and vertical migration of contaminants within groundwater
- **P7:** Direct contact of soils with construction materials
- **P8:** Root Uptake

3.3.1.3 Receptors

- **R1:** Future End Users (Commercial)
- **R2:** Construction/Maintenance Workers
- **R3:** Controlled Surface Waters (Kirkby Brook)
- **R4:** Controlled Groundwaters (Wilmslow Sandstone Principal Aquifer)
- **R5:** Flora and Fauna
- **R6:** Off-site receptors e.g. Residential Properties
- **R7:** Subsurface Infrastructure (Foundations and Utilities)

For each potential pollutant linkage identified with the conceptual Model detailed in Table 4, the potential risk to each receptor has been evaluated using a preliminary Qualitative Risk Assessment based on the probability of the pollution event, and the severity it may have on site users and the environment. The methodology of this assessment is provided in Appendix F. The results of this assessment are presented in Table 5.

Table 4: Site Conceptual Model

Potential Sources	Potential Receptors	Potential Pathways
S1: Made Ground S2: Ground Gas	R1: Future End Users (Commercial)	● P1: Human uptake pathways; – Ingestion – Inhalation – Dermal contact with exposed soils. ● P4: Vertical and lateral migration of ground gases ● P5: Wind blown dust.
S1: Made Ground S2: Ground Gas	R2: Construction/Maintenance Workers	● P1: Human uptake pathways; – Ingestion – Inhalation – Dermal contact with exposed soils. ● P2: Overland flow of surface water ● P4: Vertical and lateral migration of ground gases ● P5: Wind blown dust ● P6: Horizontal and vertical migration of contaminants within groundwater ● P7: Direct contact of soil with construction materials
S1: Made Ground	R3: Controlled Surface Waters (Kirkby Brook)	● P2: Overland flow of surface water ● P3: Vertical and horizontal percolation within the unsaturated zone ● P5: Wind blown dust ● P6: Horizontal and vertical migration of contaminants within groundwater
S1: Made Ground	R4: Controlled Groundwaters (Wilmslow Sandstone Principal Aquifer)	● P2: Overland flow of surface water ● P3: Vertical and horizontal percolation within the unsaturated zone ● P6: Horizontal and vertical migration of contaminants within groundwater
S1: Made Ground	R5: Flora and Fauna	● P8: Root Uptake
S1: Made Ground S2: Ground Gas	R6: Off-site receptors e.g. Residential	● P1: Human uptake pathways; – Ingestion – Inhalation – Dermal contact with exposed soils. ● P2: Overland flow of surface water ● P4: Vertical and lateral migration of ground gases ● P5: Wind blown dust ● P6: Horizontal and vertical migration of contaminants within groundwater

Potential Sources	Potential Receptors	Potential Pathways
S1: Made Ground	R7: Subsurface Infrastructure (Foundations and Utilities)	● P3: Vertical and horizontal percolation within the unsaturated zone ● P6: Horizontal and vertical migration of contaminants within groundwater ● P7: Direct contact of soils with construction materials

Table 5: Initial Qualitative Risk Assessment for the Proposed Development Site at Headbolt Lane

Potential Source	Potential Receptor	Potential Pathway	Consequence	Probability	Risk	Comments
S1: Made Ground S2: Ground Gas	R1: Future End Users (Commercial)	● P1: Human uptake pathways; – Ingestion – Inhalation – Dermal contact with exposed soils. ● P4: Vertical and lateral migration of ground gases ● P5: Wind-blown dust ● P6: Horizontal and vertical migration of contaminants within groundwater	Mild	Likely	Moderate/Low	The probability of occurrence for this source-pathway-receptor linkage is considered to be low for the majority of the site. Localised areas of Made Ground are likely only present along the railway line and in the location of the former quarry and house. It is also unlikely that the end users will come into direct contact with the ground as the majority of the area will be covered in hardstanding. An appropriate ground investigation will need to be undertaken in order investigate further the likelihood of encountering contamination on site and what remedial measures may be required. There is considered to be low risk of ground gas, however gas monitoring standpipes should be installed in areas of Made Ground to assess the risk of ground gases associated with these areas.
S1: Made Ground S2: Ground Gas	R2: Construction/ Maintenance Workers	● P1: Human uptake pathways; – Ingestion – Inhalation – Dermal contact with exposed soils. ● P4: Vertical and lateral migration of ground gases ● P5: Wind-blown dust ● P6: Horizontal and vertical migration of contaminants within groundwater	Mild	Likely	Moderate/Low	The probability of occurrence for this source-pathway-receptor linkage is considered to be low. Localised areas of Made Ground are likely only present along the railway line and in the location of the former quarry and house in the north of the site. An appropriate ground investigation will need to be undertaken in order investigate further the likelihood of encountering contamination on site and what remedial measures may be required. There is considered to be low risk of ground gas, however gas monitoring standpipes should be installed in areas of Made Ground to assess the risk of ground gases associated with these areas. During construction the contaminant pathway can be prevented through the use of PPE and good site safety practice.

Potential Source	Potential Receptor	Potential Pathway	Consequence	Probability	Risk	Comments
						Good site practice during construction incorporating dust suppression will mitigate risks associated with wind blown dust.
S1: Made Ground	R3: Controlled Surface Waters (Kirkby Brook)	● P2: Overland flow of surface water ● P3: Vertical and horizontal percolation within the unsaturated zone ● P6: Horizontal and vertical migration of contaminants within groundwater	Mild	Likely	Moderate/Low	The Kirkby Brook flows through the centre of the site at a topographic low, and therefore any surface water onsite is likely to flow into the brook. Surface water should be controlled during construction works to mitigate the risk of surface water contamination entering the Kirkby Brook. The proposed development should incorporate a strategic drainage system to prevent surface water entering controlled waters without the correct consents.
S1: Made Ground	R4: Controlled Groundwaters (Wilmslow Sandstone Principal Aquifer)	● P3: Vertical and horizontal percolation within the unsaturated zone ● P6: Horizontal and vertical migration of contaminants within groundwater	Mild	Likely	Moderate/Low	The ground conditions onsite are likely to comprise Made Ground over a thin (<1.5m) layer of sand and clay directly above the Wilmslow Sandstone which is a principal aquifer. Therefore, it is considered likely that a linkage may be present between the Made Ground and the bedrock aquifer. A suitable ground investigation is required to determine the levels, if any, of contamination across the site and will allow appropriate mitigation measures to be implemented during construction.
S1: Made Ground	R5: Flora and Fauna	● P8: Root Uptake	Mild	Unlikely	Very Low	Any ecological constraints such as protected or invasive species, and TPO's should be identified and considered during any design works and again before commencing on site. This will ensure no harm is caused to flora or fauna. An appropriate ground investigation will identify any potential contamination across the site and allow appropriate mitigation measures, such as importing clean fill to landscaped areas, to be recommended.
S1: Made Ground S2: Ground Gas	R6: Off-site receptors e.g. Residential	● P1: Human uptake pathways; – Ingestion – Inhalation	Mild	Unlikely	Very Low	There is a potential for contaminated shallow soils to impact surrounding land uses during future construction and development works through windblown dust.

Potential Source	Potential Receptor	Potential Pathway	Consequence	Probability	Risk	Comments
		– Dermal contact with exposed soils. • P2: Overland flow of surface water • P4: Vertical and lateral migration of ground gases • P5: Wind blown dust • P6: Horizontal and vertical migration of contaminants within groundwater				Suitable investigation to address the levels, if any, of contamination will allow appropriate mitigation measure to be implemented during construction.
S1: Made Ground	R7: Subsurface Infrastructure (Foundations and Utilities)	• P3: Vertical and horizontal percolation within the unsaturated zone • P6: Horizontal and vertical migration of contaminants within groundwater • P7: Direct contact of soils with construction materials	Mild	Likely	Moderate/Low	Soils and groundwater may come into direct contact with buried concrete and potable water supply pipe materials. An assessment of the chemical properties of the underlying soils will enable an assessment of the risk to these receptors.

4 Potential Ground Related Constraints

The potential ground related constraints for the proposed station have been summarised into a risk register provided in Table 9. Table 6 and Table 7 show the impact index and likelihood index respectively for assessing a hazard. Table 8 presents the Risk Matrix, which shows the actual risk level, rated from 'Severe' (max. risk level) to 'Negligible' (min risk level). These constraints require further investigation or consideration as the scheme progresses to reduce and minimise the impacts of these on the scheme. The locations of potential geotechnical and geo-environmental risks (where easily identifiable) have been mapped on to the Geo-environmental constraints plan (Drawing 394359-HBL-GEO-01) provided in Appendix A.

Table 6: Negative Consequence Score Table

	Impact	Health and Safety	Time	Cost	Reputation	Environment
Very Low	negligible	negligible	negligible effect on programme	negligible	negligible	negligible
Low	minor	minor injury	5% effect on programme	1% budget	minor effect on local company image/ business relationship mildly affected	minor environmental incident
Medium	serious	major injury	12% effect on programme	10% budget	local media exposure/ business relationship affected	environmental incident requiring management input
High	threat to future work and client relations	fatality	25% effect on programme	20% budget	nationwide media exposure / business relationship greatly affected	environmental incident leading to prosecution or protestor action
Very High	threat to business survival and credibility	multiple fatalities	50% effect on programme	50% budget	permanent nationwide effect on company image/ significant impact on business relationship	major environmental incident with irreversible effects and threat to public health or protected natural resource

Table 7: Likelihood Score Table

	Likelihood	Probability
Very Low	negligible / improbable	<1%
Low	unlikely / remote	>1%
Medium	likely / possible	>10%
High	probable	>50%
Very High	very likely / almost certain	>90%

Table 8: Risk Matrix

		Likelihood				
		Very Low	Low	Medium	High	Very High
Negative Consequence	Very Low	N	N	N	N	T
	Low	N	N	T	T	S
	Medium	N	T	T	S	S
	High	N	T	S	S	I
	Very High	T	S	S	I	I

Risk Key

intolerable

RED

significant

AMBER

tolerable

YELLOW

negligible / trivial

GREEN

I
S
T
N

GEOTECHNICAL RISK REGISTER

Date: 01/07/2018

Project Phase: GRIP 3A

Project: Skelmersdale Rail Link - Headbolt Lane Station

Risk Assessment carried out by: Kevin Wells

Ref No.	Threat	Consequences	IMPACT	LIKELIHOOD	RISK	RISK TYPE	Potential Risk Control Measures / Actions	IMPACT	LIKELIHOOD	RESIDUAL RISK	OWNER	Action (by whom and when)
1	Made Ground. Localised areas of Made Ground are expected on site associated with former Tanpit House, the former quarry, the railway line, and the road embankment.	*Made Ground should not be considered as suitable as founding strata due to its variable geotechnical properties and high potential for differential settlement. *Potential contamination within the Made Ground material may present a risk of harm to sensitive receptors. *If Made Ground is identified as hazardous, there will be increased costs associated with disposal of the material to a suitable landfill.	M	H	S	HS/T/C/E	1) Carry out a full geo-environmental site investigation to determine extent, properties, and contamination status of Made Ground. 2) Findings of ground investigation to be incorporated into detailed design and construction planning. 3)Site staff to wear appropriate PPE.	M	L	T	Construction contractor/Designer/Client	Construction contractor prior to and during construction works. Designer to design GI. Client to enable access for ground investigation.
2	Obstructions encountered during construction. Potential old foundation obstructions are likely present in the north of the site in the location of the former Tanpit House.	* Delays in the construction progress. * Leading to delay in overall construction programme.	M	M	T	T/C/R	1) Carry out ground investigation to identify presence and nature of any obstructions. 2) Risk mitigation strategy for obstructions to be developed based on proposed construction methodology and technology to be deployed.	M	L	T	Construction contractor	Construction contractor during planning of works
3	Unforeseen ground conditions. The geology on site is thought to comprise Alluvium, Made Ground, Shirdley Hill Sand and Topsoil as a thin (<2m) superficial deposit above sandstone bedrock. However, the thicknesses and distribution of these deposits are unknown.	* Inappropriate design and construction methodologies. * Impact on suitability and stability of design. * Impact on cost and project programme.	VH	M	S	HSTCR	1) Carry out ground investigation to further understand the ground conditions. 2) Construction Control - logging of excavation and pile arisings during works.	VH	VL	T	Designer Construction contractor	Designer prior to detail design. Construction contractor during planning of works and construction.
4	Compressible ground conditions - could be present in the alluvium/Shirdley Hill Sand Formation/made ground	* Settlement of the car park and other hardstanding areas * Additional reinternment/maintenance costs.	M	L	T	HSTCR	1) Carry out ground investigation to further understand the ground conditions. 2) Construction Control - logging of excavation and pile arisings during works.	M	VL	N	Designer Construction contractor	Designer prior to detail design. Construction contractor during planning of works and construction.
5	Incomplete knowledge of groundwater conditions at the site.	* Inaccurate assumptions for design. * Leading to damage and instability issues for structures.	VH	M	S	HSTCR	1) Install groundwater monitoring installations. 2) Long term monitoring of standpipes. 3) Design to make conservative groundwater assumptions.	VH	VL	T	Designer	Designer to make appropriate assumptions in detailed design.
6	Existing Services. Potential for underground services to cross the site.	* Damage to services/culvert. * Possible damage to rig/construction equipment through encountering a void. * Loss of concrete into drain. * Delay to construction programme.	M	M	T	TCRE	1) All available services information/drawings for the site area to be passed to the Construction Contractor by designer in pre-construction information. 2) Service diversion to be designed where required. 3) Construction Contractor to satisfy himself as to the adequacy of available information and make additional enquires as necessary. 4) Appropriate methods to be utilised whilst constructing the diversion and the main proposed works.	M	VL	N	Designer/Construction Contractor	Designer prior to construction. Construction Contractor prior to and during construction works.
7	Aggressive Ground. Site soils, including the Made Ground, have the potential to be aggressive to concrete and steel.	* Degradation of foundations and pile caps, leading to long term repairs and maintenance.	H	M	S	TCR	1) Results of chemical test suites to be reviewed to determine appropriate concrete class to use.	H	VL	N	Designer	Designer at detailed design stage.
8	Instability in excavations due to the presence of loose peat and sand in the Shirdley Hill Sand Formation	* Potential collapse of excavations * Risk to site workers and future users.	H	M	S	HSTCR	1) Carry out ground investigation to further understand the ground conditions. 2) Construction Control - logging of excavation and pile arisings during works.	H	L	T	Designer Construction contractor	Designer prior to detail design. Construction contractor during planning of works and construction.

GEOTECHNICAL RISK REGISTER

Date: 01/07/2018

Project Phase: GRIP 3A

Project: Skelmersdale Rail Link - Headbolt Lane Station

Risk Assessment carried out by: Kevin Wells

Ref No.	Threat	Consequences	IMPACT	LIKELIHOOD	RISK	RISK TYPE	Potential Risk Control Measures / Actions	IMPACT	LIKELIHOOD	RESIDUAL RISK	OWNER	Action (by whom and when)
9	Ground gases. There is a potential for ground gas generation from any Made Ground and peat deposits within the Shirdley Hill Sand Formation on Site.	* Ground gas from Made Ground could cause the development of an explosive or asphyxiation hazard. * Risk to site workers and future users.	VH	M	S	HSTCR	1) GI to identify the nature and thickness of Made Ground and other strata that may produce hazardous gases. 2) Ground Investigation to include ground gas monitoring to determine the levels of ground gas on site. 3) Reports to consider appropriate mitigations measures to protect future users.	VH	VL	T	Designer/Client	Designer to design GI to include contamination testing. Contamination land specialist to review ground investigation results and produce reports as required.

NOTES: RISK TYPES; HS = Health & Safety, T = Time, C = Cost, R = Reputation, E = Environment
Risk level: I = Intolerable, S = Significant, T = Tolerable, N = Negligible

		Likelihood				
		Very Low	Low	Medium	High	Very High
Impact	Very Low	N	N	N	N	T
	Low	N	N	T	T	S
	Medium	N	T	T	S	S
	High	N	T	S	S	I
	Very High	T	S	S	I	I

5 Conclusion and Recommendations

5.1 Geotechnical

The information summarised in Section 2, indicates that ground conditions on the site comprise a thin (<2m) layer of superficial deposits above sandstone bedrock of the Wilmslow Sandstone Formation. Made ground is anticipated beneath the railway line and the mound to the north of site. The Shirdley Hill Sand Formation is indicated to be present in the extreme east of the site, and superficial deposits in the rest of the site are expected to comprise topsoil over clay and/or sand, alluvium or Made Ground.

Although no Made Ground is shown to be present on the site it is to be expected in the railway embankment in the south of the site, the road embankment in the east of the site, and the former quarry and Tanpit House in the north of the site. The ground level in the north of the site is also indicated to have changed in the past possibly as a result of Made Ground material being placed on the site during the construction of the surrounding residential developments and/or from the demolition of Tanpit House.

Several potential geotechnical risks have been identified to the proposed development as detailed in Table 9; these include Made Ground of varying thickness and material properties, the possibility of subsurface obstructions such as foundations in the area of Tanpit House, and the variable topography of the site that will necessitate cut/fill requirements to produce a level platform for construction of the station development and the river will need culverting. Despite these risks however, the overall geotechnical risk for the site is considered to be low.

It is recommended that suitable ground investigation works are undertaken across the site to define the ground conditions for foundation design, to assess the suitability of the near surface strata for reuse in earthworks, cut/fill design, and to assess the geotechnical constraints highlighted in this desk study.

5.2 Geo-Environmental

The initial qualitative contamination risk assessment has shown that there are feasible contamination linkages present which may pose a low to moderate risk to human health (future end users, construction works and adjacent site users) and controlled waters (Kirkby Brook and Wilmslow Sandstone Principal Aquifer). At present the risks relate predominantly from the potential for localised areas of Made Ground associated with the former quarry and house in the north of the site, and the railway on the southern boundary of the site which may be potentially contaminated.

The most significant risk is considered to apply to human health and controlled waters through human uptake pathways, overland flow of surface water, and horizontal and vertical migration of contaminants in the soil. The actual level of risk should be reviewed once a site specific geo-environmental ground investigation has taken place.

Where contamination is encountered within site, soils which are required to be disposed of offsite, may be classified as potentially hazardous. In order to dispose of this material there may be a requirement for treatment prior to disposal resulting in increased costs.

Potential geo-environment constraints to the development have been identified and are listed in Table 5.

5.3 Recommendations

5.3.1 Walkover Survey

A walkover survey was not possible during the desk study phase however, it is highly recommended that a walkover is carried out prior to the ground investigation. The walkover would primarily serve two purposes:

1. Field reconnaissance to record any visible evidence of features that are not present from maps and aerial photographs such as suspicious depressions, colour and condition of standing water etc.
2. Assist in scoping of the ground investigation.

5.3.2 Ground Investigation

5.3.2.1 Objectives

The ground investigation is required in order to validate the geotechnical and geo-environmental risks and identify remedial requirements. It is recommended that an intrusive ground investigation be undertaken to assess the existing ground and groundwater conditions present beneath the site. Investigation works will enable the collection of geo-environmental samples for chemical and geotechnical testing which are required to inform both:

- A Geotechnical Report (GIR and GDR) for the site together with an appropriate foundation strategy; and
- A generic quantitative risk assessment (GQRA) and if required, detailed quantitative risk assessment (DQRA) facilitating the completion of a robust Remediation Strategy and Materials Management Plan.

The ground investigation and testing should be done in accordance with BS 5930, BS EN 1997-2, BS 10175 and BS 8576.

5.3.2.2 Techniques

Given the proposed development it is considered that an appropriate preliminary ground investigation scope will comprise a mixture of the following ground investigation techniques with associated geotechnical testing of the samples;

- Windowless Samples;
- Trial pits;
- Rotary Cored Boreholes; and
- Automatic Ballast Samplers.

In situ testing is likely to comprise standard penetration tests (SPT), plate load tests and soakaway tests. Groundwater/gas monitoring points will be required in some of the investigation locations with groundwater sampling.

5.3.2.3 Laboratory Testing

Geotechnical testing laboratory used should be UKAS accredited and is recommended to include, but not limited to classification, strength, compaction and compressibility testing.

The chemical testing laboratory used should be UKAS and MCerts accredited and all samples are to be accompanied by appropriate chain of custody documentation.

Testing of soils, soil leachates and groundwater are recommended to include, but not limited to the following:

- **Soils:** Metals and metalloids (to include lead and speciated chromium), Total Petroleum Hydrocarbons (Carbon Working Group banding), speciated PAHs, VOCs (where visual/olfactory evidence of hydrocarbons, otherwise on selected samples only to be advised by contamination specialist), MTBE, pH, soil organic matter (SOM), sulphate, asbestos screen.
- **Leachates:** Metals and metalloids (to include lead and speciated chromium), speciated PAHs, VOCs (where visual/olfactory evidence of hydrocarbons, otherwise on selected samples only to be advised by contamination specialist), MTBE, pH, sulphate.
- **Groundwaters:** Metals and metalloids (to include lead and speciated chromium), Total Petroleum Hydrocarbons (Carbon Working Group banding), speciated PAHs, VOCs (where visual/olfactory evidence of hydrocarbons, otherwise on selected samples only to be advised by contamination specialist), MTBE, PCBs on samples within close proximity to substations and transformers (screen then speciated if detected), pH, sulphate, carbonate hardness.

Chemical testing in accordance with the aforementioned suites will enable detailed contamination risk of the site to be determined and allow an assessment of the chemical suitability for reuse of site won materials or whether off-site disposal will be required.

The soil testing suite identified above incorporates a standard soil asbestos screen. Any samples taken during the ground investigation works which are found to be positive will be further quantified to determine concentrations in soil through standard testing procedures. Quantification testing will assist in a risk assessment to be undertaken by a suitably qualified asbestos specialist, and will also assist in defining remedial requirements. The requirements for any additional asbestos testing should be defined by a specialist asbestos advisor prior to remedial and/or construction works.

Chemical testing of soil samples, in accordance with UK Water Industry Research (UKWIR) publication 10/MM/03/21 "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" is recommended once the proposed route of any potable water supply pipes has been finalised. This should include the appropriate in situ tests (pH, conductivity) and soils testing to include speciated TPHs, VOCs and SVOCs where potable supply pipes are to be laid.

5.3.2.4 Groundwater and Gas Monitoring

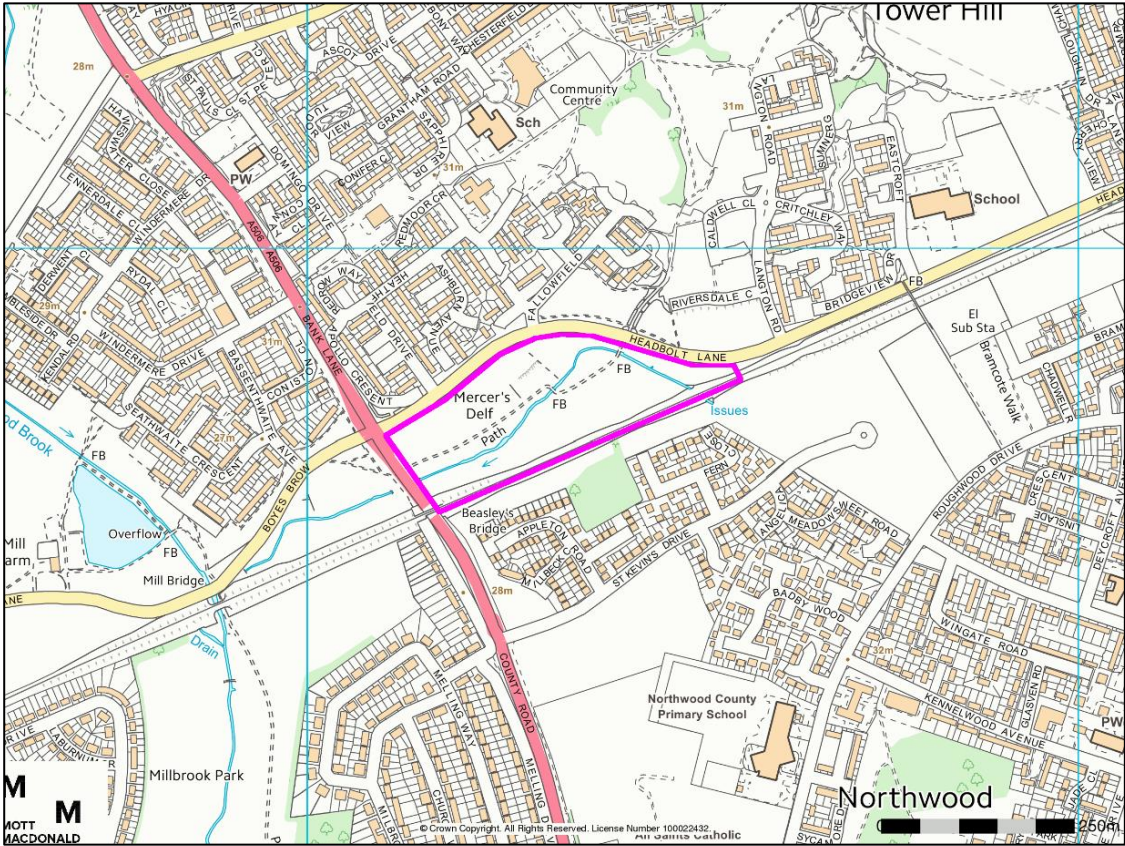
Following completion of ground investigation works, a programme of groundwater and gas monitoring is recommended to determine the groundwater and gassing regime together with a minimum of two rounds of groundwater sampling. Groundwater should only be sampled following a full (3x well volume) purge. Ground gas monitoring should include carbon dioxide, methane, oxygen, carbon monoxide and hydrogen sulphide concentrations along with atmospheric pressure and flow rates. At least one round should be completed at a time of falling atmospheric pressure. Up to date comprehensive ground gas monitoring will inform whether any gas mitigation measures are required within the proposed building design.

Appendices

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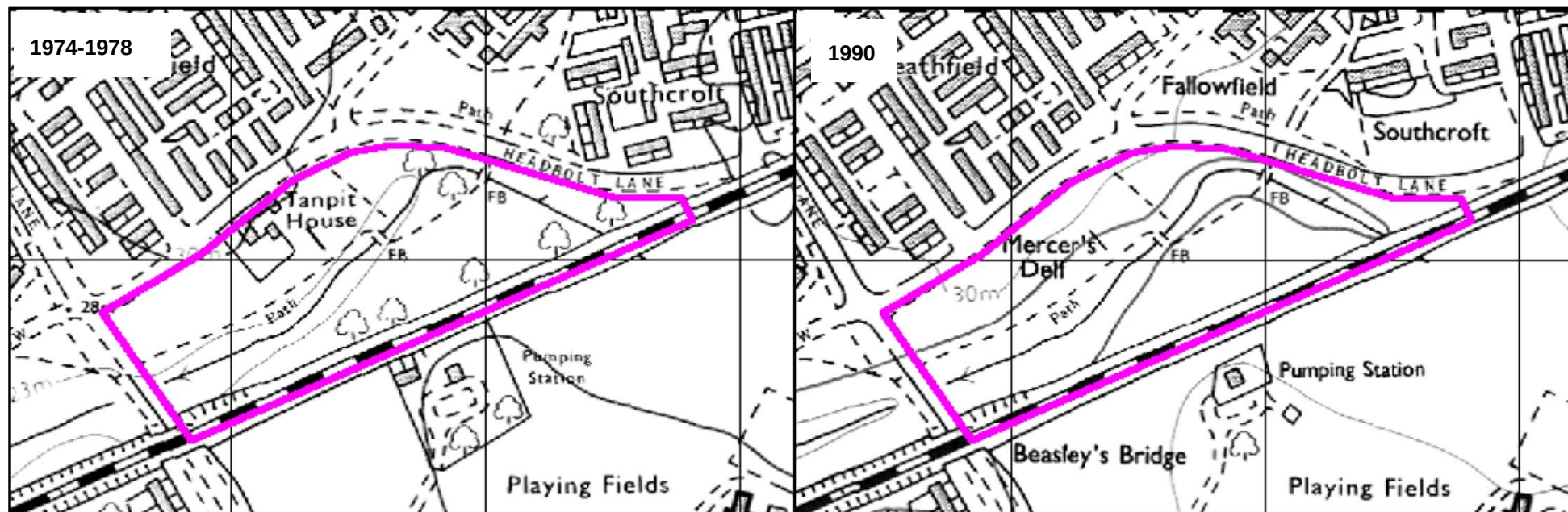
A. Drawings

Figure A1: Site Location Plan

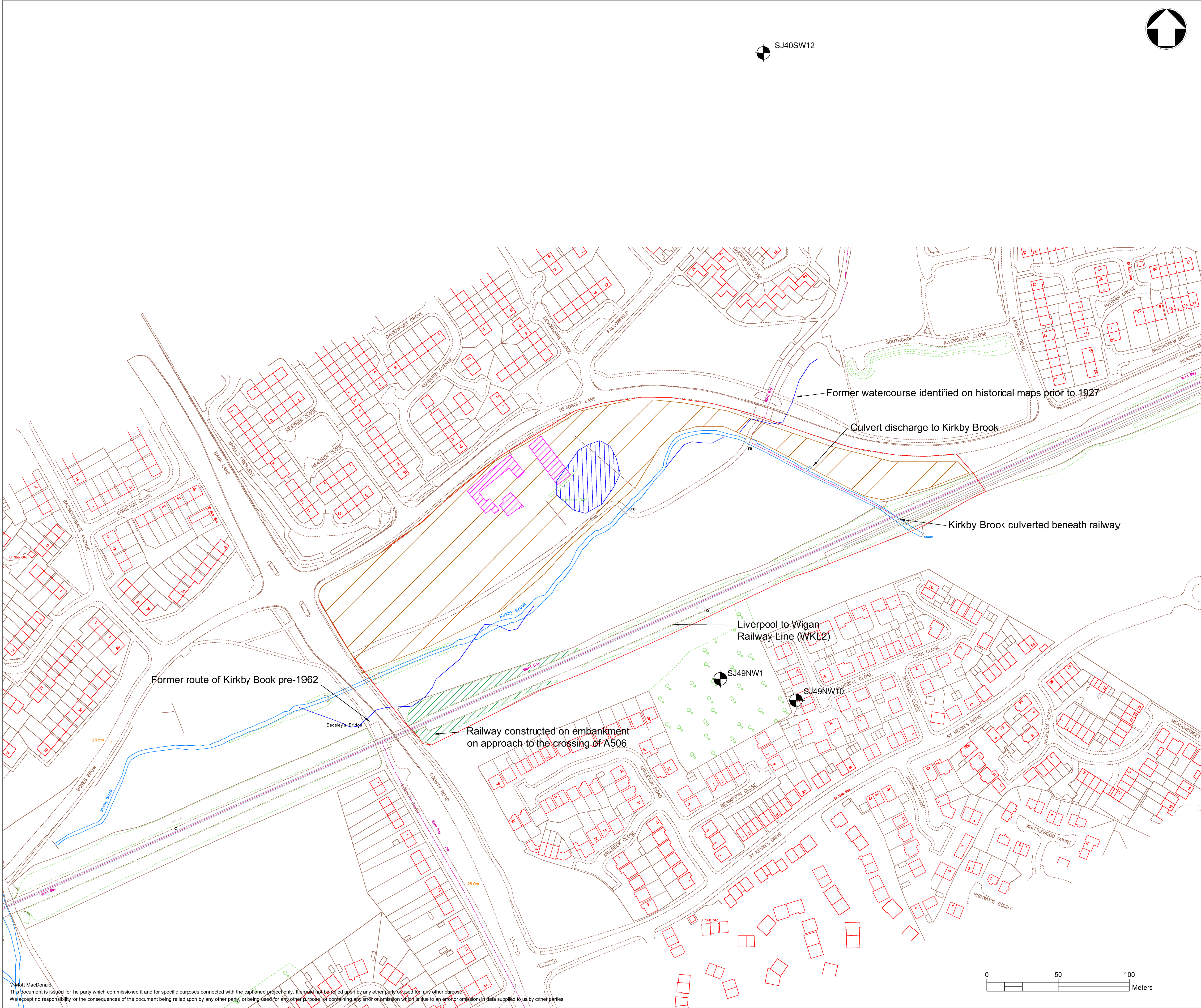


Source: Envirocheck, (2018)

Figure A2: Historical Map Extract Showing Change in Ground Levels



Source: Envirocheck, (2018)



Notes

This drawing should be read in conjunction with the Headbolt Lane Station Geo-Environmental Desk Study Ref. 394539-GEO2-A.

Key to symbols

SJ49NW10

Location of Historical BGS Boreholes

Approximate location of former Mercer's Delf Sandstone Quarry Lancashire and Furness Plan, 1850, 1:10,560

Approximate Location of former Tanpit House Farm Steading Lancashire & Furness Plan, 1908, 1:2,500

Approximate extent of Made Ground expected on site from review of historical mapping (Envirocheck, 2018).

Location of railway embankments

Former watercourses/stream channels

Reference drawings

P1	24/08/2018	KW	First Issue	KM	CH
Rev	Date	Drawn	Description	Ch'k'd	App'd

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Headbolt Lane Station
Geo-Environmental Constraints Plan

Designed	K Wells	Eng check	K McInnes
Drawn	K Wells	Coordination	K McInnes
Dwg check	K McInnes	Approved	C Hurst
Scale at A1	Status	Rev	Security
1:1250	PRE	P1	STD

Drawing Number 394359-HBL-GEO-01

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C:\Users\wel78498\Mott MacDonald\394359 - Skelmersdale Station GRIP3 - 07_GEO\TECHNICAL (394359GEO)\Headbolt Lane Desk Study\Drawings\Headbolt Lane Plan.dwg Aug 24, 2018 - 1:39PM WEL78498

B. Detailed Review of Historical Mapping

Table 10: Review of historical maps around the proposed Headbolt Lane Station

Year	OS Map Scale	On Site	Off Site
1850	1:10,560	- Land comprises agricultural land. - A railway line is aligned along the southern boundary of the site, that is indicated to be located on embankment in the west of the site. - A stream is culverted under the railway line in the east of the site. Towards the north it joins Rigby's Brook and flows out of the site towards the south-western corner of the site. - A building is present in the centre north of the site, labelled Tanpit House. - A small sandstone quarry, Mercer's Delf, is present to the north of Rigby's Brook in the centre of the site.	- A road is present on the northern and western boundaries of the site. - An Inn and a blacksmiths is located 100m northeast of the site. - Some cottages and houses are present along the road on the western boundary of the site. - A large area of woodland is situated 250m to the south of the site call 'Old Rough'
1893	1:2,500	Quarry no longer indicated to be present.	- A pumping station is located 50m south of the site. - Road on northern boundary is labelled Headbolt Lane.
1894	1:10,560		
1908	1:2,500	Change in layout of Tanpit House	No significant change
1909	1:10,560	No significant change	No significant change
1927	1:2,500		
1928	1:10,560		
1955	1:10,000		
1962 – 1973	1:2,500	No significant change	- Additional houses built to the south of the site along Bank Lane to the south of the railway line. - School built to the south in the location of 'Old Rough' woodland.
1962 - 1975	1:2,500		
1966-1972	1:2,500	- The stream has been realigned, away from railway embankment, in west of the site. - Footpath is indicated to cross centre of the site east-west	- Headbolt Lane has been re-aligned to follow the northern and eastern boundaries of the site. - Significant housing developments have been constructed immediately to north and east of the site.
1974-1978	1:10,000	No significant change	No significant change
1987	1:1,250	The stream is now called Kirkby Brook.	The southern section of Bank Lane (called County Road in this location) changed alignment and created a by-pass for the houses along this section of County Road.
1990	1:10,000	- Tanpit House no longer indicated on the map. - Crest of hill on northern site boundary has indicated to have moved southwards. Change in ground levels.	No significant change
1993	1:2,500	No significant change	No significant change
1993 – 1994	1:2,500		
1996			
1999	1:10,000		
2006	1:10,000	No significant change	Pumping Station is no longer indicated to be present.
2018			

Source: Envirocheck, (2018)

C. Historical Borehole Records

Test

NGR 4142 0084

WELL BORING at

Headholt Lane

Comm. Lines

84/34

Geol. map

1 in map New Series 84

Geol. map No. 100 NW

Made by

Date

Sunk

feet.

Bored

feet.

Communicated by Southport & W. Lanes. Water Board

Height above Ordnance Datum 105 1/2 ft.

Rest level of water 53 ft.

Yield

Quality (with copy of analysis on separate sheet)

GEOLOGICAL FORMATION

Geological Survey

NATURE OF STRATA.

British Geological Survey

THICKNESS.

Feet.

Inches.

DEPTH.

Feet.

Inches.

Soil

1 6

1 6

Sand

4 -

5 6

Clay

- 6

4 -

Soft rock

4 -

10 -

Red rock

55 -

65 -

SD 46 SW/12

0 46 0 46

1 22 1 68

0 15 1 83

1 22 3 05

16 76 19 81

Copied from tracing supplied to Water Board
by A. Rife & Son Engineers, 8 Victoria St. SW.1.

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