HyNet North West Hydrogen Pipeline

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Appendix 12A

Geoenvironmental Desk Study

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1. Introduction

1.1 Background

1.1.1 This report presents a Phase 1 Geo-environmental Desk Study on land in the North West of England identified for the HyNet North West Hydrogen Pipeline Project ("the Project").

1.1.2 The primary purpose of this report is to inform the baseline conditions for **Chapter 12: Ground Conditions** of the Draft Environmental Statement (ES) to accompany the Development Consent Order (DCO) Application. With reference to the National Planning Policy Framework ("NPPF"), the report will subsequently assist in determining whether the land required for the Project is suitable for use.

1.1.3 For the purposes of this report, the term "the Site", where the Project is proposed to be constructed, has been used to refer to the land encompassed by the scoping assessment boundary, as shown on **Figure 12A.1** in **Annex 12A1**.

1.1.4 The Phase 1 Geoenvironmental Desk Study was previously issued in support of the Preliminary Environmental Information Report (PEIR)[1] and was based on the scoping assessment boundary prior to subsequent design changes in addition to having been informed by preliminary assessments undertaken by other technical specialists for the PEIR.

1.1.5 As the design of the Project has evolved in response to baseline information, engineering design and stakeholder feedback, it is noted that not all of the land within the scoping assessment boundary (and therefore included within "the Site" described in this report) has ultimately been included in the 'Draft Order Limits' considered in the Draft ES.

1.1.6 As such, this updated Phase 1 Geoenvironmental Desk Study has been prepared to support the Draft ES with reference to the 'Draft Order Limits' which is the presently anticipated maximum extent of land in which the Project may take place As well as the permanent features (including the pipeline, Hydrogen Above Ground Installations (HAGIs) and Block Valve Installations (BVIs), these include areas to account for temporary construction works including compounds, accesses and other temporary works including drainage. Further details are outlined in **Section 2** of this report.

1.1.7 Further details are outlined in **Section 2** of this report.

1.2 Scope of Work

1.2.1 This report comprises a Phase 1 Geoenvironmental Desk Study and includes the following:

[1] Wood Group UK Ltd (2022), Hynet North West Hydrogen Pipeline Project, Preliminary Environmental Information Report

- identification and review of selected contemporary information including geological, environmental, hydrological and hydrogeological data, where available, for the Site and its surroundings;
- review of historical mapping for the Site (here defined as the area within the Scoping Boundary) and its immediate surroundings to investigate historical land uses and to identify potential contaminative activities;
- a walkover of accessible areas of interest of the Site undertaken between 20 and 22 July 2022 to verify desk study information, as necessary;
- development of a Conceptual Model (CM) and a Tier 1: Preliminary Risk Assessment, to assess the status of potentially contaminative historical land uses identified from historical mapping, and associated potentially significant contaminant linkages that may require further consideration in line with current guidance, including the Land Contamination Risk Management (LCRM) guidance published by the Environment Agency;
- identification of information gaps, geo-environmental development constraints and possible requirements for further assessment; and
- assessment of geotechnical hazards and constraints affecting the Site and the Project, including the development of a Geotechnical Risk Register (GRR), highlighting potential geotechnical risk and suitable control measures.

1.2.2 Reviews of contemporary information and historical mapping have been undertaken using the same spatial scope as defines the Study Area in **Chapter 12: Ground Conditions** of the Draft ES, which is as follows:

- The land included within the Draft Order Limits;
- A Zone of Influence (ZoI) 250m from the outer extents of the Draft Order Limits along the pipeline corridors; and
- A ZoI 500m around the outer extents of the Draft Order Limits around permanent above-ground infrastructure (HAGIs and BVIs).

1.2.3 The rationale for the ZoI is informed from professional judgement by considering:

- The spatial extent (taking account of contaminant degradation, dilution and dispersion in the environment) at which significant ground effects could be present through potentially active contaminant linkages.
- The spatial extent from which off-site sources of contamination have the potential to lead to significant effects on human health receptors (workers, landowners and members of the public along the pipeline route and adjacent to the pipeline route and above-ground structures during the construction and operational stages) within the Project. It is noted that workers during the operational stage will comprise temporary maintenance workers, and the above-ground installations will not be permanently staffed during operation.

1.3 Regulatory Context

1.3.1 DCOs were introduced by the Planning Act 2008 for Nationally Significant Infrastructure Projects (NSIPs). The Planning Act 2008 (as amended) sets out the decision-making framework for NSIPs in conjunction with relevant National Planning Policy Statements. The Overarching National Policy Statement for Energy (EN-1) (DESNZ, 2023) requires that for developments on previously developed land, applicants should ensure that they have considered the risk posed by land contamination.

1.3.2 The National Planning Policy Framework (Ministry of Housing, Communities & Local Government, 2023) (NPPF) does not contain specific policies for NSIPs; however, it sets out the Government's planning policies and how these should be applied, and it is a material consideration in planning decisions.

1.3.3 Of relevance to ground conditions, the NPPF states that planning policies should contribute to and enhance the environment by:

- *"Preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability.* [paragraph 174 (e)]; and*"*
- *"Remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate* [paragraph 174(f)]*".*

1.3.4 Therefore, planning policies and decision should ensure that:

- *"A site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land 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 available to inform these assessments.* [paragraph 183 (a) to (c)]*".*

1.3.5 Where land is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

1.3.6 The statutory definition of contaminated land is given under Part IIA of the Environmental Protection Act (EPA) 1990 (Part IIA) (Defra, 2012). This generally does not include land that is already regulated through other means, such as waste management legislation or the Environmental Permitting Regulations 2016. Therefore, sites currently regulated under Environmental Permitting Regulations or other current regime are not included in this assessment.

1.4 Sources of Information

1.4.1 The following sources of information were reviewed as part of this desk study. It is noted that all of these sources of information covered the full extent of the site during preparation of the original Phase 1 Desk Study (i.e. the Scoping boundary) and where a source is considered unlikely to include significant additional data since originally being accessed in 2022 (e.g. historical maps, coal mining search, brine subsidence compensation board search) this desk study has been prepared using the originally accessed information:

- Groundsure EnviroGIS reports (ref. GSIP-2021-12402-9275, GSIP-2021-12402-9276, GSIP-2021-12402-9281 and GSIP-2021-12402-9282 (historical maps only), dated 02 April 2022);
- Groundsure EnviroGIS reports (ref. GSIP-2024-16193-20473, GSIP-2024-16193-20474, GSIP-2024-16193-20477), dated 24 July 2024.
- Groundsure CON29M Official Coal Mining Search (ref. GS-8910663, dated 18 July 2022);
- Cheshire Brine Subsidence Compensation Board Cheshire Salt Search (ref. GS-8910632, dated 18 July 2022);
- Responses to environmental data requests made to:
  - Cheshire West and Chester Council (CWAC);
  - Salford City Council (SCC) (adjacent local authority);
  - Cheshire East Council (CEC);
  - Trafford Council (TC);
  - Warrington Borough Council (WBC);
  - Halton Borough Council (HBC);
  - Knowsley Council (KC) (adjacent local authority); and
  - St Helens Borough Council (SHBC).
- Environment Agency, Land contamination risk management (LCRM), July 2023, https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm;
- Ministry of Housing, Communities & Local Government, National Planning Policy Framework, December 2023;
- Department for Environment, Food and Rural Affairs (Defra), Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, Reference PB13735, April 2012;
- National House Building Council (NHBC) and Environment Agency R&D Publication 66: Guidance on the Safe Development of Housing on Land Affected by Contamination, 2008;

- Environment Agency Catchment Data Explorer https://environment.data.gov.uk/catchment-planning/, accessed July 2024;
- Multi Agency Geographic Information for the Countryside (MAGIC) interactive map, www.magic.gov.uk, accessed July 2024;
- Google Maps, accessed July 2024;
- Google Earth Pro, accessed July 2024;
- BGS, GeoIndex, http://mapapps2.bgs.ac.uk/geoindex/home.html, accessed July 2024;
- BGS, Geology of Britain Viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html, accessed July 2024;
- Coal Authority, Interactive Map Viewer, http://mapapps2.bgs.ac.uk/coalauthority/home.html accessed July 2024;
- Public Health England and British Geological Survey, Indicative Atlas of Radon in England and Wales, Interactive Map, https://www.ukradon.org/information/ukmaps accessed July 2024;
- Historical aerial photography, accessed via Google Earth Pro, July 2024; and
- Zetica unexploded ordnance (UXO) risk maps, https://zeticauxo.com/guidance/risk-maps/, accessed July 2024.

1.5 Assumptions and Limitations

1.5.1 The following assumptions and limitations apply:

- This Phase 1 Geoenvironmental Desk Study report provides available factual data for the Site obtained only from the sources highlighted in **Section 1.4**, which are related to the Site on the basis of its location (as shown in **Figure 12A.1** in **Annex 12A1**).
- The desk study information is not necessarily exhaustive and further information relevant to the Site may be available from other sources.
- The accuracy of historical maps cannot be guaranteed, and it should be recognised that different conditions onsite may have existed between and subsequent to the various map surveys.
- A site walkover survey was undertaken in July 2022. Where land access could not be obtained, information was limited to photos and observations made from the nearest available publicly accessible location.
- This Phase 1 Geoenvironmental Desk Study report has been prepared and written in the context of legislation and guidance available in August 2024. New information, improved practices and changes in legislation may necessitate a re-interpretation of the report in whole or in part after its original submission.

- WSP cannot warrant the accuracy of works or reporting undertaken by third parties.

2. Description of the Project and the Site

2.1 The Project

2.1.1 A detailed description of the Project is presented in **Chapter 2: The Project** of the Draft ES and a summary is presented below.

2.1.2 The Project includes the construction, operation and eventual decommissioning of approximately 100km of new pipeline to distribute hydrogen to industry in the North West. A number of HAGIs, including Block Valve Installations BVIs are required to control the flow and pressure of hydrogen at key points along the proposed pipeline.

2.1.3 The Project connects the Hydrogen Production Plant (HPP) at the Stanlow site, as the source of hydrogen, for onward distribution to the network. The pipeline transports hydrogen to the Central Hub HAGI at the centre of the network, which then serves as the connection and onward distribution point to the North, East and South corridors, which would extend to St. Helens, Partington and Northwich respectively. Branching off from each main corridor would be pipeline spurs connecting hydrogen customers to the main pipeline. Infrastructure has also been included which supports the potential blending of hydrogen with methane in the existing gas network. The Project would also link to underground hydrogen storage facilities in Cheshire used to balance supply and demand through the network.

2.1.4 The Site Location is shown on **Figure 12A.1 (Annex 12A1).**

2.2 Project Components

2.2.1 The Project comprises the construction, operation and maintenance of a number of elements, which are summarised as follows:

Pipeline Corridors

2.2.2 The pipeline elements of the Project route along what are defined as the North, South, East and West Corridors. The pipeline would vary in diameter along the route between approximately 6” and 42”. The pipeline would be buried along the entire route apart from at locations where HAGIs or BVIs are required. The pipeline would be constructed predominantly using open cut techniques and trenchless crossing techniques (which includes Horizontal Directional Drilling (HDD)) at key locations including motorways and major highways, rail, rivers (typically those classed as main rivers, but some may be ordinary watercourses) and canals. Major crossings would be engineered to minimise the environmental and community impact as far as reasonably practicable. The potential impact of all techniques such as open cut and trenchless methods have been considered, and a reasonable worst case assessed in **Chapter 12: Ground Conditions** of the Draft ES.

Pipeline Spurs

2.2.3 The pipeline spurs refer to pipeline routes diverting off from the main four pipeline corridors, connecting to HAGI or customers. These spurs include:

- Runcorn/Rocksavage Spur;
- Warrington Spurs;
- Clock Face Spur;
- St Helens Spurs;
- Warburton Spurs; and
- Partington Spur.

2.2.4 The locations of the spurs within the Project are detailed in **Section 2.3.**

Hydrogen Above Ground Installations (HAGIs)

2.2.5 The HAGI sites include a range of permanent above ground installations including Pressure Reduction Units (PRU), metering facilities, inspection facilities, Instrumentation and Control Local Equipment Rooms (I&C LERs), hydrogen generators and a Cathodic Protection (CP) system. Each HAGI will include one or more of these elements in addition to fencing, telecommunications equipment, lighting and electric vehicle charging facilities, and will be connected to the local distribution network operator's electrical distribution network. The proposed HAGIs include:

- Central Hub HAGI;
- Hydrogen Production Plant (HPP) HAGI;
- Rocksavage HAGI;
- Runcorn HAGI;
- Higher Walton HAGI (options HWH2 and HWH8);
- Clock Face HAGI;
- Warburton HAGI;
- Partington HAGI (options PH1 and PH2); and
- Hydrogen Storage Facility (HSF) HAGI.

2.2.6 The locations of the HAGIs are detailed in **Section 2.3**.

Block Valve Installations (BVIs)

2.2.7 The BVI sites are separate facilities to the HAGIs and would be housed in compounds less than 0.5ha in size, comprising an access track, facilities for turning vehicles, fencing and an access gate, and a I&C LER containing the valves and associated on-site equipment.

2.3 Site Location

2.3.1 The Site is located within the counties of Cheshire, Merseyside and Greater Manchester, England. The approximate centre of the Central Hub HAGI is located 3.3km north-west of the town of Barnton at approximate National Grid Reference (NGR) 360050, 377850 (approximate post code WA4 4HB). The site location is shown on **Figure 12A.1 (Annex 12A1).** The locations of key areas and components in the context of the Project referenced in this report are summarised in **Table 12A2.1** and illustrated on **Figure 12A.2** in **Annex 12A1.**

Table 12A2.1 Key Areas and Components of the Project

Area	Route	Key Components	Component Location
Central Hub HAGI	N/A	• Central Hub HAGI	Common connection point for each corridor, located in an agricultural field approx. 380m north of the A533 (National Grid Reference (NGR) 360284 378215).
West Corridor	Extends west and south-westwards over approximately 16.5km from Central Hub HAGI to HPP HAGI.	• HPP HAGI • Rocksavage HAGI • Runcorn HAGI • Runcorn/Rocksavage spur	The HPP HAGI would be located in the south-easterly extent of Stanlow Refinery, approximately 30m north of the A5117 and 180m west of Pool Lane (NGR 344745 374976). Rocksavage HAGI would be located on land bound by the M56 to the northwest, Weaver Navigation to the northeast, the River Weaver to the southwest and a railway viaduct to the southeast (NGR 352863 379276). Runcorn HAGI would be located on land between the Weaver Navigation (approximately 40m to the south) and Weaver View (minor road, approximately 30m to the north) (NGR 352243 380041). The Runcorn/Rocksavage Spur would start at the Rocksavage HAGI and run to the Runcorn HAGI, before continuing broadly northwest to connect to a customer (Intergen (Rocksavage)).
North Corridor	Extends north-westwards over approximately 16.5km from Central Hub HAGI to Clock Face HAGI.	• Higher Walton HAGI (options HWH2 and HWH8) • Clock Face HAGI • Warrington Spurs • Clock Face Spur	There are two options being considered for the location of the Higher Walton HAGI – HWH2 located on land north of the Manchester Ship Canal (NGR 358793 385747) and the southern edge of the Moore Nature Reserve, or HWH8 in an agricultural field to the

Area	Route	Key Components	Component Location
		• St Helens Spurs	southeast of the Manchester Ship Canal (NGR 359399 385664). Clock Face HAGI would located be in an agricultural field bound by the M62 approximately 20m to the north and the B5419 approximately 30m to the east (NGR 351288 389965). The Warrington Spurs would start at the Higher Walton HAGI and run northeast to connect to customers Ingevity approximately 1.5km northeast and Novelis approximately 5km northeast. The Clock Face Spur would start at the Clock Face HAGI and runs northeast to connect to a customer, NGF Europe Ltd. The St Helens Spurs would continue north of the Clock Face HAGI and connect to customers Glass Futures Ltd approximately 1.5km north and Pilkington UK's Greengate Works approximately 4.5km north.
East Corridor	Extends north-eastwards over approximately 15km from Central Hub HAGI to the Partington HAGI	• Warburton HAGI • Partington HAGI (options PH1 and PH2) • Warburton Spur • Partington Spur • Sworton Heath BVI	The Warburton HAGI would be located adjacent to the existing Cadent Above Ground Installation (AGI) facility at Carr Green Lane, in a field to the southeast of the B5160 (Dunham Road) (NGR 372235 388611). There are two options being considered for the location of the Partington HAGI – PH1 located west of the junction on Ashton Road and Townsend Farm Lane on an existing disused brownfield site (NGR 372704 391682) or PH2 located in an agricultural field to the east (NGR 373251 391561).

Area	Route	Key Components	Component Location
			Warburton Spur would start at the Warburton HAGI and run west to connect to the existing Cadent AGI on Carr Green Lane. The Partington Spur would start at the Partington HAGI and run northwest to the existing Cadent AGI at Partington, and north to a customer, Basell Polyolefins. The BVI would be located between the Central Hub HAGI and Warburton HAGI in an agricultural field off the A50, west of High Leigh (NGR 369379 384096).
South Corridor	• Extends south-eastwards over approximately 15km from Central Hub HAGI to HSF HAGI.	• HSF HAGI • Hartford BVI	The HSF HAGI would be located in an agricultural field approximately 250 m east of the A530 (NGR 369688 370035). The BVI would be located in an agricultural field to the north of the A556 (Chester Road) (NGR 361669 371210).

2.4 Site Description

2.4.1 Most of the topography of the landscape within the Site is relatively flat lying. It is incised by shallow river valleys associated with the River Weaver, which flows in a north-easterly direction from Northwich to the Mersey Estuary, and the Mersey Estuary and River Mersey, which bisects the North Corridor. Overall, the topography falls very gently towards the River Mersey. The highest elevations are within the Higher Walton HAGI to Central Hub HAGI section of the North Corridor (to a maximum of approximately 78 mAOD in the vicinity of the M56) and Sworton Heath BVI to Central Hub HAGI section of the East Corridor (to a maximum of approximately 85 mAOD in the vicinity of the A559 road). The lowest elevations are adjacent to the Mersey Estuary (approximately 2 mAOD at the proposed access routes northeast of the HPP HAGI, and at the intersection between the Clock Face HAGI to Higher Walton HAGI section of the North Corridor and the River Mersey).

2.4.2 The four pipeline corridors are located within predominantly agricultural land between the towns of St. Helens, Warrington, Widnes, Runcorn and Northwich. The spurs are located in areas of predominantly industrial land use. The Project crosses, or is immediately adjacent to, several major roads, railways and surface watercourses. These are summarised as follows. Minor roads and small surface watercourses are omitted:

- Central Hub HAGI:
  - Roads: A49, A533 and various minor (Band C) roads;
  - Railways: None; and
  - Surface watercourses: River Weaver, Longacre Brook, Trent and Mersey Canal, Whitley Brook.
- West Corridor (and associated spurs):
  - Roads: M56, A56, A533, A557 and various minor (Band C) roads;
  - Railways: Ince and Elton to Helsby line, Helsby to Frodsham Line, Frodsham to Runcorn East line, Acton Bridge to Runcorn / Warrington Bank Quay lines; and
  - Surface watercourses: the River Weaver, Weaver Navigation, Trent and Mersey Canal, Longacre Brook and unnamed streams and ponds.
- North Corridor (and associated spurs):
  - Roads: M56, A49, A50, A56, A562, A57, M62 and A570 and various minor (Band C) roads;
  - Railways: Acton Bridge to Runcorn / Warrington Bank Quay, Liverpool South Parkway to Warrington Bank Quay, Widnes to Sankey for Penketh and Rainhill to Lea Green; and

  - Surface watercourses: River Weaver, Trent & Mersey Canal, Bridgewater Canal, Manchester Ship Canal and River Mersey and unnamed streams and ponds.
- East Corridor:
  - Roads: A49, A559, M6, M56, A50, A56 and various minor (Band C) roads;
  - Railways: None; and
  - Surface watercourses: Whiteley Brook, Gale Brook, Arley Brook, Bridgewater Canal, Agden Brook, the River Bollin, Caldwell Brook, Red Brook and various unnamed drains and ponds.
- South Corridor:
  - Roads: A530, A533, A556, A559, A49 and various minor (Band C) roads;
  - Railways: Acton Bridge to Hartford / Greenbank lines, Cuddington to Greenbank line, Winsford to Hartford line, Northwich and Greenbank to Sandbach lines; and
  - Surface watercourses: the River Weaver, the River Dane, Trent and Mersey Canal, Puddinglake Brook and various unnamed drains and ponds.

2.5 Site Surroundings

2.5.1 The surrounding area is mainly agricultural, with several towns, villages and commercial/industrial areas connected by roads. There are a number of designated environmentally sensitive sites in the vicinity of the Project, two of which extend within the Study Area. These are the Woolston Eyes Site of Special Scientific Interest (SSSI), located approximately 150m east of the easternmost extent of the Warrington Spur to Novelis, and the Pettypool Brook Valley SSSI, located 220m southwest of the South Corridor. Woolston Eyes is designated as a SSSI for its value as a breeding site for birds and wintering site for wildfowl, and Pettypool Brook Valley is designated for its value as an invertebrate habitat.

3. Historical Land Use

3.1 Site History Summary

3.1.1 The historical land use of the Site and its immediate surrounding area has been established from a review of the historical mapping and historical land use data provided in the Groundsure EnviroGIS report[2]. Google Earth Pro[3] has also been used to provide some historical and recent aerial photographic coverage of the Site.

3.1.2 The available historical mapping reveals that much of the East Corridor, South Corridor and part of the West Corridor has remained agricultural throughout its recorded history. Elsewhere, however, extensive industrial development has taken place. The list below identifies selected former industrial land uses on the Site with the potential to give rise to soil and groundwater contamination. Note that not all the industrial land uses identified present the same risk of contamination. While the risk associated with large scale industrial activity such as refining, chemical works, iron and steel and major gas works may be higher, the risk associated with collieries, rail land, sewage works and small to medium sized fuel tanks is likely to be low to moderate. As before, the Site has been divided into its constituent areas for ease of reference.

- Central Hub HAGI: Predominantly agricultural with isolated residential development and sparse industrial use, including a brick and tile works, depot, garage, dredging disposal ground, marl and gravel pits, farms and roads.
- North Corridor:
  - St Helens Spurs and Clock Face Spur: densely concentrated industrial works including glass and bottle works, pottery works, copper works, brick and tile works, lead works, boiler works, timber yards, foundries, sewage works, transport depots, landfills, collieries, clay pits, coal pits, coal shafts and smalt works, magazines, garages, tanks, unspecified works and factories, power station, waste recycling centre, canals, railway infrastructure, roads and isolated farms.
  - Clock Face HAGI and corridor section to Higher Walton HAGI: Predominantly agricultural with isolated residential development and sparse industrial use including a sewage farm, a septic tank, a tannery, canal turn bridge and ferry lock, hydraulic installation, sheep dip works, shipyard, unspecified works buildings, cannery, sandstone quarries and sand pits, canals, railway infrastructure, roads and isolated farms.

[2] Groundsure EnviroGIS reports (ref. GSIP-2021-12402-9275, GSIP-2021-12402-9276, GSIP-2021-12402-9281 and GSIP-2021-12402-9282 (historical maps only), dated 02 April 2022)
[3] Historical aerial photography, accessed via Google Earth Pro, July 2024

  - Warrington Spurs*:* Mixed residential and industrial uses, including unspecified works and depots, borate works, bitumen works, iron works, tube works, tanneries, industrial estates (Richmond Works, Palatine Works), tanks, canal deposit land, allotment gardens and roads.
  - Higher Walton HAGI (HWH2); Mixed agricultural and industrial uses, including Runcorn and Latchford Canal, Manchester Shipping Canal, railway lines and sidings, sewage disposal works, saw mills, timber yards, dredging deposit ground (Arpley Landfill), iron foundry, warehouses, depots, tanks and roads.
  - Higher Walton HAGI (HWH8); Agricultural fields with isolated industrial use comprising the Manchester Shipping Canal.
  - Corridor section to Central Hub HAGI: Predominantly agricultural with isolated residential development and sparse industrial use including sewage works, farms and roads.
- West Corridor:
  - HPP HAGI and corridor section to Rocksavage HAGI: Oil refinery located within the HAGI, brick fields, gasworks, gasometer, water works, electricity generating station, sewage works, telephone exchange, unspecified works, depots, glass manufacturing plant, reservoir, fire station, motorway services area, tanks, dredging disposal ground, railway infrastructure and roads.
  - Rocksavage HAGI and Runcorn HAGI (and adjoining spur): Various industrial works including bone and charcoal works, chemical works, a tube works, tanks and power stations, industrial estates, pumping stations, depots and unspecified works, gas pressure breakdown station, electricity substation, canal deposit tip and dredging disposal ground, lagoon and sludge lagoon, railway infrastructure and roads.
  - Corridor section to Central Hub HAGI: Rare clay pits, farms, smithies and roads scattered sparsely throughout the corridor.
- South Corridor:
  - Corridor section from Central Hub HAGI to Hartford BVI: Predominantly agricultural with isolated residential development and sparse industrial use, including a quay, refining works, creamery, gasometer, coal yard, sanatorium, caravan parks, nursery, sand/marl pits and unspecified pits, farms, railway infrastructure and roads.
  - HSF HAGI and corridor section to the west: Predominantly agricultural with isolated residential development and sparse industrial use, including brick field, pumping station and water tower, salt works, caravan site, telephone exchange, sand pits, farms, smithies, railway infrastructure and roads.
- East Corridor:
  - Partington HAGI (PH1 only): Densely concentrated industrial uses including gasworks, petrochemical works, associated tanks, gasholders, pipework, unspecified industrial works, paper manufacturing plant, warehouses, depots, tramways, railway infrastructure and roads.

- Partington HAGI (PH2): agricultural fields.
- Corridor from Central Hub HAGI to Sworton Heath BVI: Predominantly agricultural with isolated residential development and sparse industrial use including clay and gravel pits, farms and roads.
- Corridor section from Sworton Heath BVI to Warburton HAGI (and corridor to Partington HAGI); Predominantly agricultural with isolated residential development and sparse industrial use including brick field, depot, gas valve compound, farms, smithies, clay and gravel pits, railway infrastructure and roads.

3.1.3 A more detailed review of historical mapping (from which the above list is derived) is presented as **Annex 12A2**.

4. Site Walkover

4.1 Introduction

4.1.1 A site walkover survey of accessible areas of interest on the Site was carried out between 20 July and 22 July 2022. The purpose of the site walkover survey was to verify information obtained by the desk study. Observations and photographs of areas of interest were primarily made from the nearest publicly accessible location using the highway network and public rights of way.

4.1.2 Areas of interest were selected based on a review of historical setting against most recent Google Maps aerial imagery to investigate locations of historical industrial features potentially remaining on Site, areas of historical mining and/or infilling of land and areas of proposed HAGIs for surface evidence of potential contaminant sources, which may coincide with the Project. A selection of photographs taken during the site walkover are presented in **Annex 12A3** and are referenced throughout this section.

4.1.3 It is noted that the site walkover survey targeted areas of interest included within the original Scoping boundary for the Project, which covered an area significantly larger than the current Study Area[4]. While the current Study Area does not include significant areas which were outside the original Scoping boundary and areas of interest which are now located entirely outside of the Study Area have been excluded from this report, certain areas of interest (such as Fiddler's Ferry Power Station) are located adjacent to and slightly within the Site, and as such have been included in the report.

4.2 Site Walkover Observations

Central Hub HAGI

4.2.1 The land proposed for the Central Hub HAGI has undergone limited historical development, however this included a historical dredging disposal ground and an industrial estate with a garage, unspecified depot and electricity substation.

- The historical dredging disposal ground near the Central Hub HAGI was identified as Acton Dredging Disposal Ground and noted to be operated by the Canal and River Trust. Observations suggest that the location remains in use for ongoing dredging disposal. No additional visible evidence of potential contamination was noted (Photos 1 and 2); and
- The industrial estate near the Central Hub HAGI was noted to remain in a similar land use identified by the historical maps, comprising a petrol filling station, two hotels, a bakery and a vehicle repair garage (Photo 3).

[4] BVIs were not included as components of the Project at the time of the 2022 site walkover and were not targeted as areas of interest.

North (St Helens Spurs to Higher Walton HAGI and Warrington Spurs)

4.2.2 The site walkover survey investigated the local environment at the St Helens Spurs, Clock Face HAGI and Higher Walton HAGI (HWH2), Warrington Spurs and the corridor section from St Helens Spurs to Higher Walton HAGI. The site walkover targeted the HAGI locations, and potential historical features including Pilkington Glass works (occupying an area of historical industrial works and collieries), Ravenhead Nature Park (a former colliery), a transport depot and adjacent former landfill, an industrial estate, Sutton Manor Woodland (a former colliery), Fiddlers Ferry Power Station (adjacent to and slightly within the Study Area), Arpley Landfill and adjacent former timber yards and railway sidings along St Helens Canal, and several industrial estates, unspecified industrial works and a bitumen works in the Warrington Spurs:

- The footprint of a historical brickworks (originally the footprint of a proposed St Helens HAGI – now no longer part of the Project - and now simply adjacent to the St Helens Spurs) was confirmed to be fenced off undeveloped land with no visible evidence of contamination (Photos 4 and 5).
- Ravenhead Nature Park was confirmed to be a nature park. No visible contamination or surface features associated with former colliery were noted, however Groves Dam pond in the northeast of the park was noted to be murky and polluted with litter (Photos 6 and 7).
- Pilkington Glass Works was confirmed to be present and operational based on road signage (Photo 8) and to occupy the historical industrial and colliery area to the north of the Site, however the site was not accessible and no suitable vantage point was available to observe it from a distance.
- The transport depot was noted to have undergone demolition, with stockpiles of building rubble and ground remediation and drilling contractors present during the site walkover. Signage at the entrance indicated that the transport depot is being redeveloped as residential housing. The historical landfill adjacent to the east of the transport depot was not accessible and no suitable vantage point was available to observe it from a distance.
- The industrial estate was not accessible. Signage visible from a distance indicated that a generator and switchgear servicing activity was present on the industrial estate.
- Clock Face HAGI was observed to be located within agricultural fields with no visible contamination or potentially contaminative features (Photo 9).
- Sutton Manor Woodland was confirmed to be a nature park. No visible contamination was noted within the park, however a derelict business of unspecified nature ‘DGS Integrated Services’ with evidence of fly tipping was located on the western boundary of the woodland, and a possible electricity substation was located within the western boundary (Photo 10 to 13).
- Fiddler’s Ferry Power Station was confirmed to be present (Photo 14).

- Arpley Landfill site was not directly accessible. Where visible, the landfill was covered with vegetated scrubland. No exposed waste deposits were observed. Borehole covers and limited remains of infrastructure were observed, including pieces of railway track and brick structures potentially containing deep borehole headworks (Photo 15 to 18).
- The former timber yards and railway sidings along St Helens Canal were observed to be occupied by Denholm Logistics (a depot observed to store bricks, pipework, metal fencing and a cylindrical tank of unknown content) and FloMix UK (a concrete works) (Photo 19).
- The historical bitumen works was confirmed to still be present. A large number of cylindrical tanks of unknown content were observed and the bitumen works appeared to be derelict and/or in a state of disrepair (Photo 20 and 21).
- The historical Richmond Works in the east of the *Warrington spur* was observed to still be an industrial site, including a metal and vehicle recycling plant and a storage container retailer/manufacturer (Photo 22 to 24).

West (HPP HAGI to Runcorn and Rocksavage HAGIs)

4.2.3 The site walkover survey investigated the local environment of the HPP HAGI, the Runcorn and Rocksavage HAGIs and connecting corridors. The site walkover targeted the HAGI locations, and potential historical features including a former electricity station with cooling towers, a glass manufacturing plant in part of the footprint of the electricity station, unspecified works (identified by Google Earth as CF Fertilisers), former railway sidings, a dredging disposal ground, a gas distribution station, a power station, industrial estate, a lagoon (historical landfill), a refuse tip and industrial sludge landfill and an electricity substation:

- The site of the proposed HPP HAGI is confirmed to be located within Stanlow Oil Refinery. No suitable vantage point was available to take photographs.
- The glass manufacturing plant was confirmed to be present within the footprint of the historical electricity power station. No suitable vantage point was available to take photographs.
- The unspecified works (identified by Google Earth) as CF Fertilisers was confirmed to be present, however the precise nature of the works could not be confirmed (Photo 25).
- The dredging disposal ground was observed as an area of raised land with a heavily vegetated bund. It was not possible to determine if the location was being used for continued dredging disposal. No additional visible evidence of potential contamination was noted (Photo 26 and 27).
- The power station was confirmed to be present, including an electricity pylon at the power station entrance. Most of the power station was noted to be outside of the Site boundary (Photo 28).
- The gas distribution station was confirmed to be present (Photo 29 and 30).

- The lagoon (historical landfill) and Runcorn HAGI was observed to be fenced off and either raised land or surrounded by steep heavily vegetated banks. An unidentified brick structure and covered brick well were located on the south-eastern boundary. It is unknown whether these are associated with the historical landfill. No direct access was available and no suitable vantage point was available to observe the landfill beyond the south-eastern boundary (Photos 31 to 33).
- The electricity substation was confirmed to still be present (Photo 34).
- The refuse tip and industrial sludge landfill east of Rocksavage HAGI was observed to be an area of raised, heavily vegetated land from the road along the northern boundary of the landfill. No direct access was available and no suitable vantage point was available to observe the landfill beyond the northern boundary (Photo 35). A concrete post and a sign both marked “ICI” were observed on the northern boundary of the landfill (Photo 36 and 37).

South (HSF HAGI and Corridor Section to Central Hub HAGI)

4.2.4 The site walkover survey investigated the local environment of the HSF HAGI and the corridor section to the Central Hub HAGI. The site walkover targeted the HAGI location, and potential historical features including an unspecified works with a shaft and a historical salt works and landfill:

- The site of the proposed HSF HAGI is occupied by agricultural fields with no other features visible (Photo 38);
- The unspecified works with a shaft was confirmed to be present, however no evidence of a shaft was visible. (Photo 39); and
- The salt works was confirmed to still be present, with stockpiles visible on the salt works. No evidence of historical landfill was visible from the nearest accessible location (Photo 40).

East (Partington HAGI to Central Hub HAGI)

4.2.5 The site walkover survey investigated the local environment of the Partington HAGI (PH1) which was historically occupied by densely concentrated industrial uses including a gasworks, petrochemical works, associated tanks, gasholders, pipework, unspecified industrial works, paper manufacturing plant, warehouses, depots, tramways and railway infrastructure, and the proposed Warburton HAGI including a gas distribution station located immediately to the west of the HAGI:

- The historical industrial features occupying the footprint of Partington HAGI (PH1) and surrounding area were noted to predominantly demolished, but with limited infrastructure associated with the historical industrial use of the area remaining, including tanks (Photo 41);
- The former steel works adjacent to the south of the Partington HAGI (PH1) was noted to have been demolished and undergone enabling works for redevelopment as residential housing (Photo 42); and

- The proposed Warburton HAGI was noted to be occupied by an open field with crops. No potential contaminant sources were visible (Photo 43).

4.2.6 The nature of land use observed across the Site during the site walkover was generally concurrent with land uses identified from historical maps and Google Earth aerial imagery, with limited areas changing from industrial land use to residential land use since the most recently available aerial imagery. Based on the site walkover, no additional potentially significant risks of contamination were identified by the site walkover beyond those identified in the historical setting (**Section 3**) and environmental setting (**Section 5**) of this report.

5. Environmental Setting

5.1 Geology

5.1.1 Information on the geological setting has been obtained from the British Geological Survey (BGS)[5,6] 1:10,000 and 1:50,000 scale drift and solid geological mapping provided as part of a Groundsure EnviroGIS report[7].

Made Ground / artificial ground

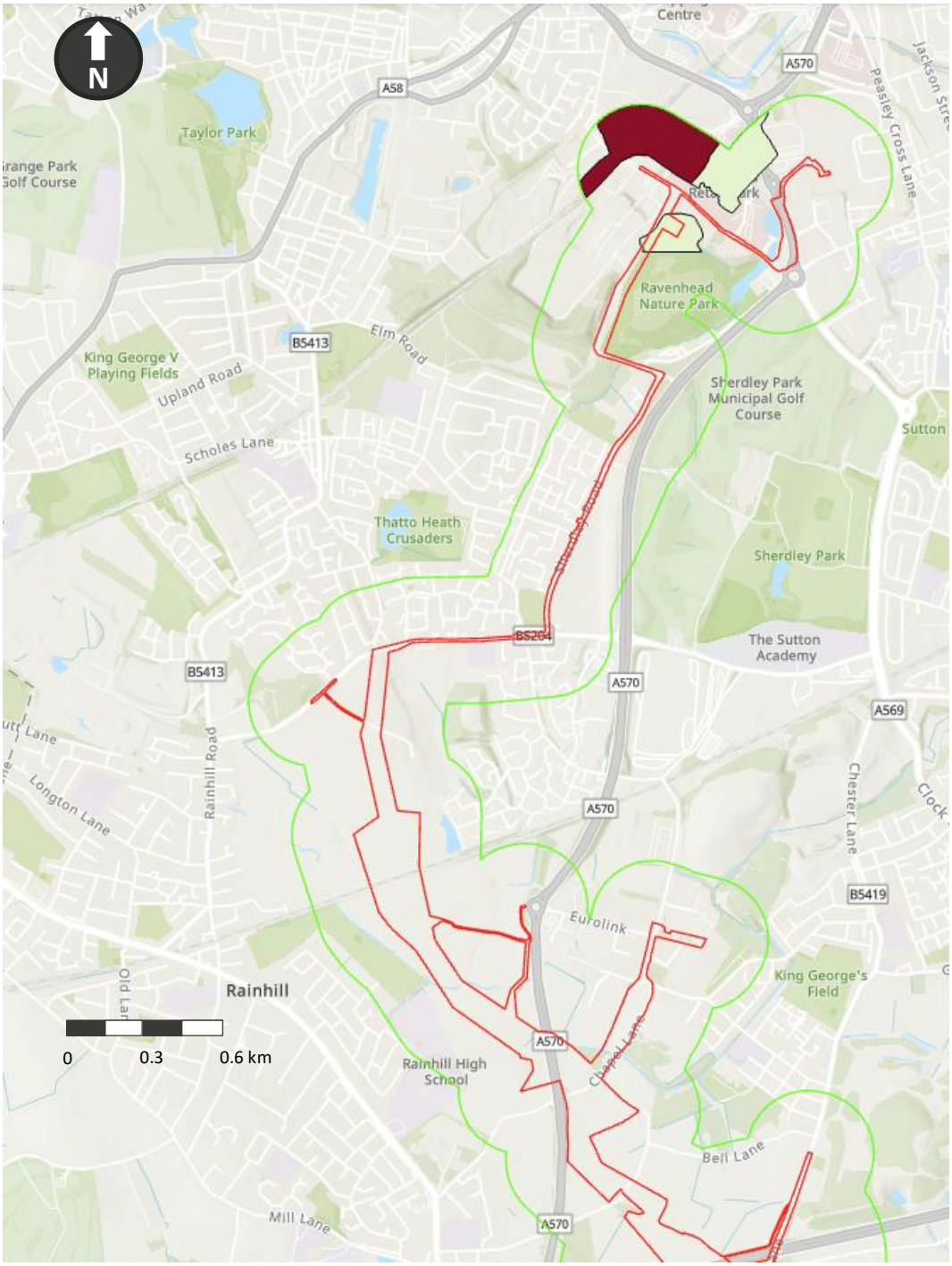
5.1.2 BGS 1:10,000 scale mapping shows Made Ground / artificial ground present in the Study Area at the north of St Helens Spurs:

- An area of infilled ground within and adjacent to the St Helens Spurs;
- Areas of infilled ground in the Study Area to the northeast of the St Helens Spurs; and
- An area of Made Ground (undivided) to the northeast and northwest of the St Helens Spurs.

5.1.3 The location of Made Ground identified by BGS mapping is approximately consistent with historical industrial development as well as historical and authorised landfills recorded by the Groundsure EnviroGIS report in the vicinity of the St Helens Spurs. It is noted that that similar industrial development, as well as historical and authorised landfills are present in parts of the wider Study Area which have been recorded by the Groundsure EnviroGIS report but have not been identified by the BGS. The location and extent of the Made Ground and infilled ground identified by the BGS in the vicinity of the Site is illustrated in **Graphic 12A5.1.** Landfills and other historical industrial uses with the potential to include Made Ground recorded by the Groundsure EnviroGIS report are further detailed in **Sections 5.9 and 5.10**.

[5] BGS, GeoIndex, http://mapapps2.bgs.ac.uk/geoindex/home.html, accessed July 2024
[6] BGS, Geology of Britain Viewer, http://mapapps.bgs.ac.uk/geologyofbritain/home.html, accessed July 2024
[7] Groundsure EnviroGIS reports (ref. GSIP-2024-16193-20473, GSIP-2024-16193-20474, GSIP-2024-16193-20477), dated 24 July 2024

Graphic 12A5.1 Made Ground / artificial ground at St Helens Spurs and Clock Face Spur[7]



- Draft Order Limits
- Study Area Extent
- Made Ground (undivided)
- Worked Ground (undivided)
- Infilled Ground

Superficial geology

5.1.4 The superficial geology is summarised from the BGS 1:50,000 scale mapping provided with the Groundsure data and available on the BGS website. Superficial deposits are present across the majority of the Site, however the 1:50,000 scale mapping shows superficial deposits are absent from localised areas within the Central Hub HAGI and corridor sections to the north, south and east and from the Runcorn/Rocksavage spur. Areas where superficial deposits are present are described in **Table 12A5.1** below.

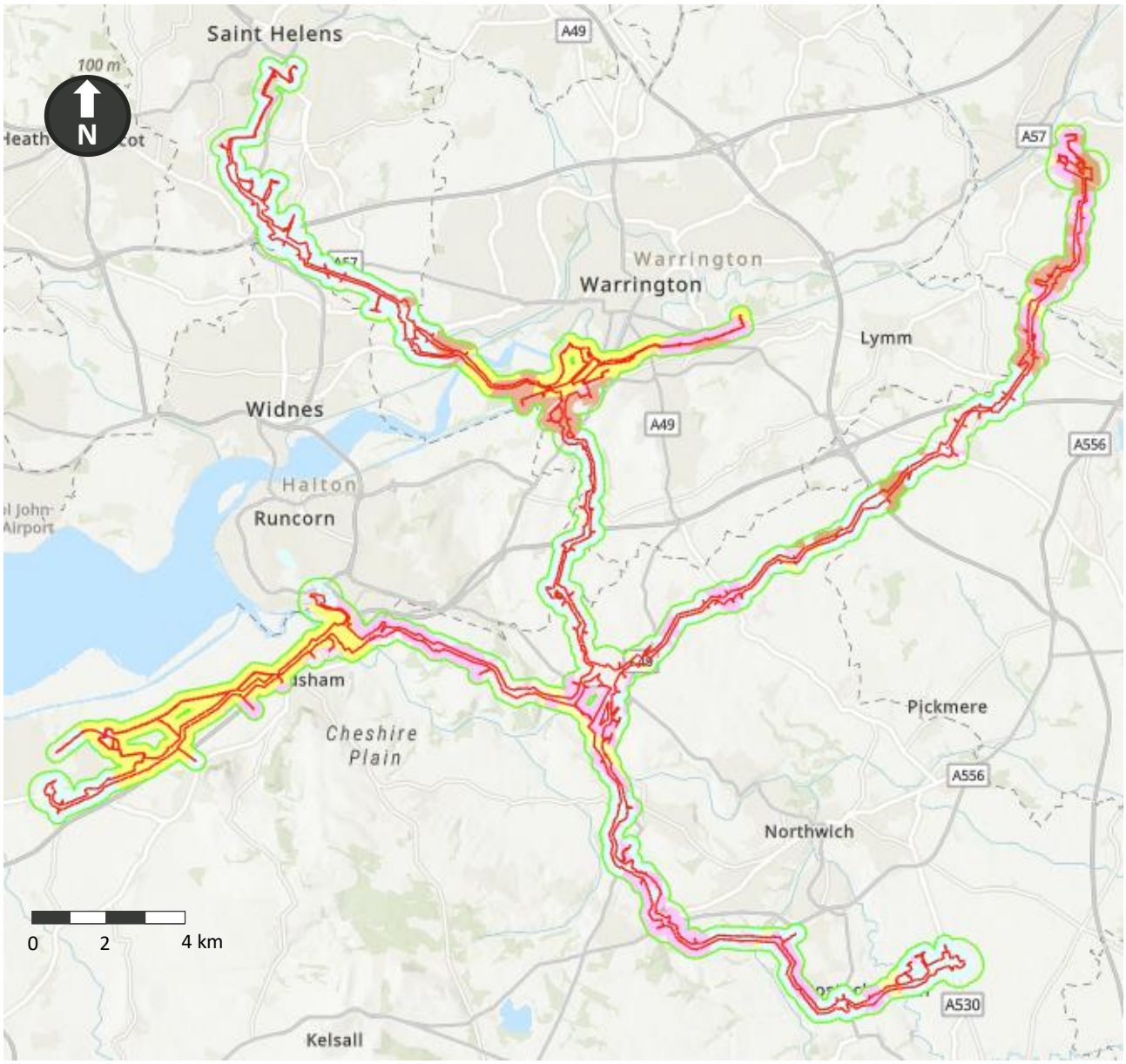
Table 12A5.1 Summary of superficial geology on Site

Units present in BGS 1:50,000 scale mapping	Description	Location
Glacial Till - Diamicton	Diamicton	Approximately 30% of the Site. St Helens Spurs to north of Higher Walton HAGI (north of River Mersey), south of Higher Walton HAGI to Central Hub HAGI, HPP HAGI and West Corridor section adjacent, Runcorn HAGI, HSF HAGI and South Corridor to Central Hub HAGI, East Corridor section to north of Warburton HAGI and from Warburton HAGI to Central Hub HAGI.
Shirdley Hill Sand Formation	Sand	Approximately 10% of the Site. Higher Walton HAGI (HWH8) and Warrington Spurs and North Corridor sections adjacent to north and south. Warburton HAGI and East Corridor section adjacent to north and south.
Tidal Flat Deposits	Clay, silt and sand	Approximately 20% of site. Higher Walton HAGI (HWH2) and Warrington Spurs. Rocksavage and Runcorn HAGIs (and adjoining spur) and West Corridor section to HPP HAGI.
Glaciofluvial Sheet Deposits	Sand and gravel	Approximately 20% of the Site. Warrington Spurs, Rocksavage and Runcorn HAGIs (and adjoining spur) and West Corridor sections to HPP HAGI and Central Hub HAGI. Central Hub HAGI and South Corridor to HSF HAGI. Partington HAGI (PH1 and PH2) and Warburton HAGI and adjacent East Corridor sections.

Units present in BGS 1:50,000 scale mapping	Description	Location
Alluvium	Clay, silt, sand and gravel	Approximately <5% of the Site. North Corridor north of Higher Walton HAGI. Central Hub HAGI and South Corridor to HSF HAGI. Partington HAGI (PH1) and Warburton HAGI and adjacent East Corridor sections.
River Terrace Deposits	Sand and gravel	<1% of the Site. South Corridor section adjacent to west of HSF HAGI.
Peat	Peat	<5% of the Site. Partington HAGI (PH2), corridor section from Warburton HAGI to Central Hub HAGI. Corridor section between Central Hub HAGI and HSF HAGI.
Superficial Deposits absent	Made Ground directly underlain by bedrock	Approximately 10% of the Site. Central Hub HAGI, West Corridor sections to Rocksavage HAGI, Higher Walton HAGI and Warburton HAGI.

5.1.5 The superficial geology is illustrated below in **Graphic 12A5.2**.

Graphic 12A5.2 Superficial Geology[7]



- Draft Order Limits
- Study Area Extent
- Glacial Till - Diamicton
- Shirdley Hill Sand Formation
- Alluvium
- Tidal Flat Deposits
- Glaciofluvial Sheet Deposits
- River Terrace Deposits
- Peat

Peat

5.1.6 The potential implications of peaty soils for foundation design are discussed further in Section 6, and a preliminary peat desk study has been undertaken by WSP and is presented in **Appendix 13A** of **Chapter 13: Agriculture and Soils** of the Draft ES.

5.1.7 The BGS 1:50,000 scale mapping and the BGS website indicate the presence of extensive areas of peat within parts of the Site. These are predominantly located in the Runcorn and Rocksavage HAGI and West Corridor section to the HPP HAGI, Partington HAGI and East Corridor section from Partington HAGI to Central Hub HAGI with smaller areas located to the west of Higher Walton HAGI (HWH2) and in the South Corridor section between Central Hub HAGI and HSF HAGI (see **Appendix 13A** of **Chapter 13: Agriculture and Soils**).

Solid geology

5.1.8 The bedrock geology is summarised from the BGS 1:50,000 scale mapping provided with the Groundsure data and available on the BGS website in **Table 12A5.2** below.

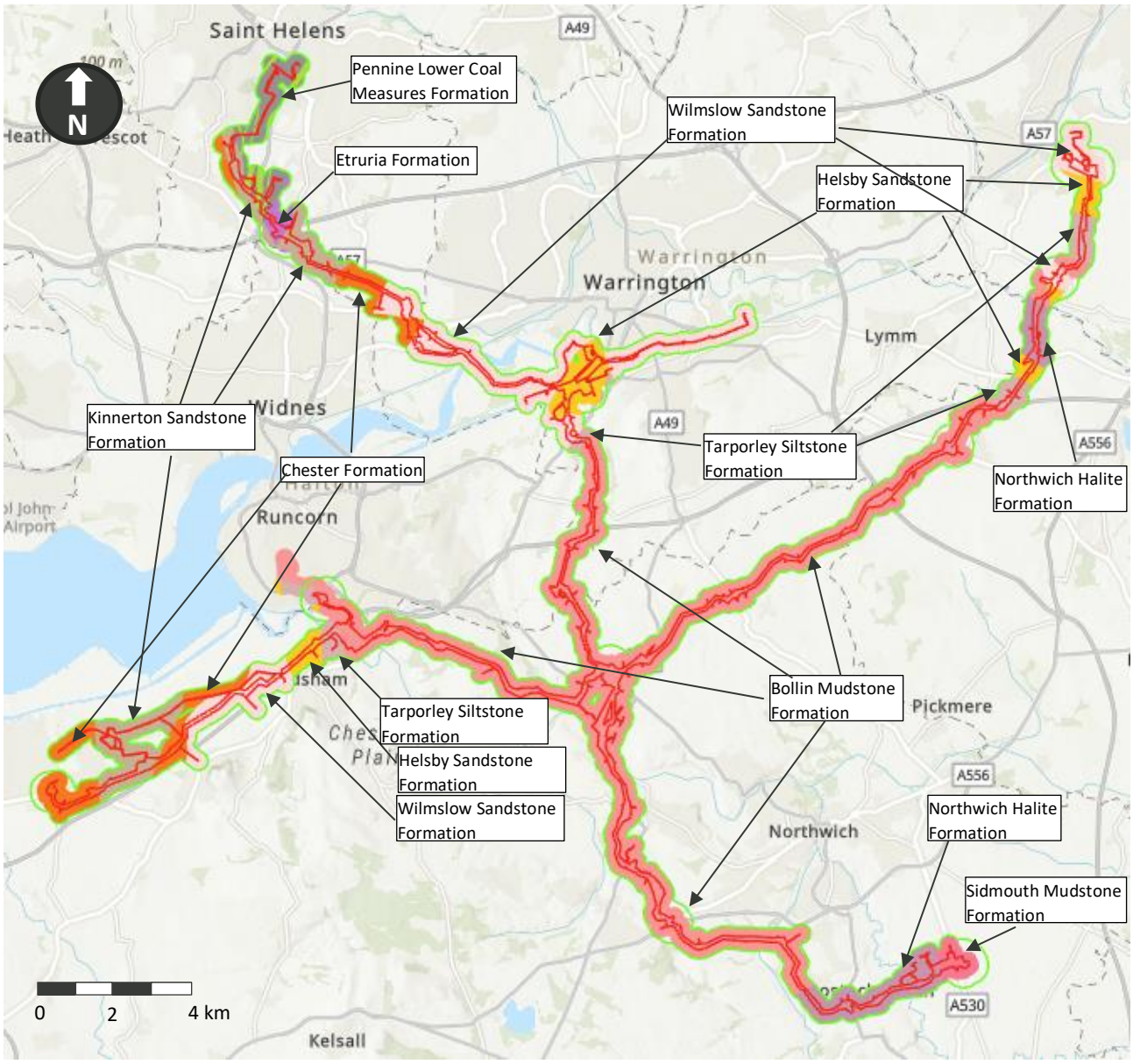
Table 12A5.2 Summary of bedrock geology on Site

Units present in BGS 1:50,000 scale mapping	Description	Location
Northwich Halite Member	Halite and mudstone	Approximately 5% of the Site. South Corridor section west of HSF HAGI, East Corridor section south of Warburton HAGI to Central Hub HAGI. Brine extraction known to have taken place on site within this unit (see **Section 4.2**).
Sidmouth Mudstone Formation	Mudstone	<5% of the Site, in HSF HAGI and surrounding Study Area only.
Bollin Mudstone Member	Mudstone	Approximately 50% of the Site. Central Hub HAGI and North Corridor sections to Higher Walton HAGI, Warburton HAGI, HSF HAGI and Rocksavage HAGI. Also present in southern half of Warburton HAGI, Rocksavage and Runcorn HAGIs (and adjoining spur).
Tarporley Siltstone Formation	Siltstone, Mudstone and Sandstone	<5% of the Site. Rocksavage HAGI, Runcorn HAGI, North Corridor section south of Higher Walton HAGI, East

Units present in BGS 1:50,000 scale mapping	Description	Location
		Corridor section to north and south of Warburton HAGI.
Helsby Sandstone Formation	Gravelly Sandstone	<5% of the Site. Higher Walton HAGI (HWH2 and HWH8) and Warrington Spurs, Rocksavage HAGI, Runcorn HAGI, Warburton HAGI and East Corridor sections to north and south.
Wilmslow Sandstone Formation	Sandstone	Approximately 15% of the Site. Corridor section northwest of Higher Walton HAGI, Warrington Spurs and North Corridor approximately halfway to Clock Face HAGI. Partington HAGI (PH1 and PH2), part of Warburton HAGI and West Corridor section between Rocksavage HAGI and HPP HAGI.
Chester Formation	Gravelly sandstone	Approximately 5% of the Site. North Corridor sections to west and east of Clock Face HAGI, HPP HAGI and West Corridor section to east.
Kinnerton Sandstone Formation	Sandstone	<5% of the Site. Clock Face HAGI, West Corridor section east of HPP HAGI.
Etruria Formation	Mudstone, sandstone and conglomerate	<1% of the Site. Clock Face HAGI and Clock Face Spur.
Pennine Middle Coal Measures Formation	Interbedded mudstone and sandstone	Approximately 5% of the Site. St Helens Spurs, North Corridor section to Clock Face HAGI and Clock Face Spur. Coal mining known to have taken place on Site within this unit (see **Section 4.2**).
Geological faults and coal seams	N/A	Frequent coal seams in St Helens Spurs (within Pennine Middle Coal Measures Formation). Occasional faults across site, predominantly trending north-south.

5.1.9 The solid geology is illustrated below in **Graphic 12A5.3**.

Graphic 12A5.3 Solid Geology[7]



- Draft Order Limits
- Study Area Extent
- Chester Formation
- Kinnerton Sandstone Formation
- Pennines Middle Coal Measures Formation
- Wilmslow Sandstone Formation
- Etruria Formation
- Helsby Sandstone Formation
- Tarporley Siltstone Formation
- Bollin Mudstone Formation

Northwich Halite Formation

Sidmouth Mudstone Formation

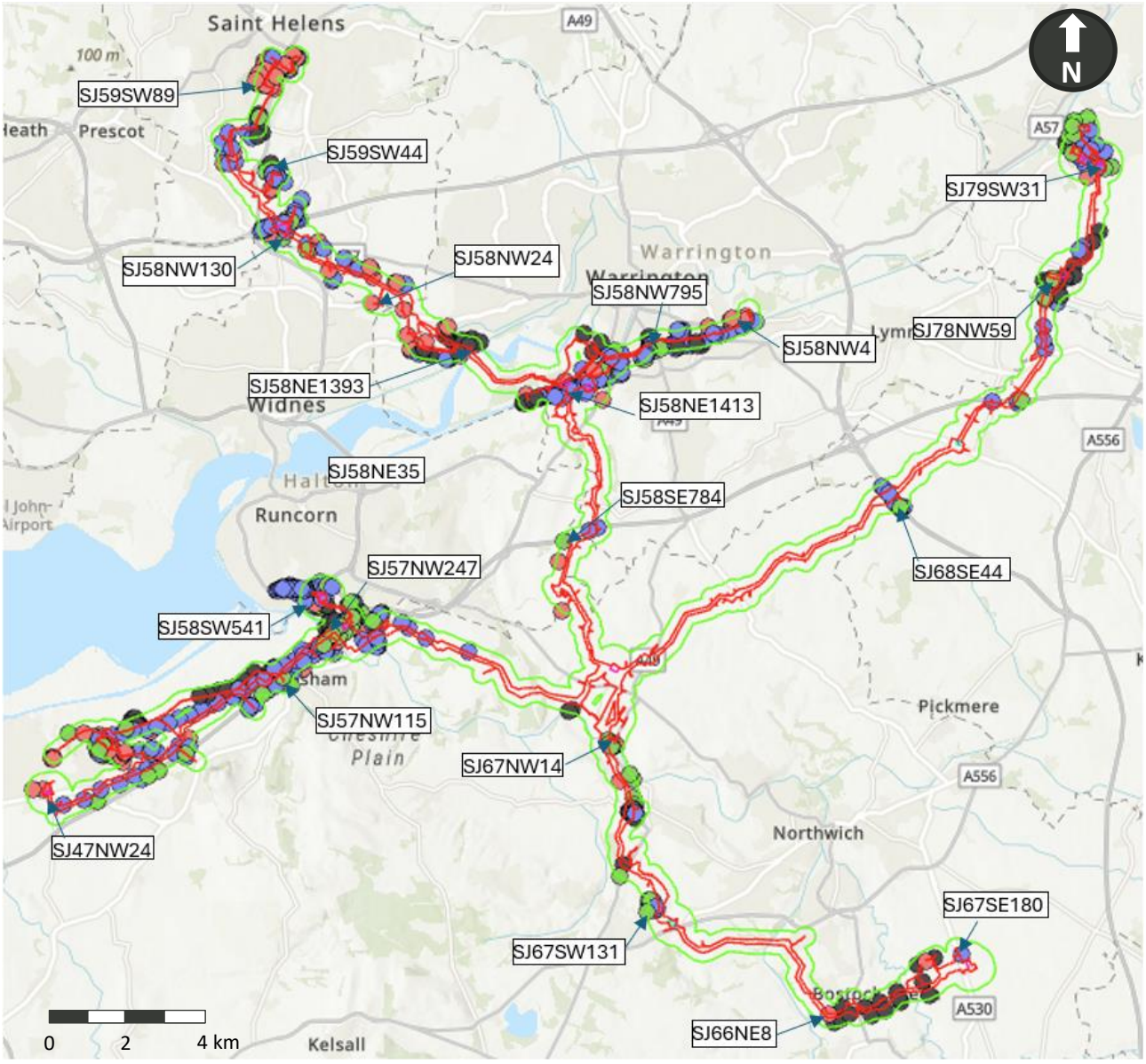
Coal Seam

Geological Fault

BGS historical borehole records

5.1.10 A selection of available BGS borehole records located on or adjacent to the Site has been reviewed and these are summarised below. The locations of the selected boreholes are presented in **Graphic 12A5.4**.

Graphic 12A5.4 Selected BGS Borehole Records[7]



Draft Order Limits

Study Area Extent

- BGS borehole (0 – 10m)
- BGS borehole (10 – 30m)
- BGS borehole (30m +)
- BGS borehole (Confidential)

5.1.11 BGS Borehole log SJ59SW89 (no date provided) recorded the following ground conditions:

- Superficial deposits comprising brown clay to a depth of 0.5m below ground level (bgl);
- Bedrock comprising brown to grey siltstone to approximately 5m bgl;
- Grey siltstone with “stripes and bands” of sandstone to 12.2m bgl;
- Silty mudstone was recorded to 16.5m bgl with “old workings in a new mine” recorded at 13.7m bgl to 14.5m bgl;
- Grey siltstone with “stripes and bands” of sandstone to a depth of 29.7m bgl;
- Grey mudstone to 30.2m bgl (base of hole); and
- Water return was noted to be ‘lost at 7.0m bgl, regained at 15.7m bgl, and lost again at 17.2m bgl. It is unclear if this referred to groundwater strikes or to the use of water in the drilling process.

5.1.12 BGS borehole log SJ59SW44 is dated 1955. The borehole recorded the following ground conditions:

- Topsoil to 0.25 mbgl;
- Yellow to red brown clay with small pebbles to 7.3 mbgl;
- “Boulder pebbles and hard sandstone pebbles” to 8.1 mbgl;
- Interbedded grey fine grained sandstone, grey argillaceous mudstone and grey “fireclay” with rootlets and/or ironstone nodules with individual layer thickness of approximately 0.5 m to 1.0 m to 21.0 mbgl (base of hole); and
- Groundwater level was not recorded.

5.1.13 BGS borehole SJ58NW130 at the A557 south of the Site dates from 1973 and recorded the following ground conditions:

- Topsoil to 0.5m bgl;
- “Brown clay with pockets and bands of sand with cobble and pebble inclusions (Glacial Till) to 18.0 m bgl;
- “Red and light brown bunter sandstone with pebble inclusions” to 30 mbgl (base of hole); and
- Groundwater level was not recorded.

5.1.14 BGS borehole SJ58NW24 dates from 1944 and recorded the following ground conditions:

- Superficial deposits (comprising “surface soil”, “hard clay and stones” and “sand and gravel”) to a depth of 6.3m bgl;
- Bedrock comprising “Bunter Pebble Beds” (red sandstone with occasional bands of sandy marl or marly sandstone) to a depth of 257 m bgl;
- Bedrock comprising “Lower Mottled Sandstone” (soft red sandstone) to a depth of 267.8 mbgl; and
- Groundwater level was not recorded.

5.1.15 BGS borehole SJ58NE1393 dates from 2007 and recorded the following ground conditions:

- Made Ground (“hard core”) to a depth of 0.5m bgl;
- Brown clay with cobbles to a depth of 1.5m bgl;
- “Consolidated brown clay” to a depth of 3m bgl;
- “Sands, gravel, clays” to a depth of 10m bgl;
- “Consolidated brown clay with some gravel” to a depth of 12m bgl;
- Bedrock comprising “Medium red sandstone with small marl mudstone bands (Red)” to a depth of 91m bgl (base of hole); and
- Groundwater was encountered at 4m bgl, 25m bgl, 66m bgl and 81m bgl.

5.1.16 BGS borehole SJ58NE35 (Borehole 1) dates from 1959 and recorded the following ground conditions:

- “Made up ground” to a depth of 0.4m bgl;
- Superficial deposits comprising “brown boulder clay” interbedded with layers of silt, gravel and sand to a depth of 28.96m bgl;
- Bedrock comprising red sandy marl to a depth of 32.16m bgl and red sandstone to a depth of 76.2m bgl (base of hole); and
- Groundwater was encountered at 2.9m bgl.

5.1.17 BGS borehole SJ68NW795 dates from 1991 and recorded ground conditions including:

- Made Ground (asphalt over brick fill) to a depth of 0.7m bgl;
- Made Ground (black clayey sandy silt with brick fragments and organic material to a depth of 6.2m bgl);
- Made Ground (dark grey silty organic sand with fine to medium gravel of brick fragments) to a depth of 8.5m bgl;
- Superficial deposits of fine to coarse gravelly sand to a depth of 9.2m bgl;

- Bedrock comprising red brown weathered sandstone to a depth of 22m bgl (base of hole); and
- Groundwater was encountered at 3.1m bgl (slight seepage) and at 5.7m bgl rising to 3.5m bgl in 20 minutes.

5.1.18 BGS borehole SJ68NW4 dates from 1915 and recorded ground conditions including:

- Superficial deposits (sand and gravel) to a depth of 2.4m bgl;
- Bedrock comprising red sandstone to a depth of 61.3m bgl; and
- Groundwater at 5m bgl.

5.1.19 BGS borehole SJ58NE1413 dates from 1971 and recorded the following ground conditions:

- Red/brown sandy clay to a depth of 1.5m bgl;
- Red/brown fine to medium sand to a depth of 3.8m bgl;
- Dense red weathered sandstone to a depth of 6.3m bgl (base of hole), becoming unweathered at 5.3 mbgl; and
- Groundwater level was not recorded.

5.1.20 BGS borehole SJ58SE784 dates from 1995 and recorded the following ground conditions:

- Topsoil to a depth of 0.15m bgl;
- Made Ground (red brown clayey sandy gravel) to a depth of 1.1m bgl;
- Superficial deposits comprising Glacial Till (red brown sandy gravelly clay) to a depth of 13.5m bgl;
- Thin layers of Glaciofluvial Sheet Deposits (< 1 m thick) comprising gravelly clayey sand between 4.4m bgl and 5.1m bgl, and gravel of mudstone and siltstone between 13.5m bgl and 14.1m bgl;
- Bedrock comprising red brown to grey green gravelly clay to a depth of 16.7m bgl, with thin bands of gravelly silt below 15.8m bgl;
- Red brown slightly weathered mudstone to 17m bgl (base of hole); and
- Groundwater encountered at 12.1m bgl.

5.1.21 BGS borehole SJ47NW24 dates from 1940 and recorded the following ground conditions:

- “Drift” to a depth of 1.52m bgl;
- “Dull grey and light red sandstones with quartzite pebbles abundant at many horizons. Two small faults”; to a depth of 152.4m bgl (base of hole); and
- Groundwater encountered at 5.2m bgl.

5.1.22 BGS borehole SJ57NW115 dates from 1995 and recorded the following ground conditions:

- Made Ground comprising sandy gravelly topsoil underlain by grey limestone fill to a depth of 1m bgl;
- Glaciofluvial Deposits comprising clayey gravelly sand and clayey sandy gravel to a depth of 9.35m bgl;
- Glacial Till comprising brown sandy clay to a depth of 9.85m bgl;
- Glaciolacustrine Deposits comprising thinly laminated brown clay to a depth of 12.7m bgl;
- Further Glaciofluvial Deposits to a depth of 13.8m bgl;
- Further Glaciolacustrine Deposits to a depth of 15.35m bgl (base of hole); and
- Groundwater encountered at 2.35m bgl and at 12.2m bgl.

5.1.23 BGS borehole SJ58SW541 dates from 1996 and recorded the following ground conditions:

- Completely weathered marl comprising red brown gravelly clay to a depth of 0.25m bgl;
- Highly weathered red brown thinly laminated marl to a depth of 2.56m bgl;
- Bedrock comprising fractured sandstones, mudstones and siltstones with occasional calcite and possible salt nodules to a depth of 29.65m bgl (base of hole); and
- Groundwater level encountered at 5.4m bgl.

5.1.24 BGS borehole SJ57NW247 dates from 1966 and recorded the following ground conditions:

- Topsoil to a depth of 0.15m bgl;
- Superficial deposits comprising sandy silty clay, silty gravelly sand and sandy gravel with bands of peaty clay to a depth of 17.1m bgl;
- Possible bedrock comprising sandy clay with boulders, clayey sand and occasional layers of sandy silt to a depth of 45.7m bgl (base of hole); and
- Groundwater level encountered at 1.2m bgl.

5.1.25 BGS borehole SJ76NW127 dates from 1991 and recorded the following ground conditions:

- Topsoil to a depth of 0.3m bgl;
- Superficial deposits comprising brown clayey sand to 0.8m bgl and brown silty gravelly clay to 1.2m bgl;
- Possible bedrock comprising blue grey to reddish brown silty sandy gravelly clay to 8m bgl (base of hole); and
- Water seepage at ground level.

5.1.26 BGS borehole SJ66NE2 dates from 1843 and recorded the following ground conditions:

- Superficial deposits comprising “soil and drift composed of sand and clay” to a depth of 1.83m bgl (the borehole notes that Superficial deposits vary in thickness at other parts of the Site up to 16m thick);
- Bedrock comprising “variegated marl with beds of hard blue and brown marl and marlstone with scales of limestone” to a depth of 8.23m bgl;
- Brown and blue marl and/or marlstone with containing gypsum or rock salt to a recorded depth of 150.3m bgl (subsequent pages of borehole log are missing); and
- No groundwater strikes recorded.

5.1.27 BGS borehole SJ67SW131 dates from 1993 and recorded the following ground conditions:

- Topsoil to a depth of 0.3m bgl;
- Brown silty fine to medium sand with fine gravel to 13.5 mbgl (base of hole), becoming fine to coarse with fine to coarse gravel from 8.0 mbgl to 11.5 mbgl; and
- Groundwater encountered at 11.5m bgl.

5.1.28 BGS borehole SJ66NE8 dates from 1881 and recorded the following ground conditions:

- Wet sand and gravel to a depth of 6.1m bgl;
- Clay and loam to a depth of 7.3 mbgl;
- Dry red clay to a depth of 16.5 mbgl;
- Running sand to a depth of 18.6 mbgl;
- Dry sand, loam and clay to a depth of 25.0 mbgl;
- Boulder clay and gravel to 92.3 mbgl (base of hole); and
- Groundwater level not recorded.

5.1.29 BGS borehole SJ67SE180 dates from 1991 and recorded the following ground conditions:

- Topsoil to a depth of 0.3m bgl;
- Firm orange brown to red brown mottled silty clay to a depth of 0.7 mbgl;
- Firm to stiff red brown silty clay with fine to medium rounded gravel and rootlet traces to a depth of 3.0 mbgl (base of hole); and
- Groundwater not encountered during drilling.

5.1.30 BGS borehole SJ68SE44 (no date provided) recorded the following ground conditions:

- Made Ground (unspecified) to a depth of 1.2m bgl;
- Superficial deposits comprising Glacial Till (sandy boulder clay) to a depth of 3.3m bgl;
- Bedrock comprising grey marl and red brown to grey green laminated silty mudstone with frequent discontinuities to a depth of 20.5m bgl (base of hole). Occasional gypsum bands from 9.9m bgl; and
- No groundwater strikes recorded.

5.1.31 BGS borehole SJ78NW59 is dated 1983 and recorded the following ground conditions:

- Topsoil to a depth of 0.25m bgl;
- Superficial deposits comprising brown gravelly sand to a depth of 1.75m bgl;
- Brown occasionally laminated silty gravelly clay to a depth of 15m bgl (base of hole); and
- Slight groundwater seepage at 1.8m bgl (hole sealed by casing at 2.0m bgl).

5.1.32 BGS borehole SJ79SW31 is dated 1945 and recorded the following ground conditions:

- “Cinders, soil and sand” to a depth of 0.61m bgl;
- “Brown peat” to a depth to 3.35m bgl;
- “Sand and gravel” to a depth of 5.49m bgl;
- “Stiff brown clay”” to a depth of 7.92m bgl
- “Red loamy sand and stones” to a depth of 12.04m bgl;
- “Red sandstone” to a depth of 12.19m bgl (base of hole); and
- No groundwater strikes recorded.

5.2 RSK Factual Report on Ground Investigation May 2023

5.2.1 In 2023 Ian Farmers Associates (who were commissioned by RSK) carried out a ground investigation to determine ground and groundwater conditions across the site. The site was subdivided into 11 different sheets by RSK, the ground conditions underlying which are summarised below and the sheets shown in the factual report which is included as **Appendix 12B** in **Chapter 12: Ground Conditions** of the Draft ES.

5.2.2 **Sheet 02** - Topsoil and Glacial Till until 0.9m, followed by Sand representing heavily weathered rock of the Sherwood Sandstone Group. Rockhead struck at 1.7m bgl, composed of weathered Sandstone.

5.2.3 **Sheet 03** - Glaciofluvial and Glacial Till to approximately 5.5m underlain by Mudstone and occasionally Siltstone of the Bollin Mudstone Member, Mercia Mudstone Group. BH332A records Tidal Flat Deposits composed of loose to medium dense Sand to 6.8m, underlain by Glacial Till to the base of the borehole.

5.2.4 **Sheet 04** - Glaciofluvial and Glacial Till to approximately 2.0m underlain by Mudstone and occasionally Siltstone of the Bollin Mudstone Member, Mercia Mudstone Group. Mudstone was weathered to stiff Clay up to 9m in BH017.

5.2.5 **Sheet 05** - Glacial Till until 15m underlain by firm to very stiff Clay derived from the Mercia Mudstone Group. Glacial Till gives way to Mercia Mudstone at shallower depth in certain locations, in BH040 it is encountered at5m, but is heavily weathered to Clay until 27m. Alluvium composed of silty fine Sand was encountered in BH042 to 5.20m and 6.20m in BH037 with layer of Silt.

5.2.6 **Sheet 06** - Alluvium composed of clayey, silty, fine to coarse Sand from 2.50 – 3.0m underlain by weathered Mudstone. WS34 records Glacial Till t0 3.8m underlain by Glacial Till.

5.2.7 **Sheet 07** - Siltstone and Mudstone is shallow, with rockhead at 2.5m. Locally a thin layer of Glacial Till composed of Sand and Clay up to 1.2m, underlain by firm to very stiff Clay derived from the Mercia Mudstone Group, becoming very weak to weak Mudstone at around 6.0m

5.2.8 **Sheet 08** - Alluvium composed of clayey, very silty, Sand and silty Clay from approximately 1.5m to base of borehole at 11m of BH106. BH114 indicates Silty Sand recorded as Shirdley Hill Sand Formation until 3m after which Alluvium is recorded.

5.2.9 **Sheet 09** - BH060 Shirdley Hill Sand Formation up to 2m underlain by Glacial Till. After 3m the Sherwood Sandstone Group is present, at first as Clay and Sand. Then as Weak, thinly bedded (0 to 10 degrees), reddish brown, slightly micaceous, fine and medium grained Sandstone. At BH300 Tidal Flat Deposits are recorded to 2m under which is recorded rock of the Sherwood Sandstone Group, weathered to Sand up to 3m. BH326 records Sherwood Sandstone Group under the Topsoil, weathered to Sand until rockhead

5.2.10 **Sheet 10** – Tidal Flat Deposits composed of slightly sandy Silt and slightly clayey, silty, Sand to approximately 8.5m. This is underlain by Sandstone of the Wilmslow Sandstone Formation, recorded as moderately weak, very thinly bedded to thinly bedded and fine and medium grained. BH069 recorded 17m of Made Ground, composed of Pulverised Fuel Ash, recorded as fine Silt.

5.2.11 **Sheet 11** - One Trial Pit present which records Topsoil over Glacial Till up to 3.0m.

5.3 Mining and Mineral Extraction

Coal mining

5.3.1 The Coal Authority Interactive Map[8] and the Groundsure CON29M report (ref. GS-8910663)[9] reveal that the following portions of the Site are located within the Coal Authority Mining Reporting Area:

- St Helens Spurs;
- Clock Face Spur; and
- Clock Face HAGI and corridor section to the River Mersey (northwest of Higher Walton HAGI; and northern extent of the Warrington Spurs.

5.3.2 Numerous historical mine entries are recorded in St Helens Spurs, Clock Face Spur and Clock Face HAGI, particularly to the north of the Rainhill to Lea Green railway line. Numerous BritPits (dataset collectively identifying to mines, quarries, oil wells, gas wells, ash and desulphogypsum plants) relating to collieries, coal and coal-related products are recorded between St Helens Spurs and the River Mersey.

Brine extraction

5.3.3 The Cheshire Brine Subsidence Compensation Board (CBSCB) search ref. (GS-8910632) and the Groundsure EnviroGIS report[7] reveal that the following portions of the Site are in areas that may be at risk of brine subsidence:

- Warburton HAGI to Central Hub HAGI; and
- HSF HAGI and South Corridor section to Central Hub HAGI.

5.3.4 A total of 14 Prescribed Notices of Damage (PNOD)[10] were identified within the above areas of the Site. Six of these PNODs, with dates ranging from 26th March 1959 to 22nd March 2004 were accepted by the CBSCB. Eight PNODs with dates ranging from 12th April 1961 to 24th July 2018 were rejected. Two are located in the corridor section west of the HSF HAGI. A line of weakness is recorded to the west of the HSF HAGI.

5.3.5 There has been no commutation of claims in connection with properties on the Site.

5.3.6 The Site is either within, or within 90m of historical rock salt mine workings. The property is either within, or within 200m of an area that has been granted planning consent for brine pumping.

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[8] Coal Authority, Interactive Map Viewer, http://mapapps2.bgs.ac.uk/coalauthority/home.html, accessed July 2024

[9] Groundsure CON29M Official Coal Mining Search (ref. GS-8910663, dated 18 July 2022)

[10] A detailed explanation of what a PNOD is included in the CBSCB search report ref. GS-8910632.

5.3.7 Detailed investigation of brine subsidence is outside the scope of this report. However, in accordance with comments received as part of stakeholder engagement following issue of the EIA Scoping Report, a detailed Halite Risk Assessment has been prepared and is presented as **Appendix 12C** of **Chapter 12: Ground Conditions** of the Draft ES.

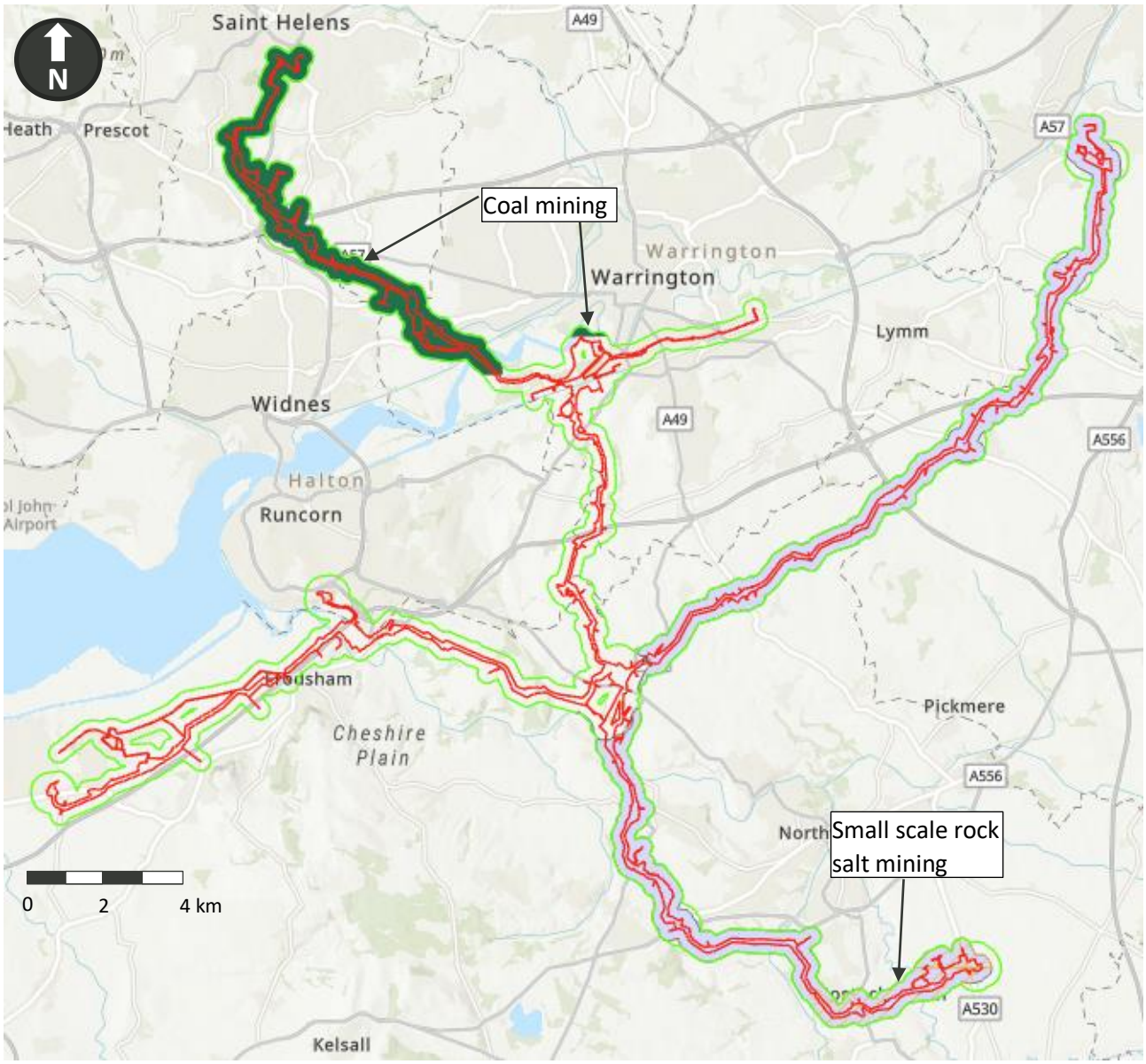
Other mining

Overview

5.3.8 The Groundsure EnviroGIS report[7] includes a comprehensive dataset for former mineral workings including brine areas, gypsum areas, underground workings, non-coal mining, tin mining, clay mining, historical mineral planning areas, and surface ground workings. The south-eastern half of the Site (see **Graphic 12A5.5**) is recorded as a brine area, and the HSF HAGI and South corridor section from the HSF HAGI to the Central Hub HAGI is recorded as being in a non-coal mining area. The Groundsure EnviroGIS report identifies numerous BritPits entries across the Site associated with clay, sand, shale, brine/salt and (in the north of the site) coal. **Graphic 12A5.5** indicates the location of coal mining areas, non-coal mining areas and brine areas across the Site. BritPit distribution is illustrated in **Graphic 12A5.6**.

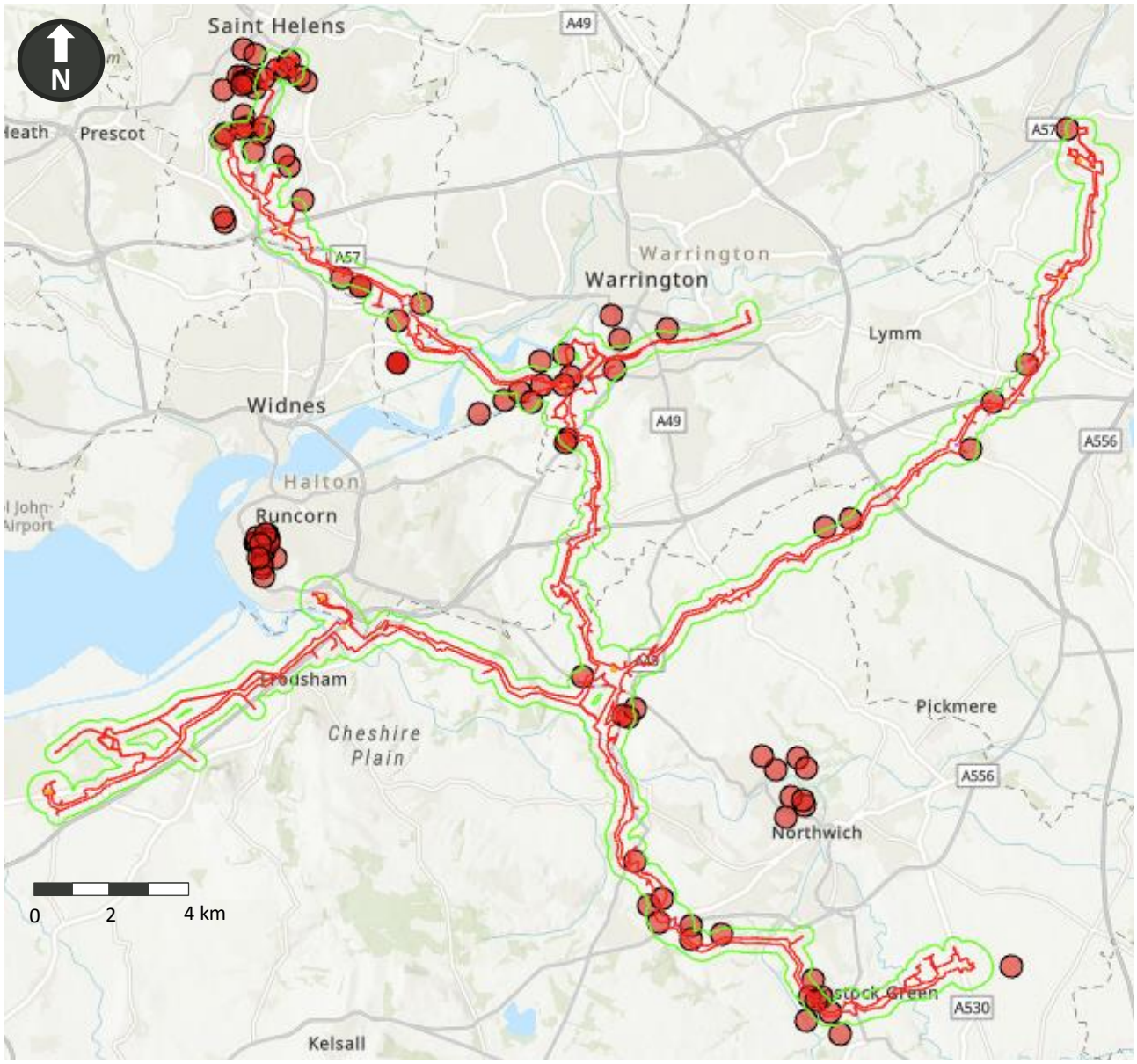
5.3.9 A detailed mineral risk assessment has been prepared as **Appendix 14A** of **Chapter 14** of the Draft ES.

Graphic 12A5.5 Mining areas[7]



- Draft Order Limits
- Study Area Extent
- Coal mining area
- Brine area
- Area in which small scale mining for rock salt may have occurred. Potential for localised difficult ground conditions should be considered.

Graphic 12A5.6 BritPits[7]



Draft Order Limits

Study Area Extent

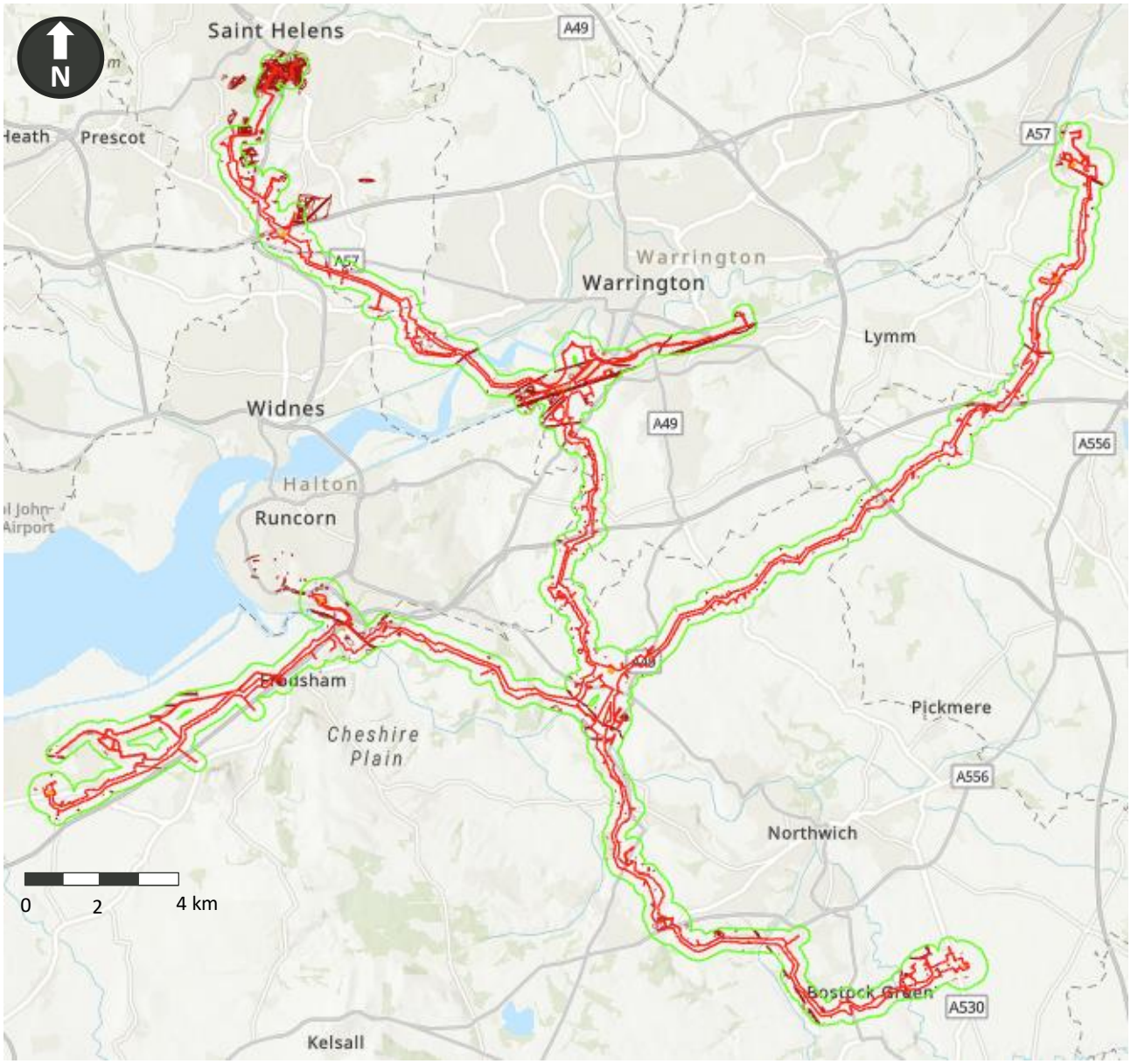
BritPit.

5.3.10 Where former mineral extraction areas (surface workings, underground workings and mineral extraction planning areas) are identified as polygons in the Groundsure data, the distribution of these locations are depicted in **Graphic 12A5.7** and **Graphic 12A5.8**.

- Surface and underground workings are predominantly concentrated in and around the St Helens Spurs in the form of coal mining features and Higher Walton HAGI (HWH2) in the form of railway cuttings and canals and the Runcorn and Rocksavage HAGIs (and adjoining spur) in the form of railway cuttings, canals and canal deposit tips and refuse heaps. Limited surface

workings are scattered across the rest of the Site in the form of railway cuttings, canals and clay/gravel/sand pits.

Graphic 12A5.7 Surface and underground workings[7]



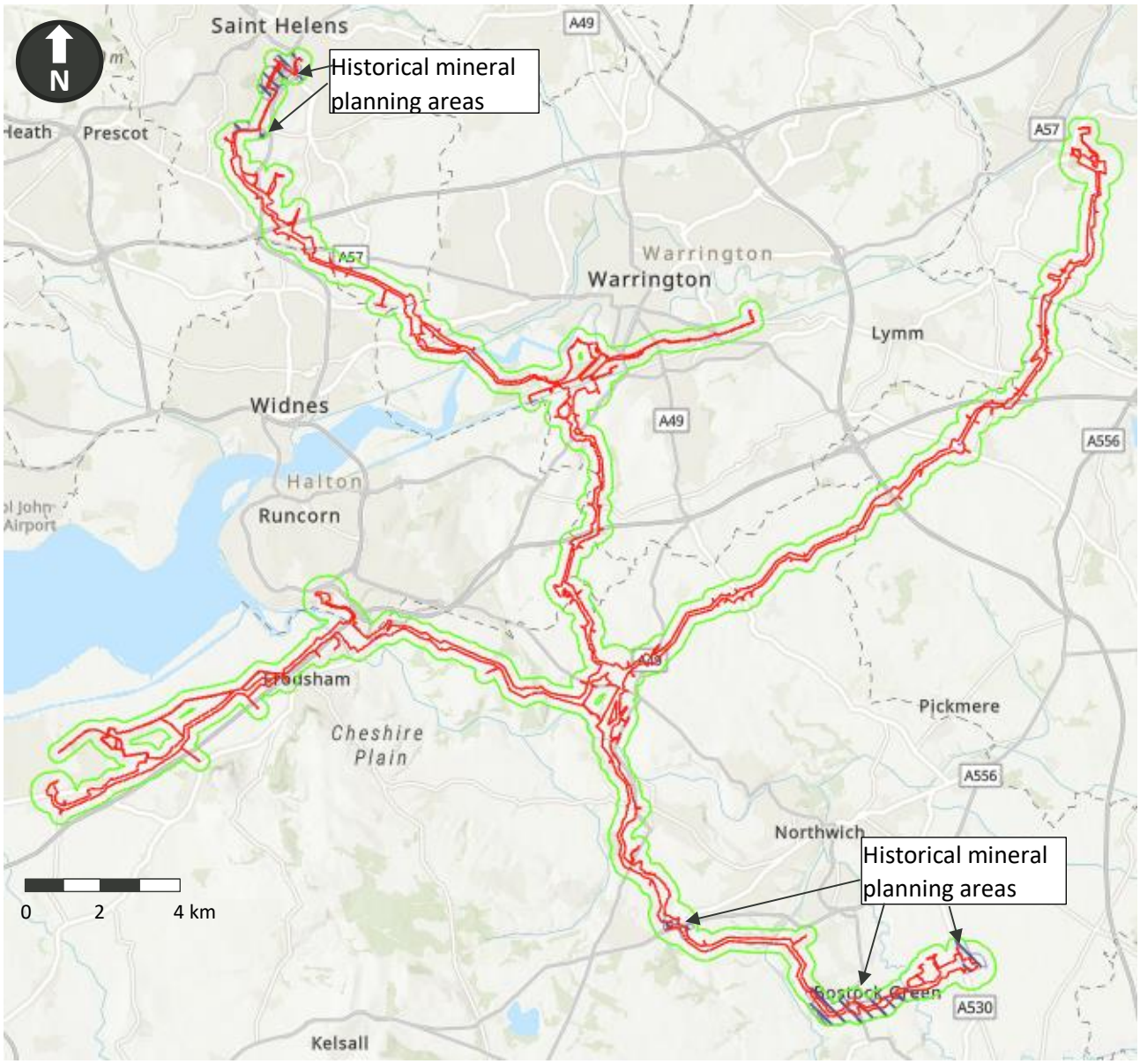
Draft Order Limits

Study Area Extent

Surface/underground workings

- Historical mineral planning areas are recorded in and around the north of St Helens Spurs, and in the HSF HAGI and the North and South Corridor sections to the Central Hub HAGI. These are further detailed in the mineral risk assessment presented as **Appendix 14A** of **Chapter 14** of the Draft ES.

Graphic 12A5.8 Historical mineral planning areas[7]



Draft Order Limits

Study Area Extent

Historical mineral planning areas

5.4 Land Stability

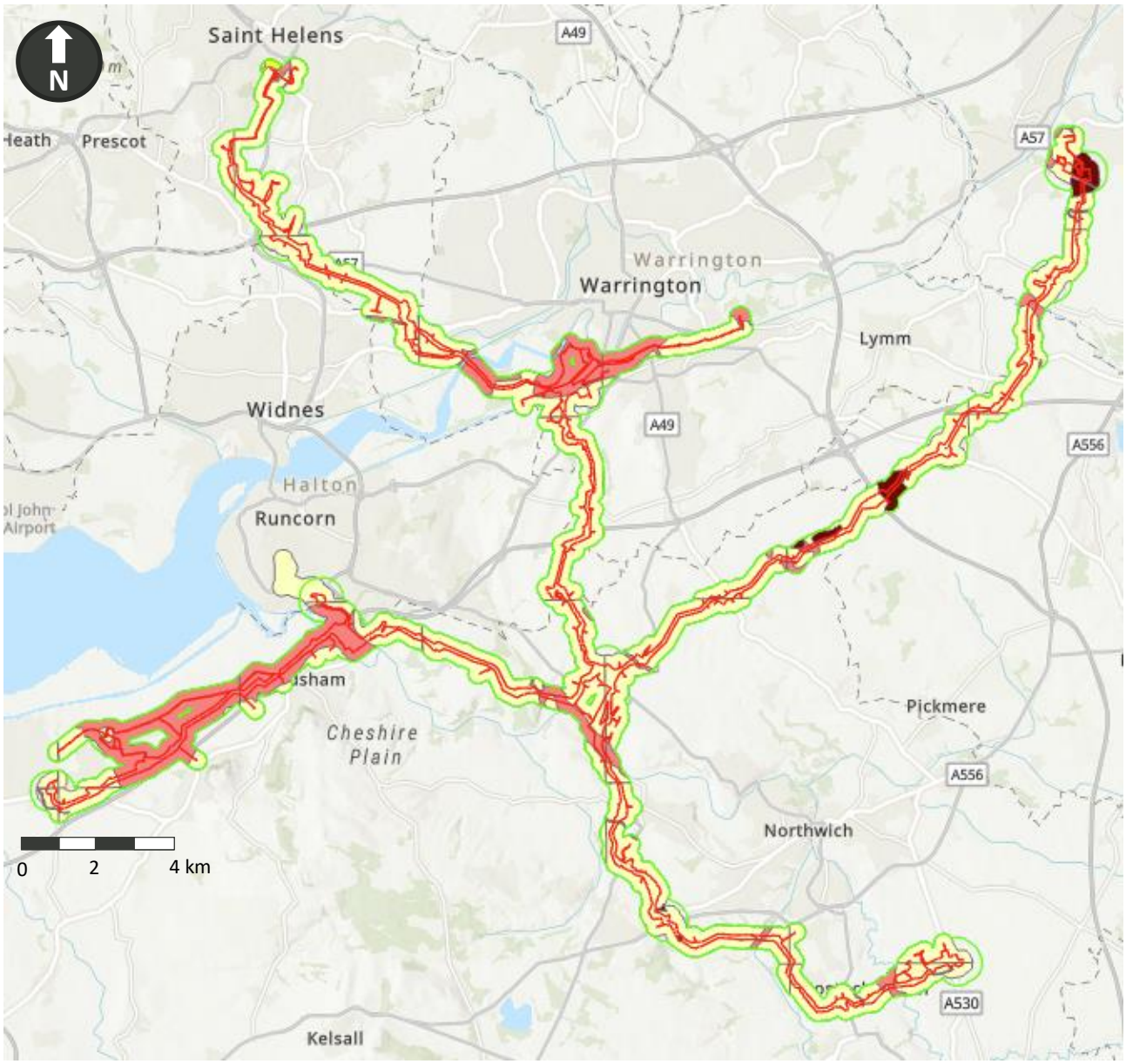
5.4.1 Information included in the Groundsure EnviroGIS report[7] indicates that there is generally a low risk of compressible ground, collapsible ground, ground dissolution, running sand, landslide stability hazards and shrink-swell hazards on the Site, with a few exceptions as described below. The Groundsure data records areas where compressible ground may be present; compressible ground conditions are recorded onsite at the following locations:

- St Helens Spurs;

- Higher Walton HAGI (HWH2) and Warrington Spurs and in the North Corridor section to the north;
- Rocksavage and Runcorn HAGIs (and adjoining spur) and in the West Corridor sections to the southeast and southwest;
- Central Hub HAGI;
- South Corridor section between the HSF HAGI and Central Hub HAGI; and
- Partington HAGI (PH1 and PH2) and in the North Corridor section to the south; and
- Warburton HAGI and in the North Corridor section to the south.

5.4.2 See pink and brown coloured areas on **Graphic 12A5**. Risks associated with land stability are considered in further detail in **Section 7**: **Geotechnical Review** and **Annex 12A5: Geotechnical Risk Register**.

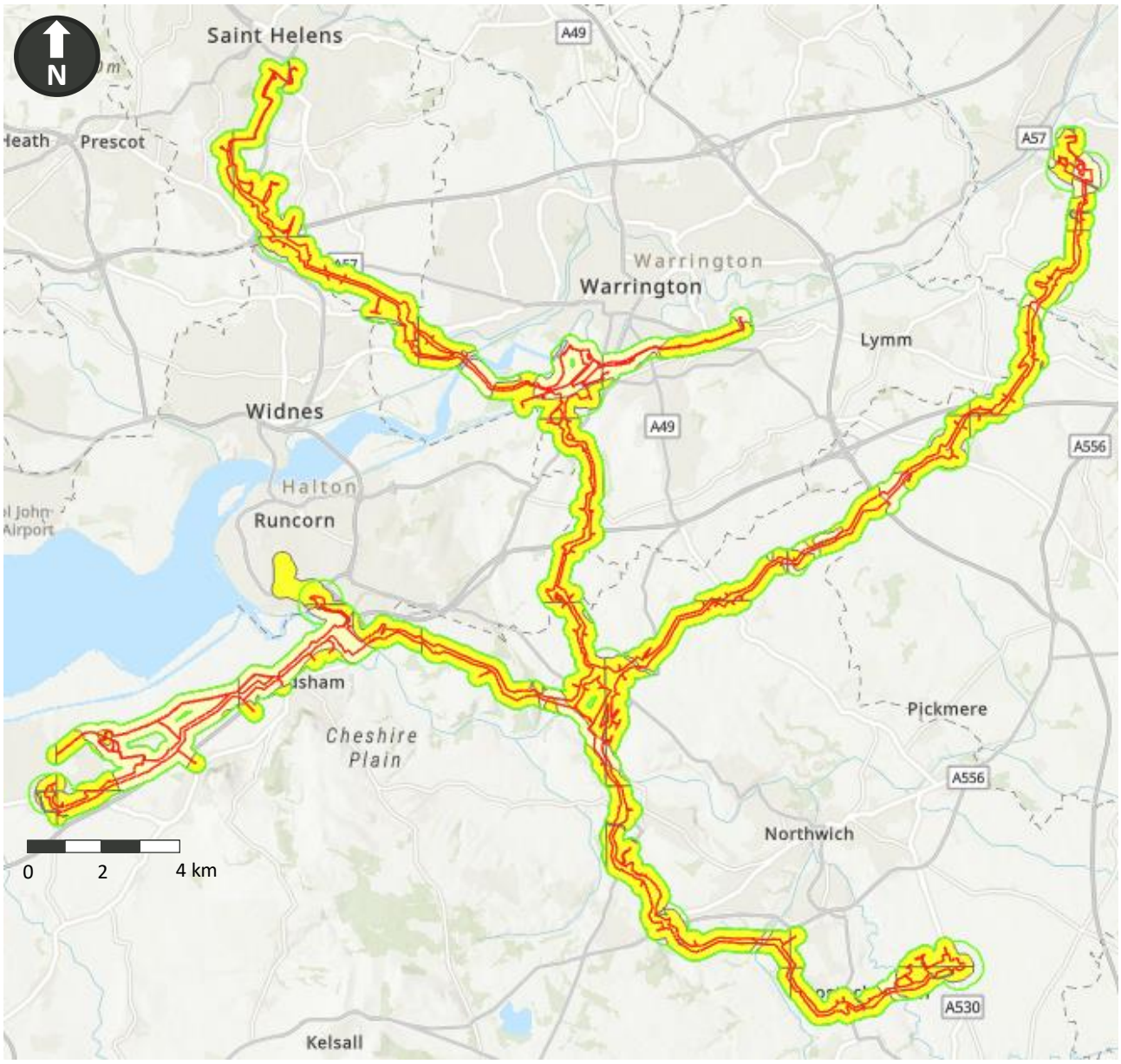
Graphic 12A5.9 Ground compressibility[7]



- Draft Order Limits
- Study Area Extent
- Compressible strata are not thought to occur.
- Compressibility and uneven settlement problems not likely to be significant on the site for most land uses.
- Compressibility and uneven settlement hazards are probably present. Land use should consider specifically the compressibility and variability of the site.
- Highly compressible strata present. Significant constraint on land use depending on thickness.

5.4.3 The Groundsure data records no likely collapsible deposits at the Site, however areas of low risk from collapsible ground are present across most of the Site. See yellow-coloured areas on **Graphic 12A5.10**. Risks associated with ground compressibility are considered in further detail in **Section 7**: **Geotechnical Review** and **Annex 12A5: Geotechnical Risk Register**.

Graphic 12A5.10 Ground collapsibility[7]

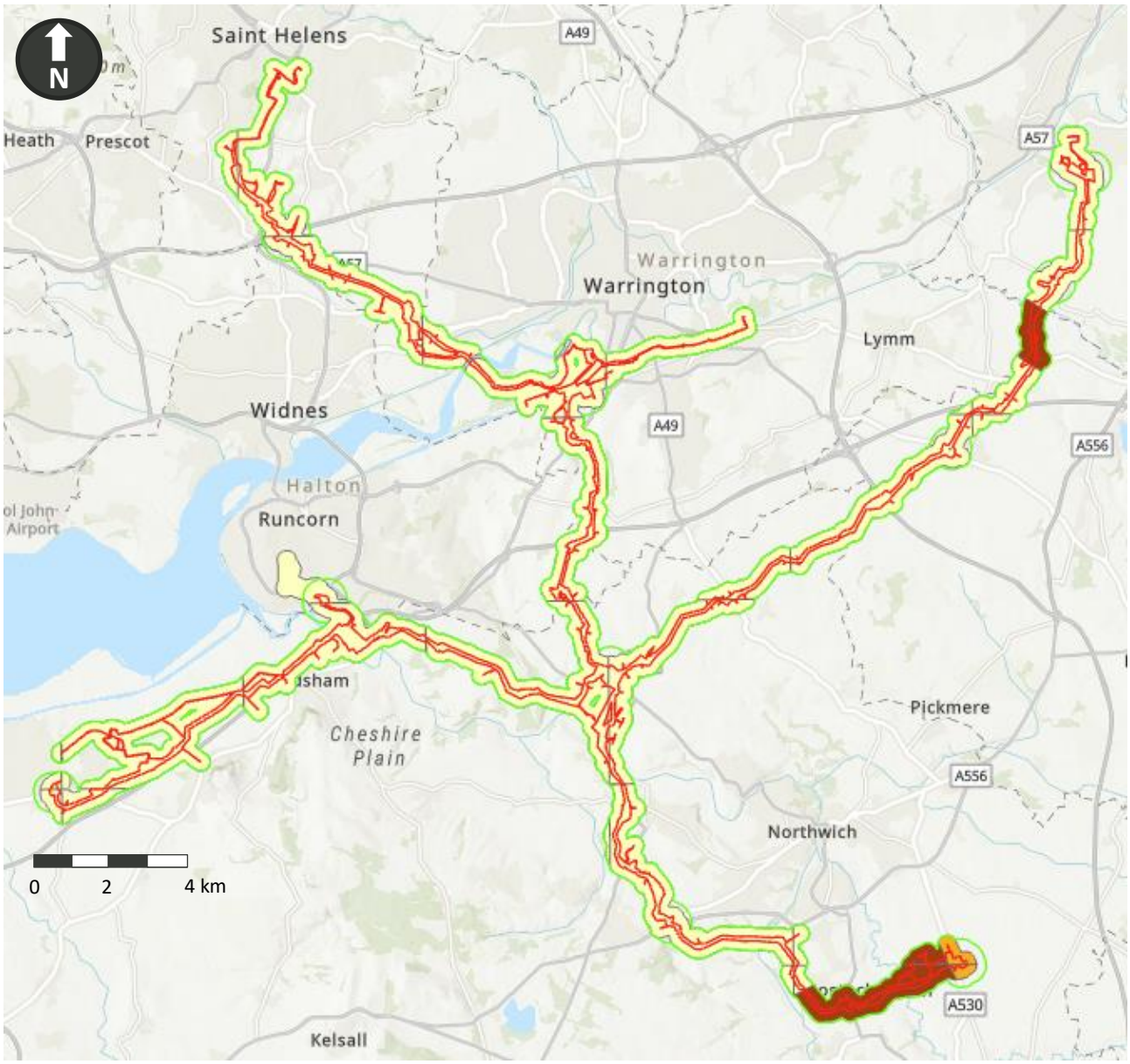


- Draft Order Limits
- Study Area Extent
- Deposits with potential to collapse when loaded and saturated are believed not to be present.
- Deposits with potential to collapse when loaded and saturated are unlikely to be present.

5.4.4 The Groundsure data records areas where ground dissolution hazards with potential for localised subsidence are likely to be present. This data shows that such hazards should be considered at the HSF HAGI and South Corridor section to the Central Hub HAGI and in the East Corridor section from Warburton HAGI to the Central Hub HAGI. See orange and brown coloured areas on

5.4.5 **Graphic** 12A5.11. Risks associated with ground dissolution are considered in further detail in **Section 7**: **Geotechnical Review** and **Annex 12A5: Geotechnical Risk Register**.

Graphic 12A5.11 Ground dissolution hazards[7]



Draft Order Limits

Study Area Extent

Soluble rocks are either not thought to be present within the ground, or not prone to dissolution. Dissolution features are unlikely to be present.

Soluble rocks are present within the ground. Some dissolution features may be present. Potential for difficult ground conditions are at a level where they may be considered, localised subsidence need not be considered except in exceptional circumstances.

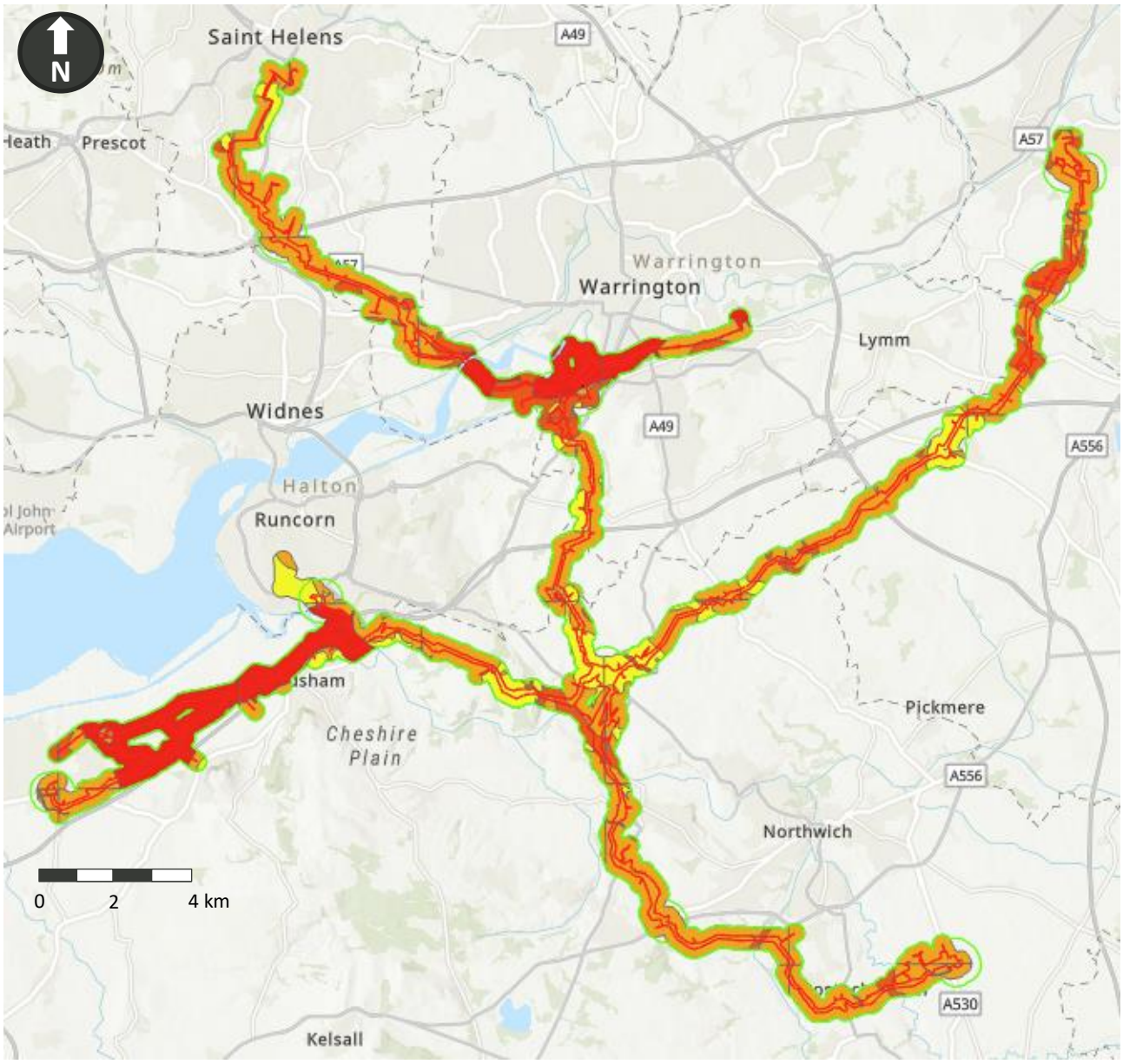
Soluble rocks are present within the ground. Numerous dissolution features may be present. Potential for difficult ground conditions should be investigated. Potential for localised subsidence is at a level where it should be considered.

5.4.6 The Groundsure data records areas where running sand hazards are likely to be present at the following locations:

- St Helens Spurs;
- Higher Walton HAGI (HWH2 and HWH8) and Warrington Spurs and in the North Corridor section to the north;
- Rocksavage and Runcorn HAGIs (and adjoining spur) and in the West Corridor sections to the southeast and southwest;
- Central Hub HAGI;
- South Corridor section between the HSF HAGI and Central Hub HAGI;
- Partington spur;
- South Corridor section to the south of Partington HAGI (PH1 and PH2); and
- Warburton HAGI and South Corridor section to the south.

5.4.7 See dark orange and red coloured areas on **Graphic 12A5.12**. Risks associated with running sand are considered in further detail in **Section 7**: **Geotechnical Review** and **Annex 12A5: Geotechnical Risk Register**.

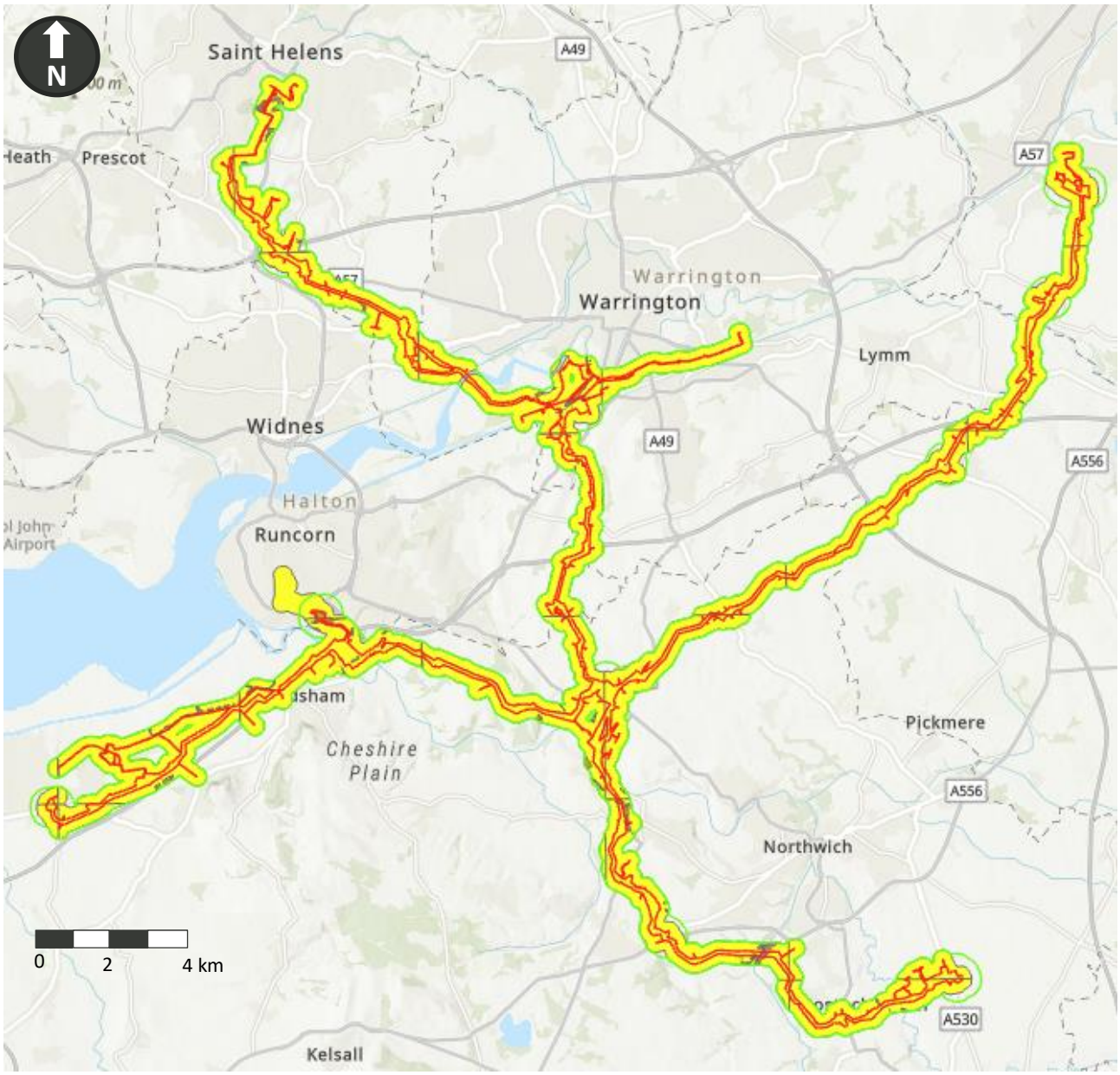
Graphic 12A5.12 Running sand hazards[7]



- Draft Order Limits
- Study Area Extent
- Running sand conditions are not thought to occur whatever the position of the water table. No identified constraints on land use due to running conditions.
- Running sand conditions are unlikely. No identified constraints on land use due to running conditions unless water table rises rapidly.
- Running sand conditions may be present. Constraints may apply to land use involving excavation or the addition or removal of water.
- Running sand conditions are probably present. Constraints may apply to land use involving excavation or the addition or removal of water.

5.4.8 The Groundsure data predominantly records areas of low risk from landslides ground are present across most of the Site, however limited areas of elevated risk are present in several locations. The pipeline may intersect with these areas of elevated risk at the St Helens spurs and are likely to cross these areas of elevated risk at the River Mersey northwest of Higher Walton HAGI, in Weaverham and at the River Weaver in the South corridor, and at the Runcorn spur. See orange and pink coloured areas on **Graphic 12A5.13**. Risks associated with landslide hazards are considered in further detail in **Section 7**: **Geotechnical Review** and **Annex 12A5: Geotechnical Risk Register**.

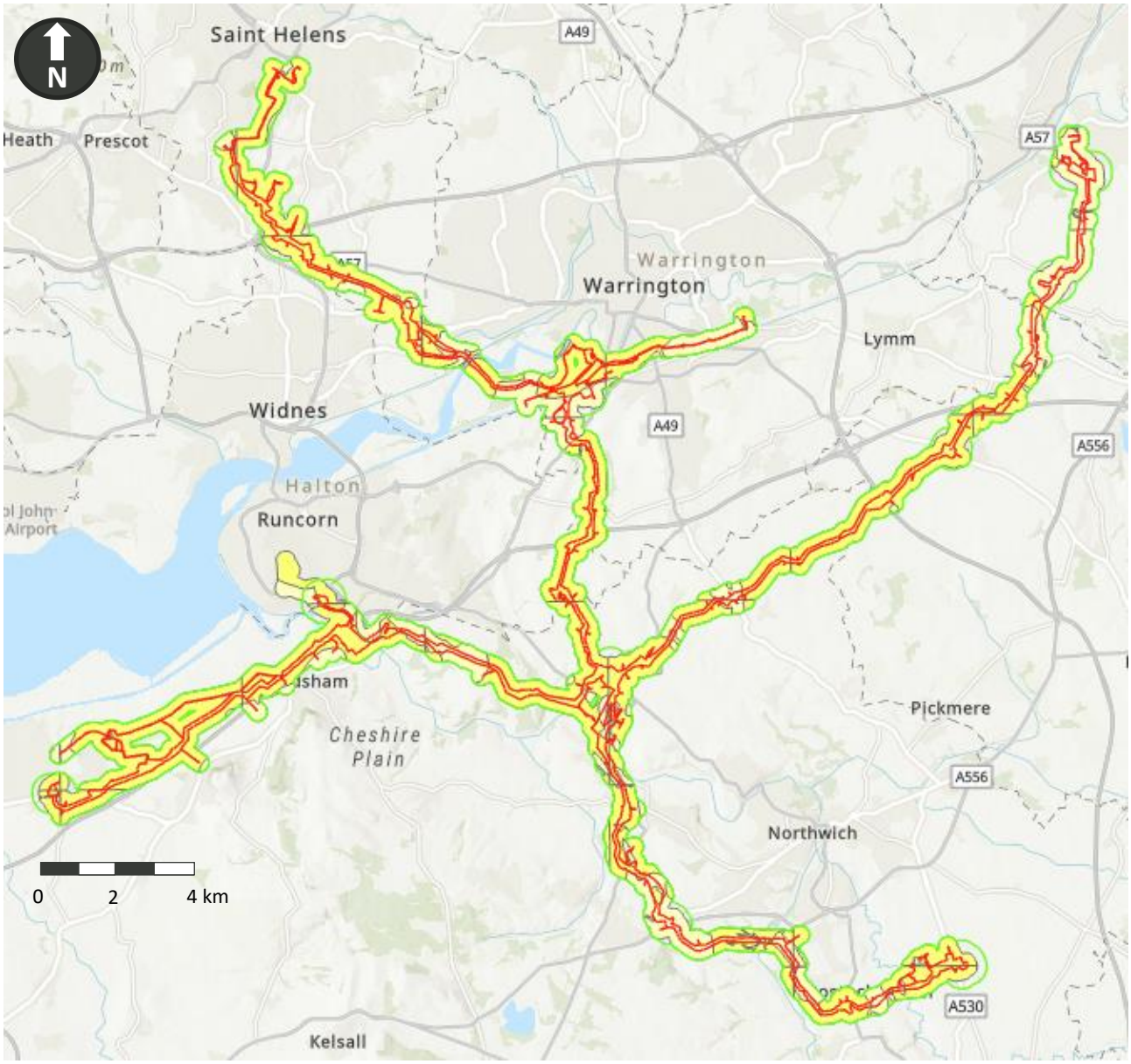
Graphic 12A5.13 Landslide hazards[7]



- Draft Order Limits
- Study Area Extent
- Slope instability problems are not likely to occur but consideration to potential problems of adjacent areas impacting on the site should always be considered.
- Slope instability problems may be present or anticipated. Site investigation should consider specifically the slope stability of the site.
- Slope instability problems are probably present or have occurred in the past. Land use should consider specifically the stability of the site.

5.4.9 The Groundsure data records no high plasticity deposits at the Site, however areas of low plasticity are present across most of the site. See yellow-coloured areas on **Graphic 12A5.14**. Risks associated with ground plasticity are considered in further detail in **Section 7**: **Geotechnical Review** and **Annex 12A5: Geotechnical Risk Register**.

Graphic 12A5.14 Ground plasticity[7]



Draft Order Limits

Study Area Extent

Ground conditions predominantly non-plastic.

Ground conditions predominantly low plasticity.

5.5 Radon

5.5.1 The Public Health England Indicative Atlas of Radon in England and Wales (Miles et al., 2007) interactive map[11] indicates that across most of the Site less than 1% of homes are affected by radon levels above the action level. Some areas in the south and central areas of the Site are classed as having between 1% and 3% of homes above the action level, including St Helens spurs, Clock Face HAGI and Clock Face spur, Higher Walton HAGI (HWH2 and HWH8) and Warrington spurs and Rocksavage and Runcorn HAGIs (and adjoining spur), as well as the intervening sections of the West Corridor.

5.5.2 Given that the Project comprises a gas pipeline and associated above-ground infrastructure with no residential development, the risks associated with radon concentrations are considered to be low and, therefore, protective measures are not considered necessary.

5.6 Hydrogeology

Superficial aquifers onsite

- Alluvium, Glaciofluvial Deposits, Shirdley Hill Sand Formation, River Terrace Deposits – Secondary A aquifers (permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers); and
- Glacial Till, Tidal Flat Deposits – Secondary (undifferentiated) Aquifer (generally lower permeability aquifers where it is not possible to apply either a Secondary A or Secondary B definition due to the variable characteristics of the rock type).

5.6.1 The distribution of superficial aquifers across the site is illustrated in **Graphic 12A5.15** and the locations of each geological unit is detailed in **Table 12A5.1**.

Bedrock aquifers onsite

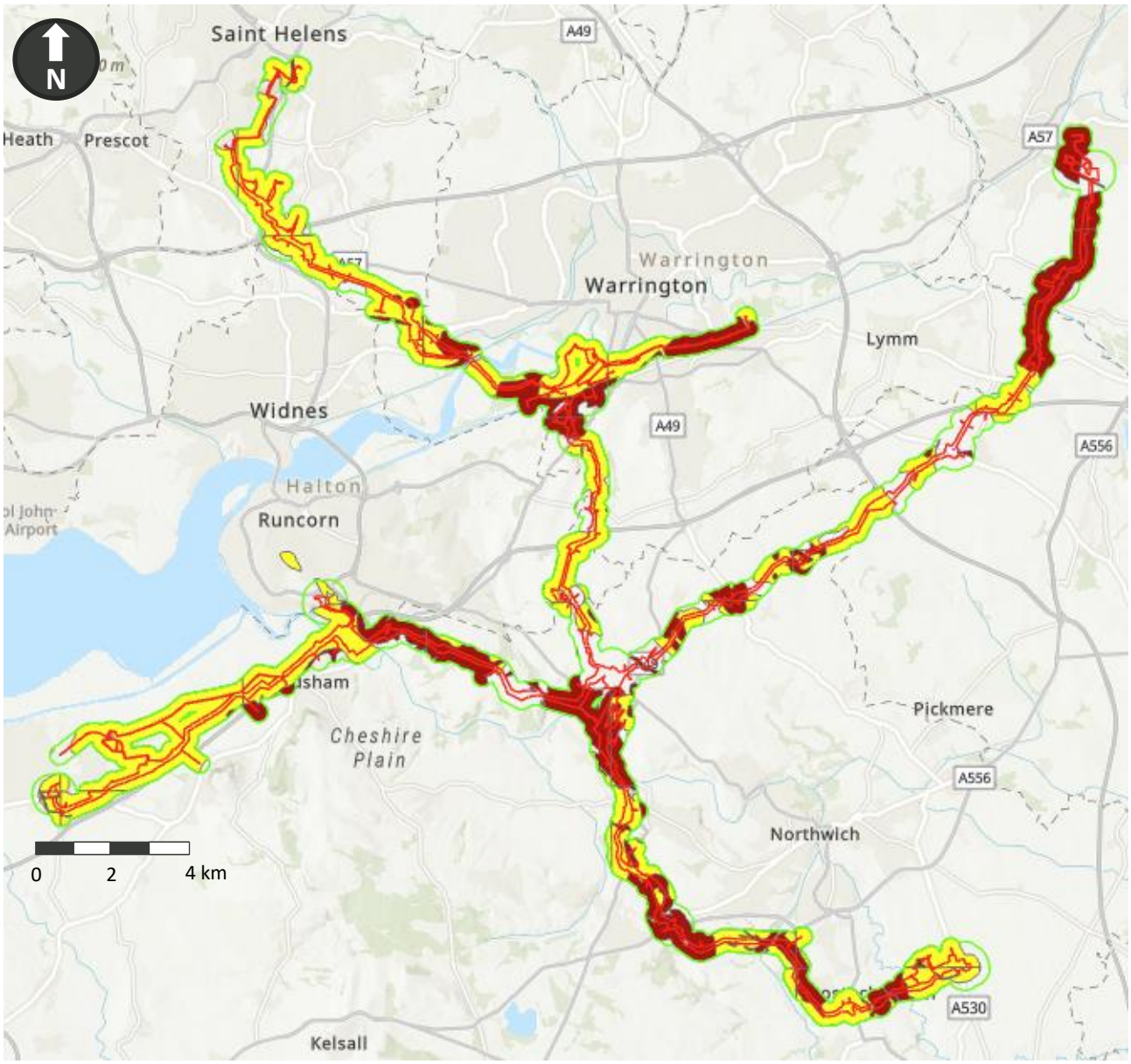
- Chester Formation - Principal aquifer (rock layers or superficial deposits of high intergranular and/or fracture permeability, usually providing a high level of water storage and may support water supply/river base flow on a strategic scale);
- Kinnerton Formation – Principal aquifer;
- Tarporley Siltstone Formation – Secondary B aquifer (rock layers or superficial deposits of lower permeability that may store and yield limited amounts of groundwater through localised features such as fissures, thin permeable horizons and weathering);

[11] Public Health England and British Geological Survey, Indicative Atlas of Radon in England and Wales, Interactive Map, https://www.ukradon.org/information/ukmaps, accessed July 2024

- Bollin Mudstone Member – Secondary B aquifer;
- Northwich Halite Member – Unproductive Strata (rock layers or superficial deposits of low permeability that have negligible significance for water supply or river base flow); and
- Sidmouth Mudstone Formation - Secondary B aquifer.

5.6.2 The distribution of bedrock aquifers across the site is illustrated in **Graphic 12A5.16,** and the locations of each geological unit is detailed in **Table 12A5.2**.

Graphic 12A5.15 Superficial aquifers[7]



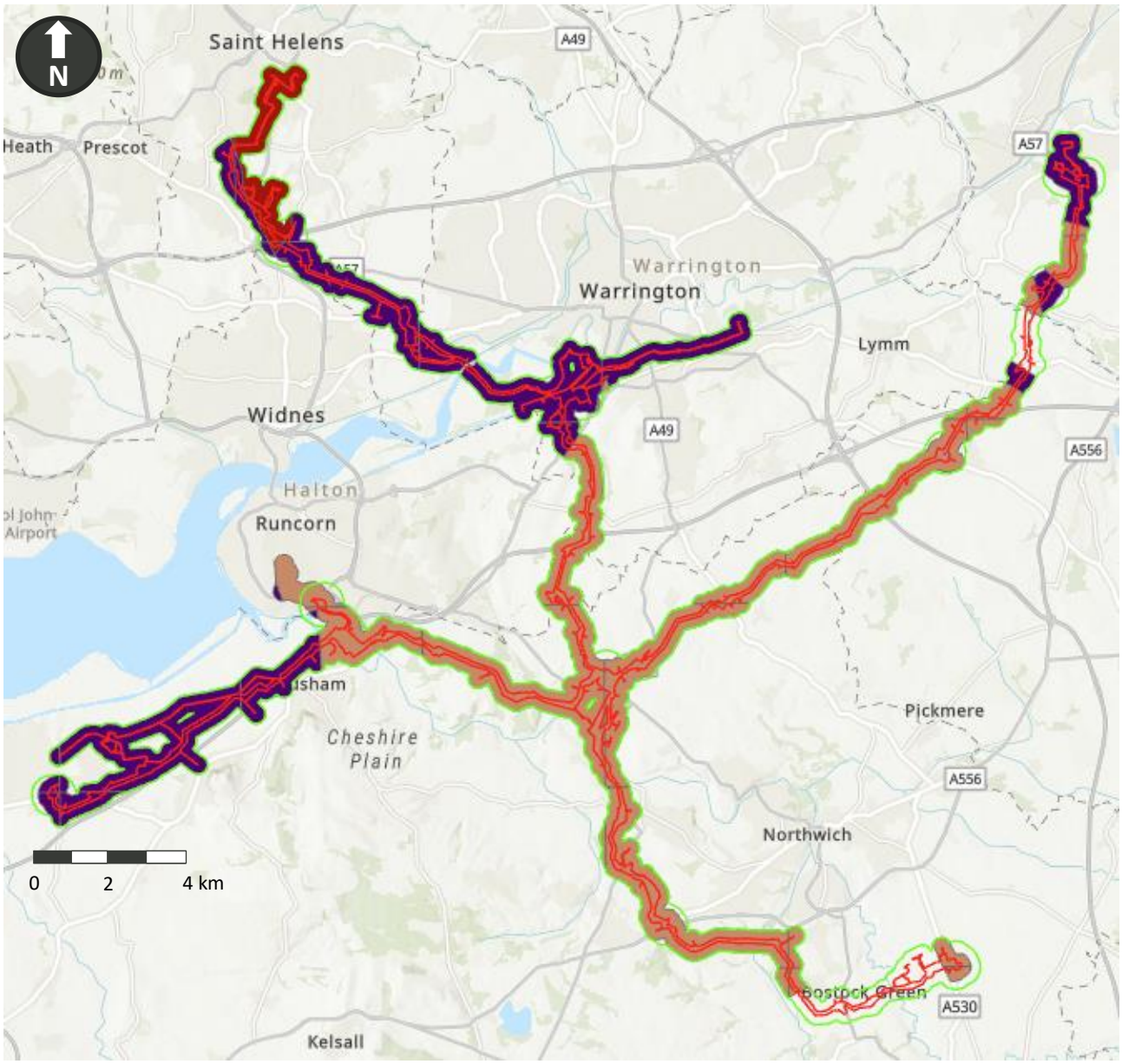
Draft Order Limits

Study Area Extent

Secondary A Aquifer

Secondary (undifferentiated) Aquifer

Graphic 12A5.16 Bedrock aquifers and Unproductive Strata[7]



- Draft Order Limits
- Study Area Extent
- Principal Aquifer
- Secondary A Aquifer
- Secondary B Aquifer
- Unproductive Strata

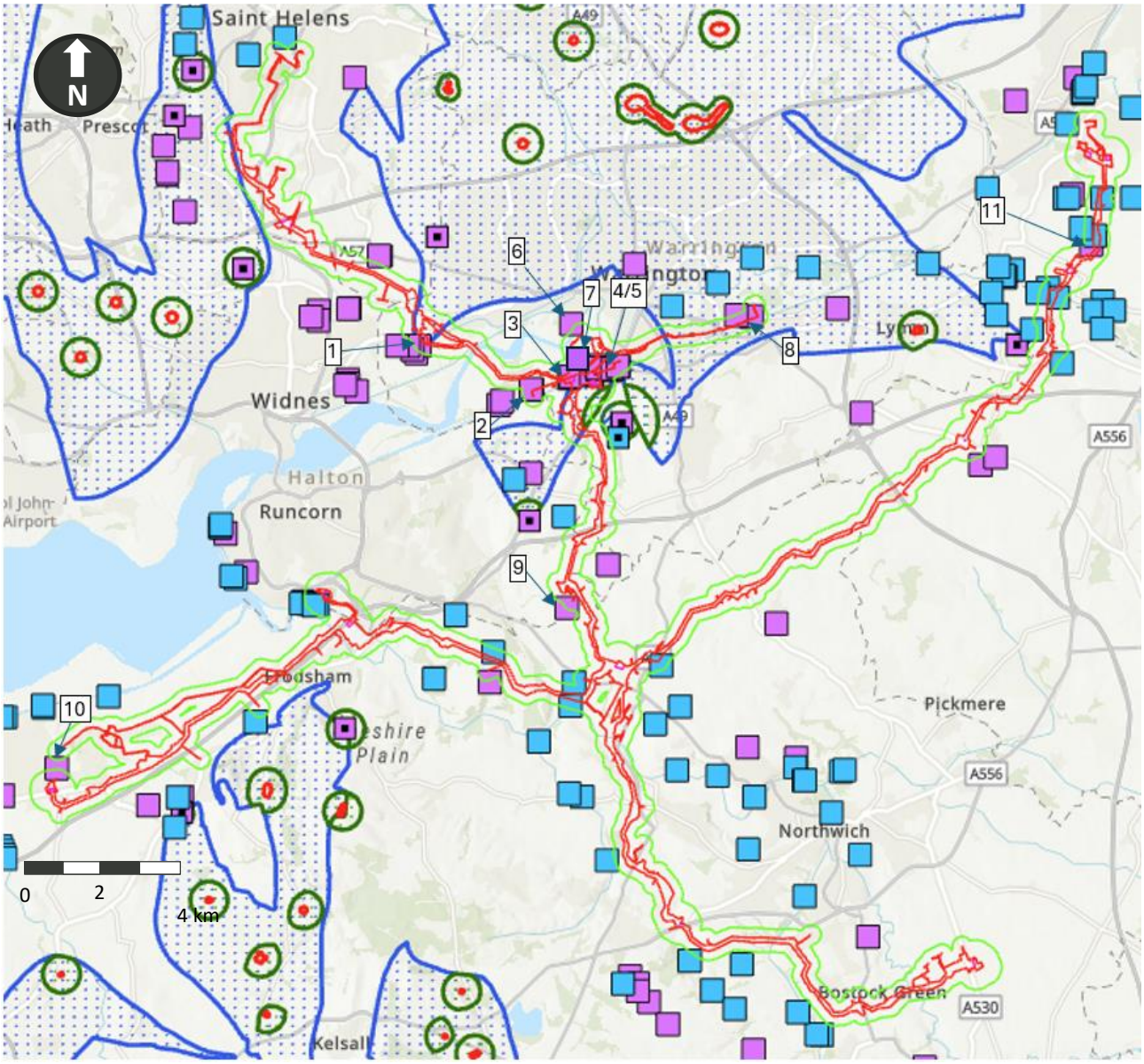
Groundwater source protection zones

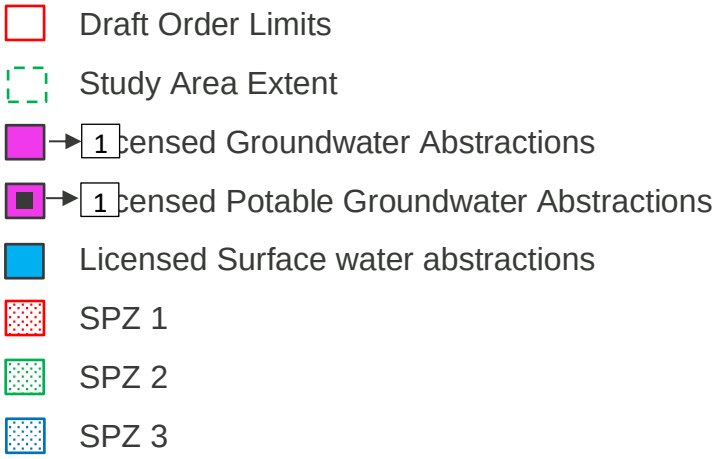
5.6.3 The Groundsure EnviroGIS report[7] reveals that several parts of the Study Area lie within a Groundwater Source Protection Zone (SPZ):

- A portion of the North Corridor section from the Higher Walton HAGI to the Central Hub HAGI is located within a SPZ2 (Outer Protection Area);
- The North Corridor section between St Helens Spurs and Clock Face HAGI lies partly within a SPZ 3 (Total Catchment);
- The North Corridor section between Clock Face HAGI and Higher Walton HAGI passes through a SPZ3; and
- The Higher Walton HAGI (HWH8), the Warrington Spurs and the North Corridor section from Higher Walton HAGI to the Central Hub HAGI are partly located in several linked SPZ3s.

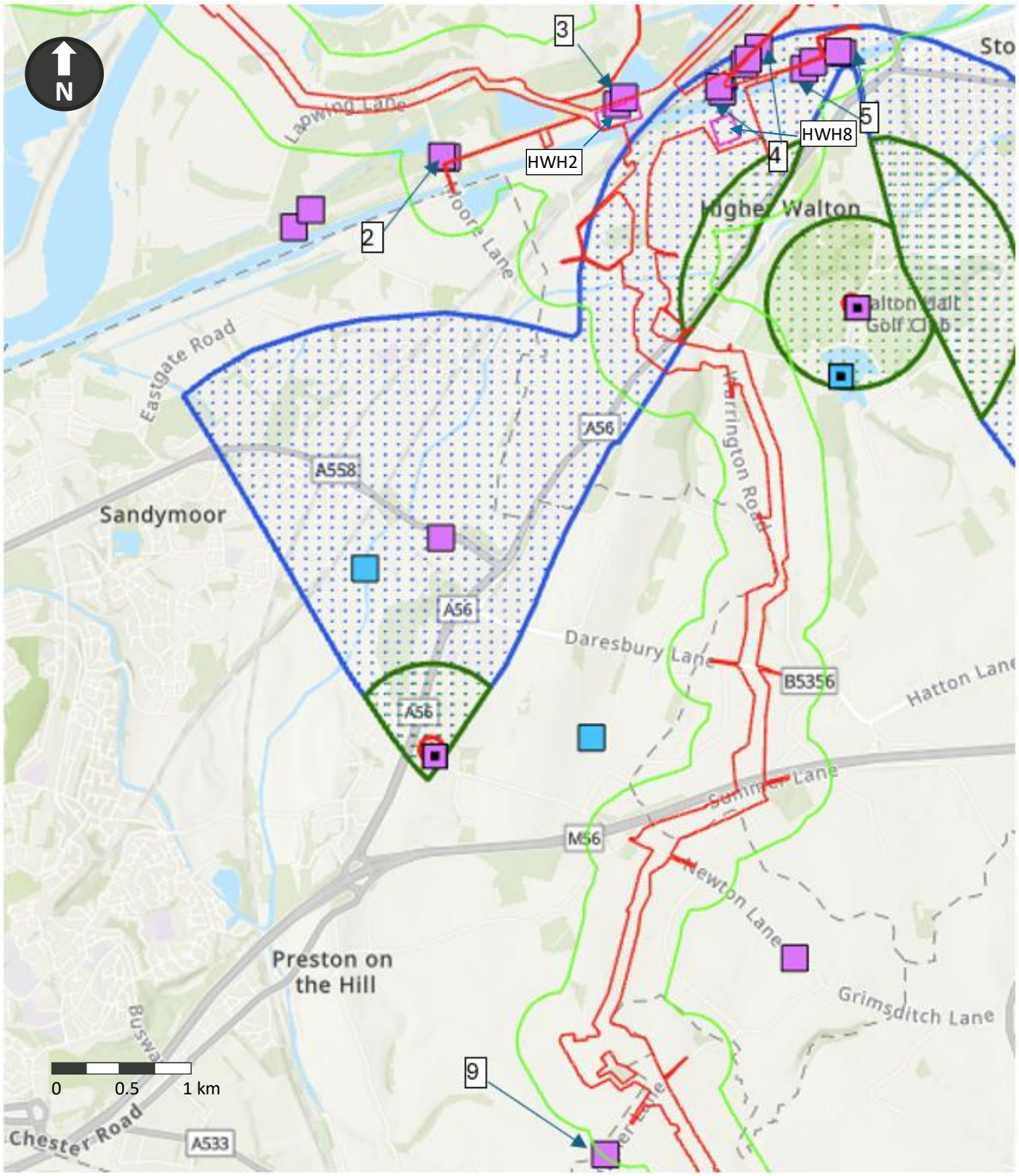
5.6.4 The locations of SPZs in the vicinity of the site are illustrated in **Graphic 12A5.17** and **Graphic 12A5.18**.

Graphic 12A5.17 Source Protection Zones[7]




Draft Order Limits
Study Area Extent
1 censed Groundwater Abstractions
1 censed Potable Groundwater Abstractions
Licensed Surface water abstractions
SPZ 1
SPZ 2
SPZ 3

Graphic 12A5.18 Source Protection Zones: Higher Walton HAGI and North Corridor section to Central Hub HAGI[7]



Draft Order Limits

Study Area Extent

HAGI

1 Licensed Groundwater Abstractions

1 Licensed Potable Groundwater Abstractions

SPZ 1

SPZ 2

SPZ 3

Groundwater abstraction

5.6.5 The Groundsure Enviro GIS report[7] records the presence of historical and active licensed groundwater abstractions within the Study Area across the Site. **Table 12A5.3** provides a summary of broadly grouped groundwater abstractions across the Site (comprising of all Groundsure abstraction records available for labelled clusters of locations) as presented in **Graphic 12A5.17** and **Graphic 12A5.18**. Further details relating to groundwater abstractions are presented in **Chapter 7: Water Environment** of the Draft ES.

Table 12A5.3 Summary of Licensed Groundwater Abstractions on Site

No.	Total abstractions represented	Total active abstractions	Potable / non-potable	Purpose of active abstractions	Potable Annual Volume (Litres)
1	6	0	Non-Potable	Historical	N/A
2	14	3	Non-potable	Non-Evaporative Cooling, Effluent/slurry dilution, Evaporative Cooling	N/A
3	9	0	Non-potable	Historical	N/A
4	15	4	Non-potable	Non-evaporative cooling, effluent/slurry dilution, evaporative cooling, pollution remediation	N/A
5	5	3	Non-potable	Non-evaporative cooling, effluent/slurry dilution, evaporative cooling	N/A
6	3	1	Non-potable	Process water	N/A
7	5	4	Non-potable	Effluent/slurry dilution, evaporative cooling, pollution remediation	N/A

No.	Total abstractions represented	Total active abstractions	Potable / non-potable	Purpose of active abstractions	Potable Annual Volume (Litres)
8	11	0	Potable	Historical	N/A
9	2	0	Potable	Historical	N/A
10	8	6	Potable / non-potable	Drinking, cooking, sanitary, washing (small garden) – commercial/industrial/public services, boiler feed, general cooling (high loss), general use relating to secondary category (medium loss), general cooling (low loss), process water.	955,636
11	3	1	Non-potable	General use relating to secondary category (medium loss)	N/A

N/A = Not applicable

5.6.6 It is noted that the only active potable groundwater abstraction identified in the vicinity of the Project is located immediately north of the Study Area at the HPP HAGI (in Stanlow Oil Refinery). Given that the groundwater abstraction is located in an area of potentially significant soil and groundwater contamination and the proposed pipeline is located to the south of the proposed HAGI (670m south of the abstraction), the proposed pipeline is not anticipated to have the potential to create a preferential pathway between the potable abstraction and potential contaminants.

5.6.7 A request was made to all local authorities in the Study Area for information they hold relating to unlicensed private water supplies (PWS). Cheshire West and Chester Council (CWAC) and Salford City Council (SCC) noted that they do not hold data relating to private water supply (PWS). Cheshire East Council (CEC) supplied a list of PWS and locations, but all PWS were found to be outside of the Study Area. Trafford Council and Warrington Borough Council (WBC) did not provide PWS information. Halton Borough Council (HBC), Knowsley Council and St Helens Councils did not respond to the data request.

5.6.8 Given the non-potable nature of the groundwater abstractions present in the Study Area and the nature of the Project (which is expected to involve excavations within a narrow corridor and may be required to be lined with impermeable lining or backfilled with impermeable materials in areas where significant potentially mobile contamination is identified by intrusive ground investigation), the Project is not

considered to introduce a significant risk to groundwater abstractions at the Site. As such, groundwater abstractions are not considered further in this report.

5.7 Climate Change

Future Climate Change under RCP8.5 Scenario

Sea Level Rise / Flood Risk

5.7.1 Most of the topography of the landscape within the Site is relatively flat lying. It is incised by shallow river valleys associated with the River Weaver, which flows in a north-easterly direction from Northwich to the Mersey Estuary, and the Mersey Estuary and River Mersey, which bisects the North Corridor. Overall, the topography falls very gently towards the River Mersey. The highest elevations are within the Higher Walton HAGI to Central Hub HAGI corridor section (to a maximum of approximately 78 mAOD in the vicinity of the M56) and Sworton Heath BVI to Central Hub HAGI East Corridor section (to a maximum of approximately 85 mAOD in the vicinity of the A559 road). The lowest elevations are adjacent to the Mersey Estuary (approximately 2 mAOD at the proposed access routes northeast of the HPP HAGI and at the intersection between the Clock Face HAGI to Higher Walton HAGI North Corridor section and the River Mersey).

5.7.2 Under RCP 8.5[12] sea level at the coastline in the vicinity of the Mersey Estuary is expected to rise by 0.7m by the year 2100. The Climate Central Coastal Risk Screening Tool[13] indicates that land approximately 25m to 30m to the north and south of the River Mersey and Manchester Ship Canal will be impacted by rising sea levels. No other area of the site is expected to be impacted by rising sea levels under RCP8.5.

Groundwater Recharge

5.7.3 The Site is located within four different groundwater bodies, as follows:

- Sankey and Glaze Carboniferous Aquifers (St Helens Spurs);
- Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers (Clock Face HAGI, Higher Walton Hagi and adjoining corridor section, Warrington Spurs);
- Wirral and West Cheshire Permo-Triassic Sandstone Aquifers (HPP HAGI, Rocksavage HAGI and adjoining corridor, Runcorn HAGI and Runcorn Spur); and

[12] RCP 8.5 is a potential future pathway which is slow to transfer to a low-carbon energy provision. It is considered a possible, but conservative, emission scenario suitable for evaluating the climate resilience of infrastructure projects.
[13] https://coastal.climatecentral.org/map (Accessed July 2024)

- Weaver and Dane Quaternary Sand and Gravel Aquifers (all other key areas of the Site).

5.7.4 **Table 12A5.4** summarises the eFLAG project far-future (2050-2079) projections for groundwater recharge[14] within these catchments.

Table 12A5.4 Summary of eFLAG project far-future (2050-2079) projections for groundwater recharge

Aquifer	Changes in groundwater recharge rate (mm/day)			
	Spring	Summer	Autumn	Winter
Sankey and Glaze Carboniferous Aquifers	<0.05 mm increase / decrease	0.05 mm to 0.1 mm decrease	0.05 mm to 0.1 mm decrease	0.2 mm to 0.3 mm increase
Lower Mersey Basin and North Merseyside Permo-Triassic Sandstone Aquifers	<0.05 mm increase / decrease	<0.05 mm increase / decrease	0.05 mm to 0.1 mm decrease	0.1 mm to 0.2 mm increase
Wirral and West Cheshire Permo-Triassic Sandstone Aquifers	<0.05 mm increase / decrease	<0.05 mm increase / decrease	0.05 mm to 0.1 mm decrease	0.1 mm to 0.2 mm increase
Weaver and Dane Quaternary Sand and Gravel Aquifers	<0.05 mm increase / decrease	0.05 mm to 0.1 mm decrease	0.05 mm to 0.1 mm decrease	0.1 mm to 0.2 mm increase

5.7.5 As indicated in **Table 12A5.4**, the maximum decrease in groundwater recharge is expected to be up to 0.1 mm per day across the site in Autumn. The maximum increase in groundwater recharge rate is expected to be 0.2mm per day in Winter across the majority of the site, with a maximum increase of 0.3mm per day in the Sankey and Glaze Carboniferous Aquifers (St Helens Spurs).

Groundwater Level

5.7.6 No data relating to projected groundwater level change due to climate change is available for the four groundwater bodies within which the Site is located.

[14] Enhanced Future Flows and Groundwater (eFLaG) Portal (ceh.ac.uk) (Accessed July 2024)

5.8 Hydrology

Introduction

5.8.1 The following section summarises the hydrology of the Site. Further information on hydrology is included as part of **Chapter 7: Water environment** of the Draft ES.

Surface water features

5.8.2 The surface water bodies classified under Cycle 2 of the Water Framework Directive (WFD) classification scheme in the Study Area are summarised below along with the latest Environment Agency monitoring results:

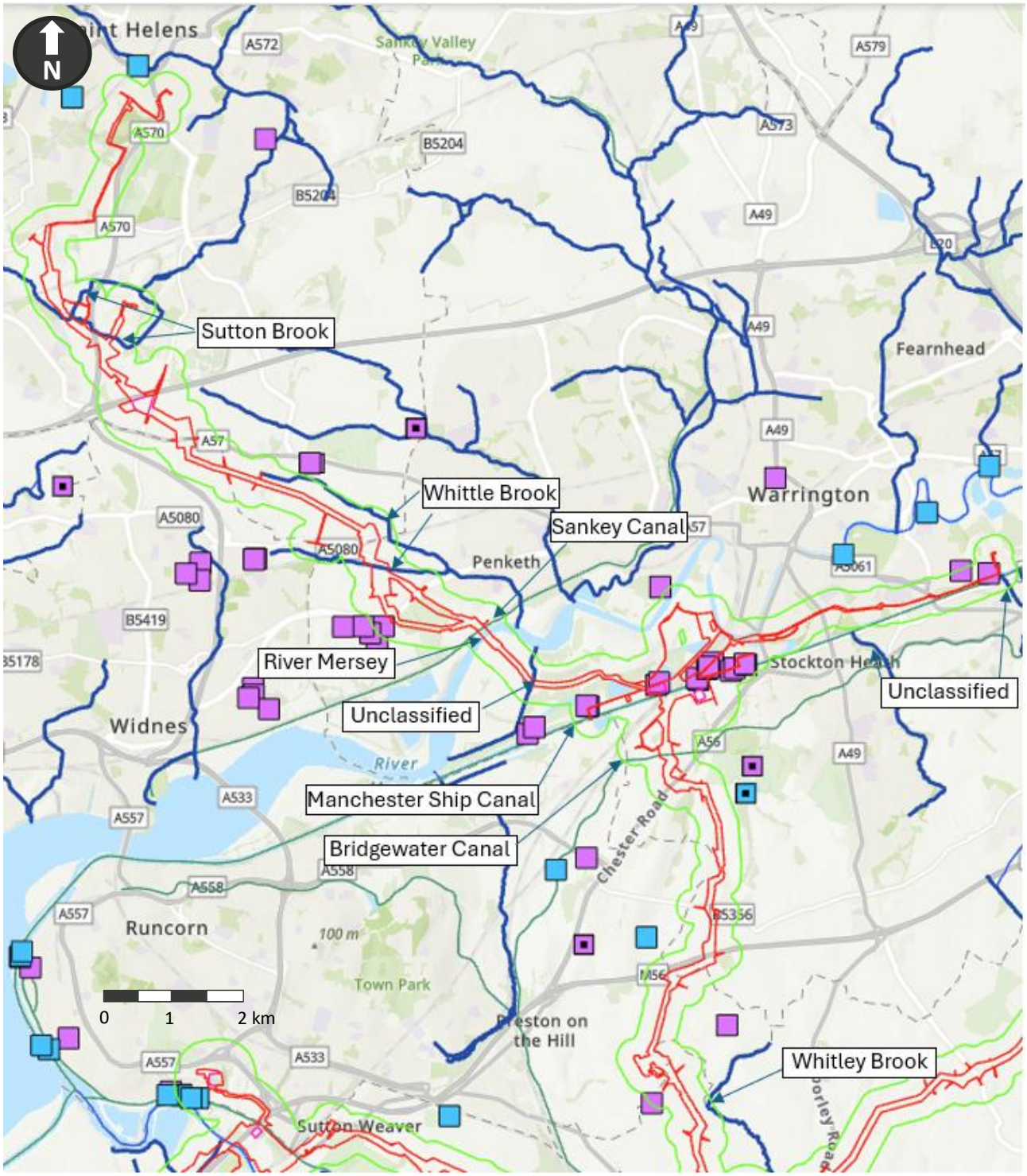
- St Helens Spurs to Central Hub HAGI (see **Graphic 12A5.19**):
  - Sutton Brook, classified as moderate ecological status and failing chemical status as of 2019;
  - Whittle Brook (Mersey Estuary), classified as moderate ecological status and failing chemical status as of 2019;
  - The River Mersey, classified as moderate ecological status and failing chemical status as of 2019;
  - Sankey Canal, classified as moderate ecological status and failing chemical status as of 2019;
  - Manchester Ship Canal, classified as moderate ecological status and failing chemical status as of 2019;
  - Bridgewater Canal, classified as moderate ecological status and failing chemical status as of 2019; and
  - Whitley Brook (not classified under the WFD framework).
- HPP HAGI to Central Hub HAGI (see **Graphic 12A5.20**);
  - Peckmill Brook, classified as moderate ecological status and failing chemical status as of 2019;
  - The River Weaver (Dane to Frodsham), classified as moderate ecological status and failing chemical status as of 2019;
  - Weaver Navigation (canal section Frodsham to Weston Point Docks).
- HSF HAGI to Central Hub HAGI (see **Graphic 12A5.21**);
  - Puddinglake Brook, classified as poor ecological status and failing chemical status as of 2019;
  - The River Dane (Wheelock to Weaver), classified as moderate ecological status and failing chemical status as of 2019;
  - The River Weaver (Marbury Brook to Dane), classified as poor ecological status and failing chemical status as of 2019;
  - The River Weaver (Dane to Frodsham); and

  - Trent and Mersey Canal (summit to Preston Brook), classified as classified as moderate ecological status and failing chemical status as of 2019.
- Partington HAGI to Central Hub HAGI (see **Graphic 12A5.22**);
  - Sinderland Brook, classified as poor ecological status and failing chemical status as of 2019;
  - Caldwell Brook (not classified under the WFD classification scheme);
  - River Bollin (Ashley Mill to Manchester Ship Canal), classified as moderate ecological status and failing chemical status as of 2019;
  - Gale Brook, classified as moderate ecological status and failing chemical status as of 2019;
  - Arley Brook, classified as moderate ecological status and failing chemical status as of 2019; and
  - Bridgewater Canal, as above.
- Central Hub HAGI (see **Graphic 12A5.23**):
  - The River Weaver (Dane to Frodsham) as above;
  - Trent and Mersey Canal (summit to Preston Brook), as above; and
  - Whiteley Brook (as above).

5.8.3 There are also numerous streams, drains and ponds crossing the Site along the corridors which are not classified under the WFD classification scheme and as such are not considered further.

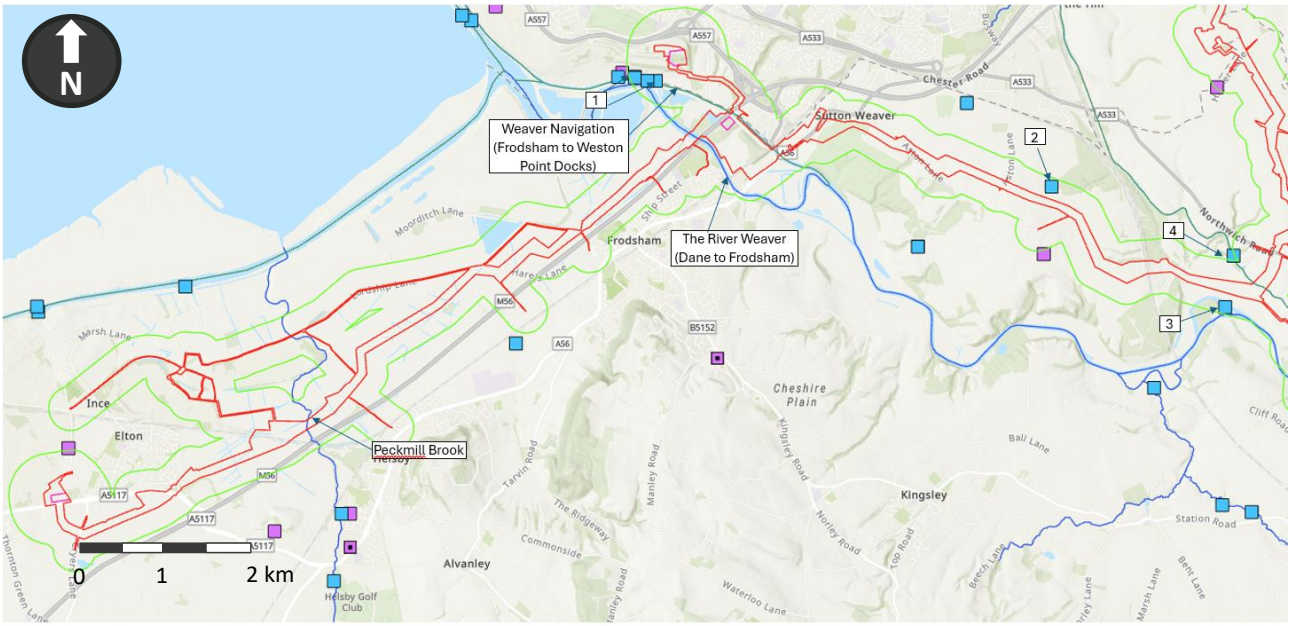
5.8.4 The locations of WFD classified water bodies across the site are illustrated in **Graphic 12A5.19** to **Graphic 12A5.23.**

Graphic 12A5.19 Site Hydrology: St Helens Spurs to Central Hub HAGI[7]



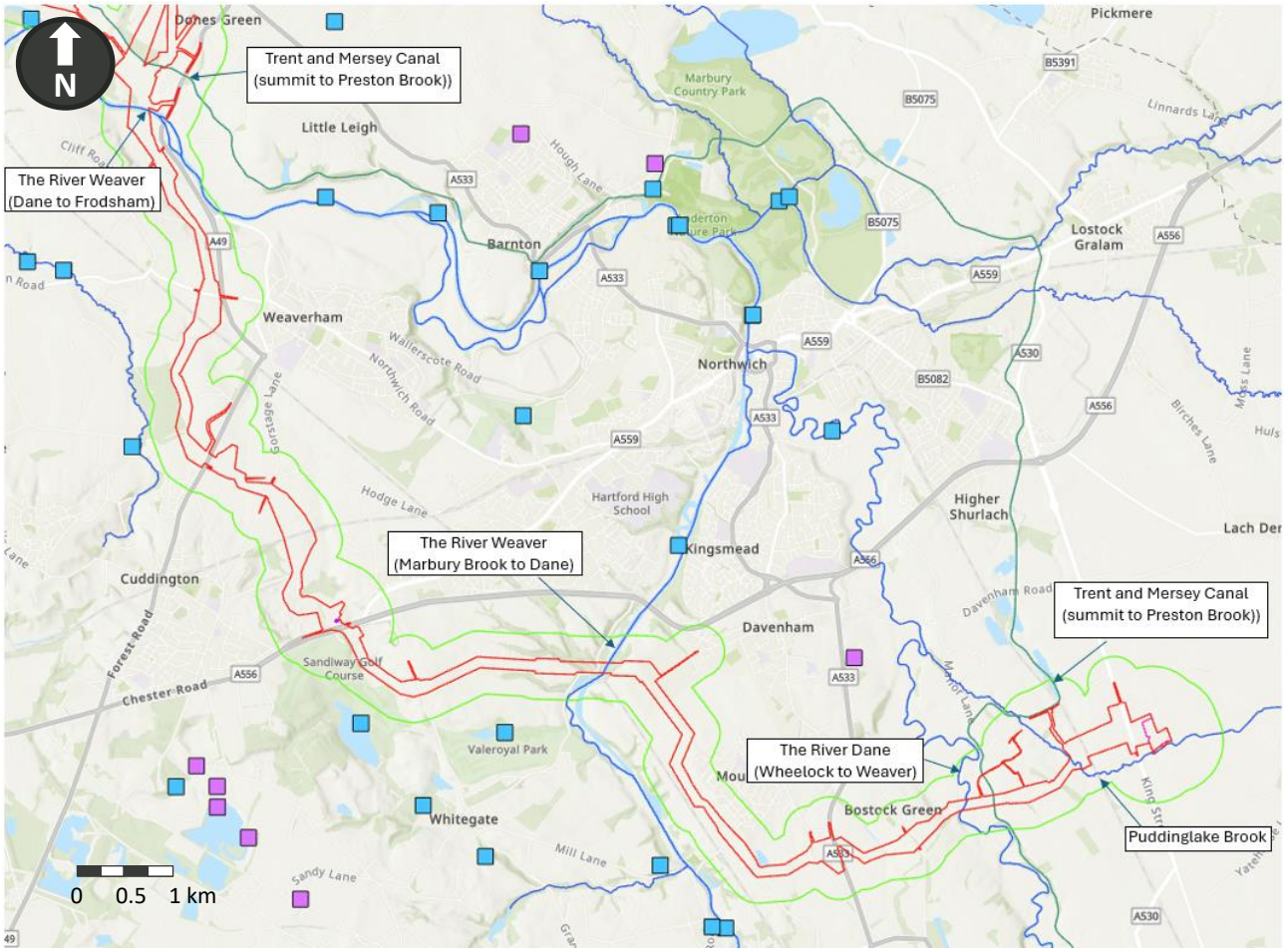
- Draft Order Limits
- Study Area Extent
- HAGI
- 1 Licenced Surface Water Abstractions
- 1 Licensed Potable Surface Water Abstractions

Graphic 12A5.20 Site Hydrology: HPP HAGI to Central Hub HAGI[7]



- Draft Order Limits
- Study Area Extent
- HAGI
- 1 Licensed Surface Water Abstractions
- 1 Licensed Potable Surface Water Abstractions

Graphic 12A5.21 Site Hydrology: HSF HAGI to Central Hub HAGI[7]



Draft Order Limits

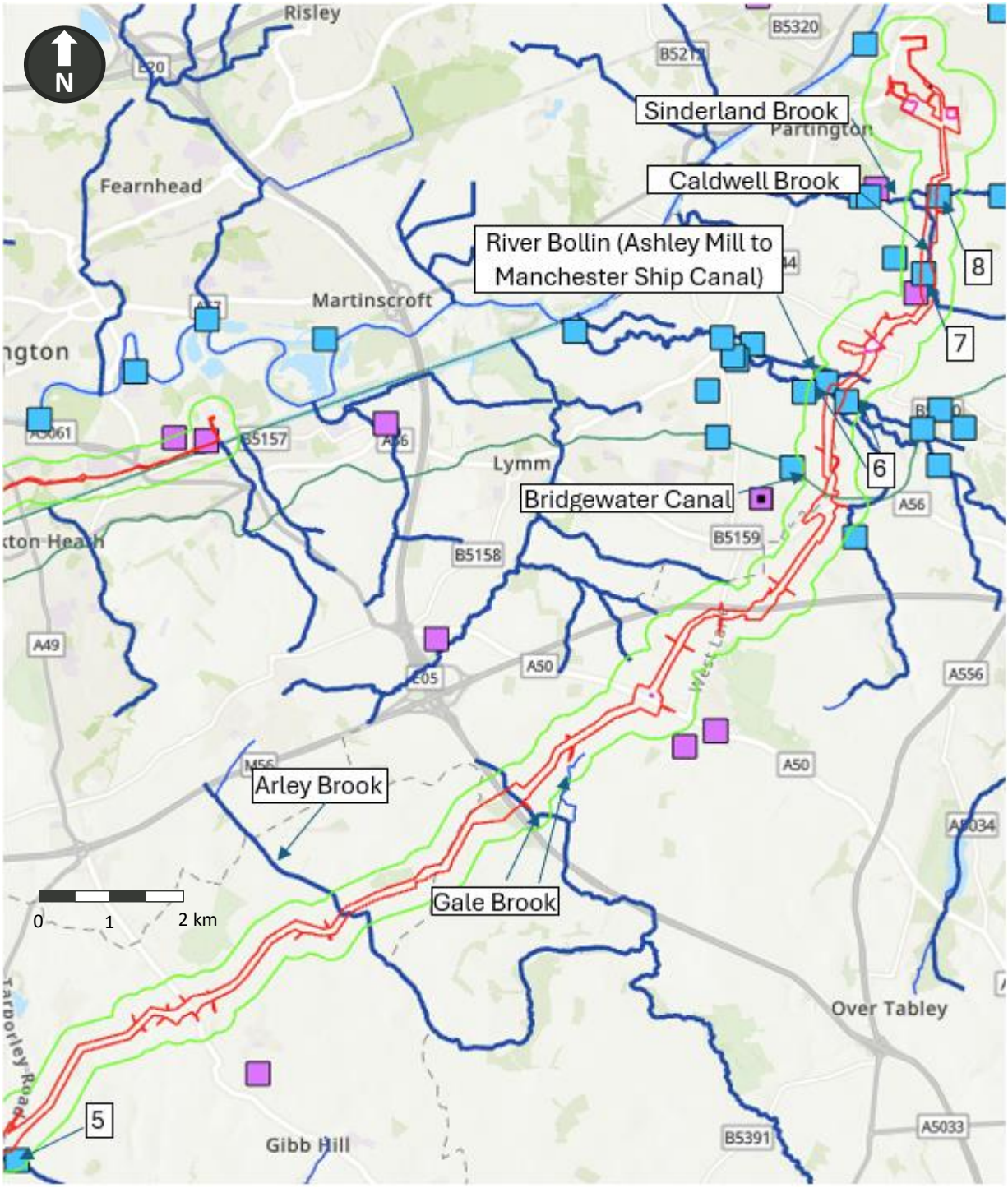
Study Area Extent

HAGI

1 Licensed Surface Water Abstractions

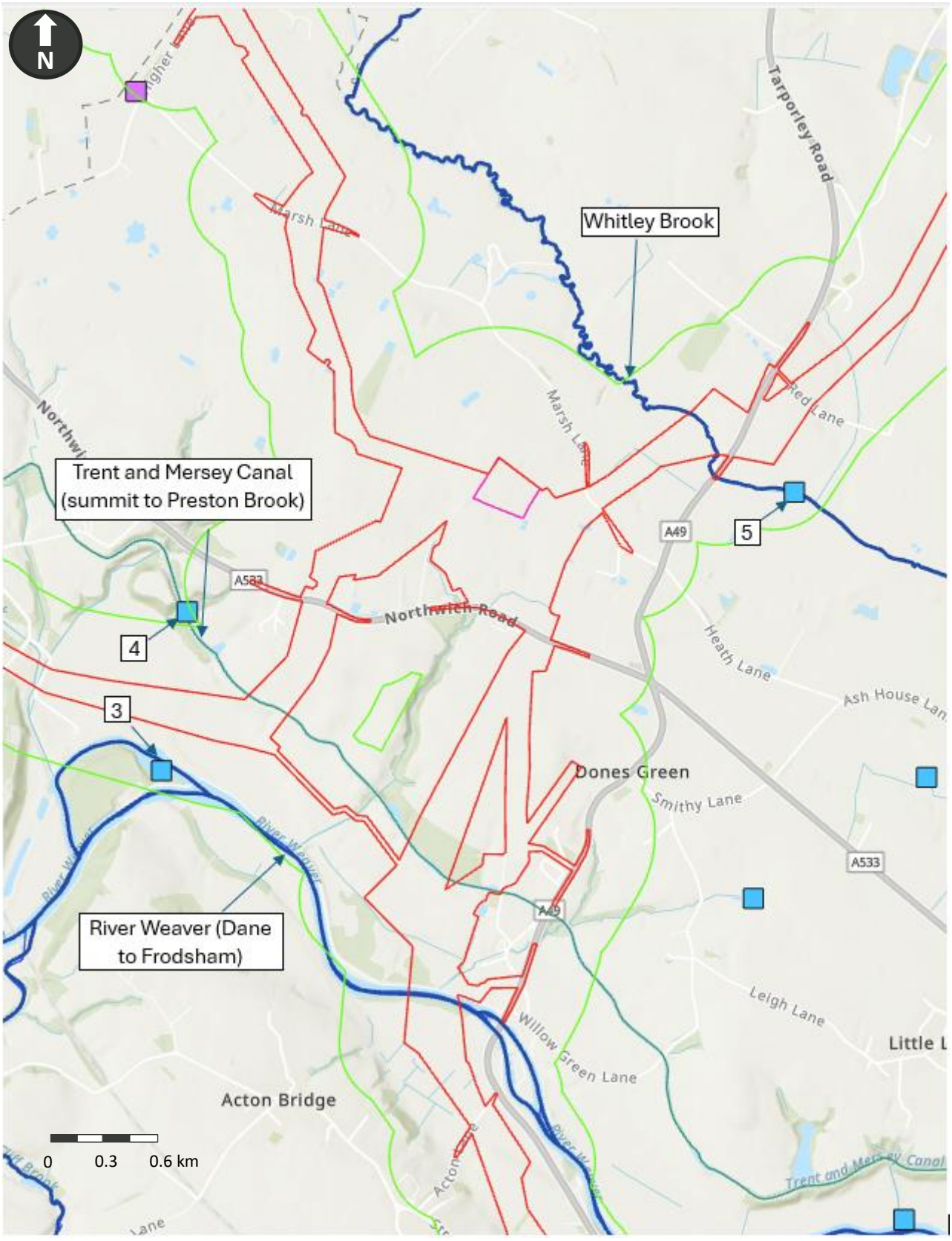
1 Licensed Potable Surface Water Abstractions

Graphic 12A5.22 Site Hydrology: Partington HAGI to Central Hub HAGI[7]



- Draft Order Limits
- Study Area Extent
- HAGI
- 1 Licensed Surface Water Abstractions
- 1 Licensed Potable Surface Water Abstractions

Graphic 12A5.23 Site Hydrology: Central Hub HAGI[7]



Draft Order Limits

Study Area Extent

HAGI

1 Licensed Surface Water Abstractions

1 Licensed Potable Surface Water Abstractions

Surface water abstractions

5.8.5 The Groundsure EnviroGIS report[7] records the presence of historical and active licensed surface water abstractions across the Site. **Table 12A5.5** provides a summary of broadly grouped groundwater abstractions across the Site (comprising of all Groundsure abstraction records available for labelled clusters of locations) as presented in **Graphic 12A5.19** to **Graphic 12A5.23**. Further details relating to groundwater abstractions are presented in **Chapter 7: Water environment** of the Draft ES.

Table 12A5.5 Summary of Licensed Surface Water Abstractions on Site

No.	Total abstractions represented	Total active abstractions	Potable / non-potable	Purpose of active abstractions	Potable Annual Volume (Litres)
1	6	0	Non-potable	Historical	N/A
2	3	0	Non-potable	Historical	N/A
3	1	0	Non-potable	Historical	N/A
4	Historical (details no longer provided in Groundsure report)				
5	Historical (details no longer provided in Groundsure report)				
6	4	0	Non-potable	Historical	N/A
7	Historical (details no longer provided in Groundsure report)				
8	Historical (details no longer provided in Groundsure report)				

N/A = Not available

5.8.6 There are no licensed active potable surface water abstractions within the Study Area, and it is noted that the nearest recorded licensed potable surface water abstraction is approximately 500m from the North Corridor section south of Higher Walton HAGI in an area with relatively few significant contaminant sources (most potential contaminant sources near Higher Walton HAGI are north of the Manchester Ship Canal, which is approximately 1.7km down-hydraulic gradient of the potable surface water abstraction). As such, the proposed development is not anticipated to form a preferential pathway from contaminant sources to the surface water abstraction.

5.8.7 A request was made to all local authorities in the Study Area for information they hold relating to unlicensed private water supplies (PWS). CWAC and SCC noted that they do not hold data relating to private water supply (PWS). CEC supplied a list of PWS and locations, but all PWS were found to be outside of the Study Area. Trafford Council and WBC did not provide PWS information. HBC, Knowsley and St Helens Councils did not respond to the data request.

5.8.8 Given the non-potable nature of the surface water abstractions present in the Study Area and the nature of the Project (which is expected to involve excavations within a narrow corridor and may be required to be lined with impermeable lining or backfilled with impermeable materials in areas where significant potentially mobile contamination is identified by intrusive ground investigation), the Project is not considered to introduce a significant risk to surface water abstractions at the Site. As such, surface water abstractions are not considered further in this report.

Drinking water safeguard zones (groundwater)

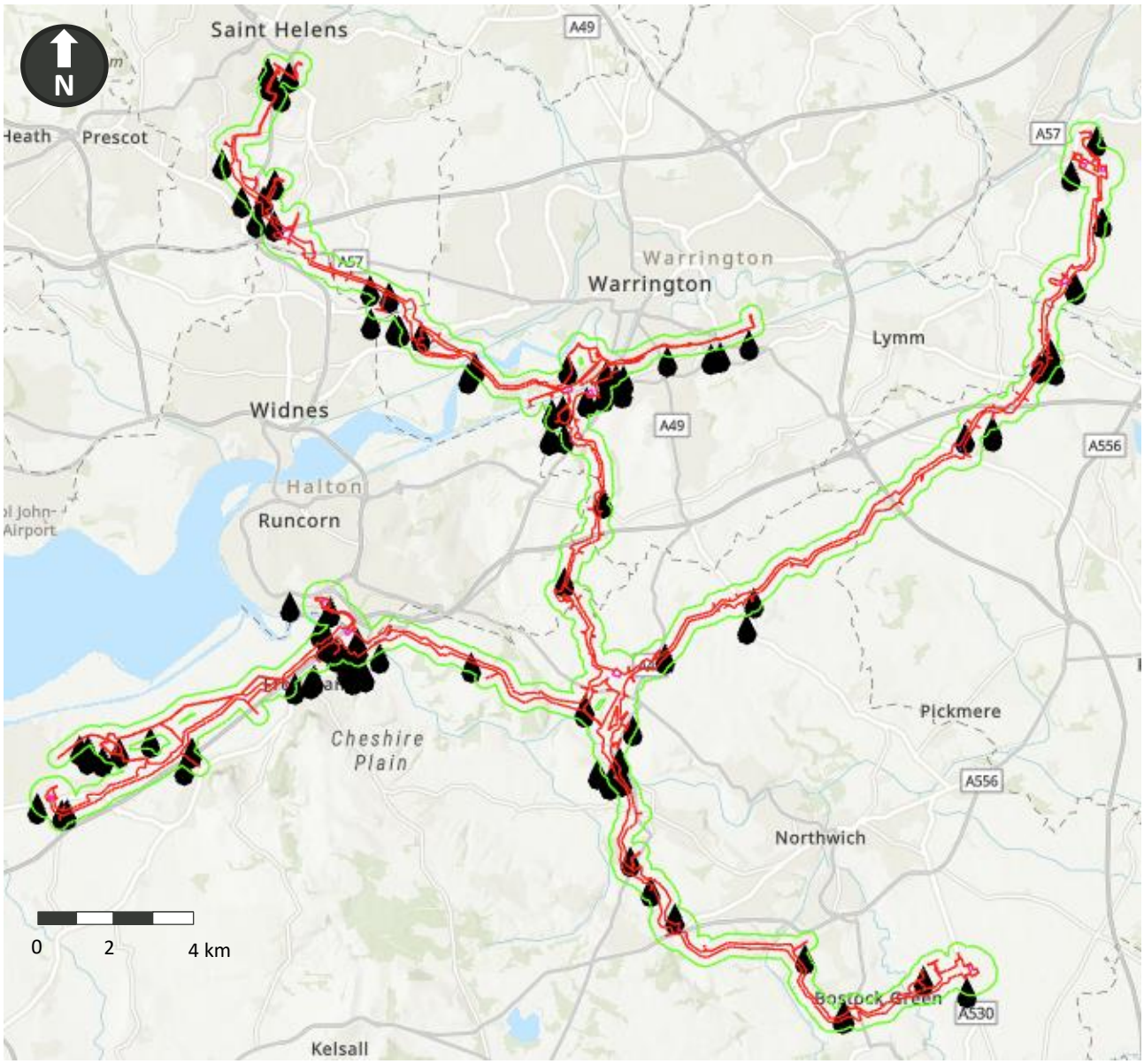
5.8.9 The Defra Magic map application[15] shows a drinking water safeguard zone (groundwater) 260 m south of the Site at Frodsham, with nitrate recorded as a pressure on the drinking water safeguard zone. Given the nature of the Project (which is expected to involve excavations within a narrow corridor and may be required to be lined with impermeable lining or backfilled with impermeable materials in areas where potentially mobile contamination is identified by intrusive ground investigation), the Project is not considered to introduce a significant risk to drinking water safeguard zones outside of the Study Area. The drinking water safeguard zone is not located within the Study Area and is not considered further.

Surface water discharge consents

5.8.10 The Groundsure data includes records of licensed discharges to controlled waters. Discharge consents are recorded across the Site with particularly elevated concentrations of discharge consents recorded in the vicinity of the Site from St Helens Spurs to Higher Walton HAGI (HWH2 and HWH8), Rocksavage HAGI, Partington HAGI (PH1) and the Central Hub HAGI. The locations of discharge consents across the site are illustrated in **Graphic 12A5.24** below:

[15] Multi Agency Geographic Information for the Countryside (MAGIC) interactive map, www.magic.gov.uk, accessed July 2024

Graphic 12A5.24 Discharge consents[7]



Draft Order Limits

Study Area Extent

Discharge consents

5.8.11 Given the nature of discharge consents, these are unlikely to have significantly influenced land quality on the Site with respect to the Project, and they are already regulated under permit/license by the Environment Agency. As such they are not considered further in this report (see **Section 1.4**).

Drinking water protected areas (surface water)

5.8.12 The Environment Agency website shows that the Appleton Reservoir (190m east of the Study Area of the North Corridor section from Higher Walton HAGI to the Central Hub HAGI) is a drinking water protected area. The Environment Agency data does not specify the reason for Appleton Reservoir being designated as a drinking water protected area, however, records its reasons for not achieving good status as being due to risks from: total phosphorus, polybrominated diphenyl ethers (PBDE), mercury and physical modification. Given the nature of the Project (which is expected to involve excavations within a narrow corridor and may be required to be lined with impermeable lining or backfilled with impermeable materials in areas where potentially mobile contamination is identified by intrusive ground investigation), the Project is not considered to introduce a significant risk to drinking water safeguard zones outside of the Study Area. The drinking water safeguard zone is not located within the Study Area and is not considered further.

Flood risk

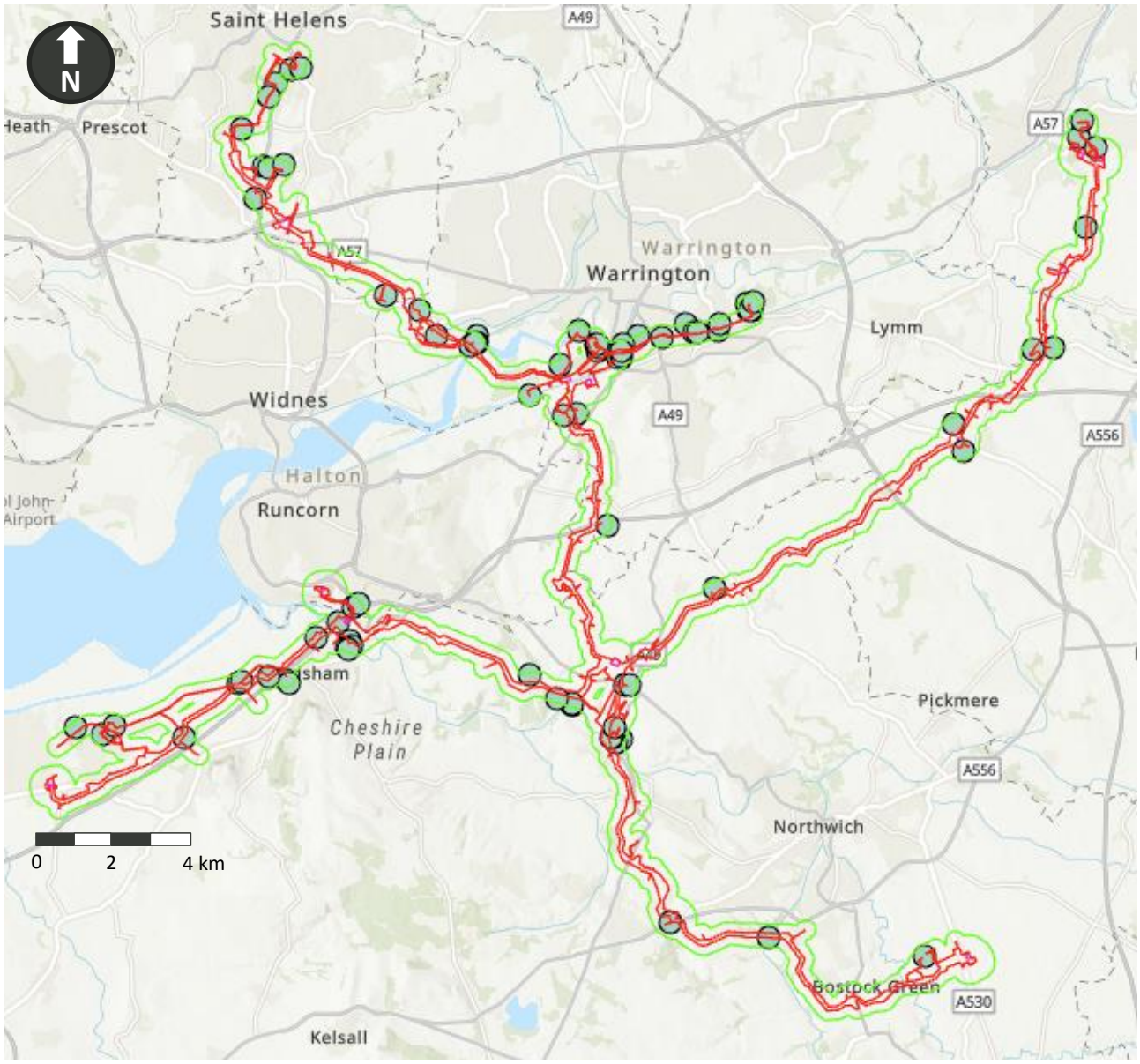
5.8.13 The Groundsure EnviroGIS report[7] reveals that some areas of the Site are in Zone 2 and Zone 3 flood risk areas. Outside of these identified areas, the Site is outside of Flood Zones 2 and 3. The Groundsure report shows the Flood Zones 2 and 3 on site generally correlate with the courses of rivers classified under Cycle 2 of the WFD classification scheme, however some areas identified as Flood Zone 2 or 3 coincide with the locations of streams, drains or ponds that are not identified by the classification scheme.

5.8.14 A flood risk assessment is included in **Appendix 7F** of **Chapter 7: Water Environment** of the Draft ES.

Pollution incidents

5.8.15 The Groundsure data includes Environment Agency pollution incident records. Pollution incidents are recorded across the Site with particularly elevated concentrations of pollution incidents recorded in the vicinity of the St Helens Spurs, Warrington Spurs, Rocksavage HAGI and Partington HAGI (PH1). The locations of pollution incidents across the site are illustrated in **Graphic 12A5.25** below.

Graphic 12A5.25 Pollution incidents[7]



Draft Order Limits

Study Area Extent

Pollution incident

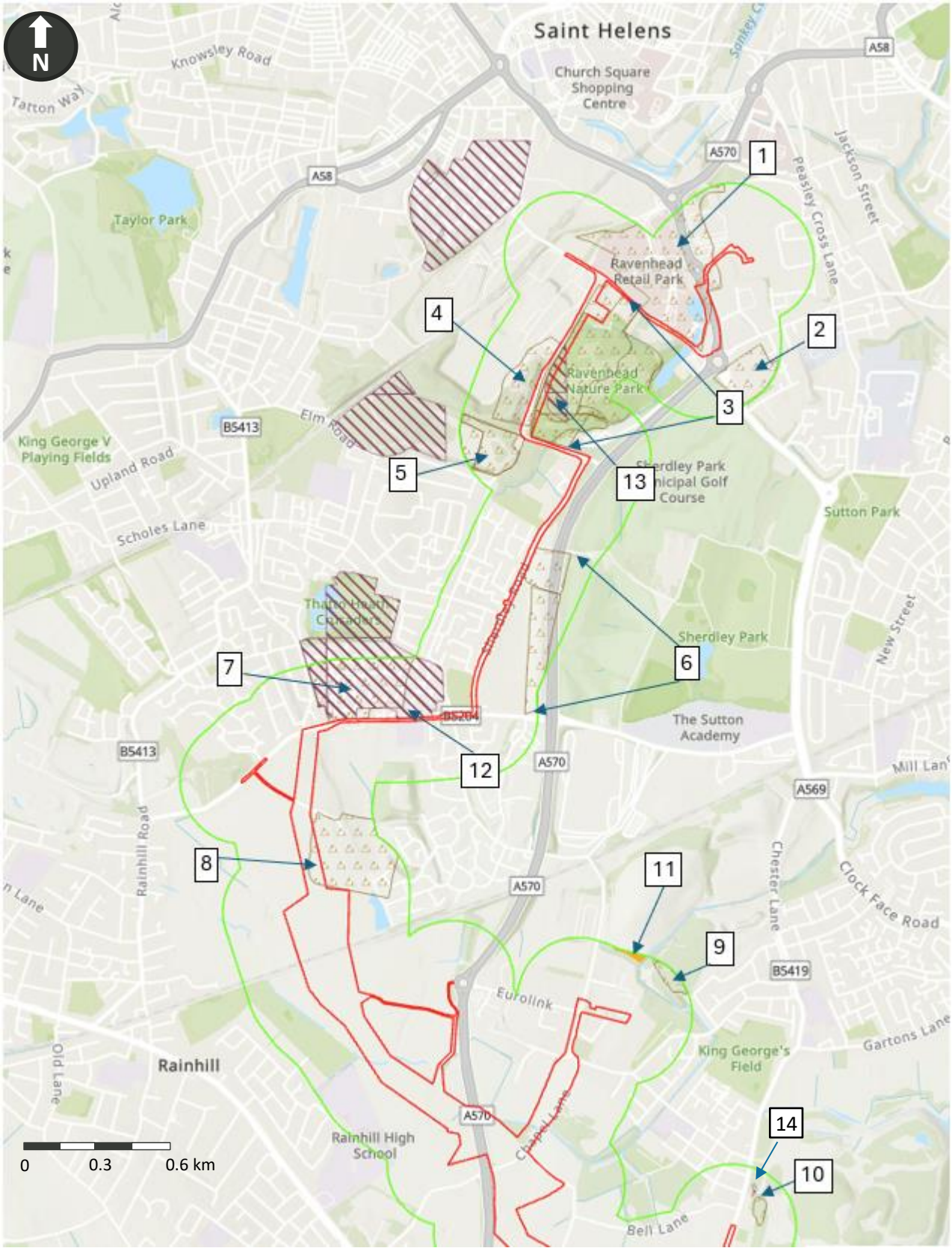
5.8.16 Given the nature of the incidents, the dates, and their locations, these are unlikely to have influenced land quality on the Site with respect to the Project and they are already regulated under reporting requirements by the Environment Agency. As such they are not considered further in this report.

5.9 Waste Management Facilities

Landfill

5.9.1 The Groundsure EnviroGIS report[7] shows active / recently active and historical landfills to be present across many parts of the Site. The locations of these landfills are illustrated in **Graphic 12A5.26 to Graphic 12A5.38**) and their input dates and recorded inputs are summarised in **Table 12A5.6 to Table 12A5.13** below.

Graphic 12A5.26 Landfills: St Helens Spurs[7]



Draft Order Limits

Study Area Extent

Active / recent landfill

Historical landfill

Authorised landfill

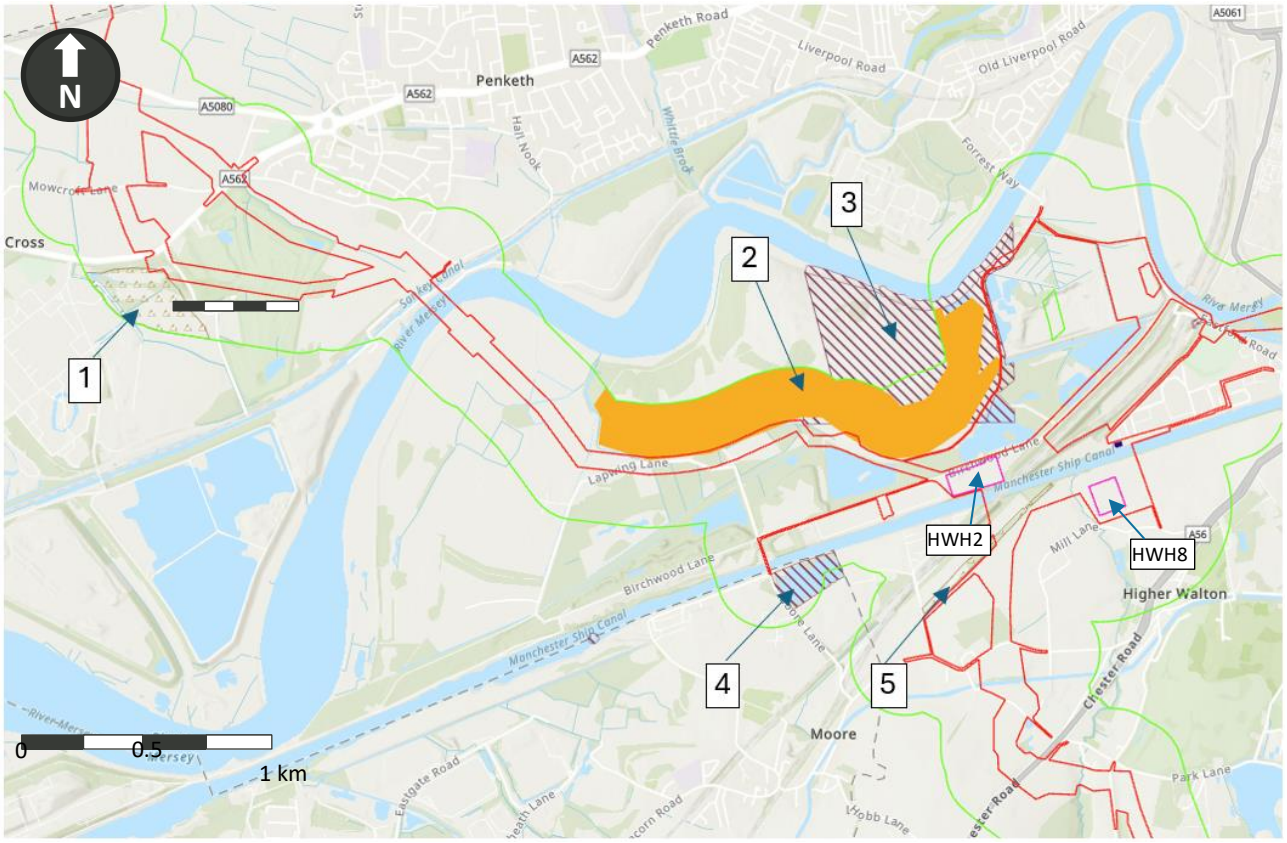
Table 12A5.6 Summary of landfill details: St Helens Spurs

Landfill no: (see Graphic 12A5.26)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	August 1977	April 1994	1	Inert and industrial waste	N/R
2	October 1967	December 1973	1	Inert, industrial, liquid sludge	N/R
3	Decembe r 1971	December 1981	4	Inert, industrial, commercial, household, special waste and liquid sludge	Gas control and leachate control
4	January 1996	N/R	1	Inert waste	N/R
5	Decembe r 1950	January 1990	4	Inert, industrial and household waste	Gas control
6	May 1976	February 1999	2	Inert waste	N/R
7	February 1989	February 1999	1	Inert	N/R
8	N/R	N/R	1	N/R	N/R
9	Decembe r 1990	March 2013	1	N/R	N/R
10	N/R	N/R	1	Inert, industrial	N/R
Active / Recent landfill					
11	N/R	N/R	1	Capacity >25,000T excluding inert waste	N/R

Landfill no: (see Graphic 12A5.26)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Authorised landfill					
12	N/R	N/R	N/R	Disused Refuse Tip	N/R
13	N/R	N/R	N/R	Disused Refuse Tip	N/R
14	N/R	N/R	N/R	Refuse Tip	N/R

N/R = Not recorded

Graphic 12A5.27 Landfills: Higher Walton HAGI[7]

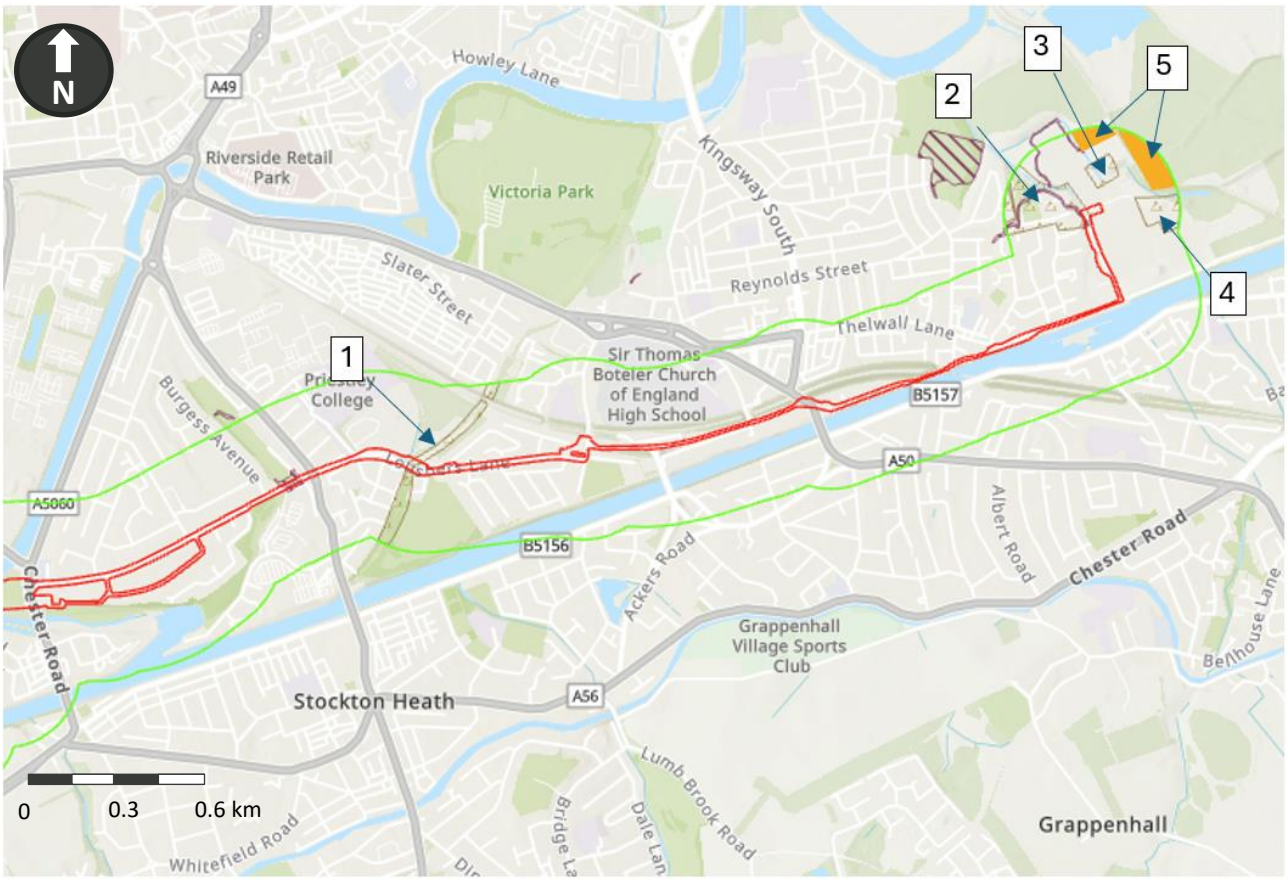


- Draft Order Limits
- HAGI
- Study Area Extent
- Active / recent landfill
- Historical landfill
- Authorised landfill

Table 12A5.7 Summary of landfill details: Higher Walton HAGI

Landfill no: (see Graphic 12A5.27)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	N/R	N/R	1	Industrial waste	N/R
Active / Recent landfill					
2	N/R	N/R	1	Capacity >25,000T excluding inert waste	N/R
Authorised landfill					
3	N/R	N/R	N/R	Landfill site	N/R
4	N/R	N/R	N/R	N/R	N/R
5	June 1993	November 2005	1	Inert, industrial, commercial, household, special waste and liquid sludge	N/R

Graphic 12A5.28 Landfills: Warrington Spurs[7]



- Draft Order Limits
- Study Area Extent
- Active / recent landfill
- Historical landfill
- Authorised landfill

Table 12A5.8 Summary of landfill details: Warrington Spurs

Landfill no: (see Graphic 12A5.28)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	December 1979	August 1982	1	Inert and industrial waste	N/R
2	December 1947	September 1989	2	Inert, industrial and special waste	N/R
3	December 1948	June 1992	1	Inert, industrial and household waste	N/R
4	December 1948	June 1992	1	Inert, industrial, commercial and household waste	Gas control
Active / Recent landfill					
5	N/R	N/R	1	A05: Landfill taking non-biodegradable wastes	N/R

Graphic 12A5.29 Landfills: Corridor section from Higher Walton HAGI to Central Hub HAGI[7]

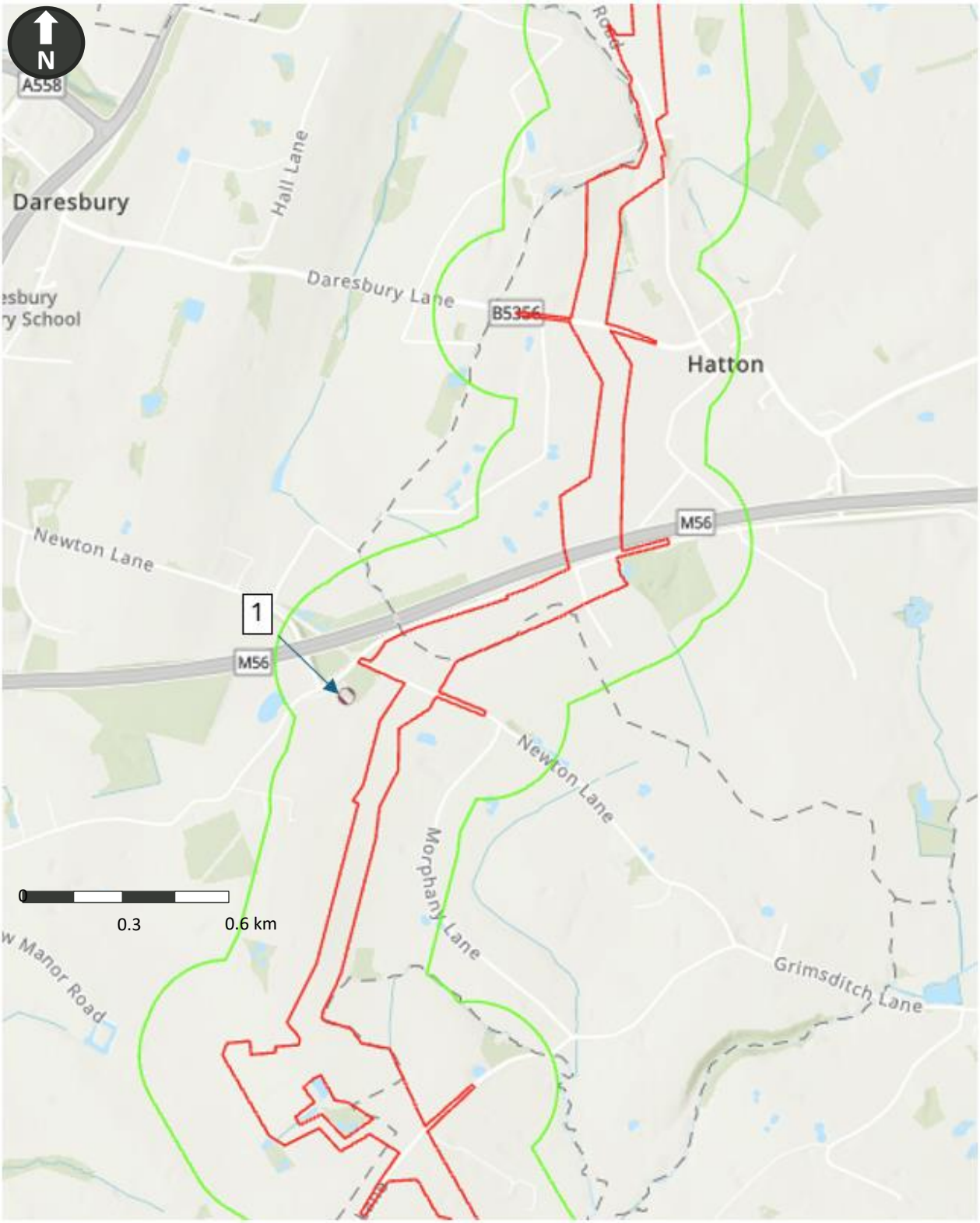
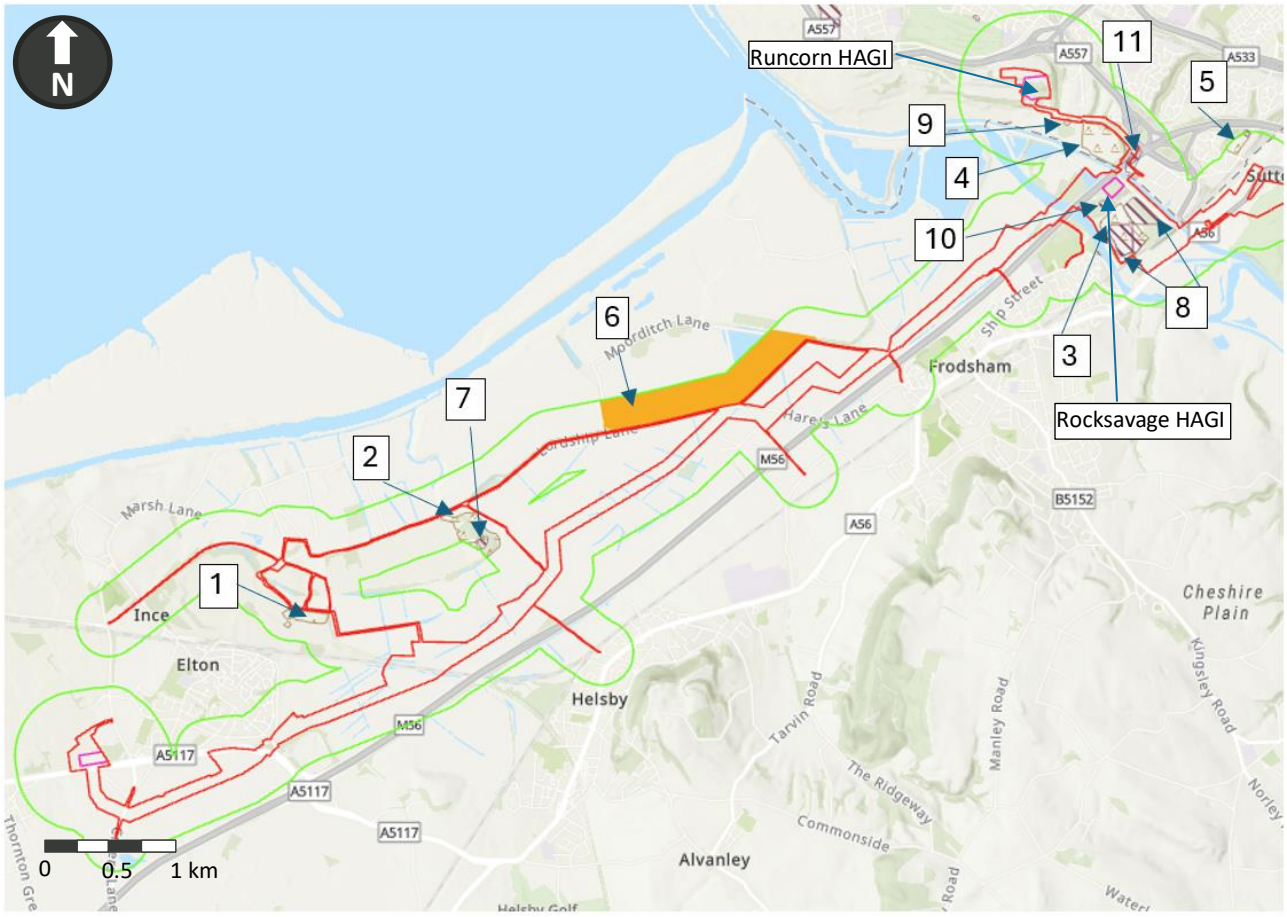


Table 12A5.9 Summary of landfill details: Higher Walton HAGI and North Corridor section to Central Hub HAGI

Landfill no: (see Graphic 12A5.29)	First input	Last input	No. of Cells	Landfill type	Gas / leachate control present?
Authorised landfill					
1	N/R	N/R	1	Council tip	N/R

Graphic 12A5.30 Landfills: HPP HAGI, West corridor section to Rocksavage and Runcorn HAGIs and Runcorn Spur[7]



- Draft Order Limits
- HAGI
- Study Area Extent
- Active / recent landfill
- Historical landfill
- Authorised landfill

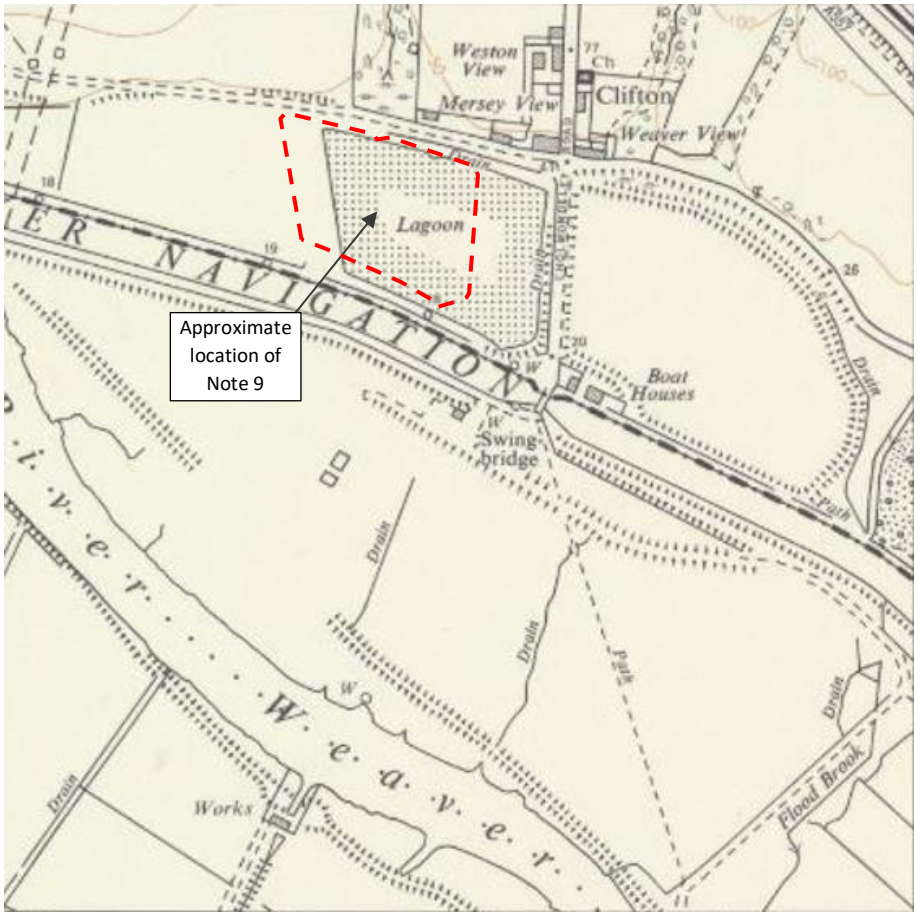
Table 12A5.10 Summary of landfill details: HPP HAGI, West corridor section to Rocksavage and Runcorn HAGIs and Runcorn Spur

Landfill no: (see Graphic 12A5.30)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	December 1960	N/R	1	Industrial waste and liquid sludge	N/R
2	December 1978	August 1983	1	Inert and industrial waste	N/R
3	June 1977	January 1993	1	Industrial waste and liquid sludge	N/R
4	December 1962	N/R	1	N/R	N/R
5	N/R	N/R	1	N/R	N/R
Active / recent landfill					
6	N/R	N/R	1	A04: Household, commercial and industrial waste	N/R
Authorised landfill					
7	N/R	N/R	N/R	Refuse Tip	N/R
8	N/R	N/R	N/R	Refuse Tip	N/R
9	N/R	N/R	N/R	Lagoon[1]	N/R
10	N/R	N/R	N/R	Sludge Lagoon[2]	N/R
11	N/R	N/R	N/R	Refuse Tip	N/R

[1] Historical Local Authority landfill mapping indicates the presence of a landfill feature (no details recorded) at the location indicated by Note 13, however the Local Authority (Halton Borough Council) were unable to confirm the extent of the landfill, and as such recorded it as a perfect circle. Historical mapping obtained from the National Library of Scotland records the presence of a “lagoon” in the location of Note 13 and indicates the maximum recorded extent of the landfill deposits referred to by Historical Local Authority landfill mapping. An extract of from the historical mapping (dates not provided) is presented as **Plate 5.1**.

[2] Historical Local Authority landfill mapping indicates the presence of a sludge lagoon (No. 3 Lagoon) at the location indicated by Note 16, however the Local Authority (Halton Borough Council) were unable to confirm the extent of the landfill, and as such recorded it as a perfect circle. Historical mapping of the nearby electricity substation (Frodsham Substation) records the presence of a "disused tip" operated by ICI Chemicals and Polymers Ltd in the location of Note 16 and indicates the maximum recorded extent of the landfill deposits referred to as a Sludge Lagoon by Historical Local Authority landfill mapping. An extract of from the historical mapping (dates not provided) is presented as **Plate 5.2**.

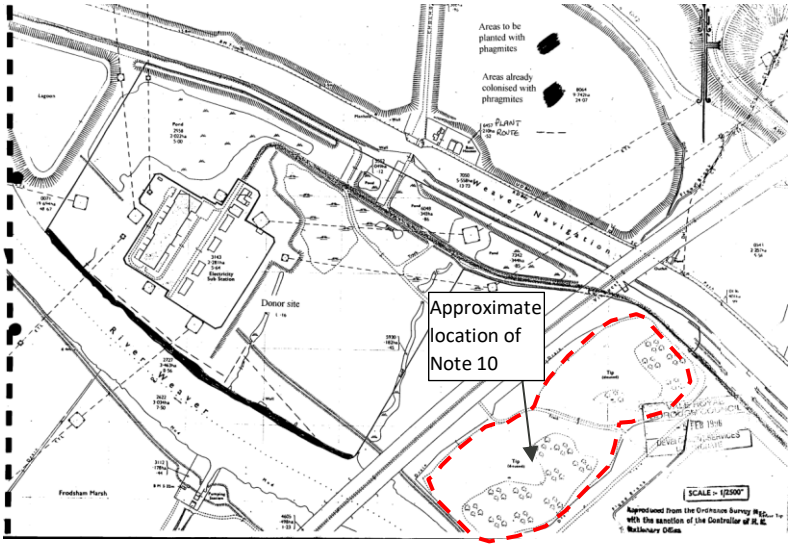
Plate 5.1 Landfills: ICI Chemicals and Polymers Ltd No. 3 Sludge Lagoon



Approximate extent of historical lagoon.

Excerpt from National Library of Scotland historical mapping (1970).

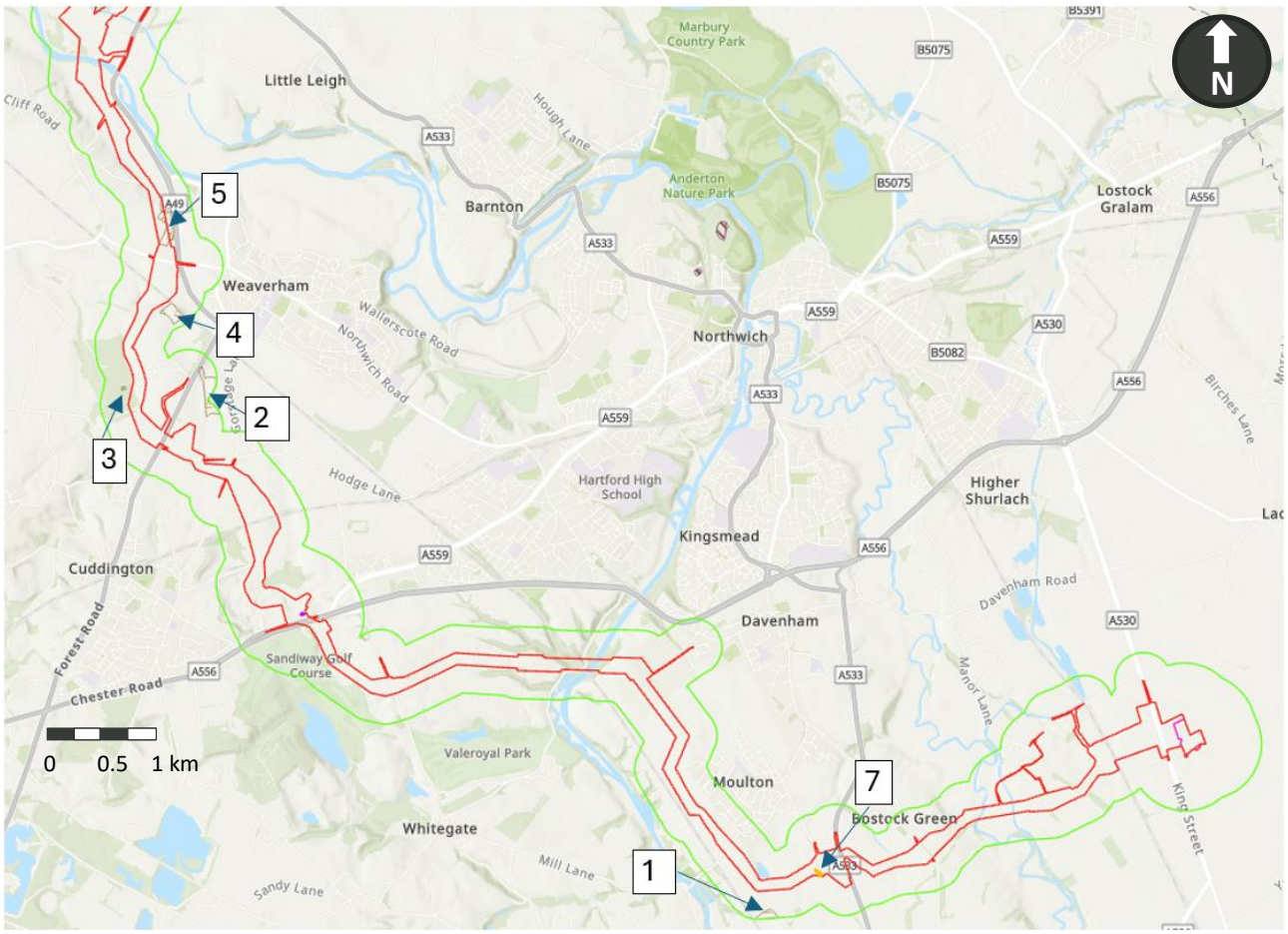
Plate 5.2 Landfills: ICI Chemicals and Polymers Ltd No. 3 Sludge Lagoon



Approximate extent of disused tip (anticipated to be No. 3 sludge lagoon) owned by ICI Chemicals and Polymers Ltd.

Excerpt from Vale Royal Borough Council historical mapping.

Graphic 12A5.31 Landfills: HSF HAGI and South Corridor to Central Hub HAGI[7]

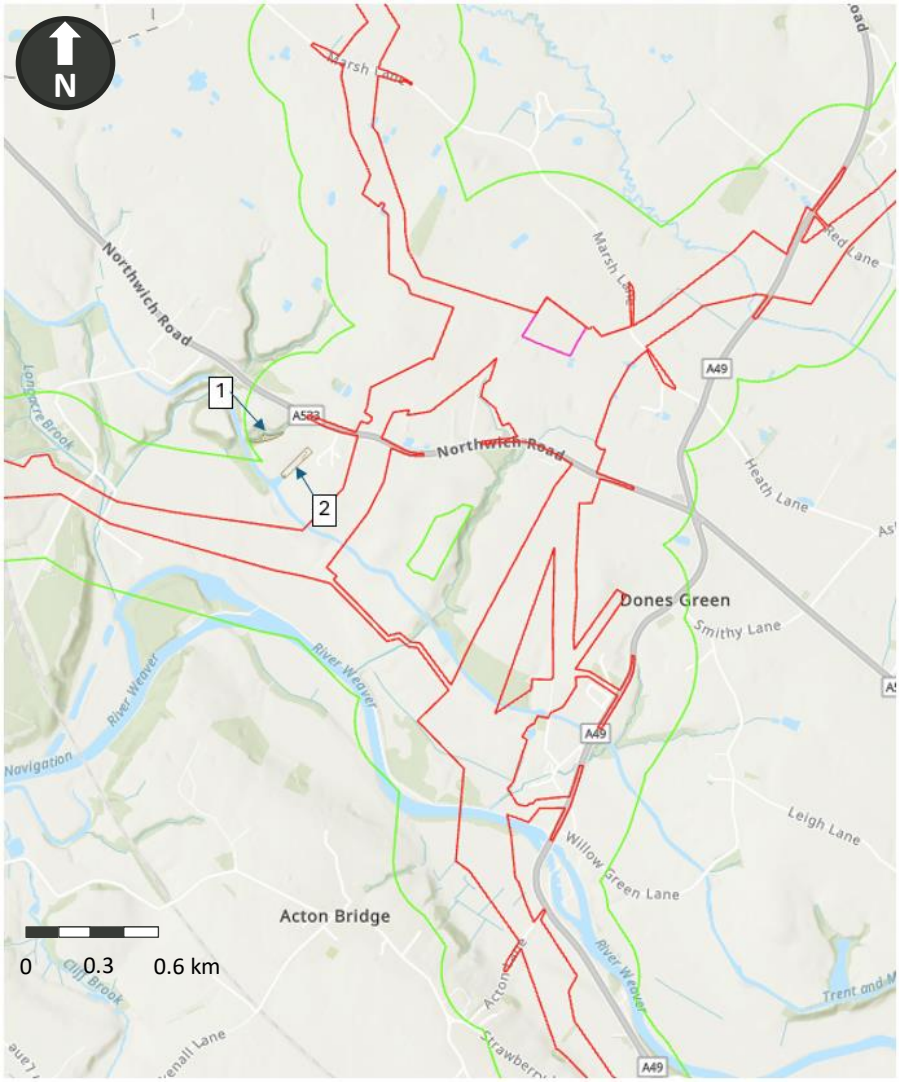


- Draft Order Limits
- HAGI
- Study Area Extent
- Active / recent landfill
- Historical landfill

Table 12A5.11 Summary of landfill details: HSF HAGI and South Corridor to Central Hub HAGI

Landfill no: (see Graphic 12A5.31)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	February 1986	N/R	1	Industrial waste	N/R
2	March 1991	November 1991	1	Inert waste	N/R
3	N/R	N/R	1	Inert	N/R
4	March 1991	October 1991	1	Inert waste	N/R
5	March 1991	October 1991	1	Inert waste	N/R
Active / recent landfill					
7	N/R	N/R	1	Underground storage of hazardous waste with a total capacity >50 tonnes	N/R

Graphic 12A5.32 Landfills: Central Hub HAGI[7]

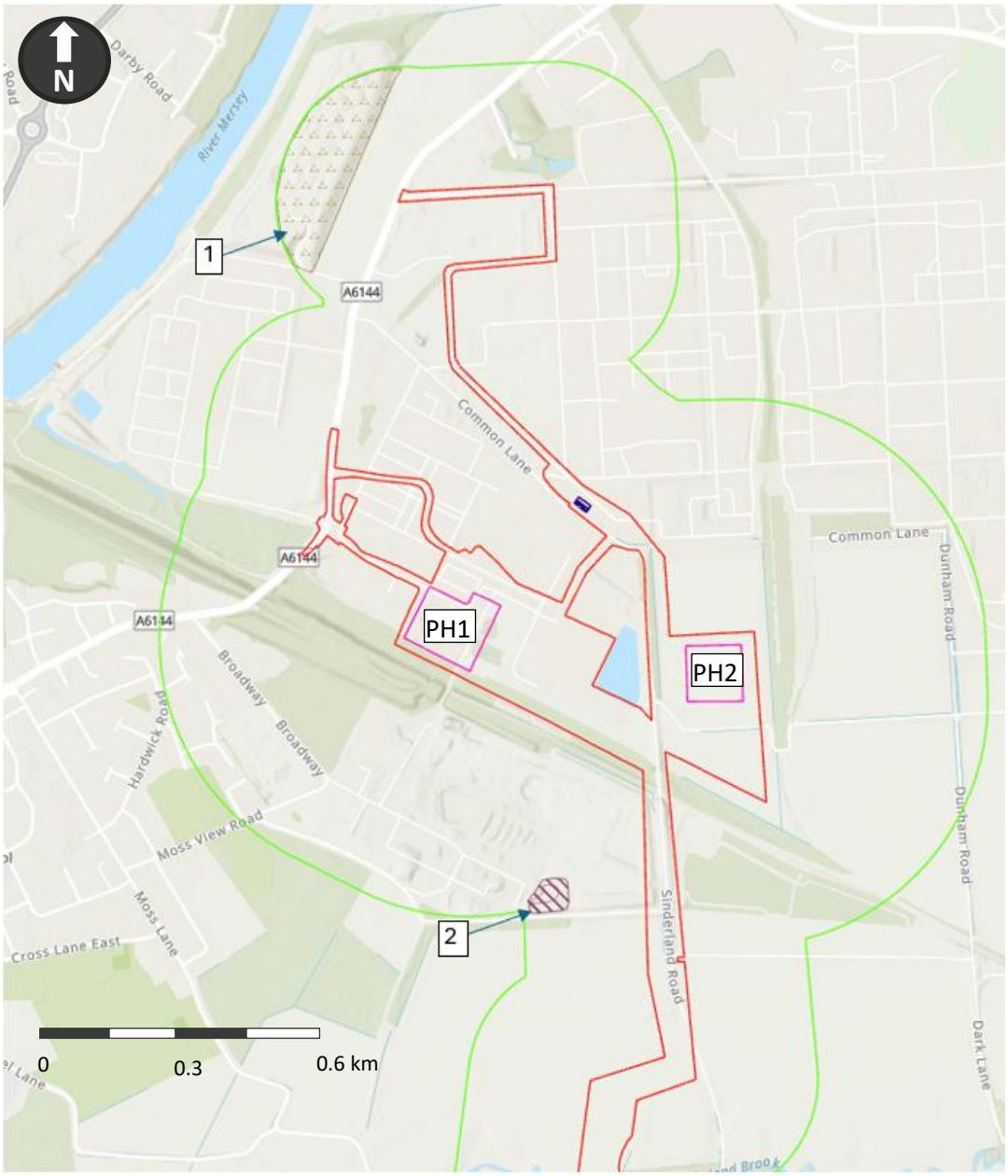


- Draft Order Limits
- Study Area Extent
- HAGI
- Historical landfill

Table 12A5.12 Summary of landfill details: Central Hub HAGI

Landfill no: (see Graphic 12A5.32)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	N/R	N/R	1	N/R	N/R
2	N/R	N/R	1	N/R	N/R

Graphic 12A5.33 Landfills: Partington HAGI to Warburton HAGI[7]



- Draft Order Limits
- Study Area Extent
- HAGI
- Historical landfill
- Authorised landfill

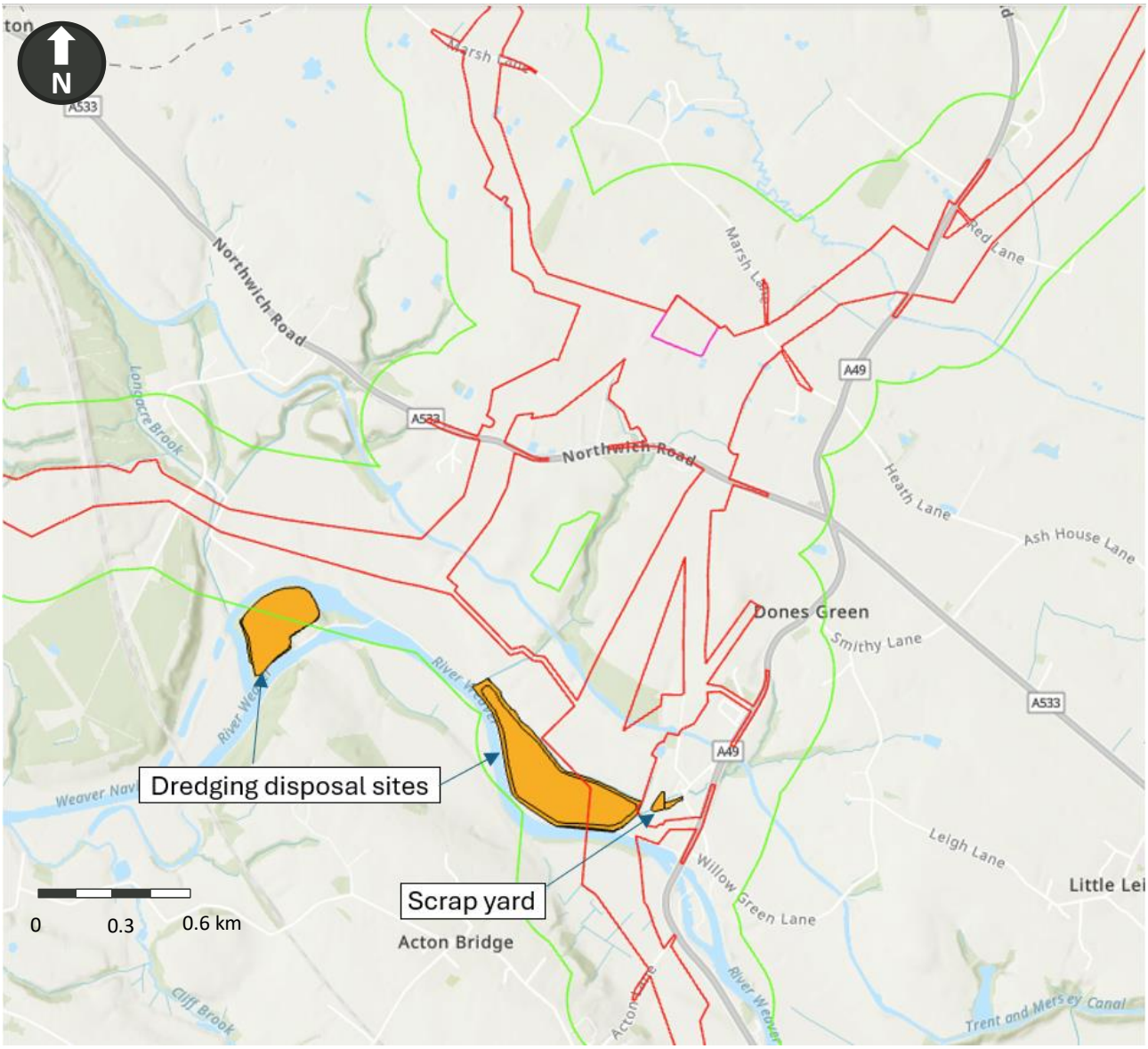
Table 12A5.13 Summary of landfill details: Partington HAGI to Warburton HAGI

Landfill no: (see Graphic 12A5.33)	First input	Last input	No. of Cells	Landfill type	Gas/leachate control present?
Historical landfill					
1	June 1988	September 2003	1	Inert, industrial, commercial and special waste	Gas control
Authorised landfill					
2	N/R	N/R	N/R	Refuse Tip	N/R

Other waste management facilities (non-landfill)

5.9.2 Two historical dredging disposal sites and a historical scrap yard are located within the south-eastern extent of the Central Hub HAGI (see **Graphic 12A5.34**).

Graphic 12A5.34 Historical waste management facilities: Central Hub HAGI[7]



- Draft Order Limits
- Study Area Extent
- HAGI
- Historical waste management facilities

5.9.3 A historical waste transfer station and scrap haulage yard are recorded at the centre of the north of St Helens Spurs (NGR 321245 394336) and car breakers yards are recorded to the east of the waste transfer station (NGR 351293 394258) and in the eastern extent of the Study Area at St Helens Spurs (NGR 321242 393863).

5.9.4 A waste transfer station is recorded in the eastern extent of the Warrington Spurs (NGR 363732 387335).

5.9.5 Historical ground workings and a refuse heap are recorded within the Study Area to the north of the HPP HAGI (NGR 344862 375390).

5.9.6 A historical waste transfer station is recorded adjacent to the south of the Rocksavage HAGI at (NGR 352985 378630).

5.9.7 A historical recycling facility and waste transfer station are recorded in the vicinity of Partington HAGI (PH1) (NGR 372325 392273 and NGR 372264 392140 respectively).

5.9.8 The sites above are of very limited scale and are anticipated to have relatively low potential to cause ground contamination over a large area. As such, they are not considered to present a significant contamination risk and are not considered further.

5.9.9 The Groundsure report also records numerous onsite waste storage exemptions, mainly for sludge storage on farms, also for spreading of plant matter to confer benefit, use of waste in construction and use of waste for other specified purposes. As these activities are recorded waste exemptions, they are not considered to present a significant contamination risk and are not considered further.

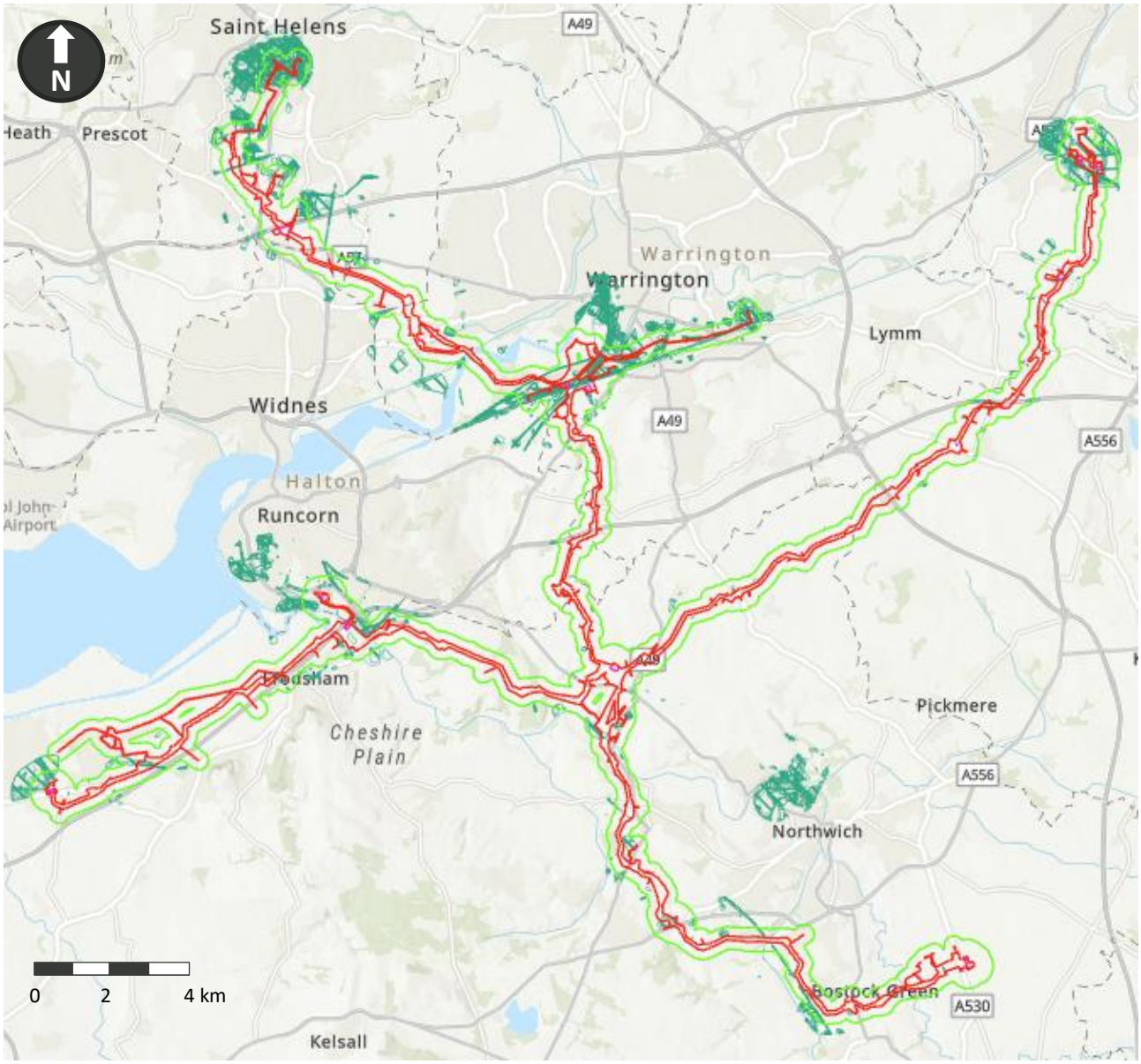
Potential infilled land

5.9.10 Other infilled land is discussed in **Section 5.1** (Made Ground) and **Section 5.2** (surface workings).

5.10 Historical Industrial Land Uses

5.10.1 The Groundsure report records the presence of historical industrial land uses, historical energy features, historical tank sites, historical petrol stations and historical garages on or close to the Site boundary. The distribution of historical industrial land use across the site is illustrated in **Graphic 12A5.35**. The locations of historical licensed industrial activities, historical energy features, historical tank sites, historical petrol stations and historical garages are illustrated in **Graphic 12A5.36** to **Graphic 12A5.44**.

Graphic 12A5.35 Historical industrial land uses: Full site[7]

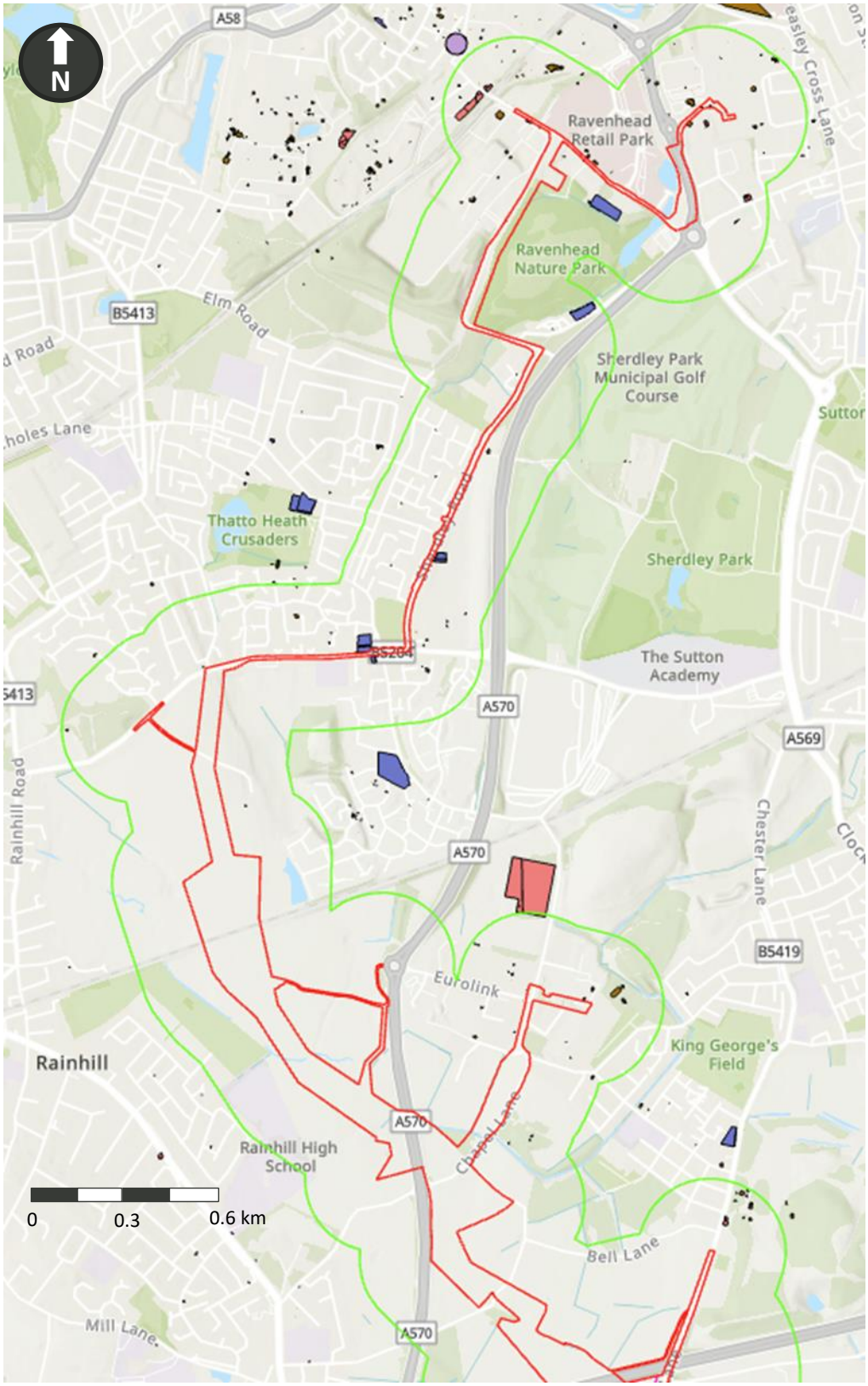


Draft Order Limits

Study Area Extent

Historical industrial land use

Graphic 12A5.36 Historical industrial land uses: St Helens Spurs and Clock Face Spur[7]

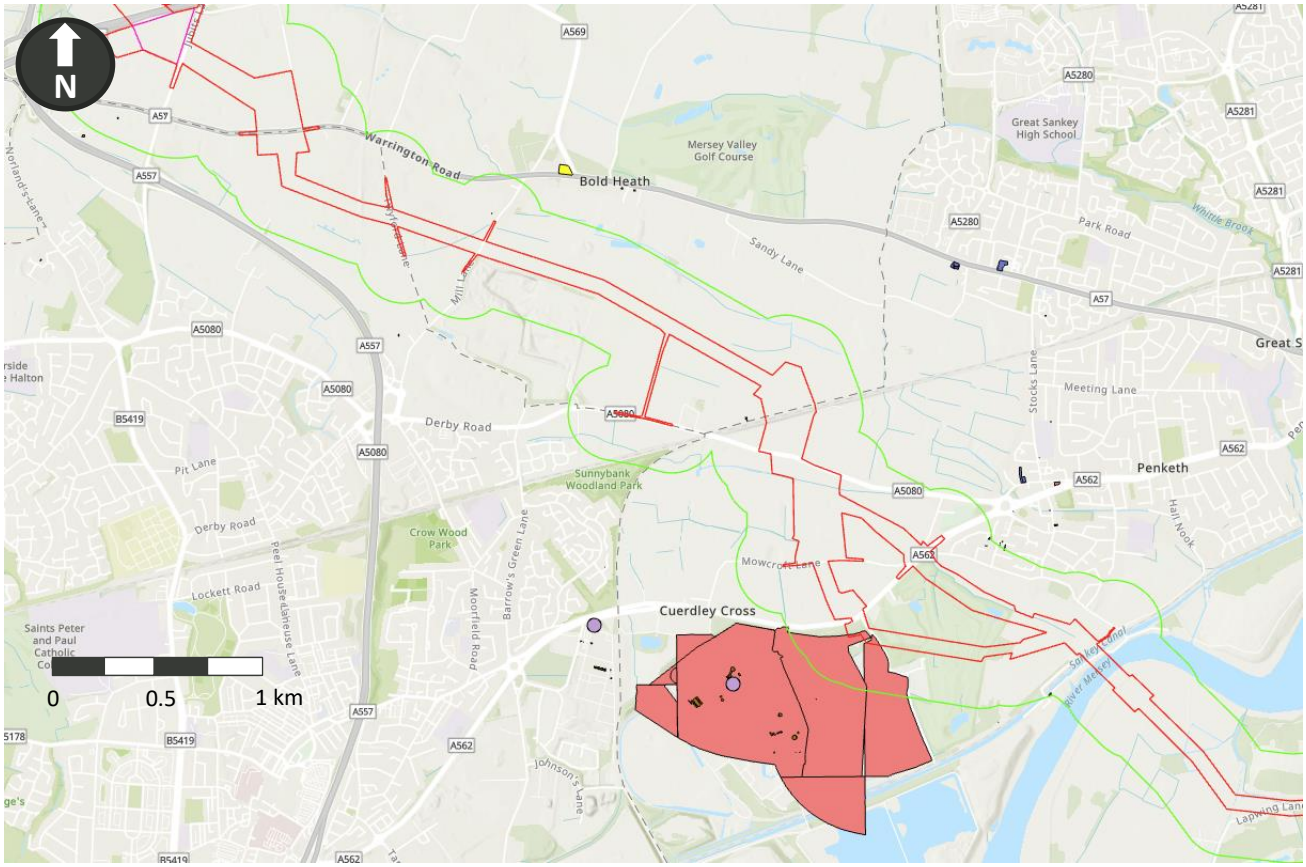


Draft Order Limits

Study Area Extent

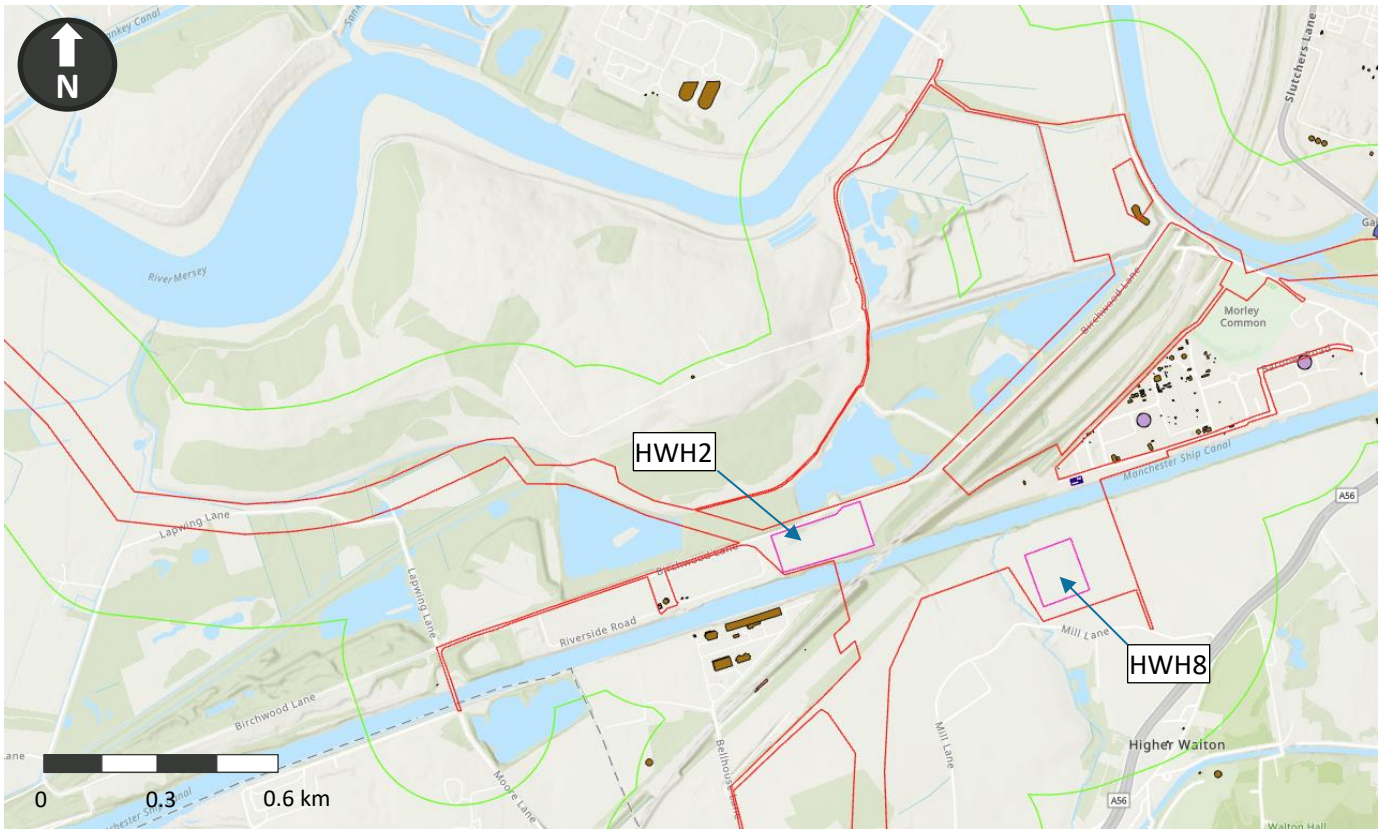
- Historical licensed industrial activities
- Historical tanks
- Historical garages
- Historical energy features

Graphic 12A5.37 Historical industrial land uses: Clock Face HAGI and North Corridor section to Higher Walton HAGI[7]



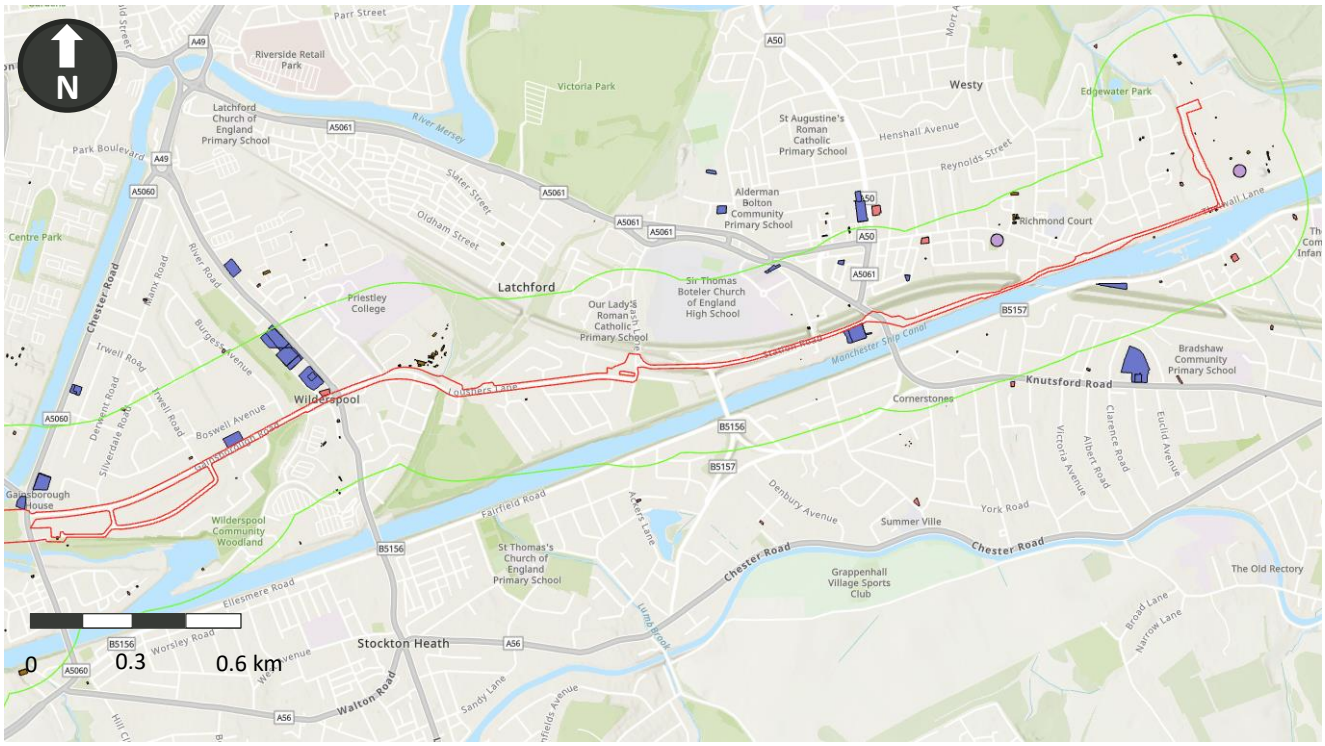
- Draft Order Limits
- Study Area Extent
- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical petrol stations
- Historical garages
- Historical energy features

Graphic 12A5.38 Historical industrial land uses: Higher Walton HAGI[7]



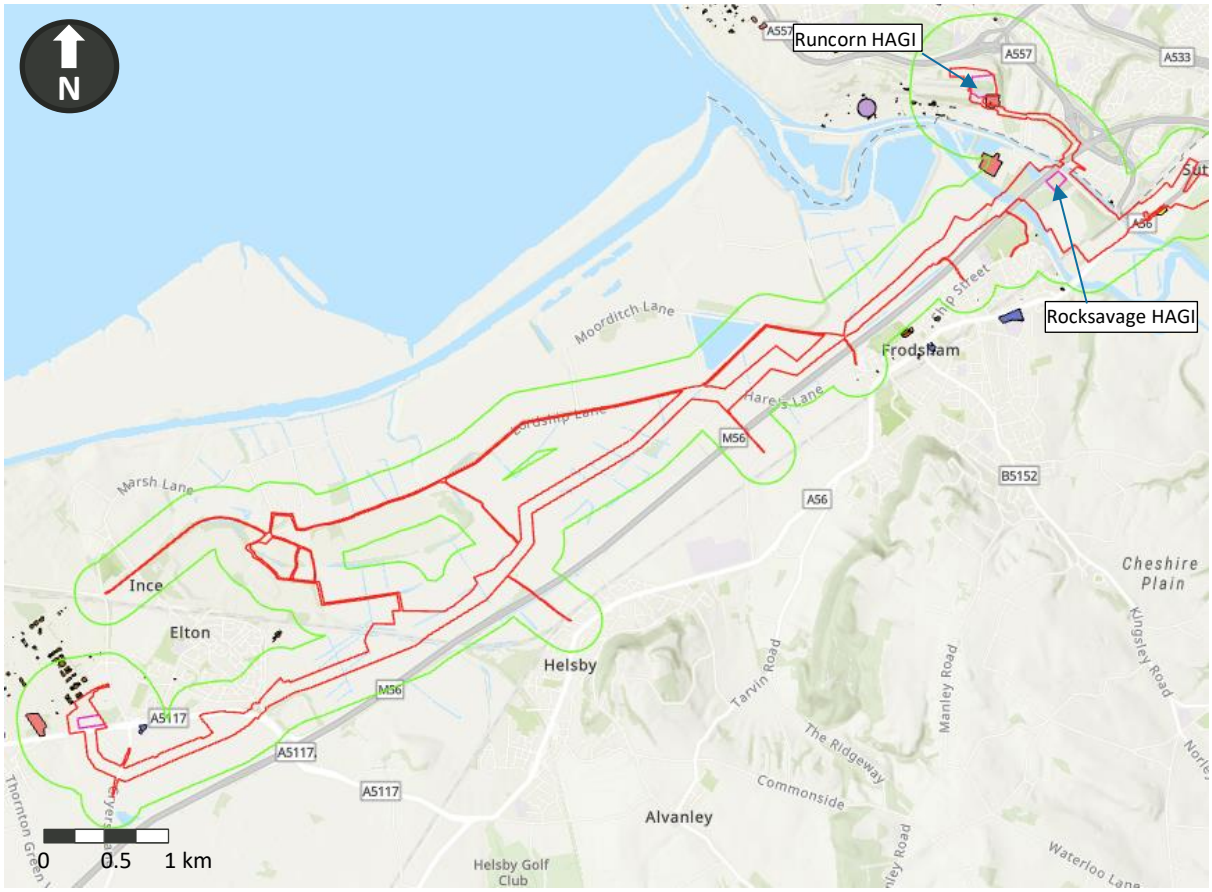
- Draft Order Limits
- Study Area Extent
- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical garages
- Historical energy features

Graphic 12A5.39 Historical industrial land uses: Warrington Spurs[7]



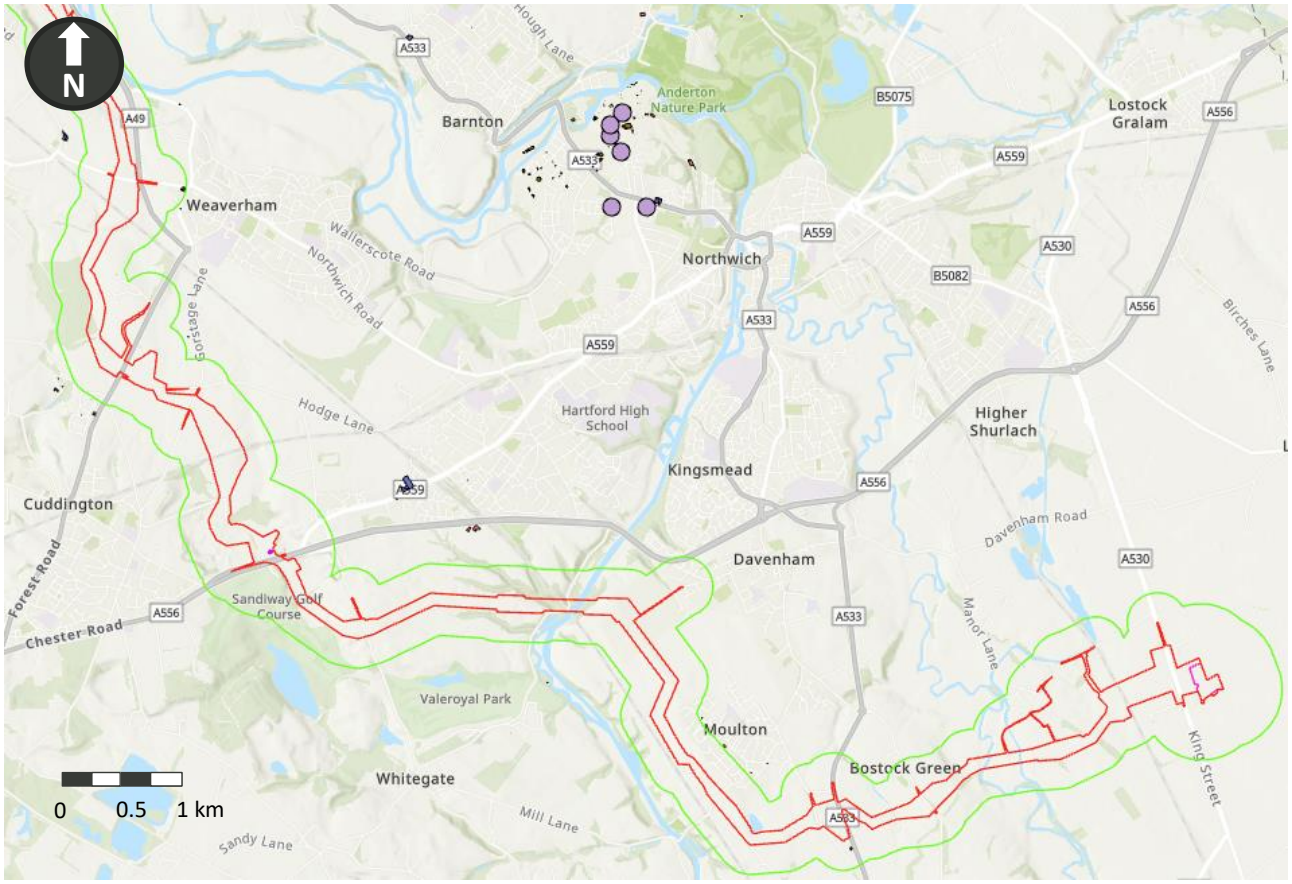
- Draft Order Limits
- Study Area Extent
- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical garages
- Historical energy features

Graphic 12A5.40 Historical industrial land uses: HPP HAGI, West corridor section to Rocksavage and Runcorn HAGIs and Runcorn Spur[7]



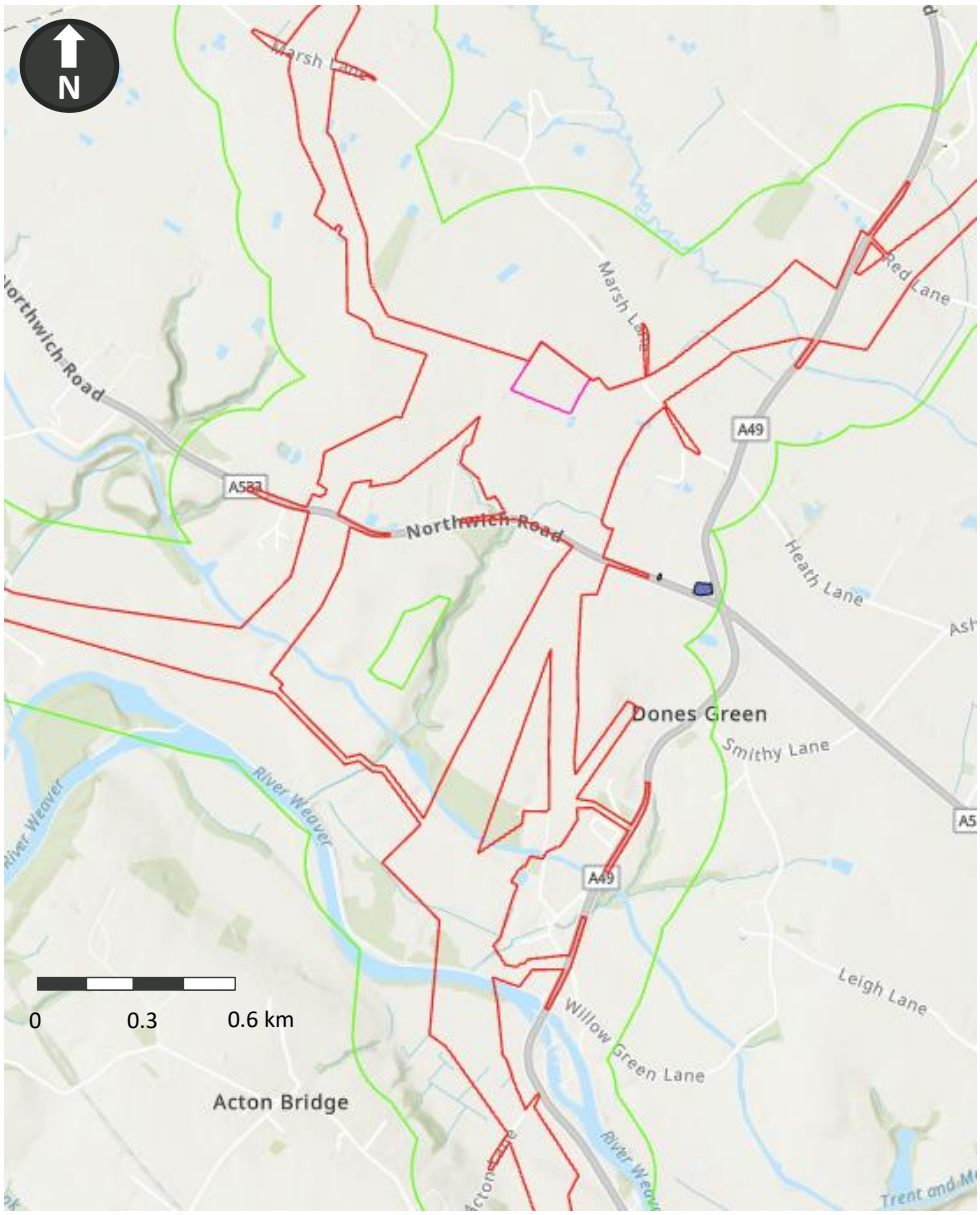
- Draft Order Limits
- Study Area Extent
- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical petrol stations
- Historical garages
- Historical energy features

Graphic 12A5.41 Historical industrial land uses: HSF HAGI and South corridor to Central Hub HAGI[7]



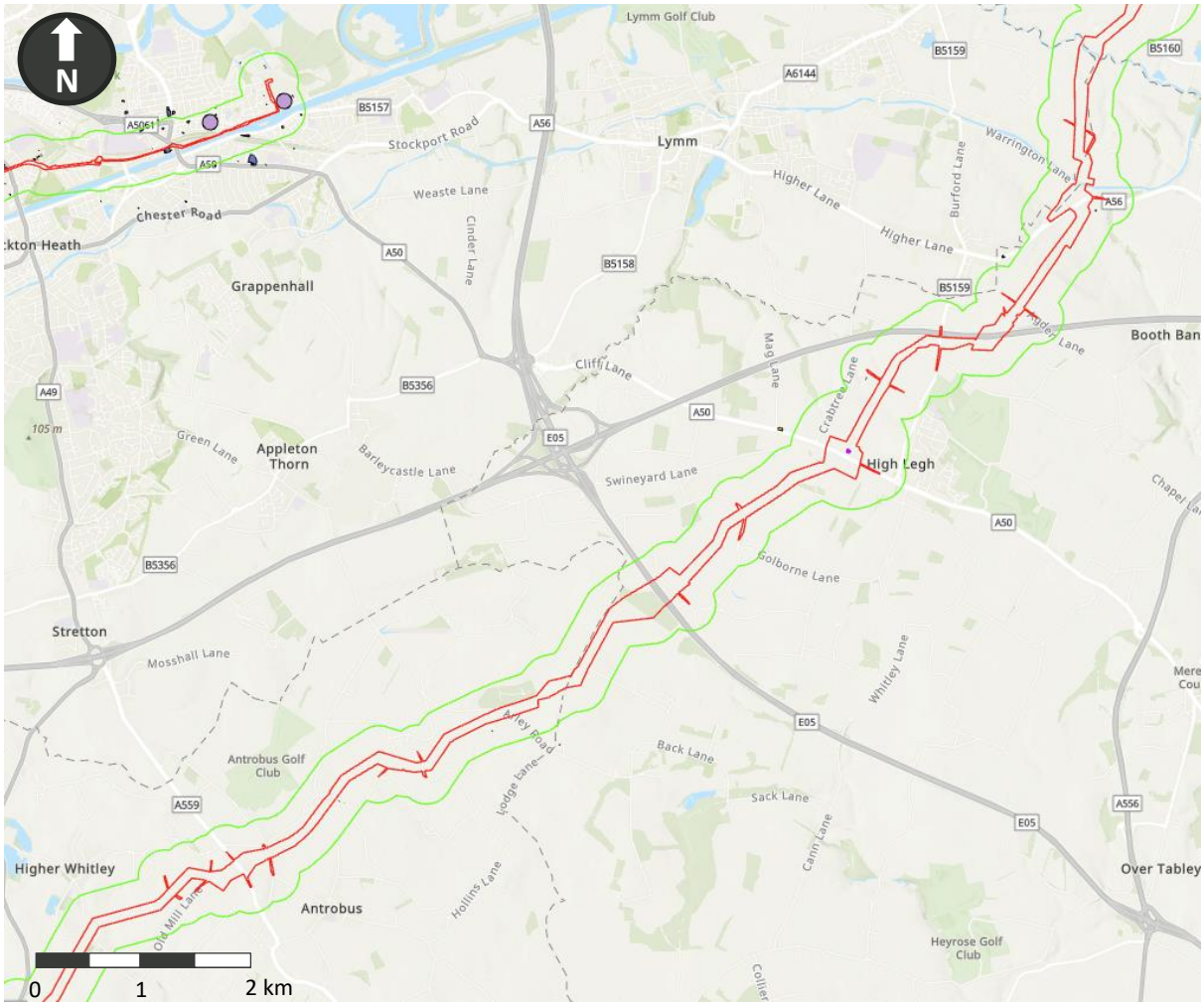
- Draft Order Limits
- Study Area Extent
- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical garages
- Historical energy features

Graphic 12A5.42 Historical industrial land uses: Central Hub HAGI[7]



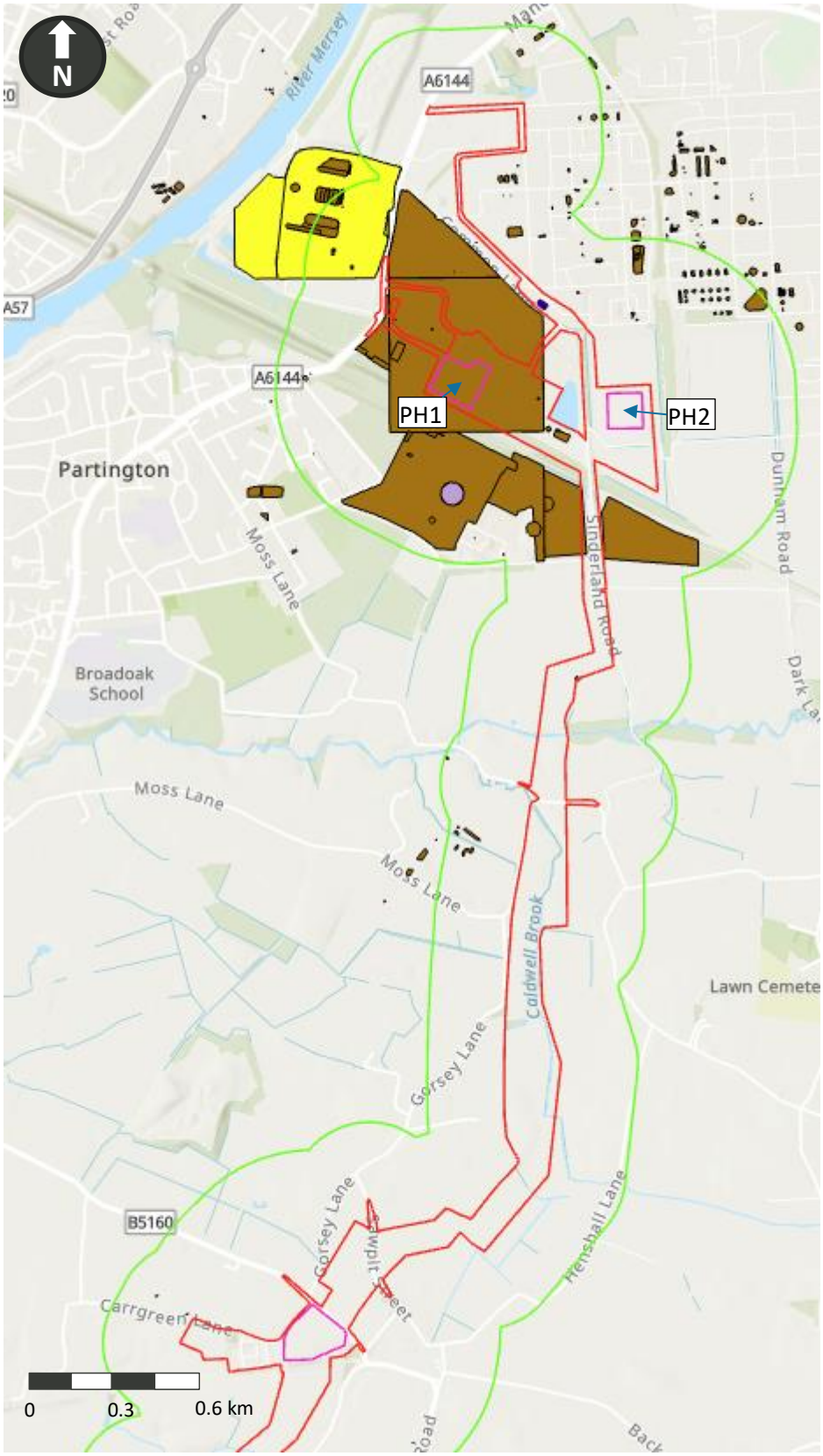
- Draft Order Limits
- Study Area Extent
- HAGI
- Historical garages
- Historical energy features

Graphic 12A5.43 Historical industrial land uses: East Corridor section between Warburton HAGI and Central Hub HAGI[7]



- Draft Order Limits
- Study Area Extent
- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical petrol stations
- Historical garages
- Historical energy features

Graphic 12A5.44 Historical industrial land uses: Partington HAGI and East Corridor section to Warburton HAGI (incl. Partington spur)[7]



Draft Order Limits

Study Area Extent

- HAGI
- Historical licensed industrial activities
- Historical tanks
- Historical petrol stations

5.10.2 Where historical industrial land uses are present within the Site, they are either minor localised features unlikely to intersect with the route of the Project, predominantly off-site features which only extend into a small area of the pipeline (e.g. Fiddler's Ferry Power Station) or are located in the vicinity of HAGIs or spurs forming terminal areas of the Project (e.g. the St Helens Spurs, the Partington HAGI (PH1) and spur, the Warrington Spurs and the Rocksavage HAGI).

Historical military land

5.10.3 A historical military installation identified as Royal Ordnance Factory (ROF) Dunham-on-the-Hill was located within and adjacent to the south of the West Corridor section south of the HPP HAGI. ROF Dunham-on-the-Hill was operational from 1941 to 1990. During the Second World War (WW2) the site was used for storage and distribution of explosives including neonite, cordite and trinitrotoluene (TNT). After WW2 until 1957 the site was used for storage of shells including phosphor bombs and was used for food storage from 1957 to 1985. The location of ROF Dunham-on-the-Hill is illustrated in **Graphic 12A5.45**.

Graphic 12A5.45 Historical Military Land: HPP HAGI and West Corridor section to Rocksavage HAGI[7]

- Draft Order Limits
- Study Area Extent
- HAGI
- Historical Military Land

Unexploded Ordnance (UXO)

5.10.4 The Zetica online UXO risk maps[16] indicate moderate UXO risks being present in the Study Area at the following locations:

- St Helens Spurs and Clock Face Spur to Clock Face HAGI;
- North Corridor section from south of the River Mersey to Higher Walton HAGI; and
- Higher Walton HAGI (HWH2 and HWH8) and Warrington Spurs.

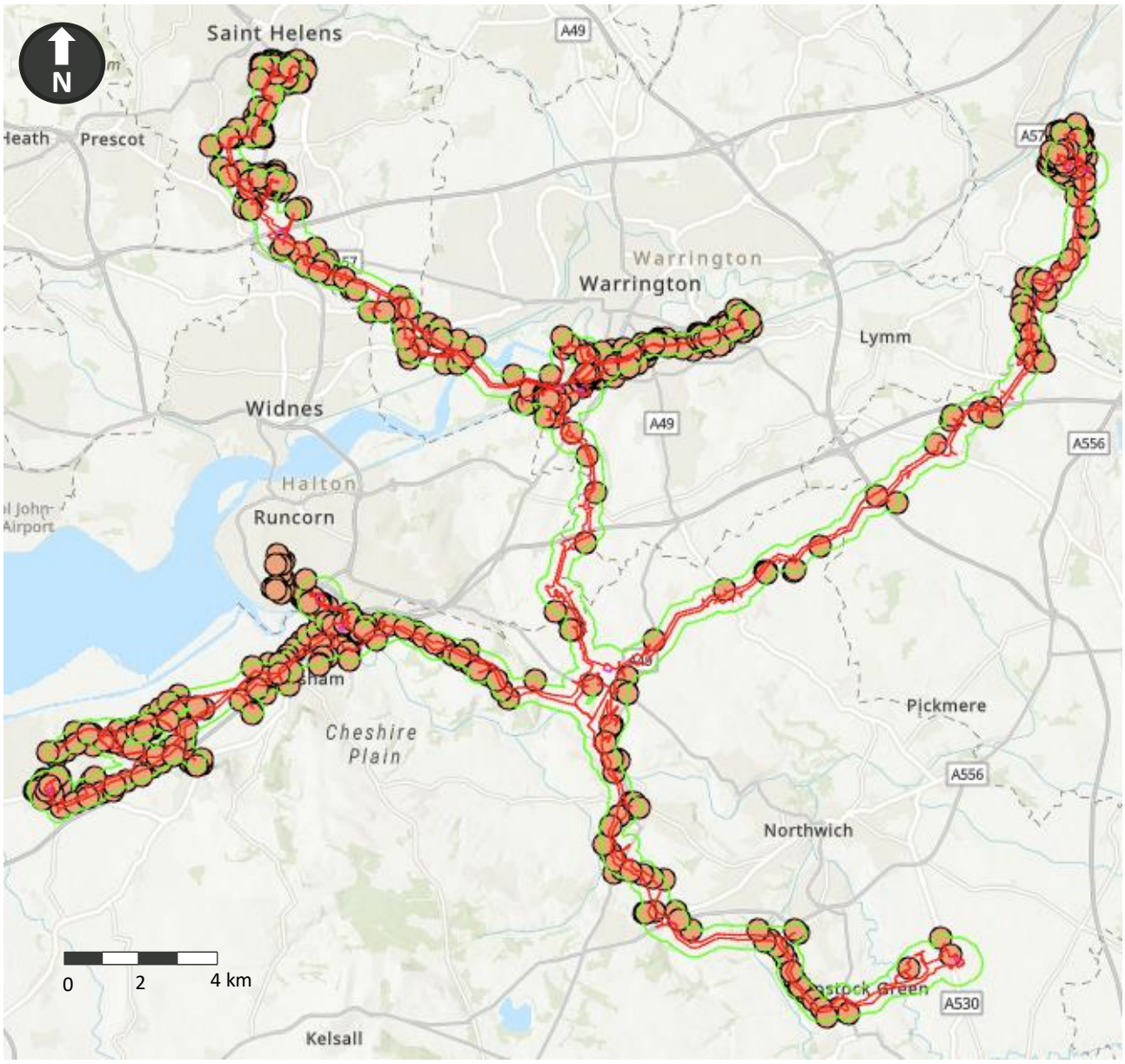
5.10.5 All other locations on the Site are recorded as being of low UXO risk, however it is noted that additional areas of moderate risk are located at Runcorn immediately adjacent to the west of the Study Area. Additionally, a number of potential WW2 Luftwaffe targets are noted to be present across the extent of the Site in areas of both moderate and low UXO risk.

Recent industrial land uses

5.10.6 The Groundsure data records recent industrial land uses across the full site, as illustrated in **Graphic 12A5.46**. These industrial land uses predominantly comprise electrical features such as electricity substations or pylons and are unlikely to unlikely to have significantly influenced land quality on the Site with respect to the Project, however, features with more potential for ground contamination are expected to be present in greater concentrations in the vicinity of the HAGIs and spurs.

[16] Zetica unexploded ordnance (UXO) risk maps, https://zeticauxo.com/guidance/risk-maps/, accessed July 2024

Graphic 12A5.46 Recent industrial land uses: Full site[7]



Draft Order Limits

Study Area Extent

Recent industrial land use

5.11 Sensitive Land Uses

5.11.1 There are a number of designated environmentally sensitive sites in the vicinity of the Project, two of which extend within the Study Area. These are the Woolston Eyes Site of Special Scientific Interest (SSSI), located approximately 150m east of the easternmost extent of the Warrington Spurs, and the Pettypool Brook Valley SSSI located 220m southwest of the South Corridor. Woolston Eyes is designated as a SSSI for its value as a breeding site for birds and wintering site for wildfowl, and Pettypool Brook Valley is designated for its value as an invertebrate habitat. There are no Ramsar sites, Special Area of Conservation (SAC), Special Protection Area (SPA) or National Nature Reserve (NNR) within the Study Area.

5.11.2 Sensitive land uses are discussed in further detail in **Chapter 5: Biodiversity** of the Draft ES.

6. Initial Conceptual Model and Preliminary Risk Assessment

6.1 Conceptual Model

6.1.1 The Conceptual Model (CM) and plausible contaminant linkages are outlined in the following sections based on the desk study review of available information collated in the previous sections. The CM is carried out in line with Land Contamination Risk Management (LCRM)[17] guidance and is based on the current and proposed uses. The CM provides an assessment of the Site's potential contamination status and identifies the presence of potentially significant contaminant linkages that require further consideration.

6.1.2 The preliminary risk assessment methodology on which the CM is based is presented as **Annex 12A4**.

6.2 Potential Contamination (Sources)

6.2.1 A review of the Site history and environmental setting has identified potential contaminant sources in the Study Area, as summarised below in **Table 12A6.1**. The list of contaminants has been established through a review of Annex 3 in the Guidance for the Safe Development of Housing on Land Affected by Contamination R&D66: 2008 Volume 2 (NHBC and Environment Agency, 2008)[18].

6.2.2 Potential for direct interaction between the Project and a potential source is considered to be low where the potential source is present within the Study Area but is not present within the Draft Order Limits. Potential for direct interaction is considered to be high where one or more examples of the potential source are present within the Draft Order Limits, regardless of size or frequency of occurrence.

6.2.3 All of the sources listed within **Table 12A6.1** were found to occur within the Draft Order Limits in one or more locations. Due to the linear nature of the Draft Order Limits, the majority of sources existing within the Draft Order Limits (the area in which excavation / construction may occur) also exist within the Study Area (outside the area of construction). Given the quantity of potential contaminant sources across the Study Area, broadly similar contaminant sources (e.g. industrial features, linear features such as roads and railways, canals and associated infrastructure and infilled ground such as landfills or dredging deposit grounds) have been grouped into Source Groups 1 to 8, as detailed in **Table 12A6.1** and **Table 12A6.3**.

[17] Environment Agency, Land contamination risk management (LCRM), July 2023, https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm

[18] National House Building Council (NHBC) and Environment Agency R&D Publication 66: Guidance on the Safe Development of Housing on Land Affected by Contamination, 2008

Table 12A6.1 Potential Sources of Contamination

No.	Source	Potential Contaminants	Source Grouping
1	Historical Industrial Works and Depots	Heavy metals, total petroleum hydrocarbons (TPH) including benzene, toluene, ethylbenzene and xylene (BTEX), polyaromatic hydrocarbons (PAH), volatile organic compounds (VOCs), semi-volatile organic compounds (SVOCs), perfluoro-alkyl substances (PFAS).	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.
2	Historical Collieries	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Source Group 4: Collieries
3	Railway land (including historical and current tracks, earthworks and buildings)	Asbestos, heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, ground gas (including carbon dioxide and methane), pH and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Source Group 5: Roads and railway land
4	Roads	Heavy metals, TPH including BTEX, PAH, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Source Group 5
5	Sewage works and septic tanks	Heavy metals, cyanide, TPH including BTEX, PAH, ground gas and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Source Group 2
6	Power Stations	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, polychlorinated biphenyls (PCBs), ground gas	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical works, ROF Dunham on the Hill)
7	Historical gasworks	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide,	Source Group 3

No.	Source	Potential Contaminants	Source Grouping
		ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.)	
8	Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Source Group 6: Canals and associated infrastructure
9	Waste sites	Asbestos, heavy metals, TPH including BTEX, PAH, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS.	Source Group 7: Landfills, dredging disposal grounds, infilled ground and waste sites
10	Historical tanneries	Heavy metals, TPH including BTEX, PAH, ammonium	Source Group 2
11	Stanlow Oil Refinery	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, solvents, ground gas, PFAS.	Source Group 3
12	Telephone Exchanges	Asbestos, heavy metals, TPH including BTEX, PAH, PCBs	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)
13	Mineral extraction works and quarries	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, ground gas	Source Group 8: Mineral extraction works, quarries, clay and gravel pits
14	Chemical works	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS.	Source Group 3

No.	Source	Potential Contaminants	Source Grouping
15	Tanks/silos	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, ground gas	Source Group 1
16	Historical farms	Asbestos, heavy metals, TPH including BTEX, PAH, ground gas, pesticides and herbicides	Source Group 1
17	Historical clay/sand/gravel pits and brick works	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, ground gas	Source Group 8
18	Historical smithies	Asbestos, heavy metals	Source Group 1
19	Electricity substations	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Source Group 1
20	Potentially infilled land	Heavy metals, TPH including BTEX, PAH, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS.	Source Group 7
21	Landfills and dredging disposal grounds	Asbestos, heavy metals, TPH, PAH, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS.	Source Group 7
22	Waste transfer stations and scrap yards	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, PFAS.	Source Group 7
23	Historical licensed industrial activities	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PFAS.	Source Groups 1 to 3 (dependant on scale)
24	Historical tanks	TPH including BTEX	Source Group 1
25	Historical petrol stations	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Source Group 1
26	Historical garages	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Source Group 1

No.	Source	Potential Contaminants	Source Grouping
27	Historical energy features	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Source Groups 1 to 3 (dependant on scale)
Within Study Area Only			
28	ROF Dunham-on-the-Hill	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, explosives, PFAS.	Source Group 3

6.3 Potential Receptors and Pathways

6.3.1 Potential receptors and associated pathways, which have been taken forward for consideration in the CM are summarised in **Table 12A6.2**.

6.3.2 Given the linear nature of the Project, there is the potential for the development to form a preferential pathway for migration of ground gas and/or contaminants mobilised in groundwater from contaminant sources in the Study Area. In locations with elevated risk of potential ground and/or groundwater contamination, this may be required to be mitigated by backfilling of pipeline trench with impermeable materials or lined with impermeable lining and will be incorporated into subsequent risk assessments and remediation strategies which will be informed by intrusive ground investigation prior to enabling earthworks.

Table 12A6.2 Potential Receptors and Pathways

Receptor	Pathway
Current site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases
Future site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases
Current adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases
Future adjacent land users (residents, workers, members of the public) following development	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases
Current properties (infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of gases (including via preferential pathway due to development).

Receptor	Pathway
Future property (onshore elements of the Project including below ground pipelines and above ground structures)	Direct contact, migration and accumulation of gases (including via preferential pathway due to development).
Current adjacent properties (infrastructure and utilities, agricultural land including crops)	Direct contact and gas migration / accumulation (including via preferential pathway due to development).
Future adjacent properties (infrastructure and utilities, agricultural land including crops)	Direct contact and gas migration / accumulation (including via preferential pathway due to development).
Current controlled surface waters (listed in Section 4.6.1, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration (including via preferential pathway due to development).
Current controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration (including via preferential pathway due to development).
Current controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration (including via preferential pathway due to development).
Current controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration (including via preferential pathway due to development).

6.4 Exclusions from Risk Assessment

Redevelopment Workers

6.4.1 The CM does not consider risks to construction/site maintenance workers on the basis that risks to workers will be dealt with under the Health and Safety at Work Act (1974) and regulations made under the Act. Site-specific contamination data obtained from all site investigations should be included in the preconstruction information (a requirement of Construction Design and Management (CDM) Regulations 2015 [Health and Safety Executive, 2015]) for the proposed works, to enable contractors to address potential risk from contamination as necessary in their risk assessments and method statements. Moreover, as the exact details of the method adopted are not currently known, it is not considered appropriate to provide a wide ranging and speculative risk assessment for redevelopment workers.

Invasive species

6.4.2 Identification of invasive species (such as Japanese knotweed and giant hogweed) is outside of the scope of works and are not considered within the risk assessment. Invasive species are considered as part of **Chapter 5: Biodiversity** of the Draft ES.

Ecological receptors

6.4.3 Ecological receptors are present within the Site, specifically the Woolston Eyes SSSI 150m east of the Warrington Spur and the Pettypool Brook Valley SSSI located 220m southwest of the South Corridor. The Project is not anticipated to have potential to introduce new land contamination to these receptors and, therefore, these receptors have been excluded from the risk assessment.

6.4.4 Ecological receptors are considered further as part of **Chapter 5: Biodiversity** of the Draft ES.

Current Land Uses

6.4.5 The CM does not consider land uses that are likely to currently be operational and regulated through other means, such as waste management legislation or the Environmental Permitting Regulations 2016. These land uses are expected to operate under requirements to monitor and control potential contaminant emissions, to have undertaken remediation of historical contamination where this has the potential to impact adjacent sensitive receptors and developments, or to remediate potential historical contamination prior to closure of the site. As such, they are expected to present a low risk of contamination to the Project.

6.4.6 Where dewatering of excavations is proposed in the vicinity of potentially contaminative operational sites, this will be incorporated into risk assessments at a later date and will be informed by intrusive ground investigation works to be undertaken prior to commencement of enabling earthworks.

Groundwater and Surface Water Abstractions

6.4.7 As detailed in **Sections 5.6 and 5.7**, no licensed active potable groundwater or surface water abstractions are present within the Study Area. Based on the locations of the nearest potable abstractions (groundwater abstraction approximately 500m north of the HPP HAGI in Stanlow Oil Refinery and surface water abstraction 500m east of the North Corridor section south of Higher Walton HAGI), the potential for the Project to create preferential pathways for contaminants to the potable abstractions is considered to be low. As such, groundwater and surface water abstractions have been excluded as specific receptors.

6.5 Preliminary Risk Assessment

Introduction

6.5.1 For land contamination risk to be realised, a 'contaminant linkage' must exist. A contaminant linkage requires the presence of a:

- source of contamination;
- receptor capable of being adversely affected by a contaminant; and
- pathway capable of exposing a receptor to the contaminant.

6.5.2 A preliminary risk assessment has been undertaken for these potential contaminant linkages to identify potentially unacceptable risks on a qualitative basis. Risk is, therefore, based on a consideration of both:

- the likelihood of an event (probability – takes into account both the presence of the hazard and receptor and the integrity of the pathway); and
- the severity of the potential consequence (takes into account both the potential severity of the hazard and the sensitivity of the receptor).

6.5.3 Further information on the risk assessment methodology used is given in **Annex 12A4**. The method of dealing with identified risks and the level of significance of those risks will be a function of site use. The risk assessment is based on the current and future proposed land use and assumes no control measures to manage the risk (e.g. source removal or capping) have been incorporated in the Project.

6.5.4 Where the risk is considered to be of moderate status or greater, based on the preliminary risk assessment and conceptual model, the contaminant linkage may require further consideration.

6.5.5 The preliminary risk assessment is presented in **Table 12A6.3**.

Overview

6.5.6 The preliminary risk assessment has identified 20 potentially significant contaminant linkages. Potentially significant contaminant linkages are those that are considered to represent a moderate or higher risk. The risks identified are:

- Moderate risks to site users (workers, landowners and members of the public) from dermal contact, ingestion and/or inhalation of contaminated soil, dust, vapours, asbestos fibres and gases associated with:
  - Medium scale industrial land uses or activities such as sewage works, warehouses and depots;
  - Large scale industrial land uses or activities such as oil refineries, power stations and chemical works, gasworks, ROF Dunham on the Hill;
  - Collieries;
  - Landfills, dredging disposal grounds, infilled ground and waste sites; and

  - Mineral extraction works, quarries, clay and gravel pits;
- Moderate risks to controlled surface water receptors from surface water runoff, leaching and groundwater migration associated with:
  - Medium scale industrial land uses or activities such as sewage works, gasworks, warehouses and depots;
  - Large scale industrial land uses or activities such as oil refineries, power stations and chemical works, ROF Dunham on the Hill;
  - Collieries;
  - Landfills, dredging disposal grounds, infilled ground and waste sites; and
  - Mineral extraction works, quarries, clay and gravel pits;
- Moderate risks to controlled groundwater receptors (Secondary A and Secondary B superficial aquifers) from leaching and groundwater migration associated with:
  - Medium scale industrial land uses or activities such as sewage works, gasworks, warehouses and depots;
  - Large scale industrial land uses or activities such as oil refineries, power stations and chemical works, ROF Dunham on the Hill;
  - Collieries;
  - Landfills, dredging disposal grounds, infilled ground and waste sites; and
  - Mineral extraction works, quarries, clay and gravel pits;
- Moderate risks to controlled groundwater receptors (Principal and Secondary A bedrock aquifers) including potential potable abstractions from leaching and groundwater migration associated with:
  - Medium scale industrial land uses or activities such as sewage works, gasworks, warehouses and depots;
  - Large scale industrial land uses or activities such as oil refineries, power stations and chemical works, ROF Dunham on the Hill;
  - Collieries;
  - Landfills, dredging disposal grounds, infilled ground and waste sites; and
  - Mineral extraction works, quarries, clay and gravel pits.

6.5.7 There are also several potential contaminant linkages where the risk from onsite and offsite sources has been assessed to be moderate/low or low. These include risks to:

- Site users (workers, land owners and members of the public), adjacent land users (residents, workers and members of the public), on-site properties (elements of the Project, infrastructure and utilities, agricultural land including crops), adjacent properties (infrastructure and utilities, agricultural land including crops) and controlled waters (including surface water, Secondary A

and Secondary B superficial aquifers, Principal, Secondary A and Secondary B bedrock aquifers) associated with:

  - Small scale industrial land uses and activities, roads and railway land and canals and associated infrastructure;

- Adjacent land users (residents, workers and members of the public), on-site properties (elements of the Project, infrastructure and utilities, agricultural land including crops), adjacent properties (infrastructure and utilities, agricultural land including crops) and controlled waters (Secondary B bedrock aquifers) associated with:

  - Medium and large-scale industrial land uses and activities, collieries, landfills, dredging disposal grounds, infilled ground and waste sites, and mineral extraction works, quarries, clay and gravel pits.

6.5.8 The Site comprises a range of heavily industrialised areas and agricultural areas with little to no development, however the majority of industrialised areas are concentrated at the HAGIs and spurs and in the nearby corridor sections (in particular the St Helens Spurs, the Clock Face Spur, Higher Walton HAGI (HWH2) and Warrington Spurs, HPP HAGI, Rocksavage and Runcorn HAGIs, and the Partington HAGI (PH1) and spur. Features anticipated to present a moderate risk with respect to the Project are predominantly concentrated in these areas; however, it is noted that sources with the potential to create moderate risks are also located elsewhere on the Site in smaller and more isolated areas.

6.5.9 A wide range of potential contaminant sources were encountered across the Site which may present a risk to human health during the construction phase. These have been considered as eight broad groups of source types for the purpose of the preliminary risk assessment (small, medium and large-scale industrial land uses/activities, collieries, roads and railway land, canals and associated infrastructure, landfills, dredging disposal grounds, infilled ground and waste sites, and mineral extraction works, pits and quarries). Given the significantly varied ground conditions and the potential differences in each industrial land use across the Site, more detailed risk assessment may be required prior to construction at each land use presenting a moderate or higher risk from ground contamination which intersects the finalised pipeline route. Allowances should also be made during intrusive groundworks for the potential to encounter significant unexpected contamination on sites identified as presenting a moderate to low or low risk.

6.6 Further Discussion

Current and future site users (human health)

Current and future site users

6.6.1 The Project will comprise buried gas pipelines and localised hydrogen above-ground installations (HAGIs) which will be secured against access by the public and accessed infrequently by workers. The risk to human health during the operational stage is anticipated to be low, and risks to human health are expected to occur during the construction phase when potentially contaminated soil is exposed during excavation.

Adjacent land users

6.6.2 Given the nature of the Project, potential risks to adjacent land users are similarly considered to be restricted to the construction phase, and the potential for off-site migration of contaminants that may impact adjacent land users is limited. Given the use of construction health and safety best practices (e.g. dust suppression and use of vehicle wash bays), the potential for contaminant migration to impact adjacent land users is anticipated to be minimised.

Controlled waters

Surface Water and Secondary A Superficial Aquifers

6.6.3 Several surface watercourses are present within the study areas, and in areas of the Site where Secondary A Aquifers are present, these aquifers are likely to provide base flow to nearby surface watercourses. Where potential sources of contamination identified as presenting a moderate or higher risk to controlled surface waterbodies or superficial aquifers are located in close proximity to a river, precautions may need to be taken to minimise the potential for contaminant migration via surface water runoff, increased contaminant leaching or creation of preferential pathways.

6.6.4 A detailed Construction Environment Management Plan (CEMP) will be prepared by the Principal Contractor prior to construction and which will specify precautions for minimisation of contaminant migration via surface water runoff. An Outline CEMP will be submitted with the draft DCO, a draft of which is provided as **Appendix 3B** of the Draft ES.

Groundwater – Principal and Secondary A Bedrock Aquifers

6.6.5 Approximately 40% of the Study Area (predominantly in the north and west of the Study Area) is underlain by Principal and Secondary A Aquifers, with groundwater SPZs identified to the south of Higher Walton HAGI in these areas. These aquifers are expected to provide a source of potable water abstraction in the vicinity of the groundwater SPZs and may form a source for private water supplies for which records are not publicly available.

6.6.6 Where potential sources of contamination identified as presenting a moderate or higher risk to bedrock aquifers are identified, in or close to areas underlain by Principal or Secondary A Aquifers, precautions may need to be taken to minimise the potential for vertical contaminant leaching or creation of preferential pathways. Given the nature of the Project (which is expected to involve excavations within a narrow corridor and may be required to be lined with impermeable lining or backfilled with impermeable materials in areas where significant potentially mobile contamination is identified by intrusive ground investigation), the potential for increased contaminant migration to bedrock aquifers at depth are anticipated to be minimal.

6.6.7 Mitigation strategies have been developed to protect abstractions and/or aquifers from effects arising from construction of the Project, particularly for receptors close to HDD crossings where excavations would be deeper within the subsurface and/or closer to watercourses and are presented in **Chapter 7: Water Environment** and **Appendix 7D: Assessment of water environment effects**. However, time and cost allowances should be made for the potential need for works to remove or remediate grossly contaminated material identified during intrusive ground investigation or groundworks. If additional precautions are identified as being required to minimise potential for vertical contaminant leaching or creation of preferential pathways following intrusive ground investigation, these will be detailed in a subsequent remediation strategy.

Groundwater – Secondary B Bedrock Aquifers

6.6.8 Approximately 60% of the Study Area (predominantly in the centre, south and east of the Study Area) are underlain by Secondary B Aquifers or Unproductive Strata. Secondary B Aquifers are not regarded as significant sources of groundwater abstraction and are considered to be of low sensitivity with respect to ground contamination. Notwithstanding in the event of gross contamination being identified (during intrusive ground investigation or subsequent earthworks) in groundwater in a Secondary B Aquifer, or where a land use which may present a moderate risk to Principal and Secondary A Aquifers is located close to the boundary between a Secondary B Aquifer and a Principal Aquifer.

6.6.9 Where potential sources of contamination identified as presenting a moderate or higher risk to bedrock aquifers are identified, in or close to areas underlain by Principal or Secondary A aquifers, precautions may need to be taken to minimise the potential for vertical contaminant leaching or creation of preferential pathways. Given the nature of the Project (which is expected to involve excavations within a narrow corridor and may be required to be lined with impermeable lining or backfilled with impermeable materials in areas where significant potentially mobile contamination is identified by intrusive ground investigation), the potential for increased contaminant migration to bedrock aquifers at depth are anticipated to be minimal,

6.6.10 Mitigation strategies have been developed to protect abstractions and/or aquifers from effects arising from construction of the Project, particularly for receptors close to HDD crossings where excavations would be deeper within the subsurface and/or closer to watercourses and are presented in **Chapter 7: Water Environment** and **Appendix 7D: Assessment of water environment effects**. However, time and cost allowances should be made for the potential need for works to remove or remediate grossly contaminated material identified during intrusive ground investigation or groundworks. If additional precautions are identified as being required to minimise potential for vertical contaminant leaching or creation of preferential pathways following intrusive ground investigation, these will be detailed in a subsequent remediation strategy.

Property

Future property

6.6.11 The risks to future property including the buried pipelines and above-ground infrastructure may include aggressive ground conditions interacting with concrete, organic contaminants infiltrating into plastic pipes and accumulation of potentially asphyxiative or explosive gases in confined spaces such as service trenches. Given that the use of concrete structures is anticipated to be limited to the HAGI foundations, the development will not include drinking water supply pipes and the pipeline is likely to be constructed within clean / impermeable service trenches and appropriately designed for the ground conditions, the risks to the Project from land contamination are generally considered to be moderate to low.

6.6.12 In the event that confined spaces such as service trenches form part of the Project and coincide with land uses identified as presenting a moderate risk to human health (or in areas where unexpected gross contamination is identified) entry into these spaces for construction, maintenance and/or operational purposes should be undertaken in accordance with construction health and safety best practices, unless further risk assessment in these areas confirms a low risk to human health from ground gas and vapours.

Adjacent property (infrastructure and utilities, agricultural land including crops)

6.6.13 Potential risks to adjacent property are anticipated to comprise migration of groundwater contaminants, ground gas and vapours along a preferential pathway formed by the pipeline route. The potential risk of contaminant migration along the pipeline corridor to be significantly increased when compared to existing ground conditions across the majority of the Site is considered to be moderate to low, with potential high risks in heavily industrialised areas such as St Helens Spurs, Clock Face Spur, Higher Walton HAGI (HWH2), Warrington Spurs, HPP HAGI, Rocksavage and Runcorn HAGIs and Partington HAGI (PH1). Notwithstanding, in the event that gross contamination is identified in soil or groundwater within the pipeline corridor in close proximity to potentially sensitive adjacent properties, allowances should be made to prevent creation of a preferential pathway (e.g. lining of the clean service trenches with impermeable material or physical barriers at intervals along the pipeline trench).

Table 12A6.3 Preliminary Risk Assessment -– Risks to current and future site users and environment from current and historical sources

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
1	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, ground gas and vapour	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, potential for accumulation of asphyxiative/explosive gases in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Small industrial sites/activities unlikely to intersect with final pipe route, and any contamination present is likely to be relatively localised. Potential to interact with narrow area of groundworks is anticipated to be low.
2	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, ground gas and vapour	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, potential for accumulation of asphyxiative/explosive gases in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Potential for localised contamination to interact with narrow area of groundworks is anticipated to be low.
3	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Potential for localised contamination to interact with narrow area of groundworks is anticipated to be low.
4	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Unlikely	Low	Potential for localised contamination to interact with narrow area of groundworks is anticipated to be low.
5	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos,	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Controlled waters (listed in **Section 5.6.1**, comprising rivers of moderate to	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of	Low likelihood	Moderate/low	Potential for localised contamination to interact with narrow area of groundworks is anticipated to be low. In the

Linkage No.	Potential Source[1F][1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	electricity substations, garages, telephone exchanges, etc)		bad ecological status and failing chemical status)		controlled surface waters [Medium]			event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances.
6	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A superficial aquifers waters [Medium]	Low likelihood	Moderate/low	Potential for localised contamination to interact with narrow area of groundworks is anticipated to be low. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances.
7	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Unlikely	Moderate/low	Potential for localised contamination to interact with narrow area of groundworks is anticipated to be low. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
8	Source Group 1: Small industrial land uses and activities (e.g. historical smithies, farms, tanks, silos, electricity substations, garages, telephone exchanges, etc)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B bedrock aquifers waters [Medium]	Unlikely	Low	Potential for localised contamination to interact with narrow area of groundworks. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
9	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, ground gas and vapours and other organic and	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, potential for	Hazardous to human health [Severe]	Low likelihood	Moderate	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless

Linkage No.	Potential Source[1F][1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
		inorganic compounds (for example ammonia, nitrate etc.)		accumulation of asphyxiative/explosive gases in buildings.				specifically avoided. Shallow excavations undertaken as part of groundworks may have the potential to expose site users to contaminants if encountered. It is noted that the risk is locally considered to be high where the Draft Order Limits intersect with heavily industrialised portions of the Site.
10	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, ground gas and vapours and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, potential for accumulation of asphyxiative/explosive gases in buildings.	Hazardous to human health [Severe]	Unlikely	Moderate/low	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Adjacent site users unlikely to be exposed to contaminants provided construction health and safety best practice utilised.
11	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to impact structures placed in contaminated ground.
12	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of groundwater contaminants.	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Unlikely	Low	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided.

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
		example ammonia, nitrate etc.), PFAS						Contaminants unlikely to migrate to adjacent properties in sufficient concentrations to impact adjacent properties.
13	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Controlled waters (listed **in Section 5.6.1**, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Likely	Moderate	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site.
14	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A superficial aquifers waters [Medium]	Likely	Moderate	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
								contaminant sources is anticipated to be low.
15	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Low likelihood	Moderate	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
16	Source Group 2: Medium industrial land uses and activities (e.g. sewage works, tanneries, warehouses and depots.	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B bedrock aquifers waters [Medium]	Low likelihood	Moderate/low	Medium industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
17	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical works, ROF Dunham on the Hill)	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, ground gas and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Low likelihood	Moderate	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Shallow excavations undertaken as part of groundworks may

Linkage No.	Potential Source[1F][1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
								have the potential to expose site users to contaminants if encountered. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
18	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical works, ROF Dunham on the Hill)	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, ground gas and other organic and inorganic compounds (for example ammonia, nitrate etc.)	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Adjacent site users unlikely to be exposed to contaminants provided construction health and safety best practice utilised.
19	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical works, ROF Dunham on the Hill)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc), PFAS	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of gases, groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to impact structures placed in contaminated ground.
20	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of gases, groundwater contaminants.	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with

Linkage No.	Potential Source1F[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	works, ROF Dunham on the Hill)	compounds (for example ammonia, nitrate etc.), PFAS						pipeline route unless specifically avoided. Contaminants unlikely to migrate to adjacent properties in sufficient concentrations to impact adjacent properties unless gross contamination is encountered during construction earthworks. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
21	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical works, ROF Dunham on the Hill)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Controlled waters (listed in Section 5.6.1, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Likely	Moderate	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
22	Source Group 3: Large industrial land uses and activities (oil refineries, power stations,	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other	Controlled water (Groundwater – Secondary A and	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A	Likely	Moderate	Large industrial sites/activities have been identified within the Draft Order Limits and may have

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	gasworks and chemical works, ROF Dunham on the Hill)	organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Secondary B superficial aquifers)		superficial aquifers waters [Medium]			potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
23	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical works, ROF Dunham on the Hill)	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for example ammonia, nitrate etc.), PFAS	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Low likelihood	Moderate	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
24	Source Group 3: Large industrial land uses and activities (oil refineries, power stations, gasworks and chemical	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, and other organic and inorganic compounds (for	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B bedrock aquifers waters	Low likelihood	Moderate/low	Large industrial sites/activities have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	works, ROF Dunham on the Hill)	example ammonia, nitrate etc.), PFAS			[Medium]			specifically avoided. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
25	Source Group 4: Collieries	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Low likelihood	Moderate	Collieries have been identified within the Draft Order Limits and may have the potential to intersect with pipeline route unless specifically avoided. Shallow excavations undertaken as part of groundworks may have the potential to expose site users to contaminants if encountered. Risk is locally considered to be high where Draft Order Limits intersect with heavily industrialised portions of site. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
26	Source Group 4: Collieries	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Collieries have been identified within the Draft Order Limits and may have the potential to intersect with pipeline route unless specifically avoided. Adjacent site users unlikely to be exposed to contaminants provided construction health and safety best practice utilised.
27	Source Group 4: Collieries	Heavy metals, TPH including BTEX, PAH,	On-site properties (Elements of the	Direct contact, migration and	Concrete attack, infiltration into	Low likelihood	Moderate/low	Collieries have been identified within the Draft

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
		VOCs, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	accumulation of gases, groundwater contaminants	pipes, deterioration of agricultural land [Medium]			Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to impact structures placed in contaminated ground.
28	Source Group 4: Collieries	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of gases, groundwater contaminants.	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Collieries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to migrate along preferential pathways formed by the pipeline route. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
29	Source Group 4: Collieries	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Controlled waters (listed in Section 5.6.1, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Likely	Moderate	Collieries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with former collieries. With implementation of appropriate mitigation measures as

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
								outlined in recommendations, risk from contaminant sources is anticipated to be low.
30	Source Group 4: Collieries	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A superficial aquifers waters [Medium]	Likely	Moderate	Collieries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with former collieries. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.
31	Source Group 4: Collieries	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Low likelihood	Moderate	Collieries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Risk is locally considered to be high where Draft Order Limits intersect with former collieries. With implementation of appropriate mitigation measures as outlined in recommendations, risk from contaminant sources is anticipated to be low.

Linkage No.	Potential Source[1F][1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
32	Source Group 5: Roads and railway land	Asbestos, heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, ground gas (including carbon dioxide and methane), pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage. Shallow excavations undertaken as part of groundworks may have the potential to expose site users to contaminants if encountered.
33	Source Group 5: Roads and railway land	Asbestos, heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, ground gas (including carbon dioxide and methane), pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
34	Source Group 5: Roads and railway land	Heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of gases, groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Unlikely	Low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
35	Source Group 5: Roads and railway land	Heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of gases, groundwater contaminants.	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Unlikely	Low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.

Linkage No.	Potential Source[1F][1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
36	Source Group 5: Roads and railway land	Heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled waters (listed in Section 5.6.1, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Low likelihood	Moderate/low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage. Likelihood of encountering gross contamination that would impact controlled waters is anticipated to be low.
37	Source Group 5: Roads and railway land	Heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A superficial aquifers waters [Medium]	Low likelihood	Moderate/low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage. Likelihood of encountering gross contamination that would impact controlled waters is anticipated to be low.
38	Source Group 5: Roads and railway land	Heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Unlikely	Moderate/low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
39	Source Group 5: Roads and railway land	Heavy metals, TPH including BTEX, PAH, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B bedrock aquifers waters [Medium]	Unlikely	Low	Roads and railway land are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
40	Source Group 6: Canals and associated infrastructure	Asbestos, heavy metals, TPH including BTEX, PAH, cyanide, ground	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts,	Hazardous to human health [Severe]	Unlikely	Moderate/low	Canals and associated infrastructure are anticipated to intersect with pipeline

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
		gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)		vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings				routes only in very localised areas, lowering the risk of a contaminant linkage. Shallow excavations undertaken as part of groundworks may have the potential to expose site users to contaminants if encountered.
41	Source Group 6: Canals and associated infrastructure	Asbestos, heavy metals, TPH including BTEX, PAH, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
42	Source Group 6: Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of gases, groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Unlikely	Low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
43	Source Group 6: Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of gases, groundwater contaminants.	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Unlikely	Low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
44	Source Group 6: Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, pH and other organic and inorganic compounds (for	Controlled waters (listed in Section 5.6.1, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Low likelihood	Moderate/low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
		example ammonia, nitrate etc)						Likelihood of encountering gross contamination that would impact controlled waters is anticipated to be low.
45	Source Group 6: Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A superficial aquifers waters [Medium]	Low likelihood	Moderate/low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage. Likelihood of encountering gross contamination that would impact controlled waters is anticipated to be low.
46	Source Group 6: Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Unlikely	Moderate/low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
47	Source Group 6: Canals and associated infrastructure	Heavy metals, TPH including BTEX, PAH, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B bedrock aquifers waters [Medium]	Unlikely	Low	Canals and associated infrastructure are anticipated to intersect with pipeline routes only in very localised areas, lowering the risk of a contaminant linkage.
48	Source Group 7: Landfills, dredging disposal grounds, infilled ground and waste sites	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, ground gas, pH and other organic and inorganic compounds	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive	Hazardous to human health [Severe]	Low likelihood	Moderate	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have the potential to intersect with pipeline route unless specifically avoided. Shallow

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
		(for example ammonia, nitrate etc)		gases and vapours in buildings				excavations undertaken as part of groundworks may have the potential to expose site users to contaminants if encountered. Risk is locally considered to be high where Draft Order Limits intersect with active or historical landfills or other infilled ground. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
59	Source Group 7: Landfills, dredging disposal grounds, infilled ground and waste sites	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc)	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have the potential to intersect with pipeline route unless specifically avoided. Adjacent site users unlikely to be exposed to contaminants provided construction health and safety best practice utilised.
60	Source Group 7: Landfills, dredging disposal grounds, infilled ground and waste sites	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, ground gas, pH and other organic and inorganic compounds (for example ammonia, nitrate etc), PFAS	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of gases, groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to impact structures placed in contaminated ground.
61	Source Group 7: Landfills, dredging disposal grounds,	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide,	Adjacent properties (infrastructure and	Migration and accumulation of gases,	Concrete attack, infiltration into	Low likelihood	Moderate/low	Landfills, infilled ground and waste sites have been identified within the Draft

Linkage No.	Potential Source1F[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	infilled ground and waste sites	pH and other organic and inorganic compounds (for example ammonia, nitrate etc), PFAS	utilities, agricultural land including crops)	groundwater contaminants.	pipes, deterioration of agricultural land [Medium]			Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to migrate along preferential pathways formed by the pipeline route. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
62	Source Group 7: Landfills, dredging disposal grounds, infilled ground and waste sites	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc), PFAS	Controlled waters (listed in Section 5.6.1, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Likely	Moderate	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with active or historical landfills or other infilled ground. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
63	Source Group 7: Landfills, dredging disposal grounds,	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic	Controlled water (Groundwater – Secondary A and	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A	Likely	Moderate	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	infilled ground and waste sites	and inorganic compounds (for example ammonia, nitrate etc), PFAS	Secondary B superficial aquifers)		superficial aquifers waters [Medium]			potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with active or historical landfills or other infilled ground. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
64	Source Group 7: Landfills, dredging disposal grounds, infilled ground and waste sites	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic and inorganic compounds (for example ammonia, nitrate etc), PFAS	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Low likelihood	Moderate	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Risk is locally considered to be high where Draft Order Limits intersect with active or historical landfills or other infilled ground. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
65	Source Group 7: Landfills, dredging disposal grounds,	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, cyanide, pH and other organic	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B	Low likelihood	Moderate/low	Landfills, infilled ground and waste sites have been identified within the Draft Order Limits and may have

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
	infilled ground and waste sites	and inorganic compounds (for example ammonia, nitrate etc), PFAS			bedrock aquifers waters [Medium]			potential to intersect with pipeline route unless specifically avoided. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
66	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, ground gas	Site users (workers, landowners, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Low likelihood	Moderate	Mineral extraction works, pits and quarries have been identified within Draft Order Limits and may have the potential to intersect with pipeline route unless specifically avoided. Shallow excavations undertaken as part of groundworks may have the potential to expose site users to contaminants if encountered. Risk is locally considered to be high where Draft Order Limits intersect with quarries or other mineral extraction features. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
67	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Asbestos, heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, ground gas	Adjacent land users (residents, workers, members of the public)	Dermal contact, ingestion and inhalation of dusts, vapours, asbestos fibres and gases, accumulation of asphyxiative/explosive gases and vapours in buildings	Hazardous to human health [Severe]	Unlikely	Moderate/low	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have the potential to intersect with pipeline route unless specifically avoided. Adjacent site users unlikely to be exposed to contaminants provided construction health

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
								and safety best practice utilised.
68	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops)	Direct contact, migration and accumulation of gases, groundwater contaminants	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants may have the potential to impact structures placed in contaminated ground.
69	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Adjacent properties (infrastructure and utilities, agricultural land including crops)	Migration and accumulation of gases, groundwater contaminants.	Concrete attack, infiltration into pipes, deterioration of agricultural land [Medium]	Low likelihood	Moderate/low	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Contaminants are unlikely to be present in concentrations sufficient to impact adjacent sites, unless localised areas of gross contamination are encountered.
70	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Controlled waters (listed in **Section 5.6.1**, comprising rivers of moderate to bad ecological status and failing chemical status)	Surface water runoff, leaching and groundwater migration	Potential for contaminants to impact quality of controlled surface waters [Medium]	Likely	Moderate	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with quarries

Linkage No.	Potential Source$_{1F}$[1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
								or other mineral extraction features.
71	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary A superficial aquifers waters [Medium]	Likely	Moderate	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. In the event of interaction, groundworks may have the potential to localise contaminants to controlled waters over short distances. Risk is locally considered to be high where Draft Order Limits intersect with quarries or other mineral extraction features. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
72	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Controlled water (Groundwater – Principal bedrock aquifer/Secondary A bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers (including potential potable abstractions) [Severe]	Low likelihood	Moderate	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. Risk is locally considered to be high where Draft Order Limits intersect with quarries or other mineral extraction features. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.

Linkage No.	Potential Source[1F][1]	Potential Pollutant[2]	Potential Receptors[2]	Potential Pathways to Receptors[2]	Associated Hazard [Severity][2]	Likelihood of Occurrence[2]	Risk / Significance[2]	Comment
73	Source Group 8: Mineral extraction works, quarries, clay and gravel pits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs	Controlled water (Groundwater – Secondary B bedrock aquifer)	Leaching and groundwater migration	Potential for contaminants to impact quality of Secondary B bedrock aquifers waters [Medium]	Low likelihood	Moderate/low	Mineral extraction works, pits and quarries have been identified within the Draft Order Limits and may have potential to intersect with pipeline route unless specifically avoided. With implementation of appropriate mitigation measures as outlined in recommendations risk from contaminant sources is anticipated to be low.
74	Source Groups 1 to 8 – outside of Draft Order Limits	Heavy metals, TPH including BTEX, PAH, VOCs, SVOCs, PCBs, cyanide, pH, organic and inorganic compounds (for example ammonia, nitrate etc), PFAS	On-site properties (Elements of the Project including below ground pipelines and above ground structures, infrastructure and utilities, agricultural land including crops) Controlled water (Groundwater – Secondary A and Secondary B superficial aquifers)	Leaching and groundwater migration	Concrete attack, infiltration into pipes, deterioration of agricultural land Potential for contaminants to impact quality of Principal and Secondary A bedrock aquifers. [Medium]	Low likelihood	Moderate/low	Given the anticipated narrow width of the earthworks corridor, the potential for contaminant migration from off-site sources is expected to be low, except in the case of dewatering works. Where dewatering is required, earthworks will be of shallow depth. Sources of potentially mobile contaminants outside of Draft Order Limits are likely to be at depth greater than extent of proposed earthworks prior to migrating to earthworks (where sources are close enough for this not to be the case, these are captured in previous linkages).

[1] Potential sources and pollutants as detailed in **Section 6.2**. Potential receptors and pathways as detailed in **Section 6.3**. Hazard severity, likelihood and risk/significance as detailed in **Annex 12A4**.

7. Geotechnical Review

7.1 Overview

7.1.1 An intrusive ground investigation was undertaken between September 2022 and December 2022 by Ian Farmer Associates (who were commissioned by RSK) and reported in a May 2023 factual report (presented as **Appendix 12B** of **Chapter 12: Ground Conditions** of the Draft ES). No additional historical targeted ground investigations have been undertaken across the Site in relation to the Project, however, historical BGS exploratory hole records exist across the Site area.

7.1.2 Information from the May 2023 historical exploratory holes has been considered in this geotechnical review to obtain preliminary interpretation of ground and groundwater conditions and to identify key geotechnical risks and hazards that may affect the Project. However, further investigation, evaluation and assessment will be required. The review findings are summarised in the subsections below.

7.1.3 A geohazards desk study was undertaken for the Site in September 2023 and is presented as **Appendix 12D** of **Chapter 12: Ground Conditions** of the Draft ES. It is noted that the geohazards desk study was undertaken based on an earlier iteration of project design, and as such uses Draft Order Limits and a Study Area which have since been superseded. Therefore the geohazards desk study includes assessment of locations which no longer form part of the Project.

7.2 Ground Conditions

St Helens Spurs

7.2.1 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton Glacial Till exist across the majority of the Site.

7.2.2 The bedrock underlying the area consists of sandstone (Kinnerton Sandstone Formation and Chester Formation) within the western boundary of the corridor section and interbedded layers of mudstone and sandstone (Pennine Middle Coal Measures Formation) in St Helens Spurs. Gravelly sandstone (Chester Formation) is present within approximately 5% of corridor section within western boundary. There is also extensive closely spaced faulting across the whole area.

7.2.3 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Superficial deposits – Comprised of stiff brown clay are expected to be encountered across the area. The thickness of these deposits is recorded to be c. 0.5m;

- Bedrock – The bedrock, consisting of stiff very weathered brown to grey Siltstone, is expected to underlie the superficial deposits across much of the site to a depth of c. 0.5m bgl. Bedrock strata are expected to alternate between Siltstone interbedded with Sandstone layers and Mudstone to a depth of c. 30m bgl;
- No clear indication of ground water levels was recorded; and
- Made Ground was not encountered in the historical exploratory holes. The identified Made Ground in the Study Area north of St Helens Spurs is related with historical industrial development as well as historical and authorised landfills.

Clock Face HAGI and North Corridor section to Higher Walton HAGI

7.2.4 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton Glacial Till exist at Clock Face HAGI and the North Corridor section north of the River Mersey. Isolated pockets of Sand (Shirdley Hill Sand Formation) exist in the southeast of the North corridor section and in the Study Area to the east of this corridor section. Isolated pockets of clay intermixed with silt, sand and gravel (Alluvium) exist in the southeast of the North Corridor section south of the River Mersey (and in the Study Area west of this corridor section and north of the River Mersey).

7.2.5 The bedrock underlying the area consists of sandstone (Wilmslow Sandstone Formation), gravelly sandstone (Chester Formation) and sandstone (Kinnerton Sandstone Formation) along the corridor section length from southeast to northwest. The Clock Face HAGI area is occupied by Kinnerton Sandstone Formation in the southeast and mudstone, sandstone and conglomerate (Etruria Formation) in the northwest.

7.2.6 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Superficial deposits comprising Glacial Till comprising of brown clay with pockets and bands of sand with cobble and pebble intrusions, underlain by bedrock comprising red and light brown “bunter sandstone with pebble inclusions”. Glacial Till thickness was not proven within the boreholes;
- Groundwater was not encountered in the selected 30m borehole. However, the record is taken from a 1988 borehole and may no longer be representative of the groundwater conditions; and
- No Made Ground was encountered. Made Ground is only likely to be present in areas affected by previous developments and is likely to vary in depth and consistency.

Higher Walton HAGI and North Corridor section to Central Hub HAGI

7.2.7 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton Glacial Till exists across this entire section of the North Corridor. Sand (Shirdley Hill Sand Formation) is present to the centre and south of Higher Walton

HAGI (HWH2) area. Clay, silt and sand (Tidal Flat Deposits) are identified across the north, east and west of the HAGI (HWH2) area. An isolated pocket of sand and gravel (Glaciofluvial sheet Deposits) was recorded within the Higher Walton HAGI (HWH8) location. Clay, silt, sand and gravel (Alluvium) deposits were identified in the north-south trending stream course in south of this section of the North Corridor. No superficial deposits were identified in isolated areas in the southeast of HAGI area.

7.2.8 The bedrock underlying the area consists of sandstone (Wilmslow Sandstone Formation) in the North Corridor section to the west and south of Higher Walton HAGI options. It also consists of gravelly sandstone (Helsby Sandstone Formation) which is present within Higher Walton HAGI (HWH2 and HWH8) and in the Study Area to the northeast and southwest. Mudstone (Bollin Mudstone Member) is present in the south of the corridor section. There is also limited faulting in the corridor section immediately to the south of Higher Walton HAGI options.

7.2.9 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Topsoil – Topsoil/fill is present to a depth of c. 0.4m bgl;
- Made Ground - this is only likely to be present in areas affected by previous developments. Made Ground encountered is described as red brown clayey sandy fine to coarse gravel of limestone, basalt and mudstone with a thickness of approximately 1.0m bgl;
- Superficial Deposits – These deposits are expected to be encountered across the site area. They typically comprise of Glacial Till to a depth of c.13.5mbgl:
  - Glaciofluvial Sheet Deposits – Expected to be less than 1m thick comprising medium dense gravelly clayey sand with fine to medium gravel of sandstone between approximately 4.4m and 5.1m bgl and medium dense fine to coarse subangular gravel of mudstone and siltstone between approximately 13.5m and 14.1m bgl.
- Bedrock – The bedrock consists of very soft weathered sandstone to a depth of c. 13.0m bgl and stiff red brown to grey green gravelly clay. A slightly weathered Mudstone layer of 0.3m in thickness was encountered within the historical borehole at 16.7m bgl; and
- Ground water levels within the historical boreholes were recorded at 4m bgl and 12m bgl respectively.

Warrington Spurs

7.2.10 Based on the information presented in **Section 5.1**, superficial deposits comprising of clay, silt and sand (Tidal Flat Deposits) exist across most of spur. Sand and gravel (Glaciofluvial Sheet Deposits) is present in the eastern spur.

7.2.11 Bedrock consists of sandstone (Wilmslow Sandstone Formation) underlying the north-western, northern and eastern extent of the Warrington Spurs. The south-

western and southern extent of the Warrington Spurs is underlain by gravelly sandstone (Helsby Sandstone Formation) and siltstone interbedded with mudstone and sandstone (Tarporley Siltstone Formation).

7.2.12 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Made Ground - only likely to be present in areas affected by previous development and is likely to vary in depth and consistency. Made Ground was also encountered to a depth of 6.2m bgl consisting of loose black clayey sandy silt with brick fragments and organic material which was underlain my loose dark grey silty organic sand with fine to medium gravel of brick fragments to a depth of 8.5m bgl. This area of localised deep Made Ground is located north or River Weaver, south of Warrington and in the middle part of Warrington Spurs;
- Superficial deposits – These deposits are expected to be medium dense fine to coarse gravelly sand to a depth of approximately 9m to 10m bgl;
- Bedrock – The underlying bedrock consists of weathered red sandstone to confirmed to varying depths of between 22m and 67m bgl; and
- Ground water strikes were recorded between 3.1m and 5.7 bgl.

HPP HAGI and West Corridor section to Rocksavage HAGI

7.2.13 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton glacial till exist across the HPP HAGI and east of the West Corridor section. Clay, silt and sand (Tidal Flat Deposits) exist across the entire corridor section. Sand and gravel glaciofluvial sheet deposits are located along the southern boundary of the corridor section. A channel of alluvium deposits consisting of clay, silt, sand and gravel exist to the west of the HPP HAGI boundary.

7.2.14 The bedrock underlying the area consists of sandstone (Wilmslow Sandstone Formation) within the east corridor section. It also consists of gravelly sandstone (Helsby Sandstone Formation) which is present in the eastern extent of the corridor section and localised areas of the HPP HAGI. Gravelly sandstone (Chester Formation) is located across the HPP HAGI and West corridor section. Sandstone of the Kinnerton Sandstone Formation is present in localised areas of the HPP HAGI and west of this section of the West Corridor. There are limited faults trending north to south widely spaced along the corridor section.

7.2.15 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Made Ground - only likely to be present in areas affected by previous developments. The encountered Made Ground has been described as sandy gravelly topsoil underlain by grey limestone fill to a depth of 1m bgl;
- Superficial Deposits – These deposits are expected to consist of Glacial Till comprising of firm brown sandy clay to depths of approximately 10.0m bgl:

  - Glaciofluvial Deposits – Expected to alternate with layers of Glacial Till and glaciolacustrine deposits comprising clayey gravelly sands of c.2.0m in thickness and clayey sandy gravels of c.1.6m thick. These deposits were encountered between a depth of 9.35m bgl and 13.8m bgl; and
  - Glaciolacustrine Deposits – Alternating with Glaciofluvial deposits comprising firm thinly laminated brown clay to unknown depths (base of stratum not proven in boreholes).
- Bedrock – The bedrock consists of red sandstone with quartzite pebbles to depths in excess of 150m bgl; and
- Ground water levels were recorded at various depths between 2.35m and 12.2m bgl.

Rocksavage HAGI, Runcorn HAGI and West Corridor section to Central Hub HAGI

7.2.16 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton Glacial Till exist in the Study Area to the east and north of Runcorn HAGI. Clay, silt and sand (Tidal Flat Deposits) exist in the Study Area between Rocksavage HAGI and Runcorn HAGI. Sand and gravel (Glaciofluvial sheet deposits) are located within the Study Area to the northwest of the Rocksavage HAGI and most of this section of the West Corridor. Alluvium deposits consisting of clay, silt, sand and gravel exist along the east and west of the corridor section. No superficial deposits were detected within the centre of the Runcorn/ Rocksavage spur.

7.2.17 The bedrock underlying the area consists of mudstone (Bollin Mudstone) across the Study Area with the exception of the Study Area to the East of Rocksavage HAGI (which is underlain by siltstone interbedded with mudstone and sandstone (Tarporley Siltstone Formation) and to the east of Runcorn HAGI (which is underlain by Tarporley Siltstone Formation and Helsby Sandstone Formation). Two north-south trending faults, widely spaced across the Runcorn/Rocksavage spur have been identified. Two widely spaced northwest-southeast trending faults are recorded in the eastern extent of the West Corridor, southeast of the Central Hub HAGI.

7.2.18 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Superficial deposits – These deposits are expected to consist of large boulders, gravels, sand and gravelly blue clay to c. 30m bgl for the spur option and weathered marl comprising firm red brown gravelly clay to a depth of c. 3.0m bgl and firm to soft sandy silty clay, silty gravelly sand and loose sandy gravel with bands of peaty clay to a depth of 17.1m bgl for the HAGI and corridor section to Central Hub HAGI;

- Bedrock – Consists of red sandstone with occasional layers of grey marl to 106mbgl for the spur option. Bedrock for the HAGI and corridor section to Central Hub HAGI comprises fractured sandstones, mudstones and siltstones with occasional calcite and possible nodules to a proven depth of at least 29m bgl. It also consists of firm to stiff sandy clay with boulders alternating with clayey sand layers to a depth of approximately 46m bgl; and
- Ground water levels were recorded at 1.2m bgl for the spur and 5.4m bgl at the HAGI and corridor section to Central Hub HAGI area.

HSF HAGI and South Corridor to Central Hub HAGI

7.2.19 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton Glacial Till exist across the HSF HAGI and the South corridor. Clay, silt and sand (Tidal Flat Deposits) exist along the eastern extent of the South Corridor. Sand and gravel (Glaciofluvial sheet deposits) are located predominantly in the west boundary of the section. Alluvium deposits consisting of clay, silt, sand and gravel exist along the course of the River Weaver and stream in the west corridor section. River terrace deposits consisting of sand and gravel exist in the south of the corridor section. Peat was also identified in isolated pockets in southwest of the South Corridor.

7.2.20 The bedrock underlying the area consists of mudstone (Bollin Mudstone Member) present within the South Corridor. Halite and mudstone (Northwich Halite Member) is present within the east of the South Corridor. Mudstone of the Sidmouth Formation is present in the HSF HAGI area and within 500m in each direction. Limited northwest-southeast and east-west trending faults, widely spaced along the South Corridor were identified.

7.2.21 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Topsoil – Is expected across the section area presenting a thickness of up to c.0.6m bgl;
- Superficial deposits – These deposits are expected to consist of:
  - Clayey medium sand and soft to firm brown silty gravelly clay to approximately 2.0m bgl; and
  - Red brown silty fine to coarse sand to a depth of 25m bgl.
- Bedrock – Consists of firm to stiff blue grey to reddish brown silty sandy gravelly clay underlain by variegated marl with beds of hard blue and brown marl and marlstone with scales of limestone" up to a depth of approximately 8.20m bgl, which in turn is underlaid by brown and blue marl and/or marlstone with containing gypsum or rock salt to a recorded depth of 150.3m bgl; and
- Ground water levels were recorded at 22.7m bgl.

Central Hub HAGI

7.2.22 Based on the information presented in **Section 5.1**, superficial deposits of Diamicton Glacial Till exist across the Central Hub HAGI area. Sand and gravel (Glaciofluvial sheet deposits) are located predominantly in the southwest of the HAGI area. Alluvium deposits consisting of clay, silt, sand and gravel exist along the course of the River Weaver and stream in the north of Central Hub HAGI area. Superficial deposits were absent across approximately 50% of the northern Central Hub HAGI area.

7.2.23 The bedrock underlying the area consists of mudstone (Bollin Mudstone Member) across the entire area. Limited northwest-southeast trending faults, widely spaced across the northwest of the HAGI area were identified.

7.2.24 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Topsoil – Is anticipated to varying shallow depths;
- Made Ground – Is expected to vary in consistency comprising coarse gravel, very stiff gravelly clay and ash (sand, gravel and cobble sized fragments), loose brown clayey sandy gravel of quartzite, brick and ash, and loose orange-brown clayey gravelly fine to coarse sand with gravel of quartzite up to depths of 5m bgl;
- Superficial Deposits – Consisting of interbedded Glaciofluvial Deposits (loose orange-brown fine to coarse gravelly sand with gravel of quartzite and granite) and Glacial Till (stiff red brown sandy gravelly clay with fine to coarse gravel of mudstone and quartzite) to a depth of 10.6m bgl;
- Bedrock comprising stiff red brown clay and red brown weak extremely closely fractured silty mudstone with occasional gypsum pockets to 11.8m bgl (base of hole); and
- Groundwater encountered at 5.1m bgl (seepage), 6.5m bgl and 8.8m bgl (in Glaciofluvial Deposits).

Warburton HAGI and East Corridor section to Central Hub HAGI

7.2.25 Based on the information presented in **Section 5.1**, superficial deposits of sand (Shirdley Hill Sand Formation) are present in Warburton HAGI and the surrounding Study Area. Diamicton (Glacial Till) is present in the majority of the East Corridor between Warburton HAGI and Central Hub HAGI. Sand and gravel (Glaciofluvial sheet deposits) are located predominantly in the northern and southern extents of the corridor section. Alluvium deposits consisting of clay, silt, sand and gravel exist predominantly in centre of the corridor section and along course of River Dame in the north. Peat was also identified in the centre of this section of the East Corridor. An absence of superficial deposits was identified in the south and centre of the corridor section.

7.2.26 The bedrock underlying the area consists of gravelly sandstone (Wilmslow Sandstone Formation) which is present within Warburton HAGI and the surrounding area to the north and southeast. Helsby Sandstone Formation and Bollin mudstone Formation are also present within the Study Area to the south and to the northeast and west respectively. Siltstone interbedded with mudstone and sandstone (Tarporley Siltstone Formation) is present in the north of this section of the East Corridor. Mudstone (Bollin Mudstone Member) is present within the southeast of the corridor section and around the HAGI area. Halite and mudstone (Northwich Halite Member) is present to the south of the HAGI area. Limited northwest-southeast trending faults, widely spaced to the west of the HAGI and throughout the corridor section were identified.

7.2.27 Based on interpretation of exploratory hole data from historical ground investigations in the surrounding areas, the ground conditions for the Site are anticipated to generally comprise the following:

- Topsoil – Topsoil of 0.25m bgl was encountered near the HAGI area;
- Made Ground – Made Ground of unknown consistency was encountered at middle-south area of the corridor to a depth of 1.2m bgl;
- Superficial Deposits – These deposits are expected to consist of Glacial Till to a depth of 3.3m bgl to the middle-south area of the corridor section and to a depth of 15m bgl in the HAGI area;
- Bedrock – Is expected to consist of grey marl and red brown to grey green laminated weak to very weak silty mudstone with frequent sub-horizontal planar discontinuities to a depth of 20.5m bgl (base of hole). Occasional sub-horizontal gypsum bands from 9.9m bgl; and
- No ground water was encountered in the middle-south corridor section while only seepage water at 1.8m bgl was encountered at the HAGI area.

Partington HAGI and East Corridor section to Warburton HAGI (incl. Partington Spur)

7.2.28 Based on the information presented in **Section 5.1**, superficial deposits of sand (Shirdley Hill Sand Formation) exist in the southern half of the corridor section between Partington HAGI and Warburton HAGI. Sand and gravel (Glaciofluvial sheet deposits) are located in the northern half of the corridor section between Partington HAGI and Warburton HAGI and to the east of Warburton HAGI. Alluvium deposits consisting of clay, silt, sand and gravel exist to the northwest of Partington HAGI and along the course of the stream running east to west through the centre of the corridor section between Partington HAGI and Warburton HAGI. Peat was also identified in isolated pockets in the northern extent of the East Corridor and in Partington HAGI (PH2) and the surrounding Study Area

7.2.29 The bedrock underlying the area consists of gravelly sandstone (Wilmslow Sandstone Formation) which is present in Partington HAGI (PH1 and PH2) and in the Study Area surrounding the HAGI to the north, east and west. The corridor section to Warburton HAGI is underlaid by gravelly Sandstone (Helsby formation) and siltstone interbedded with mudstone and sandstone (Tarporley Siltstone Formation) which is present in the south of the corridor section. Mudstone (Bollin Mudstone Member) is present within the southwest of the corridor section to the northeast of Warburton HAGI. Limited northwest-southeast trending faults, widely spaced across the HAGI and corridor section were identified.

7.2.30 The above conditions would need to be verified by site-specific ground investigation to confirm actual ground conditions.

7.3 Groundwater Conditions

7.3.1 Groundwater was recorded in several historical exploratory holes across the Site. However, due to the size of the Site and the limited data there is no clear observation of groundwater conditions.

7.3.2 Information on hydrology and hydrogeology in the Groundsure Report[7] indicated that some sections of the Site lie within Zone 2 and 3 flood areas.

7.3.3 Based on the above, further investigation and monitoring of the groundwater is required to determine the groundwater regime at the Site.

7.4 Geotechnical Parameters

7.4.1 No geotechnical laboratory testing data was available from the BGS records. However, limited Standard Penetration Testing (SPT) N-values of 50 were recorded in some of the historical logs. The limited data set was not considered sufficient to interpolate and provide geotechnical parameters characterising the strata across the site area. Site specific ground investigation is required to derive characteristic geotechnical parameters.

7.5 Geotechnical Risks and Constraints

7.5.1 Based on the geotechnical review, the following key geotechnical risks and constraints were identified:

- A preliminary interpretation of geotechnical issues and constraints has been undertaken using the available historical exploratory holes within the surrounding area. Intrusive ground investigation is required to provide accurate up-to-date information that can be used to support the detailed design of the Project.
- Potential presence of Made Ground to an unknown depth and extent, associated with pre-existing developments of landfills, railway and motorways.
- Localised areas of soft compressible peat and alluvium would not be suitable as a founding stratum due to high settlement rate. Soft alluvium could also cause excavation instability during and after construction works.

- The location of services existing across or near the proposed pipeline footprints will be considered during the detailed design stage in order to avoid damage during the construction works.
- The groundwater regime within the site boundary is unknown. Further investigation and monitoring of the groundwater conditions across the Site is required to establish groundwater levels and quality.

7.5.2 A preliminary geotechnical assessment has been undertaken to identify the geotechnical risks and hazards that may impact the Project. These together with the proposed mitigation measures to control/manage these risks and hazards are summarised in a preliminary geotechnical risk register (PGRR), The PGRR has been developed in general accordance with the guidance presented in the ICE/DETR Document 'Managing Geotechnical Risk' (2001)[19] and is included as **Annex 12A5**.

7.5.3 The GRR is considered a live document that needs to be reviewed and updated during the subsequent phases of the Project.

[19] Clayton C.R.I. (2001): Managing Geotechnical Risk: improving Productivity in UK Building and Construction

8. Conclusions and Recommendations

8.1 Conclusions

Contamination

8.1.1 The initial conceptual model and preliminary risk assessment has identified 20 potentially significant contaminant linkages within the Study Area representing moderate risks to human health, surface water and groundwater receptors. These linkages relate to a range of medium and large-scale industrial land uses, historical collieries, landfills, dredging disposal grounds, infilled ground and waste sites, and mineral extraction works, pits and quarries, historical landfills and other Made Ground onsite. It is noted that these risks are locally considered to be high where the Draft Order Limits intersect with heavily industrialised portions of the site such as St Helens Spurs, Clock Face Spur, Higher Walton HAGI, Warrington Spurs, HPP HAGI, Rocksavage and Runcorn HAGIs and Partington HAGI (PH1).

8.1.2 The conceptual model and preliminary risk assessment also identified several potential contaminant linkages spread across the Study Area representing moderate to low or low risks to human health, properties, surface water and groundwater receptors. While these linkages are considered to present lower risks due to limited probability and extent of interactions with the pipeline corridor and/or relatively limited potential for contaminants to be present on these sites, there remains the potential for unexpected gross contamination to be encountered in some of these areas, which may present a risk to sensitive receptors in the event that they occur within close proximity to the receptors.

8.1.3 Although in some instances the likelihood of potentially significant linkages relating to human health is assessed as low, where there are potentially severe consequences the overall risk is assessed as moderate or higher, and such risks should be subject to future investigation (as outlined in **Section 8.2**).

Geohazards

8.1.4 A review of the geohazards across the Site has identified several potential constraints. These are generally in relation to the limited data on ground conditions, the presence of potentially soft ground, potential ground instability and the possible presence of physical constraints such as utilities or relic structures. Ground and groundwater conditions will require further investigation in order to inform any temporary and permanent works design.

8.1.5 These constraints will require further assessment as part of the detailed design process.

8.2 Recommendations

8.2.1 Based on the available information for the Site and the preliminary risk assessment, several moderate risk contaminant linkages have been identified (which are considered to be high risk in areas where the Draft Order Limits intersect with heavily industrialised areas). Targeted Phase 2 intrusive site ground investigation (anticipated to be secured as a DCO requirement) will be undertaken prior to construction where required, to:

- characterise ground, groundwater and ground gas conditions in areas of the pipeline corridor where land fits one of the source groups identified as presenting a moderate risk to human health or controlled water receptors;
- confirm or discount any potential contaminant linkages in relation to the historical landfills and Made Ground;
- investigate the depth to groundwater in moderate risk source areas where shallow groundwater may be anticipated in superficial deposits and where Principal or Secondary A bedrock aquifers are present at or close to surface;
- investigate the potential impacts on groundwater quality from moderate risk source areas and the potential for migration of groundwater contaminants and ground gas and vapours along the pipeline corridor to human health or controlled water receptors;
- investigate the potential for structural damage of nearby structures;
- allow in-situ geotechnical testing;
- install monitoring standpipes and groundwater level monitoring;
- collect soil and groundwater samples;
- carry out laboratory analysis of soil and groundwater for potential contaminants of concern, including testing for PFAS where appropriate;
- carry out geotechnical laboratory testing of soils to inform a detailed geotechnical ground model for each area of the site;
- provide a preliminary waste classification for material excavated from moderate risk source areas; and
- inform the temporary works design and the detailed design of the elements of the Project.

8.2.2 Notwithstanding the above, an unexpected contamination protocol will be in place during the construction phase of the Project and implemented in the event that unexpected contamination is encountered.

8.2.3 In areas where dewatering of excavations is expected to be undertaken close to operational potentially contaminative sites or in areas of significant historical industrial use (such as at St Helens Spurs), dewatering risk assessment will be undertaken prior to commencement of enabling works and informed by intrusive ground investigation.

8.2.4 In areas where significant potentially mobile contamination is identified by ground investigation or as unexpected contamination during construction, measures will be in place to amend the design of the pipeline (for example through installation of an impermeable lining) to prevent the pipeline acting as a preferential pathway for contamination.

8.2.5 A detailed UXO risk assessment will be obtained for works in locations found to be of moderate UXO risk (St Helens Spurs, Higher Walton HAGI and North Corridor section south of the River Mersey, Warrington Spurs) in addition to the Runcorn HAGI given its immediate proximity to an area of moderate UXO risk.

9. Glossary of Terms and Abbreviations

Table 12A9.1 Glossary of terms and abbreviations

Term (acronym)	Definition
AOD	Above Ordnance Datum
BGS	British Geological Survey
BTEX	Ethylbenzene and Xylene
CDM	Construction Design and Management
CM	Conceptual Model
COMAH	Control of Major Accident Hazard
Development Consent Order (DCO)	This is the means of obtaining permission for developments categorised as Nationally Significant Infrastructure Projects, under the Planning Act 2008.
Environmental Statement (ES)	The written output presenting the full findings of the Environmental Impact Assessment.
EPA	Environmental Protection Act
GIS	Geographical Information Systems
Horizontal Directional Drilling (HDD)	An engineering technique avoiding open trenches.
LA PPC	Local Authority Pollution Prevention & Control
LCRM	Land Contamination Risk Management
LNR	Local Nature Reserve
NGR	National Grid Reference
NPPF	National Planning Policy Framework
NSIP	Nationally Significant Infrastructure Project
PAH	Polyaromatic Hydrocarbons
SPZ	Source Protection Zones
SSSI	Special Site of Scientific Interest
TPH	Total Petroleum Hydrocarbons

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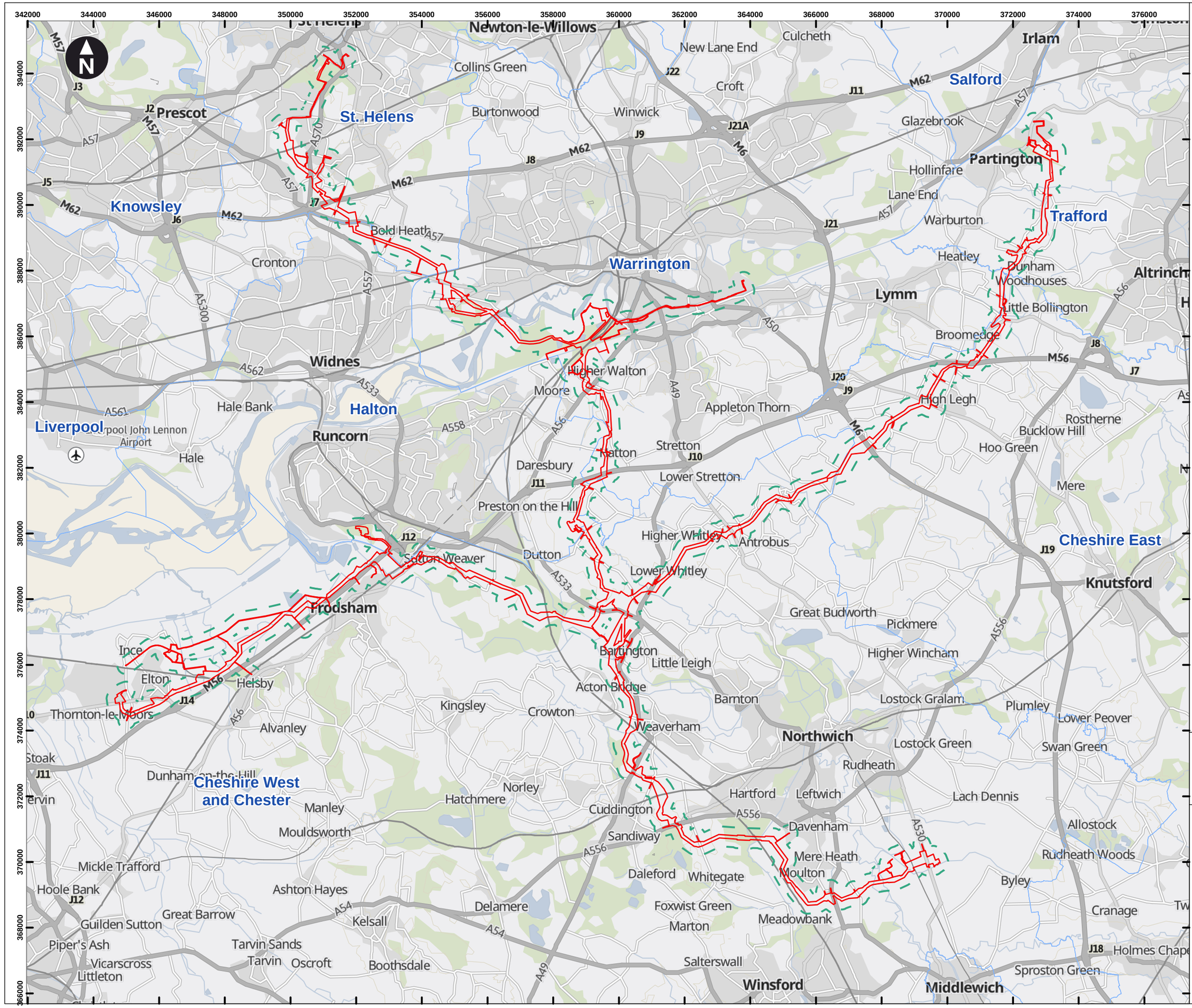
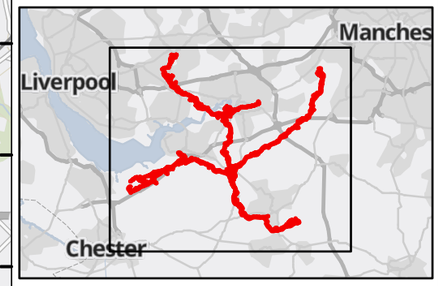
Annex 12A1 Figures



Key

Draft Order Limits

Ground Conditions Study Area



0 1 2 3 4 5 Km

Scale at A3: 1:110,000

Client

Cadent

HyNet North West Hydrogen Pipeline Project
Draft Environmental Statement
Chapter 12: Ground Conditions
Appendix 12A: Phase 1 Preliminary Risk Assessment

Figure 12A.1
Ground Conditions Study Area

October 2024

North Corridor

East Corridor

West Corridor

South Corridor

Partington HAGI Option 1

Partington HAGI Option 2

Warburton HAGI

Clockface HAGI

Higher Walton HAGI Option 2

Higher Walton HAGI Option 8

Sworton Heath BVI

Runcorn HAGI

Rocksavage HAGI

Central Hub HAGI

Hydrogen Production Plant HAGI

Hartford BVI

Hydrogen Storage Facility HAGI

Key

- Draft Order Limits
- Pipeline Limits of Deviation
- Hydrogen Above Ground Installation
- Block Valve Installation

0 1 2 3 4 5 Km

Scale at A3: 1:110,000

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Appendix 12A: Phase 1 Preliminary Risk Assessment

Figure 12A.2
Key Components of the Project

October 2024

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Annex 12A2
Historical Mapping Summary

Edition	Description (On site and within Study Area)
St Helens Spurs to Clock Face HAGI	
1849-1850	The St Helens Spurs portion of the Study Area was predominantly agricultural, however the northernmost extent of the spur extended into the town of St Helens. This area was heavily industrialised, and was extensively occupied by industrial uses including plate glass and bottle works, copper works and collieries (including coal pits and shafts) and clay pits. Dams and canals were also present throughout the area. South of St Helens, several localised and isolated industrial uses were present within the otherwise residential and agricultural land uses of the Study Area, including Sutton Colliery, old coal pits, Sutton Heath Potteries, Ravenhead Colliery and nearby old coal shafts and Sutton Smalt Works.
1892-1984	The northernmost extent of St Helens Spurs became more extensively developed with buildings, pits, railway lines and magazines associated with the existing industrial uses in the industrialised area of St Helens. South of St Helens, Ravenhead Colliery was replaced by Alexandra Colliery and Greengate Brick and Tile Works and was surrounded by active and disused clay pits, an old canal and the Huyton and St Helens branch line of the London and Northwest Railway (L & NW R) (located in a cutting). Several magazines were located throughout the St Helens Spurs. Sutton Smalts Works (located in the south of St Helens Spurs near Clock Face HAGI) was re-labelled as Brook Works (Ultramarine and Smalts).
1906	Industrial development in the northernmost extent of St Helens Spurs became more dense with assorted works buildings associated with the existing industrial uses on the site, with the addition of lead works, pipe and brick works, boiler works, timber yards and foundries. South of St Helens, the area of clay pits and old shafts around Alexandria Colliery and Greengate Brick and Tile Works expanded slightly towards the south, and the pits associated with Sutton Heath Collieries expanded to the north, east and west. Brook Works was identified as an ‘Ultramarine and Smalts Works’.
1925-1926	The heavily industrialised area in the northernmost extent of St Helens Spurs became dominated by glass and sheet glass works, though a number of pipe and brick works and foundries remained present. South of St Helens, the area of clay pits and old shafts around Alexandria Colliery and Greengate Brick and Tile Works expanded slightly towards the south, and the pits associated with Sutton Heath Collieries expanded significantly to the north, east and west, with additional clay pits and a brick works constructed to the north. Sutton Manor Colliery was constructed in the south of St Helens Spurs, to the northeast of Clock Face HAGI.
1938-1947	South of St Helens, additional works buildings associated with Alexandria Colliery and Greengate Brick and Tile Works were constructed. Sutton Manor Sewage Works was constructed in the south of St Helens Spurs.
1955-1956	No significant changes.
1965-1966	No significant changes. All existing works and collieries were shown to still be present but were labelled as unspecified ‘works’.
1974	South of St Helens, Sutton Heath Potteries was removed and the buildings of a large transport depot constructed in its place. Alexandria Colliery and Greengate Brick and Tile Works were removed and a large residential estate (Sutton Heath) was constructed between Alexandria Colliery and Greengate Brick and Tile Works and the transport depot. A second residential estate (Sutton Manor) was constructed in the south of St Helens Spurs adjacent to the northwest of Sutton Manor Colliery and two unspecified depots were build adjacent to the northwest of the residential estate.

Edition	Description (On site and within Study Area)
1981-1985	In the northernmost extent of the St Helens Spurs, a number of unspecified works buildings were removed. An area of railway sidings and pits was removed and occupied by a disused tip. A number of new unspecified works buildings were constructed in the footprint of the current Pilkington UK Ltd glass works. A number of unspecified depots and a garage were constructed to the southeast of the Pilkington UK Ltd buildings. An unspecified works and a number of disused tips were located in the area previously occupied by Sutton Heath Collieries. Several unspecified works and factories were constructed to the northwest of the residential estate of Sutton Manor. The M62 motorway and approximate contemporary road layout in the south of the St Helens Spur had been constructed.
2001	In the northernmost extent of the St Helens Spurs, additional works buildings were removed. The works buildings in the footprint of the current Pilkington UK Ltd glass works matched their contemporary layout. The A570 and approximate contemporary road layout in the north of the St Helens Spurs had been constructed. The buildings and infrastructure associated with Sutton Manor Colliery had been removed, however old shafts were indicated to still be present. The original Sutton Manor residential estate had been removed and replaced with a new residential estate of the same name. The unspecified works and factories to the northwest of Sutton Manor were identified as Lea Green Business Park.
2010	In the northernmost extent of the St Helens Spurs a retail park, power station and unspecified commercial buildings were constructed on the disused tip. A waste reception centre was constructed east of Pilkington UK Ltd glass works. Part of the footprint of the former Ravenhead Colliery (east of the former Alexandra Colliery and Greengate Brick and Tile Works) was developed as Ravenhead Nature Park. The footprint of the former Alexandra Colliery and Greengate Brick and Tile Works remained disused. The former Sutton Manor Colliery was developed as a nature park (Sutton Manor Woodland).
2022	The unspecified works and disused tips in the area of the former Sutton Heath Collieries were replaced with residential housing. No other significant changes recorded.
Clock Face HAGI and North Corridor section to Higher Walton HAGI Options	
1849	The HAGI and corridor section and surrounding ZoI (collectively the Study Area) were predominantly agricultural and residential, with isolated farms located across the area since 1849. Small sandstone quarries and sand pits were located in the northern half of the Study Area. The St Helens line of the L&NW R crossed the north of the Study Area from north to south and the Cheshire Lines Railway crossed the site from southwest to northeast to the east of the St Helens Line. Railway lines of the L & NW R, electrical telegraph lines and the St Helens Canal were located across the southern end of the Study Area adjacent to the northwest of the River Mersey.
1891-1897	No significant changes
1905-1906	A sewage farm was constructed in the north-western extent of the Study Area. A septic tank was located within the northern boundary of the Study Area at Bold Heath. A tannery was recorded within the north of the Study Area at Penketh. A turn bridge and ferry lock were located at the intersection between the Study Area and the St Helens Canal. A sheep dip works and several unspecified works buildings were located between St Helens Canal and the River Mersey.
1925-1926	The sheep dip works was replaced by a shipyard.
1938-1969	Penketh Tannery expanded to a number of works buildings – labelled as unspecified works from 1958 onwards. The shipyard buildings were labelled as a cannery. No other significant changes noted.
1970-2000	No significant changes
2001-present	Unspecified works (formerly Penketh Tannery) were replaced by residential housing.
Higher Walton HAGI Options and North Corridor section to Central Hub HAGI	
1849	The Runcorn and Latchford (R & L) Canal, was located south of the River Mersey running southwest to northeast with the Manchester Ship Canal and the L & NW R and Great Western (GW) joint railway to the south of the R & L Canal, also running southwest to northeast.

Edition	Description (On site and within Study Area)
	South of the HAGI options, the corridor section was predominantly agricultural with sparse residential development.
1891-1897	A hydraulic installation was recorded adjacent to the north of the Manchester Ship Canal.
1905-1906	Timber yards and sidings were present adjacent to the north of the Manchester Ship Canal since 1905. Sewage disposal works with tanks were present in the corridor section adjacent to the west of the Draft Order Limits.
1925	A sewage works was constructed in the corridor section to the south of Walton Hall golf course. Allotment gardens and a timber yard were constructed between the L & NW R and Great Western (GW) joint railway lines north of the Manchester Ship Canal.
1954-1958	A sewage works was recorded at the intersection between the Manchester Ship Canal and the L & NW and GW joint railway line (south of the canal and west of the railways) and railway sidings were recorded at the same intersection north of the canal, west of HWH2. A sand pumping station was constructed on the northern boundary of the Higher Walton HAGI (in the area later identified as Arpley Dredging Deposit Ground).
1967-1969	No significant changes.
1970	An area of unspecified works was recorded at the intersection between the Manchester Ship Canal and the L & NW and GW joint railway line (north of the canal and east of the railways), north of HWH8. Dredging deposit ground (later identified as Arpley Dredging Deposit Ground / Arpley Landfill site) occupied land between the River Mersey and Manchester Ship Canal within the study Area north of the Higher Walton HAGI options. A pipeline was present in the north of the dredging deposit ground between the River Mersey and an unnamed drain. The sewage works to the south of Walton Hall golf course was removed.
1975	The Timber yards and sidings at Manchester Ship Canal were replaced by a warehouse.
1982	The M56 motorway was constructed across the middle section of the corridor section running east to west.
1987	An additional warehouse was constructed at the former timber yards.
2001-present	A depot was constructed to the south of Manchester Ship Canal, adjacent to the sewage works.
Warrington Spurs	
1894	Mixed residential, industrial and railway development present since 1894, including borate works, iron works, tanneries and hide yards. The Study Area to the east and northeast of the Warrington Spurs (identified as ‘The Eyes’ was occupied by undeveloped land with a network of unnamed land drains.
1905	A mineral railway was constructed along the eastern length of the Warrington Spurs. A number of industrial works were constructed in the Study Area, including Palatine Works (unspecified), Latchford Tannery, Wilderspool Iron Works and a ‘Hide Yard’ to the north of the Warrington Spur, a hydraulic installation house was constructed adjacent to the north and Mostyn Tube works with tanks constructed to the east of the Warrington Spur.
1926	Additional iron works and foundries were constructed in the north and south of the Study Area in the west of Warrington Spurs. Allotment gardens were constructed in the south of the Study Area in the west of Warrington Spur. Richmond Works constructed adjacent to the north of the eastern extent of Warrington Spur.
1938	Significant increase in overall density of residential and unspecified industrial developments in the Study Area to the north and south of Warrington Spurs between 1938 and 1969. The Study Area to east and northeast of site were occupied by Canal Deposit Land. Iron foundry and a bitumen works constructed in approximate centre of the spur. Full length of Warrington Spurs were occupied by roads.

Edition	Description (On site and within Study Area)
1954	Additional unspecified works were constructed adjacent to the east of the Warrington Spurs. A large area of The Eyes was occupied by a blank space on the map surrounded by a slope (possible lagoon).
1969	Additional unspecified works were constructed adjacent to the northeast of the eastern end of the Warrington Spurs. The allotment gardens to the south of the western extent of the Warrington Spurs were replaced by a warehouse.
1987	The warehouse to the south of the western extent of the Warrington Spurs was expanded and additional unspecified industrial buildings were constructed to the south of the warehouse. A depot and additional unspecified works buildings were constructed to the north of the Warrington Spurs immediately north of the warehouse (the existing Premium Tanker Services and Colas Bitumen Works respectively).
2010	Richmond Works was removed. The warehouse and majority of the unspecified industrial buildings to the south of the western extent of the Warrington Spurs were replaced by a recreation ground, and the remaining industrial buildings were labelled as depots and warehouses. No additional significant developments were observed.
HPP HAGI and West Corridor Section to Rocksavage HAGI	
1897	The Study Area around the HAGI and corridor section were predominantly agricultural with sparse residential development. Land to the north of the corridor section was occupied by undeveloped land with a network of unnamed land drains. A railway line ran from east to west along the northern boundary of the HAGI. A brick field was present in the corridor section north of the village of Frodsham. A gasworks and a gasometer were present on the southern edge of the Study Area at the eastern extent of the corridor in the village of Frodsham.
1908	A water works was constructed between the corridor section and the gas works at Frodsham.
1912	The gasworks in Frodsham was removed.
1967-1968	Stanlow Oil Refinery was constructed, occupying the footprint of the HAGI and the Study Area to the north of the HAGI (it is understood that elements of Stanlow Oil Refinery were initially constructed in 1924, however these are not shown to be present in the Study Area until 1967). The NCR 5 road was constructed adjacent to the south of the HAGI to the south of the HAGI (separated from Stanlow Oil Refinery by the railway line). An unspecified works including tanks was located to the north of the corridor section adjacent to the south of the proposed access routes.
1982-1983	A telephone exchange, depot, reservoir and fire station were recorded in the village of Frodsham within the southern edge of the Study Area, in the vicinity of the former gasworks. A service area was constructed to the south of the corridor section north of the Hapsford Junction on the NCR 5 road.
1990	A sewage works was located approximately 250 m north of the corridor section near the HAGI and to the south of the proposed access routes. The unspecified works to the north of the corridor section adjacent to the south of the proposed access routes was removed. An electricity generating station including tanks and cooling towers was located within the north of the Study Area adjacent to the south of the proposed access routes north of the HAGI. An additional unspecified works with tanks (currently identified as CF Fertilisers) was located within the north of the Study Area adjacent to the south of the proposed access routes.
2001	Parts of Stanlow Oil Refinery within the HAGI and to the north of the HAGI were removed. Previously undeveloped land in the north of the Study Area in the eastern extent of the corridor section was occupied by a canal deposit dump.
2010	The electricity generating station was removed and replaced by Quinn Glass manufacturing plant (existing to the present and currently identified as Encirc Glass). No additional significant developments were observed.
Rocksavage and Runcorn HAGIs and West Corridor section to Central Hub HAGI	
1897	The Study Area around Rocksavage and Runcorn HAGIs and the corridor sections between them and to the southwest and east were predominantly agricultural with sparse residential development. Several bone and charcoal works (Weston Bone and Charcoal Works, Rocksavage Bone Works and Runcorn Bone Works), were located between the HAGIs along the Weaver Navigation, including in the corridor section between the HAGIs (Rocksavage Bone Works). A chemical works (Weaver Chemical Works) was located in the Study Area south of

Edition	Description (On site and within Study Area)
	Rocksavage HAGI and south of the River Weaver. The L & NW & GW Joint railway crossed the corridor section to the east of Rocksavage HAGI. Old clay pits, farms and smithies were present within the Study Area along the western extent of the corridor section.
1908	Tanks were recorded at Weaver Chemical Works and Rocksavage Bone Works and at the intersection between the River Weaver and the corridor section.
1938	A steel tube works was located between Rocksavage HAGI and Runcorn Bone Works northeast of the Weaver Navigation.
1953-1954	A canal deposit tip was located within the Study Area to the south of Runcorn HAGI.
1964-1968	The canal deposit tip was replaced by a lagoon. Runcorn Bone Works was labelled as an unspecified works with a chimney.
1982	Significant industrial development took place to the west of Runcorn, including unspecified works extending into the Study Area. A pipe line was recorded from the northern bank of the River Weaver into the corridor section southeast of Runcorn HAGI. A gas pressure breakdown station was constructed in the south of Runcorn HAGI. An electricity substation was constructed adjacent to the east of Rocksavage HAGI between the Weaver Navigation and the River Weaver. A pumping station was located adjacent to the north of the corridor section south of the River Weaver. The M56 was constructed through Rocksavage HAGI running southwest to northeast and Weston Point Expressway were constructed to the northeast of the corridor section between Rocksavage and Runcorn HAGIs and north of Runcorn HAGI. An industrial estate (Ashville Industrial Estate) was constructed adjacent to the northeast of Rocksavage HAGI and a number of pumping stations, depots and unspecified works were constructed adjacent to the north of the corridor section to the Central Hub HAGI.
2001	Weaver Park Industrial Estate was constructed adjacent to the south of the corridor section southeast of Rocksavage HAGI. A power station was constructed adjacent to the east of Runcorn HAGI. No additional significant developments were observed.
South Corridor section from Central Hub HAGI to Hartford BVI	
1897	The corridor section and the Study Area were predominantly agricultural with sparse residential development. Acton Quay was located in the Study Area adjacent to the east of the northern extent of the corridor section. Weaver Refining Works was located in the Study area adjacent to the east of the northern extent of the corridor section at Acton Bridge. The L & NR railway (Grand Junction Line) crossed the Study Area southwest of Weaverham. The Cheshire Lines railway crossed the Study Area east of Cuddington, running southwest to northeast. A creamery was located within the south-western boundary of the Study Area east of Cuddington. Old sand / marl pits, farms and smithies were present at isolated locations within the Study Area along the length of the corridor section. A gasometer was located in the Study Area adjacent to the east of the corridor section east of the BVI.
1908	A coal yard was located east of the corridor section at Acton Quay.
1938	A sanatorium was constructed in the Study Area adjacent to the east of the corridor section southwest of Weaverham. The gasometer adjacent to the east of the corridor section east of the BVI was removed.
1954	An unspecified pit was located in the Study Area west of the corridor section and partly within the corridor section west of the BVI.
1969-1973	The coal yard east of the corridor section at Acton Quay was replaced by a caravan park. The creamery within the south-western boundary of the Study Area east of Cuddington was labelled as an unspecified factory. The unspecified pit in the Study Area west of the corridor section and partly within the corridor section west of the BVI was expanded into the corridor section adjacent to the north and west of the BVI. The A556 was constructed crossing the Study Area from east to west adjacent to the south of the BVI.
1979-1984	A nursery was constructed in the Study Area to the west of the corridor section east of Cuddington. The unspecified pit to the north and west of the BVI was labelled as disused workings. No additional significant developments were observed.
Hartford BVI and South Corridor section to HSF HAGI	

Edition	Description (On site and within Study Area)
1897	The corridor section and the Study Area were predominantly agricultural with sparse residential development. A brick field (Brickhill Pits) was located in the Study Area adjacent to the north of the corridor section southwest of Hartford. Old sand pits, farms and smithies were present at isolated locations within the Study Area along the length of the corridor section. The L & NR railway (Grand Junction Line) crossed the Study Area west of Davenham, running northwest to southeast. A pumping station and a water tower associated with Northwich Water Works were located in the Study Area at Moulton west of the corridor section and east of the corridor section respectively. Newbridge Salt Works was located in the Study Area to the west of the corridor section.
1969-1970	The Northwich Water Works pumping station and water tower were removed. Newbridge Salt Works was no longer labelled and the associated brine cisterns were labelled as disused.
1979-1981	A caravan site was constructed in the footprint of the former Newbridge Salt Works. A telephone exchange was constructed 300 m north of the HSF HAGI in 1977. No additional significant developments were observed.
Central Hub HAGI	
1897	The Central Hub HAGI and surrounding area are predominantly agricultural with isolated residential development. A brick and tile works and an old marl pit were present in the Study Area to the southeast of the Central Hub HAGI at Bartington. An old gravel pit was located in the Study Area to the west of the Central Hub HAGI. Isolated farms were located across the Study Area and corridor section at the Central Hub HAGI.
1973	A depot and garage were constructed in the Study Area east of the Central Hub HAGI at Dones Green at the intersection between Warrington Road and the A533.
1985	A dredging disposal ground was located at in the Study Area between the corridor sections to the HSF HAGI to the south and and the HPP HAGIs to the east, and extended into the corridor section to the HSF HAGI.
Central Hub HAGI and East Corridor section to Sworton Heath BVI	
1897 to present	The corridor section and the Study Area were predominantly agricultural with sparse residential development and no potentially significant pertinent features were identified with the exception of isolated farms and clay and gravel pits. No additional significant developments were observed.
Sworton Heath BVI and East Corridor section to Warburton HAGI	
1897-1899	The HAGI and corridor section and the Study Area were predominantly agricultural with sparse residential development. A brick field was located in the corridor section to the northeast of the BVI, north of High Legh. The Warrington and Stockport railway line crossed the Study Area adjacent to the south of the HAGI. No other potentially significant pertinent features were identified with the exception of isolated farms, smithies and clay and gravel pits.
1905-1908	The brick field northeast of the BVI was replaced by a brick works. A disused quarry was located in the Study Area west of the corridor section at Agden.
1968-1971	The brick works was removed. A depot was constructed in the Study Area adjacent to the south of the corridor section adjacent to the southwest of the former brick works.
1981	A gas valve compound was constructed in the corridor section adjacent to the west of the HAGI. No additional significant developments were observed.
East Corridor section from Warburton HAGI to Partington HAGI options (incl. Partington Spur)	
1885-1897	The Partington HAGI options, spur, corridor section and Study Area were predominantly agricultural. The Cheshire Lines railway crossed the Study Area adjacent to the south of the HAGI options, running from northwest to southeast. A network of tramways were located to the east of the corridor section north of the Cheshire Lines railway and crossed the corridor section from east to west south of the Cheshire Lines railway. Partington Station was located in the Study Area to the west of the HAGI option (PH1) and railway sidings were located to the west of Partington Station. A peat desk study undertaken by Wood (**Appendix 13A** of the draft ES) identified the disposal of 'nightsoil' at Carrington Moss in the vicinity of Partington HAGI taking place from 1885 to 1910. This is anticipated to have been located to the east of the Site, however the 'nightsoil' disposal area was not recorded in the Groundsure historical maps.

Edition	Description (On site and within Study Area)
1904-1908	An engine shed was located on the railway sidings west of Partington Station.
1938	Several unspecified works buildings were constructed in the Study Area to the west of the corridor section south of the Cheshire Lines railway.
1950-1954	The unspecified works in the Study Area to the west of the corridor section south of the Cheshire Lines railway was identified as Partington Gas Works, and railway sidings and several cylindrical tanks were constructed among the works buildings. A gas works was constructed on HAGI option (PH1) including a gasholder. Partington Gasworks . A petrochemicals plant with tanks was constructed approximately 400 m to the northeast of the corridor section, partly extending into the Study Area.
1981	The gas works and the petrochemical plant had been significantly expanded with a number of additional tanks and buildings constructed across the entire area of the HAGI option (PH1) and spur. The Partington Gasworks was redeveloped with a new layout of the works buildings, four new cylindrical tanks and reservoir adjacent to the west of the corridor section. Three additional cylindrical tanks associated with the gasworks were constructed adjacent to the east of the corridor section south of the railway line. A tank farm and depot were constructed adjacent to the northwest of the HAGI (PH1) and spur. The HAGI option (PH2) remained undeveloped, however additional railway sidings were constructed adjacent to the east of the HAGI option (PH2), running north to south.
1995	The Cheshire Lines railway adjacent to the south of the HAGIs had been dismantled. Several of the buildings and tanks associated with the gas works in the HAGI (PH1) footprint and surrounding Study Area had been removed, as had the gasworks tanks to the east of the corridor section south of the railway line. Many of the buildings associated with the petrochemical plant were removed suggesting that the plant had been decommissioned or was in the process of being decommissioned, though these buildings were predominantly outside the Study Area to the northeast.
2001	Additional petrochemical plant buildings were removed within the Study Area to the north of the HAGIs. A garden centre was recorded in the study Area adjacent to the northern extent of the spur.
2003	The tank farm to the northwest of the HAGI (PH1) and spur were removed. Google Earth imagery identified the depot as a paper manufacturing plant.
2009-2017	Between 2009 and 2017 the gasworks to the west of the corridor section south of the former railway was removed. Between 2009 and 2013 a large unspecified works was constructed adjacent to the northwest of the paper manufacturing plant in the footprint of the former tank farm, including circular tanks and a lagoon. Most of the former petrochemical plant buildings were removed. Several warehouses were constructed adjacent to the north and west of the northernmost spur.
2019	The gasholders in the vicinity of HAGI (PH1) were removed, including the gasholder located in the immediate footprint of HAGI (PH1), the base of which remain in place and filled with water. An unspecified former gasworks building and above-ground pipework remain adjacent to the west of the PHAGI (PH1). No additional significant developments were observed.

Annex 12A3
Site Walkover Photographs

Photo 1 – Sign at Central Hub HAGI Dredging Disposal Ground

Photo 2 – Central Hub HAGI Dredging Disposal Ground

Photo 3 – Central Hub HAGI industrial estate petrol filling station

Photo 4 – Historical brick and tile works (former location of proposed St Helens HAGI), southern boundary

Photo 5 - Historical brick and tile works (former location of proposed St Helens HAGI), northern boundary

Photo 6 - Ravenhead Nature Park (former colliery)

Photo 7 - Ravenhead Nature Park – pollution in Groves Dam Pond

Photo 8 – Pilkington Glass Works

Photo 9 –Clock Face HAGI

Photo 10 – Sutton Manor Woodland (former colliery). Possible electricity substation visible in left rearground

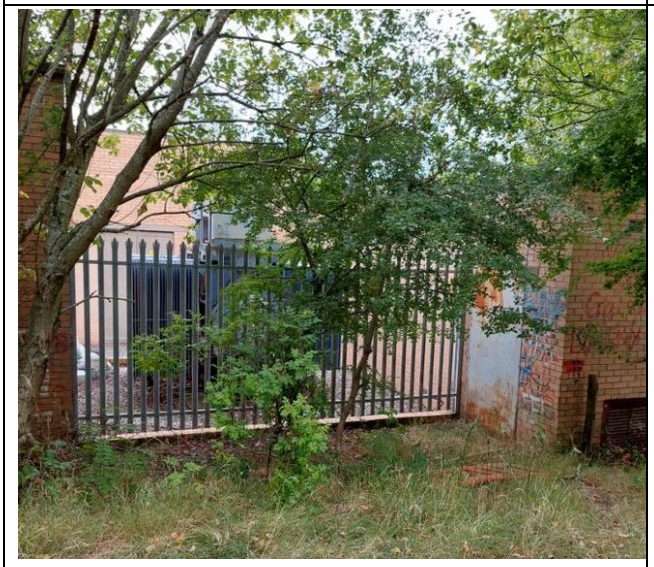

Photo 11 - Possible electricity substation at Sutton Manor Woodland

Photo 12 – Derelict DGS Integrated Services on western boundary of Sutton Manor Woodland

Photo 13 – Fly tipping at derelict DGS Integrated Services

Photo 14 – Fiddlers Ferry Power Station

Photo 15 – Arpley Landfill, scrubland

Photo 16 – Borehole cover (blue) at Arpley Landfill

Photo 17 – Remains of railway track at Arpley Landfill (centre of road)

Photo 18 – Brick structure at Arpley Landfill (behind gate)

Photo 19 – FloMix UK in footprint of former timber yards and railway sidings along St Helens Canal.

Photo 20 – Historical bitumen works in rearground, photo taken from southwest

Photo 21 - Historical bitumen works in rearground, photo taken from southeast

Photo 22 – Metal and vehicle recycling centre in location of historical Richmond Works

Photo 23 – Storage container retailer/manufacturer in location of historical Richmond Works

Photo 24 – Industrial site in location of historical Richmond Works

Photo 25 – Unspecified works (CF Fertilisers) east of Hydrogen Production Facility HAGI

Photo 26 – Historical dredging disposal ground between HPP HAGI and Rocksavage HAGI

Photo 27 - Historical dredging disposal ground between HPP HAGI and Rocksavage HAGI

Photo 28 – Power station entrance northwest of Runcorn HAGI

Photo 29 – Gas distribution station adjacent to southeast of Runcorn HAGI.

Photo 30 - Gas distribution station adjacent to southeast of Runcorn HAGI.

Photo 31 – Unidentified brick structure at south-eastern boundary of lagoon (historical landfill) and Runcorn HAGI

Photo 32 - South-eastern boundary of lagoon (historical landfill) and Runcorn HAGI

	
Photo 33 - Covered brick well at south-eastern boundary of lagoon (historical landfill) and Runcorn HAGI	Photo 34 – Electricity substation between Rocksavage and Runcorn HAGIs
	
Photo 35 – Northern boundary of refuse tip and industrial sludge landfill east of Rocksavage HAGI	Photo 36 – Post labelled “ICI” at northern boundary of refuse tip and industrial sludge landfill east of Rocksavage HAGI

Photo 37 – ICI sign at northern boundary of refuse tip and industrial sludge landfill east of Rocksavage HAGI

Photo 38 – HSF HAGI (in rearground)

Photo 39 – Unspecified works with shaft in west corridor between HSF HAGI and Central Hub HAGI

Photo 40 – Historical salt works east in west corridor between HSF HAGI and Central Hub HAGI.

	
Photo 41 – Infrastructure (tanks) in vicinity of Partington HAGI (PH1)	Photo 42 – Former steel works to south of Partington HAGI (PH1) undergoing redevelopment as residential housing
	
Photo 43 -Warburton HAGI	

Annex 12A4 Preliminary Risk Assessment Methodology

The environmental risk assessment aims to assess the significance of each potential contaminant linkage. The key to the classification is that the designation of risk is based upon the consideration of both:

- **the magnitude of the potential consequence (i.e. severity).** It takes into account both the potential severity of the hazard and the sensitivity of the receptor; and
- **the magnitude of probability (i.e. likelihood).** It takes into account both the presence of the hazard and receptor and the integrity of the pathway.

The definitions for the qualitative risk assessment have been taken from 'Guidance for the Safe Development of Housing on Land Affected by Contamination' Annex 4 R&D Publication 66: 2008 Volume 2.

The Likelihood Probability Classifications of SPR Linkage being realised is presented in **Table 12A4.1**

Table 12A4.1 Likelihood Probability Classifications of SPR Linkage being realised

Classification	Definition	Examples
Unlikely	There is pollutant linkage but circumstances are such that it is improbable that an event would occur even in the very long-term.	a) Elevated concentrations of toxic contaminants are present below hardstanding. b) Light industrial unit <10 yrs old containing a double skinned Underground Storage Tanks (UST) with annual integrity testing results available.
Low Likelihood	There is pollutant linkage and circumstances are possible under which an event could occur. However, it is by no means certain that even over a long period such an event would take place, and is less likely in the shorter term.	a) Elevated concentrations of toxic contaminants are present in soils at depths >1m in a residential garden, or 0.5-1.0m in public open space. b) Ground / groundwater contamination could be present on a light industrial unit constructed in the 1990s containing a UST in operation over the last 10 years – the tank is

Classification	Definition	Examples
		double skinned but there is no integrity testing or evidence of leakage.
Likely	There is pollutant linkage and all the elements are present and in the right place which means that it is probable that an event will occur. Circumstances are such that an event is not inevitable, but possible in the short-term and likely over the long-term.	a) Elevated concentrations of toxic contaminants are present in soils at depths of 0.5-1.0m in a residential garden, or the top 0.5m in public open space. b) Ground / groundwater contamination could be present from an industrial site containing a UST present between 1970 and 1990. The tank is known to be single skin. There is no evidence of leakage although there are no records of integrity tests.
High Likelihood	There is pollutant linkage and an event would appear very likely in the short-term and almost inevitable over the long-term, or there is evidence at the receptor of harm or pollution.	a) Elevated concentrations of toxic contaminants are present in soils in the top 0.5m in a residential garden. b) Ground / groundwater contamination could be present from chemical works, containing several USTs, having been in operation on the same site for over 50 years.

“Potential Consequence of Contaminant Linkage” gives an indication of the sensitivity of a given receptor to a particular source or contaminant of concern under consideration. It is based on full exposure via the particular linkage being examined. The classification of consequence is presented in **Table 12A4.2**.

Table 12A4.2 Outline of Hazard Consequence Classifications for Receptor Types from Contamination Impact:

Classification	Human Health	Controlled Water	Ecology	Property Structures/ Crops and animals	Examples
Severe	Highly elevated concentrations likely to result in "significant harm" to human health as defined by the EPA 1990, Part 2A, if exposure occurs.	Equivalent to Environment Agency Category 1 pollution incident including persistent and / or extensive effects on water quality; leading to closure of a potable abstraction point; major impact on amenity value or major damage to agriculture or commerce.	Major damage to aquatic or other ecosystems, which is likely to result in a substantial adverse change in its functioning or harm to a species of special interest that endangers the long-term maintenance of the population.	Catastrophic damage to crops, buildings or property.	Significant harm to humans is defined in Circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Major fish kill in surface water from large spillage of contaminants from site. Highly elevated concentrations of Hazardous or priority substances present in groundwater close to small potable abstraction (high sensitivity). Explosion, causing building collapse (can also equate to immediate human health risk if buildings are occupied).

Classification	Human Health	Controlled Water	Ecology	Property Structures/ Crops and animals	Examples
Medium	Elevated concentrations which could result in "significant harm" to human health as defined by the EPA 1990, Part 2A if exposure occurs.	Equivalent to Environment Agency Category 2 pollution incident including significant effect on water quality; notification required to abstractors; reduction in amenity value or significant damage to agriculture or commerce.	Significant damage to aquatic or other ecosystems, which may result in a substantial adverse change in its functioning or harm to a species of special interest that may endanger the long-term maintenance of the population.	Significant damage to crops, buildings or property.	Significant harm to humans is defined in Circular 01/2006 as death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions. Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability). Ingress of contaminants through plastic potable water pipes.
Mild	Exposure to human health unlikely to lead to	Equivalent to Environment Agency Category 3 pollution	Minor or short-lived damage to aquatic or other ecosystems, which is unlikely to result	Minor damage to crops, buildings or property.	Exposure could lead to slight short-term effects (e.g. mild skin rash). Surface spalling of concrete.

Classification	Human Health	Controlled Water	Ecology	Property Structures/ Crops and animals	Examples
	"significant harm".	incident including minimal or short-lived effect on water quality; marginal effect on amenity value, agriculture or commerce.	in a substantial adverse change in its functioning or harm to a species of special interest that would endanger the long-term maintenance of the population.		
Minor	No measurable effects on humans	Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems.	Equivalent to insubstantial pollution incident with no observed effect on water quality or ecosystems.	Repairable effects of damage to buildings, structures and services.	The loss of plants in a landscaping scheme. Discoloration of concrete.

The risk matrix to link the likelihood and consequence is shown in **Table 12A4.3.**

Table 12A4.3 Risk Matrix

Likelihood:	Unlikely	Low Likelihood	Likely	High Likelihood
Potential Consequence:				
Severe	Moderate / low risk	Moderate Risk	High Risk	Very High Risk
Medium	Low	Moderate / low risk	Moderate Risk	High Risk
Mild	Very low risk	Low Risk	Moderate / low risk	Moderate Risk
Minor	Very low risk	Very low risk	Low Risk	Low Risk

The overall risk definitions are summarised in **Table 12A4.4.**

Table 12A4.4 Risk Definitions

Risk	Definition
Very Low	It is a low possibility that harm could arise to a designated receptor, but it is likely at worst, that this harm if realised would normally be mild or minor.
Low	It is possible that harm could arise to a designated receptor from identified hazard, but it is likely at worst, that this harm if realised would normally be mild. It is unlikely that the Site owner / or occupier would face substantial liabilities from such a risk. Further investigative work (which is likely to be limited) to clarify the risk may be required. Any subsequent remediation works are likely to be relatively limited.
Moderate	It is possible that harm could arise to a designated receptor from an identified hazard. However, it is either relatively unlikely that any such harm would be severe, and if any harm were to occur it is more likely, that the harm would be relatively mild. Further investigative work is normally required to clarify the risk and to determine the potential liability to site owner / or occupier. Some remediation works may be required in the longer term.
High	Harm is likely to arise to a designated receptor from an identified hazard at the Site without remediation action. Realisation of the risk is likely to present a substantial liability to the Site owner / or occupier. Investigation is required

Risk	Definition
	as a matter of urgency to clarify the risk. Remediation works may be necessary in the short-term and are likely over the longer term.
Very High	There is a high probability that severe harm could arise to a designated receptor from an identified hazard at the Site without remediation action or there is evidence that severe harm to a designated receptor is already occurring. Realisation of that risk is likely to present a substantial liability to be site owner / or occupier. Investigation is required as a matter of urgency and remediation works likely to follow in the short-term.

Annex 12A5
Geotechnical Risk Register

The risk register is a means of documenting perceived risks and their importance and recording actions taken to manage them. The key elements of a geotechnical risk register are as follows:

1.	Identify the geotechnical risks.
2.	Identify the methods of construction that may be incorporated into the project.
3.	Scale the risks according to probability and impact.
4.	Based on the severity of each risk, decide on the type of action.
5.	Identify how each risk should be managed.
6.	Record the actions taken to manage the risk.
7.	Reassess the severity of each risk after action has been taken.
8.	Review the risk register at regular intervals and communicate.

The risk register is a live document and should be reviewed on a regular basis and at the end of each stage of the project.

The probability (P) that a given event will occur is given by the following:

Scale	Probability (Likelihood)	Chance per section of work
		(Amend to suit local conditions and to be agreed with the Client)
1	Negligible	< 1 in 100
2	Unlikely	1 in 100 to 1 in 10
3	Possible	1 in 10 to 1 in 5
4	Probable	1 in 5 to 1 in 2
5	Almost certain	> 1 in 2

The impact (I) of a given event is given by the following:

Scale	Impact (Effect)	Increase in cost or time (% increase)
		(Amend to suit local conditions and to be agreed with the Client)
1	Negligible	< 1%
2	Very low	1% to 4%
3	Low	4% to 8%
4	High	8% to 15%
5	Very high	> 15%

The risk after the application of risk control measures should be reviewed in the light of the following table:

Degree of Risk	Risk Level	Action Required
1 - 4	Trivial	None
5 - 9	Tolerable	Consider more cost-effective solutions or improvements
10 - 15	Substantial	Work must not start until risk has been reduced
16 - 25	Intolerable	Work must not start until risk has been reduced. If risk cannot be reduced, project should not proceed.

The risks and their potential impacts may vary between the various stages of the project, such as the risk to and from buried services, where the impact can be much higher during a ground investigation than during a desk study.

Stage	Risk No	Hazard	Prior to RCM			Risk Control Measure (RCM)	After RCM		
			Probability (P)	Impact (I)	Risk (R = P x I)		Probability (P)	Impact (I)	Risk (R = P x I)
Completion of Desk Study	DS1	Made Ground of unknown composition, depth and extent	4	3	12	Undertake an intrusive site investigation to delineate the Made Ground) and determine its composition and thickness. Develop site ground models. Geotechnical design to provide appropriate foundation design to mitigate any Made Ground and its impact on the Project	2	2	4
	DS2	Presence of sulphate and other chemicals in soils and groundwater that may lead to attack on buried concrete and services	2	3	6	Undertake an intrusive site investigation to complete determination of presence of sulphate and other potentially aggressive soils and groundwater. Determine appropriate concrete class and carry out design of buried concrete to meet any requirements in accordance with relevant standards	2	1	2

Stage	Risk No	Hazard	Prior to RCM			Risk Control Measure (RCM)	After RCM		
			Probability (P)	Impact (I)	Risk (R = P x I)		Probability (P)	Impact (I)	Risk (R = P x I)
	DS3	Damage to existing underground and overhead services.	4	4	16	Use best practice to identify all utilities onsite prior to any intrusive investigation or construction. This may include obtaining service plans and call out all service providers, carry out CAT/GPR scans, and hand excavated inspection pits at all intrusive locations.	4	1	4
	DS4	Groundwater at shallow depth	4	3	12	Undertake intrusive investigation and identify groundwater levels on site via installation of monitoring wells. Carry out monitoring to identify typical groundwater levels including periods of high rainfall. Determine long term design groundwater level and include appropriate mitigation measure within geotechnical design. Determine short term groundwater levels and mitigate within temporary works design.	4	1	4

Stage	Risk No	Hazard	Prior to RCM			Risk Control Measure (RCM)	After RCM		
			Probability (P)	Impact (I)	Risk (R = P x I)		Probability (P)	Impact (I)	Risk (R = P x I)
	DS5	Shrink/swell potential of soils leading to heave in excavations and foundations	2	3	6	Undertake an intrusive site investigation including in situ and laboratory testing to enable soil parameters to be identified. Develop site geology model. Geotechnical design to provide appropriate design to mitigate any areas of potential high and/or differential settlements on the Project	2	1	2
	DS6	Stability of temporary excavations due to groundwater ingress and running sand	3	2	6	Undertake an intrusive site investigation including *in situ* and laboratory testing to enable temporary works design parameters to be identified. Carry out temporary works design in accordance with relevant design standards	3	1	3

Stage	Risk No	Hazard	Prior to RCM			Risk Control Measure (RCM)	After RCM		
			Probability (P)	Impact (I)	Risk (R = P x I)		Probability (P)	Impact (I)	Risk (R = P x I)
	DS7	Variable and/or difficulty excavating with conventional backhoe excavators (JCB 3CX or similar)	3	3	9	Undertake an intrusive site investigation including *in situ* and laboratory testing to enable strength of materials anticipated within excavation depths to be identified. Include summary of feasibility of excavation within geotechnical design report to assist contractor in choosing appropriate plant and equipment for Project	3	1	3
	DS8	Potential for differential settlement of tilt of foundations straddling interface of solid geology and superficial deposits	3	4	12	Undertake an intrusive site investigation including *in situ* and laboratory testing to delineate areas where superficial deposits are anticipated within excavation depths and assess during geotechnical design.	3	1	3

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