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THE IRON LINE, MILLOM (VISITORS CENTRE)
PHASE 2 GROUND INVESTIGATION REPORT

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Site Address: The Iron Line, Millom, Cumbria, LA18 4LB

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EXECUTIVE SUMMARY

Appointment	Curtins were instructed by Cumberland Council to undertake an intrusive site investigation at the proposed development site known as The Iron Line, located in Millom, Cumbria, LA18 4LB. Part of the site is a Site of Special Scientific Interest (SSSI), a Ramsar Site, a Special Protection area and a Special Area of Conservation which comprises RSPB Hodbarrow and the southern side of the Redhills Quarry (owned by Cumbria County Council). The site is centred on SD 17877 79009 and covers an area of approximately 58 Ha. The aim of the ground investigation is to characterise the geo-environmental and geotechnical conditions prior to the development of the site for a commercial end-use which comprises access improvements, car parking, new paths, repairs of existing structures and the construction of a new visitor centre in the northeast. Works have been carried out over two phases. The site itself has been split into distinct sections, with the majority of works being undertaken within the northeast of the site in the proposed Visitors Centre Area, identified as Zone 1. This report summarises ground investigation works that have taken place in Zone 1 only.

Current Site Status	The site comprises RSPB Hodbarrow which covers the majority of the site, and land to the southern side of the Redhills Quarry (owned by Cumbria County Council).
	A sea wall is present bounding the south of the site, extending from east to west. Heritage and historic structures are present such as the Hodbarrow lighthouse and Hodbarrow Beacon.
	There is a large lagoon located within the southeastern portion of the site, with the majority of the site is covered by grassland and tree cover. A footpath extending the entire length of the outer seawall is present, with several footpaths extending into the RSPB Hodbarrow site to the east.
	The site is a Site of Special Scientific Interest (SSSI), Ramsar Site, Special Protection Area and Special Area of Conservation.
	The site itself has been split into distinct sections for the purpose of Curtins assessments:
	• Zone 1: Visitors Centre
	  ○ Proposed New Visitors Centre, car parking, roads and infrastructure.
	• Zone 3: Towsey Hole Windmill
	  ○ Improvement of existing paths and construction of new paths.
	• Zone 4: Haverigg Lighthouse & Tern Island Hide
	  ○ Improvement to paths/roads
	• Zone 5: Annie Lowther Hide
	  ○ Improvement of existing paths and construction of new paths.
	• Zone 7: Quarry Hides
	  ○ Improvement to paths/roads
	• Zone 8: Iron Line Railway
	  ○ Improvement to paths/roads
	• Zone 9: Iron Line Entrance
	  ○ Improvement to paths/roads
	• Zone 10: Mainsgate Road Entrance & Hodbarrow Car Park
	  ○ Improvement to paths/roads
	The main development is proposed in Development Zone 1, where a Visitors Centre building will be constructed. The remainder of the Development Zones will receive some development such as new roads, paths and hides.

Summary of Existing Information	The earliest available mapping (1867) shows the site as largely undeveloped comprising predominantly marshland and part of the estuary, with some evidence of mineral extraction. The industrial premises of Redhills Quarry (to the north-east) and the Hodbarrow Iron Mine / Hodbarrow Quarries (south-east of the site) can be seen in mapping from 1867, including the 'Hodbarrow Scar', an engine house, the Old Wind Mill and shafts in the south-east of the site. By 1898, Redhill Quarry and the Hodbarrow Iron Mine had undergone significant expansion, with various pits noted across the east of the site, and the addition of a major rail network, the construction of reservoirs and a number of spoil pits across the east of the site. The Hodbarrow Lighthouse was constructed in the south-east of the site, along with the Hodbarrow Sea Wall which extended across to Steel Green in the west. By 1924, the 'Outer Barrier' Sea Wall was constructed at the south of the site, a large sea wall extending further out into the Duddon Channel, along with the construction of a lighthouse within the centre of the barrier. During this time, the spoil pit areas on site had been increased, and the reservoir previously present to the south-east had been infilled. The Hodbarrow Iron Mine closed in 1968, anecdotal evidence suggests that subsidence of the Inner Sea Wall caused the collapse and subsequent flooding of the Hodbarrow Mine. The rail network within the site had been dismantled and buildings disused. Disused spoil pits remained during this time, with a slag heap noted in the east of the site. Buildings surrounding the Arnold and Annie Lowther Pits had been dismantled. During 1986, the majority of the site was converted into a Nature Reserve. The remaining buildings associated with the mine and quarry workings were dismantled, with the majority of spoil and slag pits removed. The reservoirs once throughout the site had been infilled. One shaft remained on mapping within the northern area of the site. Heritage buildings such as the Old Wind Mill, Hodbarrow Beacon and Hodbarrow Lighthouse remain on site. The Hodbarrow Sea Wall had been reduced in size to allow the connection between lakes forming the Hodbarrow Lagoon. BGS mapping indicates the site is heavily worked with numerous areas of infilled and worked ground, with Made Ground indicated across the site on mapping. Superficial deposits are not noted to be present across the majority of

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	the site on BGS records. Bedrock geology comprises multiple lithologies across the site, recorded as the Red Hill Limestone, Martin Limestone Formation, Low Furness Basal Formation and the Dalton Formation. A BGS radon report indicates full radon protection measures are required for the new Visitors Centre building. The site is underlain by a Secondary A Aquifer within the bedrock formation. The nearest surface water feature is the RSPG Hodbarrow nature reserve lakes, a River feature in the south west and the Tidal Duddon River approximately 16m south of the site.
Fieldworks Undertaken	Initial ground investigation works were undertaken in multiple visits across Zone 1 due to site access constraints, the works were completed between the 11th and 13th of March, 20th and 22nd March, 16th and 18th April. Site investigation works on the ancillary Zones were scheduled for September 2024, once nesting season has come to an end on affected development zones. The March – April 2024 ground investigation comprised of the following works; 4no. window sample boreholes to a maximum depth of 5.45m bgl, 3 no. rotary open-hole boreholes to a maximum depth of 40.50m bgl, 4no. trial pits to a maximum depth of 2.90m bgl, 4no. Trial Trenches to a maximum depth of 3.90m bgl, 3no. Soak away trial pits to a maximum depth of 2.70m bgl, and 15no. CBR tests to a maximum depth of 0.92m bgl. Additional ground investigation works were undertaken between the 09th and 12th December 2024 and included the advancement of 5no. cable percussive boreholes to a maximum depth of 15.10m bgl. 6no. boreholes were installed with ground gas/water monitoring installations within the building development area; all within Made Ground or Glacial Till deposits.
Encountered Ground Conditions	Ground conditions encountered generally comprise of Made Ground deposits overlying cohesive Glacial Till deposits (with localised granular Glacial Till deposits). Bedrock at the site generally comprises of the Red Hill Limestone Formation however, localised conglomerates consistent with the Low Furness Basal Formation are present (RH1-02 only). Made Ground deposits comprised of both granular and cohesive soils and were encountered to prove depths of 0.40m and 4.00m bgl (13.00m to 9.40m AOD). The site is identified as a BGS and historic landfill site. Cohesive Glacial Till deposits were recorded underlying the Made Ground from depths ranging between 2.00m and 13.50m bgl (12.00m to -0.10m AOD). Thickness of this deposit where proven ranged between 6.0m and 12.10m and was typically described as a reddish-brown to brown mottled grey slightly sandy slightly gravelly clay. Granular Superficial deposits were typically encountered underlying the cohesive deposits in RH1-01, RH1-02, RH1-03 and CP1-03. This deposit typically comprised brown, slightly gravelly sand, underlain by brown sandy gravel, or Brown gravelly sand. The Low Furness Basal Formation Bedrock deposit was encountered at 18.0m bgl in RH 1-02. The formation comprised reddish brown conglomerate with lithoclasts of mudstone and sandstone and a reddish-brown sand matrix. The base of the deposit was not encountered during the investigation. Bedrocks deposits consistent with the Red Hill Limestone Formation were encountered from depths ranging between 9.00m to 15.00m bgl (5.46m to -1.60m AOD. This deposit was encountered as a grey limestone. The extent of this deposit was not proven during the ground investigation.
Environmental Laboratory Testing and Ground Gas Monitoring Results	Asbestos was present in 5 No. soil samples, recorded as loose fibres of chrysotile (<0.001% w/w to 0.034 % w/w) and amosite (0.003% w/w) and chrysotile cement (0.087% w/w). Additionally, fragments of bulk asbestos cement were encountered in CP1-01 and CP1-01B Made Ground soils. Two samples of asbestos cement were taken and confirmed that it was chrysotile cement (15%). No exceedances were identified in soil samples, when compared against the relevant Environmental Quality Standards. A maximum carbon dioxide concentration of 6.1% $^{v}/_{v}$ and methane concentration of <0.1% $^{v}/_{v}$ have been recorded. The greatest peak air flow rate was recorded in DSBH 1-01 recorded an airflow of -27.7 l/hr during the third visit. Steady state air flow rates recorded during the monitoring period remained at a steady state of <0.1 within all boreholes. A 'worst case' scenario site characteristic for carbon dioxide within the Made Ground is taken as 0.0061 l/hr and 0.0273l/hr for natural soils, corresponding with a CS-1 classification, however with the elevated concentrations (>5% v/v) recorded throughout monitoring and considering the potential sources of ground gas identified (infilled ground) it is recommended that the regime classification is increased to CS-2. The worst case gas regime at the site taken is CS-2, and on this basis gas protection measures will be required for the proposed development.
Ground Contamination and Ground Gas Assessment	A **Moderate** risk rating is identified to end-users from direct contact, inhalation, and ingestion of contaminants within Made Ground soils on site. A **Low** risk is identified to the underlying Aquifers and to the surface waters. A **Moderate/Low** risk is identified to site end-users from ground gas migration and inhalation from soils, corresponding to BS8485 CS2 gas regime requiring gas protection measures.
Geotechnical Assessment	Made Ground deposits are considered to be an unsuitable founding stratum. It is recommended that piled foundations should be adopted, the carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes, it is therefore recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site. Pile type should consider obstruction and potential for driving contaminants downwards. There will be a requirement for an appropriately designed pile mat.

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	It is recommended that suspended ground floor slabs are adopted, bearing on pile caps by a network of beams to minimize differential settlement between the floor and the piled structure. Laboratory test results indicate a DS-1, AC-1 classification for the Made Ground and natural soils.
Recommendations	Based on the findings of the ground investigation, the following recommendations are made in relation to Zone 1 (Visitors Centre Site): 1. Additional ground investigation is required following an updated site plan. Due to the close proximity of the Visitors Centre to the possible location of the Underground Mine Roadway it is recommended that a further deep rotary borehole is undertaken. The additional borehole should be undertaken in the area between the feature and the proposed structure to ensure it does not impact the building. 2. Installation of engineered capping layer in areas of soft landscaping, described in a Remediation Strategy. 3. Asbestos management plan to be put in place during construction works due to presence of asbestos fibres in shallow Made Ground. 4. Install gas protection measures in line with a CS-2 classification. 5. Install full radon protection in new buildings. 6. Construction and maintenance workers should be provided with suitable PPE with respect to environmental chemical results presented herein. 7. Should unexpected contamination be observed during construction advice should be obtained from a Geo-environmental Engineer. 8. Consideration of slope stability risk with respect to the steep slope on northern boundary (subject to value engineering assessment). 9. The ventilation borehole on site should be located as part of construction works and decommissioned in accordance with EA guidance. 10. Watching brief to be carried out during groundworks by geotechnical engineer to monitor for evidence of shafts. If any are recorded construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided. 11. The engineering recommendations contained within the report should be reviewed once the final development proposals and site levels are confirmed. A Remediation Strategy and Mining Risk Mitigation Strategy should be produced to further detail respective requirements on the site.

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1 INTRODUCTION

1.1 Project Background

Curtins were instructed by Cumberland Council to undertake an intrusive site investigation at the proposed development site known as The Iron Line, located in Millom, Cumbria, LA18 4LB. Part of the site is a Site of Special Scientific Interest (SSSI), a Ramsar Site, a Special Protection area and a Special Area of Conservation which comprises RSPB Hodbarrow and the southern side of the Redhills Quarry (owned by Cumbria County Council). The site is centred on SD 17877 79009 and covers an area of approximately 58 Ha.

The location and extent of the site is shown in *Figure 1* overleaf. It is understood that the project comprises erection of a Visitor Centre with café/shop, group room, staff/volunteer, toilet facilities and car park.

A proposed site plan is included in *Appendix A*.

1.2 Project Aim

This aim of the investigation is to characterise the geo-environmental and geotechnical conditions for the proposed construction works.

A Preliminary Risk Assessment (Ref. 080874-CUR-00-XX-RP-GE-001-P03) (Ref. 1) and Mining Risk Assessment (Ref. 080874-CUR-XX-XX-T-GE-00005-P02) (Ref. 2) were undertaken by Curtins in 2024 which included recommendations for intrusive ground investigation works to further characterise the site. This report aims to address those recommendations.

Ground investigation is reported on for the proposed Visitors Centre Site only in this report (herein identified as Zone 1), in support of design and construction of the new visitor centre. Intrusive works have been carried out across two main stages, ‘initial’ and ‘additional’ works.

Ground Investigation across the wider site has been presented in a separate Phase 2 Ground Investigation Report Ref. 080874-CUR-XX-XX-T-GE-00007-P02.

1.3 Scope of Services

In order to achieve the project aim, the Phase 2 report is intended to assess:

a) If there is a risk of the proposed end user being adversely impacted upon by potential contamination in shallow site soils that may be present on the site due to its known current, recent and historical use;
b) If there is a risk of groundwater and/or surface water being adversely impacted upon by potential contamination that may be present on the site due to its known current, recent and historical use;
c) If there is a risk to the end user from soil gases including methane, carbon dioxide, carbon monoxide and hydrogen sulphide;
d) Likelihood of the proposed works being adversely impacted by potential geo-hazards across the site; and
e) If there is a risk to the proposed works from historic mining activities.

In addition, recommendations on foundation solutions for the proposed structures are provided.

Detailed flood risk assessment, ecology and archaeological studies are outside of the scope of this report.

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2 PHASE 1 PRELIMINARY SITE ASSESSMENT SUMMARY

This section presents a summary of the Phase 1 Preliminary Risk Assessment (PRA) that has been completed for the subject site. This incorporates a summary of site setting, history and geology as presented in the Curtins PRA and Curtins MRA (Ref. 1 & 2). For further detail Curtins previous reports should be consulted.

2.1 Site Location and Current Details

Site use, location and description are shown below in *Table 1* and *Figure 1*.

Table 1 – Site Details

Site Address	The Iron Line, Millom, Cumbria, LA18 4LB
NGR	SD 17877 79009
Area of Site	Approximately 58 Ha.
Current Site Use and Description	The site comprises RSPB Hodbarrow which covers the majority of the site, and land to the southern side of the Redhills Quarry (owned by Cumbria County Council). A sea wall is present bounding the south of the site, extending from east to west. Heritage and historic structures are present such as the Hodbarrow lighthouse and Hodbarrow Beacon. There is a large lagoon located within the southeastern portion of the site, with the majority of the site is covered by grassland and tree cover. A footpath extending the entire length of the outer seawall is present, with several footpaths extending into the RSPB Hodbarrow site to the east. The site is a Site of Special Scientific Interest (SSSI), Ramsar Site, Special Protection Area and Special Area of Conservation. Due to the size of the site, it has been split into Development Zones (See *Figure 1 and Appendix A*).

Development Proposals	The site itself has been split into distinct sections, with the majority of works being undertaken within the north of the site in the proposed Visitors Centre Area:
	
	• Zone 1: Visitors Centre
	  ○ Proposed New Visitors Centre Building, car parking, roads and infrastructure.
	• Zone 3: Towsey Hole Windmill
	  ○ Improvement of existing paths and construction of new paths.
	• Zone 4: Haverigg Lighthouse & Tern Island Hide
	  ○ Improvement to paths/roads
	• Zone 5: Annie Lowther Hide
	  ○ Improvement of existing paths and construction of new paths.
	• Zone 7: Quarry Hides
	  ○ Improvement to paths/roads
	• Zone 8: Iron Line Railway
	  ○ Improvement to paths/roads
	• Zone 9: Iron Line Entrance
	  ○ Improvement to paths/roads
	• Zone 10: Mainsgate Road Entrance & Hodbarrow Car Park
	  ○ Improvement to paths/roads
	
	The main development is proposed in Development Zone 1, where a Visitors Centre building will be constructed. The remainder of the Development Zones will receive some development comprising consolidation, repair and installation of interpretive sculpture to Towsey Hole Windmill; refurbishment of the existing Tern Island hide; new bird hides, pathways, gateway

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	features and street furniture; enhancement of wildlife habitats; associated landscaping and drainage infrastructure; and maintenance of byway with restricted vehicular access.

Figure 1 – Site Location Plan with Development Zones, site boundary shown in red.

2.2 Historical Mapping Records

The site has an extensive mining history with Hodbarrow iron mine in operation between 1850 and 1968. Ore was removed by a form of pillar-and-stall working known as “top slicing”. Levels, some of which were accompanied by short rises, were driven from the shafts into the heart of the ore body, each level being separated from the one beneath by unrobbed ground known as ‘middling’s’.

A review of the available historical mapping information for the site has been undertaken as part of the Curtins Phase 1 Preliminary Risk Assessment (Ref. 1) with specific reference to potential historic mining.

Earliest mapping records show the site to have been largely undeveloped comprising predominantly marshland and part of the estuary, with some evidence of mineral extraction. The industrial premises of Redhills Quarry (to the north-east) and the Hodbarrow Iron Mine / Hodbarrow Quarries (south-east of the site) can be seen in mapping from 1867, including the ‘Hodbarrow Scar’, an engine house, the Old Wind Mill and shafts in the south-east of the site. By 1898, Redhill Quarry and the Hodbarrow Iron Mine had undergone significant expansion, with various pits noted across the east of the site, and the addition of a major rail network, the construction of reservoirs and a number of spoil pits across the east of the site. The Hodbarrow Lighthouse was constructed in the south-east of the site, along with the Hodbarrow Sea Wall which extended across to Steel Green in the west.

By 1924, the ‘Outer Barrier’ Sea Wall was constructed at the south of the site, a large sea wall extending further out into the Duddon Channel, along with the construction of a lighthouse within the centre of the barrier. During this time, the spoil pit areas on site had been increased, and the reservoir previously present to the south-east had been infilled.

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The Hodbarrow Iron Mine closed in 1968, anecdotal evidence suggests that subsistence of the Inner Sea Wall caused the collapse and subsequent flooding of the Hodbarrow Mine. The rail network within the site had been dismantled and buildings disused. Disused spoil pits remained during this time, with a slag heap noted in the east of the site. Buildings surrounding the Arnold and Annie Lowther Pits had been dismantled. The area behind the outer sea wall barrier became gravelled with the lighthouse becoming disused. During 1986, the majority of the site was converted into a Nature Reserve. The remaining buildings associated with the mine and quarry workings were dismantled, with the majority of spoil and slag pits removed. The reservoirs once throughout the site had been infilled. One shaft remained on mapping within the northern area of the site. Heritage buildings such as the Old Wind Mill, Hodbarrow Beacon and Hodbarrow Lighthouse remain on site. The Hodbarrow Sea Wall had been reduced in size to allow the connection between lakes forming the Hodbarrow Lagoon.

Redhills Quarry to the north of the site is noted as disused in 1973, with the active workings to the west noted as disused in 1993. 'Millom Raceway' was opened in 1995 on the former pit slag heap, the track was formally known as the Redhills Raceway until 2003 when it fell into disuse. A Household Wate Recycling Centre is now located at Redhills Quarry immediately north east of site (zone 1).

Further review of Cumbria mining archive maps is included in Curtins Mining Risk Assessment Report (Ref.2)

2.3 Geology, Hydrogeology and Hydrology

A study of the BGS mapping records (Sheet 048 for Ulverston), along with the Envirocheck Report (Ref. 3), indicates the following geological succession underlying the site:

2.3.1 Made Ground

Geological Maps indicate the site is heavily worked with numerous areas of infilled ground, worked ground (undivided) and Made Ground (undivided) indicated on mapping, comprising voids and artificial deposits.

It is likely that the Made Ground will comprise the iron works process arisings.

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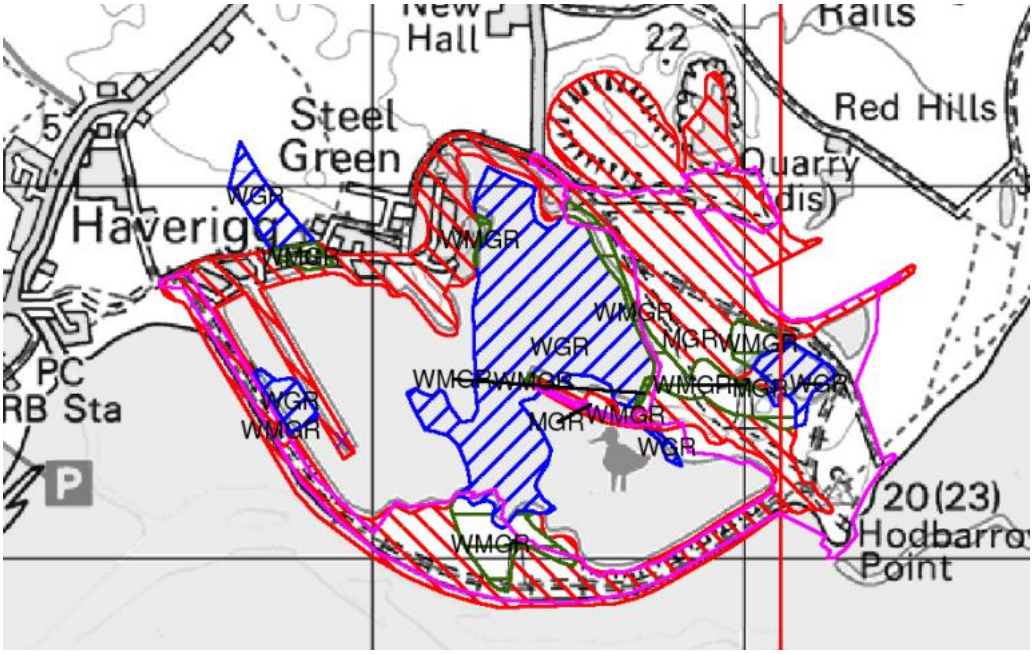

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	WMGR	Infilled Ground	Artificial Deposit	Not Supplied - Holocene
	WGR	Worked Ground (Undivided)	Void	Not Supplied - Holocene
	MGR	Made Ground (Undivided)	Artificial Deposit	Not Supplied - Holocene

Figure 2 – Extract from BGS 1:50,000 mapping (Artificial Ground)

2.3.2 Superficial Deposits

Superficial deposits are not recorded to be present on the majority of the site.

A limited area of Raised Marine Deposits are noted to be present in the far east of the site, with a limited area of Glacial Till recorded in the south-eastern corner of the site.

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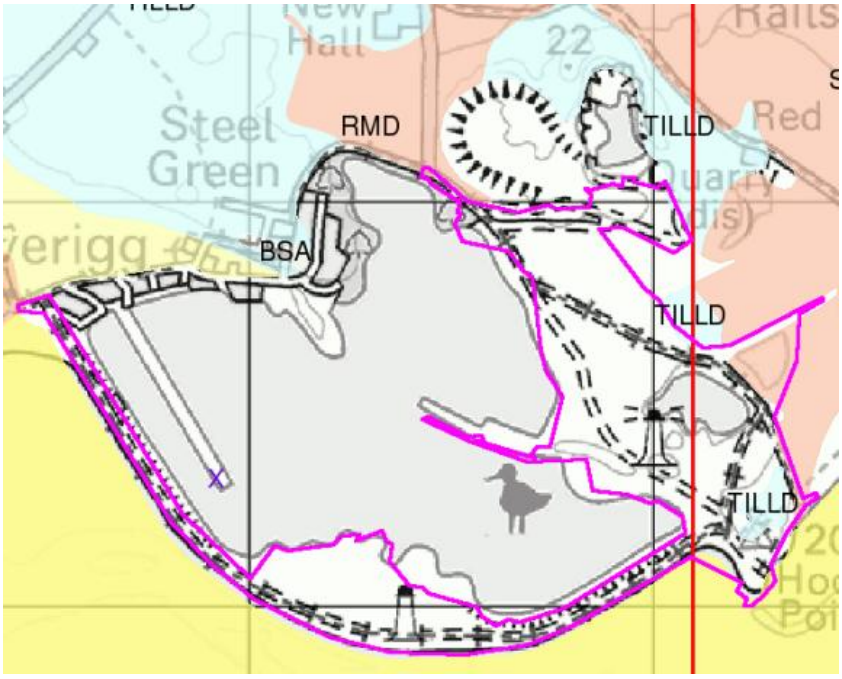

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	TFD	Tidal Flat Deposits	Clay and Silt	Not Supplied - Holocene
	ALV	Alluvium	Clay, Silt, Sand and Gravel	Not Supplied - Holocene
	SAMD	Saltmarsh Deposits	Clay and Silt	Not Supplied - Holocene
	TILLD	Till, Devensian	Diamicton	Not Supplied - Devensian
	GFDUD	Glaciofluvial Deposits, Devensian	Sand and Gravel	Not Supplied - Devensian
	BSA	Blown Sand	Sand	Not Supplied - Quaternary
	STOB	Storm Beach Deposits	Gravel	Not Supplied - Quaternary
	RMD	Raised Marine Deposits	Sand and Gravel	Not Supplied - Quaternary

Figure 3 – Extract from BGS 1:50,000 mapping (Superficial Deposits)

2.3.3 Bedrock Deposits

Bedrock geology comprises multiple lithologies across the site, recorded as the Red Hill Limestone, Martin Limestone formation, Low Furness Basal Formation, and the Dalton Formation.

- The Red Hill Limestone Formation is described as a carbonate bioclastic, intraclastic and peloidid grainstones, coarse-grained and virtually structureless following bioturbation;
- the Martin Limestone formation described as mainly carbonate mudstones with significant grainstones, locally cross-bedded, and oolites in the upper part, ranging from peritidal to marine;
- the Low Furness Basal formation as conglomerate, sandstones, siltstones and mudstones with subordinate evaporites, the upper part of limestones and siltstones, mostly red with interbedded conglomerates, all presumed of marine origin; and,
- the Dalton Formation at base as a mid to dark grey, even bedded carbonate grainstone and packstone, with dark grey thinly bedded backstones and wackestones with shaly interbeds, with the upper part comprising even bedded packstones and grainstones.

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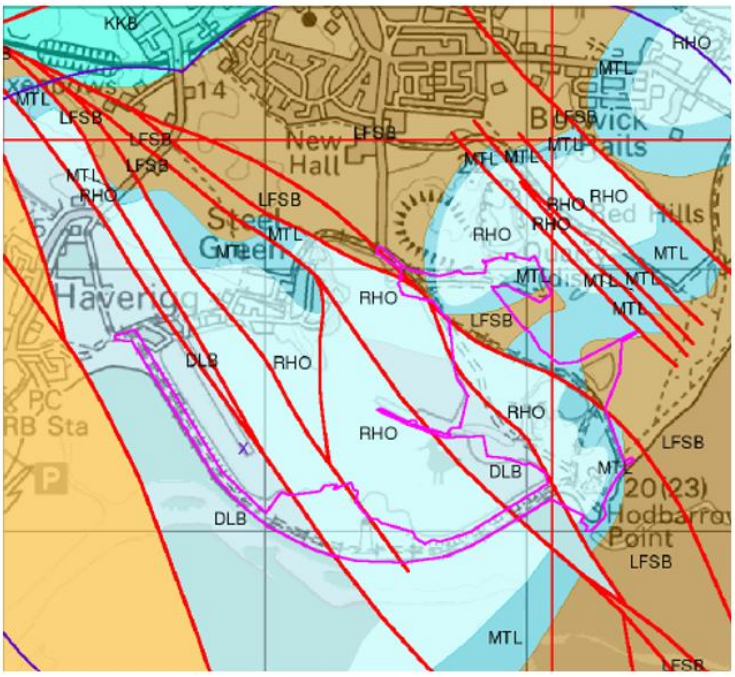

Bedrock and Faults

Map Colour	Lex Code	Rock Name	Rock Type	Min and Max Age
	SBS	St Bees Sandstone Member	Sandstone	Not Supplied - Early Triassic
	PKUL	Park Limestone Formation and Urswick Limestone Formation (Undifferentiated)	Calcarenite	Not Supplied - Visean
	DLB	Dalton Formation	Calcarenite	Not Supplied - Visean
	RHO	Red Hill Limestone Formation	Calcarenite	Not Supplied - Visean
	LFSB	Low Furness Basal Formation	Conglomerate and [Subequal/Subordinate] Sandstone, Interbedded	Not Supplied - Tournaisian
	MTL	Martin Limestone Formation	Limestone	Not Supplied - Tournaisian
	KKB	Kirkley Bank Formation	Mudstone, Calcareous	Not Supplied - Cautleyan
	WB	Waberthwaite Tuff Formation	Lapilli-Tuff	Not Supplied - Caradoc
		Faults		

Figure 4 – Extract from BGS 1:50,000 mapping (Bedrock).
Site outlined in purple.

The site and surrounding area are heavily faulted, with shallow dipping (5-15 degrees) SW and striking NW-SE cutting across all lithology types.

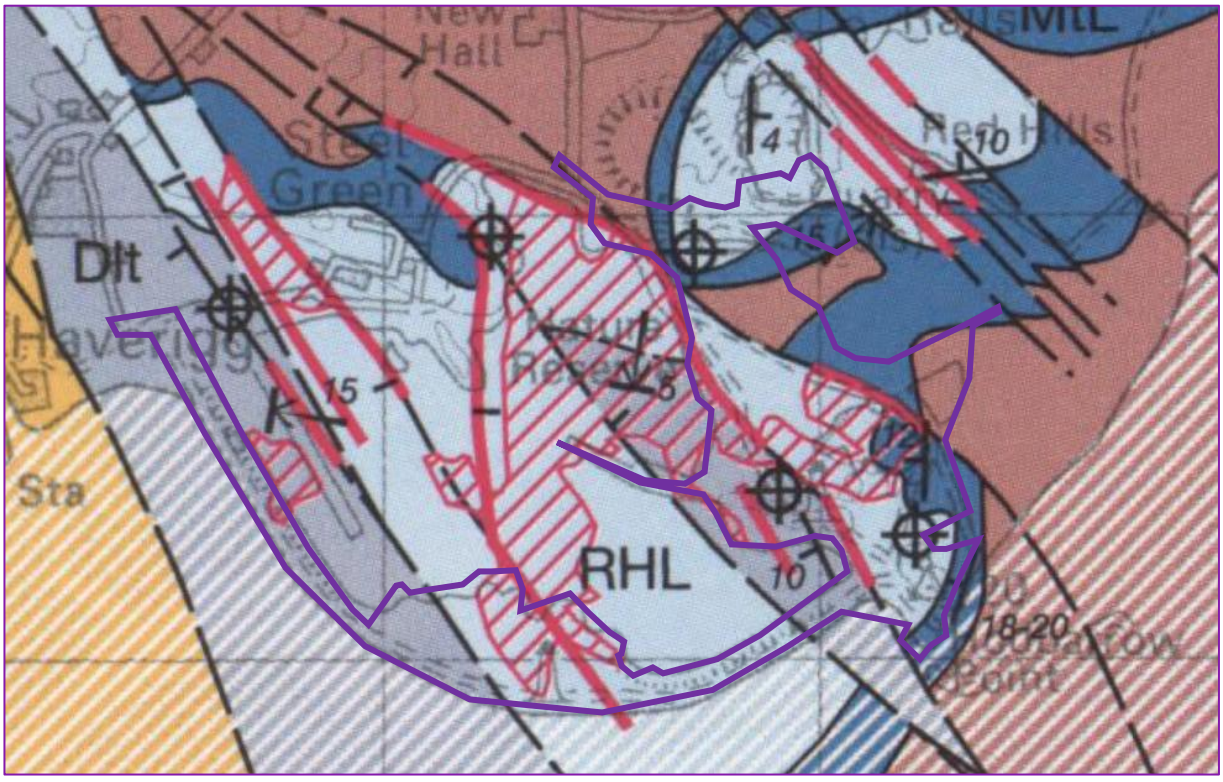

Figure 5 – Extract from BGS 1:50,000 mapping (Bedrock)
Approximate Site Boundary in Purple.
Red lines showing haematite veins

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Red cross-hatched showing hematite deposits, worked at rockhead and at depth
***Black lines** showing faults*
***Black Crossed circles** showing abandoned mine shafts.*

2.3.4 Hydrogeology

Bedrock deposits on site are identified as Secondary A Aquifers. Secondary A aquifers comprise permeable layers that can support local water supplies, and may form an important source of base flow to rivers.

Groundwater vulnerability has been assessed as high risk; the site is situated on a Productive Bedrock and Secondary Superficial Aquifer which has well connected fractures, contributing to a high pollutant speed and a dilution of >550mm/year. There is low soluble rock risk in relation to groundwater vulnerability.

No groundwater abstractions are listed within 1km of the site.

2.3.5 BGS Borehole Records

There are 160 noted boreholes located within 500m of the site. 23 No. boreholes are recorded within the site boundary, 21 No. of which are deep boreholes (greater than 30m), 1 No. is moderately deep (between 10 – 30m) and 1 No. is shallow (between 0 – 10m). The boreholes on and around the site were undertaken between 1882 and 1971, with depths between 5.00m and 222.99m bgl, all of which progressed into the bedrock strata.

Selected borehole records are further reviewed in Curtins Phase 1 PRA (Ref.1).

2.3.6 BGS Mineral Sites

The site is not situated within a coal mining reporting area, and as such risks associated with coal mining are considered Very Low.

Iron mining was undertaken at Hodbarrow Iron Mine on site. The mine opened ~1850 and was in operation until 1968, surface extraction and underground mining was undertaken. The large iron ore mine which had twice extended its capacity. Firstly, by building the inner sea barrier, and then again through construction of the outer sea barrier to allow them to mine ore which was previously beneath the sea/estuary. This area has since been flooded and is known as the Hodbarrow Lagoon. Curtins mining risk assessment is further summarised in Section 2.4.

Table 2 below provides a summary of the minerals that are recorded or likely to have been worked beneath the footprint of the site.

Table 2 – Past Underground Mining

Mine	Geology	Mineral	Depth (m)	Direction to Working	Extraction Thickness (cm)
Hodbarrow Iron Mine	Red Hill Limestone Formation Martin Limestone Formation Low Furness Basal Formation Dalton Formation	Iron Ore	Unknown	Beneath Site	Unknown

The Iron Ore containing Red Hill Limestone Formation along with the Dalton Formation are present beneath the site, and further dip towards the south-west.

There are 5 No. opencast workings recorded within 500m of the surrounding area, detailed in Table 3 below:

Table 3 – BGS Recorded Mineral Sites within 500m of the Development Area.

Site Name	Operator	Distance from Site (m)	Commodity	Status

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Red Hills Quarry	Unknown	1	Limestone	Ceased
Red Hills Slag Bank	Millom Aggregates	119	Slag	Ceased
Red Hills Quarry	Unknown	188	Limestone	Ceased
Whitriggs Close Clay Pits	Unknown	300	Common Clay and Shale	Ceased
Whitriggs Close Clay Pits	Unknown	411	Common Clay and Shale	Ceased

2.3.7 Other Ground Stability Issues

The Envirocheck Report confirms the following in relation to potential geotechnical hazards highlighted in Table 4 below:

Table 4 – Ground Stability Hazards for the site and surrounding area.

Ground Stability Hazard	Hazard Potential On-site	Hazard Potential Off-site
Collapsible Ground	No Hazard	No Hazard
Compressible Ground	Very Low - Moderate	Moderate
Ground Dissolution (Soluble Rocks)	No Hazard - Low	Low
Landslide	Very Low – Low	Very Low - Moderate
Running Sand	No Hazard - Moderate	Low
Shrinking or Swelling Clay	No Hazard - Low	Very Low

Given the information above there is unlikely to be a need to address any of the ground stability hazards mentioned above. However, slope stability should be considered for Zone 1 due to the steep slope down to Redhills Quarry at the north. Intrusive ground investigation works will confirm the nature of the ground conditions at the subject site.

2.3.8 Ground Gas

Radon

The Envirocheck Report (Ref. 3), Radon Mapping (Ref. 4) confirm that the site is within a radon affected area where 10 – 30% of homes are to be at or above the action level.

A BGS radon report has been procured for the Zone 1 Visitors Centre site which indicates that full radon protective measures are required in the construction of the new building. This report is enclosed in Appendix B.

Landfill

The Envirocheck Report (Ref. 3) show that there are seven recorded Landfill sites within the site and 250m of the site boundary, shown in Table 5 below.

Table 5 - Recorded Landfill Sites Within the Site Boundary.

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Site Name	Distance from Site/ Location	Operator / Licence Holder	Site Category & Dates Deposited	Licence Number / Provider Reference	Input Rate	Status
Red Hill	On site (north east)	BGS Recorded	N/A	N/A	N/A	N/A
Redhills Quarry	On site (north east)	Cumbria County Council	Special waste and liquid sludge, 1969-1993	EAHLD07 713	N/A	N/A
Millom Civic Amenity Site, Redhills Quarry (Licenced)	On Site (north east)	Cumbria Waste Management Ltd	Household waste amenity sites	57294	Unknown	Transferred
Redhills Quarry	139m	Cumbria County Contracting	Special waste and liquid sludge including: Inert, Industrial, Commercial and Household	R20/M4	Medium (Equal to or greater than 25,000 and less than 75,000 tonnes per year)	Licence lapsed (1st June 1991)
Redhills Quarry	139m	Cumbria County Contracting	Special waste and liquid sludge including: Inert, Industrial, Commercial and Household	R20/M4	Medium (Equal to or greater than 25,000 and less than 75,000 tonnes per year)	Record Superseded (1st October 1990)
Redhills Quarry	139m	Cumbria County Contracting	Landfill	R20	Undefined	Record Superseded (1st June 1977)
Millom C.A. Site (Waste Transfer Site)	On site	L&W Wilson (Endmoor) Ltd	Civic Amenity	294/M1	Very Small (Less than 10,000 tonnes per year)	Operational as far as is known (1st August 1995)

Review of the Envirocheck Report (Ref. 3) has also identified seven areas of potentially infilled land with 500m of the site boundary. Five of these potentially infilled land areas are within the site boundary, all of unknown filled ground (Pit, Quarry etc). The proposed Visitors Centre is situated on or very close to an infilled reservoir associated with Hodbarrow mine. The reservoir first appears on the historical maps in 1900 and was infilled around 1986 when the site was acquired by the RSPB.

2.3.9 Hydrology

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The nearest surface water feature is an unidentified river feature in the southwest of site, the RSPB Hodbarrow nature reserve lakes on site and off site, and the tidal Duddon river approximately 16m south from site. There are 23 OS Water Network Lines within 500m of the site.

There have been fourteen pollution incidents to controlled waters within 500m. All but one are classed as Category 3 Incidents (Minor), it is unlikely these will pose any risk to the proposed development. The Category 2 Significant Incident is located 330m northwest of the site at Haverigg Pool, the cause of incident is unknown. The incident occurred on 20th October 1993, incident reference 93210118.

There are seven active discharge consents issued by United Utilities within 500m of the site boundary. These are approximately 326 to 363m northwest.

2.4 Curtins Mining Risk Assessment Summary

Risk assessment has been undertaken for each of the development 'Zones' as identified in Section 2.1 using the pertinent mining records and information discussed in previous sections. Curtins drawing titled 'Summary of Historical Iron Mining and Associated Features' is enclosed in Appendix A with extracts used within the assessment below.

Development Zone 1 was assessed independently due to the development including new structures. Development Zones 3-10 are assessed collectively due to the proposed developments including improvements to paths and roadways only. Summary of Mining risk established through Curtins mining risk assessment are outlined in Table 6 & 7 below. For further detail the Mining Risk Assessment report should be consulted (Ref.2)

Development Zones 3 to 10 have been assessed separately but the conclusions summarised collectively due to the proposed developments including improvements to paths and roadways only. A summary of the mining risks pertaining to the development site is summarised in the Table 6.

Table 6 – Summary of Mining Risks and Proposed Actions associated with Development Zone 1

Scenario	Consequence	Likelihood	Risk in Development Zone 1 (Visitors Centre)	Proposed Action
Underground Mining (probable at deeper depths) ***>30m below rockhead***	Medium	Unlikely	**Low**	• No action required.
Underground Mining (probable at shallow depths) ***<30m below rockhead***	Medium	Low Likelihood	**Moderate/Low**	• An initial ground investigation for initial planning submissions and design purposes, complete rotary open boreholes to determine to determine the presence of voids, broken ground which may be indicative of shallow workings within influencing depths of the proposed structure, boreholes to be advanced to circa 40m bgl. Ground gases should be monitored during borehole advancement due to potential for mine gases. • Dependent on the findings of the ground investigation determine and produce a treatment specification from the ground investigation information. • Dependent on the findings of the ground investigation complete proof drilling and grouting of the proposed development area, relevant to the building footprints and a suitable distance surrounding any building footprints.

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Scenario	Consequence	Likelihood	Risk in Development Zone 1 (Visitors Centre)	Proposed Action
Mine entries (shafts and adits)	Medium	Low Likelihood	**Moderate - Low**	• Identify location of the ventilation borehole and decommission in accordance with EA guidance. • A watching brief should be carried out by a geotechnical engineer during groundworks to monitor for evidence of any unrecorded mine entries. Where mine entries are recorded during construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided.
Mining Geology	Medium	Unlikely	**Low**	• Complete the initial ground investigation to determine the thickness of any Made Ground or superficial deposits, and depth to bedrock across the site area.
Mine gas emissions	Medium	Low	**Moderate / Low**	• Complete the initial ground investigation and install ground gas monitoring wells in selected exploratory borehole locations to enable a monitoring programme and gas risk assessment for the site.
Recorded Mining Surface Hazard	Medium	Low Likelihood	**Moderate – Low**	• Complete the initial ground investigation to determine the thickness of any Made Ground or superficial deposits, and depth to bedrock across the site area.

Table 7 – Summary of Mining Risks and Proposed Actions associated with Development Zone 3 - 10

Scenario	Consequence	Likelihood	Risk in Development Zone 3 – 10	Proposed Action
Underground Mining (probable at deeper depths) ***>30m below rockhead***	Medium	Unlikely	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Underground Mining (probable at shallow depths) ***<30m below rockhead***	Medium	Low Likelihood	**Zone 3, 4,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Mine entries (shafts and adits)	Medium	Low Likelihood	**Zone 3,4 ,5, 7, 8, 9 & 10** **Moderate – Low**	• Watching brief to be carried out during all groundworks by geotechnical engineer to monitor for evidence of shafts. If any are recorded during construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided. • All new or upgraded roads, paths and features on Zones 3,4,5,7,8,9&10 to be underlain with geogrid

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Scenario	Consequence	Likelihood	Risk in Development Zone 3 – 10	Proposed Action
				to provide some mitigation against any shaft collapse.
Mining Geology	Medium	Unlikely	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Mine gas emissions	Medium	Low	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• No specific action required.
Recorded Mining Surface Hazard	Medium	Low Likelihood	**Zone 3,4 ,5, 7, 8, 9 & 10** **Moderate – Low**	• Complete the initial ground investigation to determine the presence of any Made Ground aggressive ground and expansivity to be considered.
Surface Mining (open cast workings)	Medium	Unlikely	**Zone 3,4 ,5, 7, 8, 9 & 10** **Low**	• Complete the initial ground investigation to determine the type of Made Ground along with taking environmental samples.

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3 ZONE 1 - PHASE 2 GROUND INVESTIGATION SCOPE OF WORKS

Initial ground investigation works were undertaken across Zone 1 in multiple visits due to site access constraints, the works were completed between the 11th and 13th of March, 20th and 22nd March, 16th and 18th April 2024.

Additional ground investigation was undertaken at Zone 1 between the 09th and 12th December 2024.

The development plan layouts have changed since the investigation scoping and undertaking.

The scope of the ground investigation was designed in general accordance with current UK guidance including LCRM (Ref. 5), BS10175 (Ref. 6), BS5930:2020 (Ref. 7) and BSEN1997-2:2007 Eurocode 7 (Ref. 8).

The scope and rationale of works undertaken to date are summarised in *Table 8.*

Table 8 - Scope of Works

Exploratory Hole Type	Exploratory Hole Reference	Exploratory Hole Depth (m bgl)	Rationale
Initial Ground Investigation			
Window Sample Boreholes	DSBH 1-01 DSBH 1-02 DSBH 1-03 DSBH 1-05	4.45 1.40 1.80 4.00	Characterise shallow ground and groundwater conditions; Collect soil samples for chemical analysis; Collect samples for geotechnical soil testing; and Gas and groundwater level monitoring.
Rotary Open-hole Boreholes	RH 1-01 RH 1-02 RH 1-03	18.00 40.00 40.50	Characterise deep ground conditions; Identify any broken ground and voids within the bedrock;
Trial Pits	TP 1-01 TP 1-02 TP 1-03 TP 1-04	2.50 1.20 2.00 2.90	Characterise shallow ground and groundwater conditions; Collect soil samples for chemical analysis; and Collect samples for geotechnical soil testing.
Trial Trenches	TT 1-01 TT 1-02 TT 1-03 TT 1-04	3.50 2.50 3.90 1.60	Characterise shallow ground and groundwater conditions within the former reservoir; and, Collect soil samples for chemical analysis.
Soakaway Trial Pits	ST 1-01 ST 1-02 ST 1-03	1.65 2.70 1.00	Characterise shallow ground and groundwater conditions; Collect soil samples for chemical analysis; Collect samples for geotechnical soil testing; and, Undertake soakaway testing.
CBR Tests	CBR 1-01 CBR 1-02 CBR 1-03 CBR 1-04 CBR 1-08 CBR 1-09 CBR 1-10 CBR 1-11 CBR 1-12 CBR 1-13 CBR 1-14 CBR 1-15	0.50 0.40 0.40 0.30 0.27 0.68 0.25 0.19 0.92 0.30 0.82 0.74	To confirm shallow ground conditions for roads and hardstanding design.
Additional Ground Investigation			
Cable Percussive Boreholes	CP1-01 CP1-01B CP1-01C CP1-02 CP1-03	0.40 0.90 15.10 9.50 15.10	Characterise shallow and deep ground and groundwater conditions to inform pile design. Confirm depth of bedrock deposits. Collect samples for chemical and geotechnical analysis.

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For information regarding the location of the exploratory hole locations, refer to Curtins drawings Ref. 080874-CUR-XX-XX-DR-GE-80010-P01 and 080874-CUR-XX-XX-DR-GE-80016-P01 enclosed within Appendix A.

3.1 Soil Logging and Sampling

Exploratory hole arisings were logged onsite by a qualified engineer in general accordance with the requirements of BS5930:2020 (Ref. 7), including recording observed visual and olfactory indicators of contamination.

Exploratory hole logs are provided in Appendix C.

3.2 Constraints and Ecological Considerations

The Zone 1 Visitors Centre building site is located within areas of protected land, including Priority Lowland Meadow habitats, and is located immediately outside the RSPB and SSSI, RSPB Hodbarrow.

Before Curtins attended site an Ecological Impact Assessment was undertaken by Greengage (Ref. 27) which provided recommendations and mitigation measures for the works and during construction.

Prior to arrival to Zone 1 the site had undergone vegetation clearance, which reduced the shrub level to 150mm above ground level.

On arrival, site staff were inducted and given a toolbox talk by Greengage ecologists to inform about the ecological considerations on site. This included the protected Priority Lowland Meadow areas, which could not be tracked across by vehicles, the flora and fauna of interest and measures to reduce the impact of works on the environment.

Vehicles tracking onto site entered from an approved specified location and where possible used the same tracks while moving across site to reduce the impact of vehicles on the environment. While tracking to the positions the route was observed by an ecologist to watch for any sign of animals of interest, such as the Natterjack Toad.

During the third visit of the investigation works, the nuisance species Mares Tail was noted by the Ecologist on site. To reduce the spread of this nuisance species track mats were used under the tracks while moving the rotary rig on and off site. Additionally, a hand pump pressure washer was used to wash down the boots of personnel onsite each time they walked off the affected areas, to further reduce the potential spread of the nuisance species. A pressure washer was used to wash the track mats, the rig and vehicle tacks at the end of the job to remove potential nuisance species and reduce the chance to potentially spread the species.

During the site investigation several positions were moved or unable to take place because of the proximity to the protected areas or due to the presence of invasive species. CBR 1-05, CBR 1-06 and CBR 1-07 we unable to be completed due to the presence of invasive species. ST 1-01, ST 1-02 and TP 1-04 were moved away from the protected grassland areas. All positions that were moved were approved by the ecologist on site from Greengage.

Other constraints to the ground investigation included inaccessible land at the north of the site, due to the location of a fence, density of vegetation and steeply sloping ground and the presence of an unrecorded water supply pipe encountered in TT1-04.

Additional ground investigation works undertaken in December 2024 were undertaken under the supervision of an ecologist. Track mats were used to facilitate access to site plant across protected grassland, adjacent to the existing road.

A plan illustrating the constraints to ground investigation encountered is included in Appendix A.

3.3 Monitoring Well Installations

Ground gas and groundwater monitoring wells (50 mm diameter) were installed in 4 No. window sample boreholes.

A bentonite seal was placed above and below the screened section of the borehole to minimise potential for downward migration of contaminants and the creation of a preferential migratory pathway. A gravel aggregate surround was installed in the annulus between the sides of the borehole and the slotted sections of pipe.

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The monitoring wells were primarily designed to assess the potential presence of ground gas as well as providing information on any groundwater levels. The screened sections therefore focused on the Made Ground, which are represent a potential ground gas source, and superficial deposits where groundwater was most likely to be encountered.

The installed response zones are summarised in *Table 9.*

Table 9 - Monitoring Well Response Zones

Exploratory Hole Reference	Response Zone(s) (m bgl, m AOD)	Strata Description
DSBH 1-01	1.00 – 2.00 (12.75 – 11.75)	MADE GROUND
DSBH 1-02	0.50 – 1.00 (13.97 – 13.47)	MADE GROUND
DSBH 1-03	0.80 – 1.80 (12.47 – 11.47)	MADE GROUND
DSBH 1-05	1.00 – 2.00 (14.75 – 13.75)	MADE GROUND
CP1-02	6.00 – 8.00 (8.46 – 6.46)	Glacial Till
CP1-03	8.00 – 11.00 (6.00 – 3.00)	Glacial Till

Copies of borehole logs can be referred to in *Appendix C* of this report.

3.4 Post Investigation Monitoring

3.4.1 Ground Gas and Groundwater Monitoring

Four ground gas and groundwater monitoring visits were completed between 29th April and 3rd June 2024.

Additional groundwater monitoring of additional cable percussive boreholes only has been undertaken between the 09th January 2025 and 22nd January 2025.

Groundwater levels were measured with an interface probe and ground gas concentrations were monitored using a gas monitor (GFM430).

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4 LABORATORY ANALYSIS

Representative soil samples were selected for laboratory geotechnical and chemical testing, based on field observations, to inform the proposed works.

Selected environmental soil samples were placed in laboratory provided containers and stored in cool boxes prior to being transported to the nominated laboratory under the laboratory's chain of custody documentation. The laboratory selected by Curtins for chemical and geotechnical analysis was Envirolab (UKAS and MCERTS accredited).

Sampling positions were generally located in a non-targeted, systematic array to give adequate and representative coverage of the site's proposed end use and the immediate environmental setting, concentrating in the Made Ground.

4.1 Environmental Chemical Analysis

The contaminants of concern potentially present on the site were considered to include, amongst others; organic matter, fill, hydrocarbons (e.g. fuel/oils) the extent of which is captured by the broad environmental testing suite listed in Table 10.

Table 10 - Environmental Chemistry Analysis Suite: Soils

Suite Ref	Analyte	LOD
Curtins Soil Suite A	Asbestos Screen, pH and Soil Organic Matter (SOM)	0.1%
	Arsenic, Chromium, Chromium VI, Copper, Lead, Selenium, Zinc, Nickel	5 mg/kg
	Boron (water soluble)	1 mg/kg
	Cadmium	0.5 mg/kg
	Mercury	0.1 mg/kg
	Cyanide (total)	10 mg/kg
	Sulphate (total)	200 mg/kg
	Sulphide	2 mg/kg
	Sulphur (elemental)	20 mg/kg
	Phenols (screen)	1 mg/kg
	PAHs (USEPA 16)	0.1 mg/kg
	TPH (Aro/Ali Split)	0.01 to 0.1 mg/kg

During the initial ground investigation, 13 No. samples were taken from Made Ground soils. All soil samples collected during the initial ground investigation were tested for Curtins Soil Suite A, as detailed in Table 9.

During the initial ground investigation asbestos quantification was undertaken on 4 No. samples where asbestos was identified in soil samples, including chrysolite and amosite as loose fibres, cement and loose insulation.

During the additional ground investigation three soils samples and two bulk (suspected asbestos containing material) were collected with asbestos quantification testing undertaken.

Copies of the environmental chemistry testing certificates are presented in Appendix D.

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4.2 Geotechnical Analysis

Soil samples for testing were prepared in accordance with BS1377: Part 1:2016 (Ref. 9). The geotechnical testing undertaken is summarised in Table 11.

Table 11 – Geotechnical Laboratory Testing (Soils)

Test Type.	Quantity	Standard
Moisture Content	11	BS1377 1990, Part 2 (clause 3.2)
pH	11	BS1377 1990, Part 3 (clause 9.4 & 9.5)
Water Soluble Sulphate 2:1 SO_4	11	BS1377 1990, Part 3 (clause 5.3 & 5.5)
Atterberg 4 Point	11	BS1377 1990 (clause 4.3 and clause 5)
Single-Stage Unconsolidated Undrained Triaxial	4	BS EN ISO17892
Oedometer One Dimensional Consolidation Test	2	BS1377 1990 Part 5 (Clause 3.3, 3.4, 3.5)
Determination of Expansion of Slag	1	BRE 481 Part B – Appendix B

The results of the geotechnical testing are summarised in *Section 7.0* of this report. Copies of the geotechnical testing certificates are presented in *Appendix E*.

4.3 Quality Assurance and Quality Control

Soil chemical analysis and soil geotechnical testing was conducted by Envirolab, a UKAS and MCERTS accredited laboratory. All samples were delivered in appropriate containers for the suites tested and analysed within the recommended holding times. No deviations were recorded at the time of analysis.

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5 ZONE 1 GROUND CONDITIONS

The ground conditions encountered during the ground investigation works generally comprised a moss and brush surface cover over sandy clay topsoil, locally gravel and tarmacadam. Superficial deposits were found underlying the Made Ground deposits in ten exploratory hole locations, generally comprising cohesive material. Bedrock deposits were encountered within all rotary open hole and three cable percussive boreholes, underlying the superficial deposits.

5.1 General

A summary of the ground conditions encountered during the site investigation works is presented in Table 12, with detailed information presented in the exploratory hole logs included in *Appendix C*.

Table 12 - Summary of Ground Conditions Encountered

Strata	Depth to Top of Strata	Recorded Thickness (m)		Description
	m bgl (m AOD)	Min	Max	
Made Ground	Ground Level	0.40[1]	4.00[1]	MADE GROUND of dark greyish brown very gravelly sand. Or Grey sandy clay; Or Brown sandy gravelly clay; Or Reddish brown sandy gravel. Composition varies position to position, see *Section 5.2* for details.
Glacial Till – Cohesive[2]	2.00 – 13.50 (12.00 - -0.10)	1.15[2]	12.1	Reddish brown to brown, locally mottled grey sandy gravelly clay.
Glacial Till – Granular[2]	8.50 – 17.00 (4.90 - -3.60)	0.40	5.00	Brown gravelly sand. Or Reddish brown to brown sandy gravel.
Low Furness Basal Formation	18.00 (-4.60)	22.00[2]		Reddish brown conglomerate with lithoclasts of mudstone and sandstone.
Red Hill Limestone Formation	9.00 – 15.00 (5.46 - -1.60)	0.10[1]	30.50[1]	Grey Limestone

1 – Made Ground depth not proven in all positions. May be reduced thicknesses locally.
2 – Thickness not proven. Greater thicknesses may be present.

5.2 Made Ground

Made Ground was encountered in all exploratory borehole locations from ground level to proven depths ranging between 0.40m and 4.00m bgl (13.00m to 9.40m AOD). The thickness of Made Ground was not proven in all locations.

5.2.1 Surface Layer

During the initial ground investigation Made Ground soils comprising of vegetation cover overlying topsoil, with a maximum depth of 0.50m bgl (13.06m AOD), was encountered in all locations, excepting ST 1-02, TP 1-04, CP 1-01, CP 1-01B, CP 1-01C, CP 1-02 and CP 1-03 which recorded surface cover comprised of vegetation overlaying granular Made Ground deposits.

5.2.2 Made Ground

Granular Made Ground was encountered in all exploratory across the site. The thickness and composition varied across the site.

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Within the footprint of the historic reservoir, Made Ground comprises:

- Dark greyish brown very gravelly sand with cobbles. Gravel comprised glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag. Cobbles include metal, mudstone and bricks.
- Brown sandy gravelly clay with cobbles. The gravel fraction includes mudstone, limestone sandstone and concrete. Cobbles include metal, mudstone and bricks.
- Grey sandy clay.

This general sequence is indicative of backfilled materials and soils within the former historic reservoir (TT 1-01, TT 1-02, TT 1-03, TT 1-04 and DSBH 1-05.

Elsewhere across the site the Made Ground comprises:

- Brown sandy gravelly clay. The gravel fraction includes mudstone, sandstone and brick;
- Greyish brown slightly clayey very gravelly sand. The gravel fraction includes brick, slag, coal, metal, mudstone, sandstone and glass.
- Reddish brown sandy gravel. The gravel fraction includes, limestone, mudstone and brick.
- Brown very clayey, gravelly, cobble fine to coarse sand. Gravels comprise of slag, clinker, limestone, glass and coal. Cobbles comprise of limestone.
- Black and grey mottled very gravelly, silty fine to coarse sand. Gravels comprise of slag, clinker, glass coal and steel.

The site is a recorded BGS and historic landfill site, part of Red Hills Quarry landfill. Deposited waste is indicated to include inert, industrial, commercial, household, special waste and liquid sludge. Varied Made Ground encountered during the ground investigation may be indicative of ‘landfill’ material, including glass bottles, tyres, scrap metal, cups, ceramics, polystyrene and plastic. Relatively limited putrescible materials were identified during the investigation.

Made Ground soils within the vicinity of CP1-01 and CP1-01B were confirmed to contain asbestos cement sheet pieces from ground level to a proven depth of 0.90m bgl.

Made Ground soils containing ash were identified in CP1-03 from 0.20m to 1.50m bgl. Fine to medium white ash was recorded to make up 20% of the total soil volume.

5.3 Superficial Deposits

5.3.1 Cohesive

Cohesive deposits indicative of Glacial Till was encountered in DSBH 1-01, RH 1-01, RH 1-02, RH 1-03, TP 1-01, TT 1-01, TT 1-03 CP1-01C, CP1-02 and CP1-03. The base of the deposit was encountered within the rotary boreholes, however due to the open hole drilling technique, only visual confirmation from chipping returns was possible. The base of the cohesive Glacial Till was confirmed in the cable percussive boreholes with the deposit proven to depths ranging between 9.00m and 15.00m bgl (5.46m to -1.60m AOD).

The Cohesive deposits comprised reddish-brown to brown, mottled grey, slightly sandy slightly gravelly clay, underlain by light brown sandy lightly gravelly clay.

5.3.2 Granular

Granular deposits were encountered in RH 1-01, RH 1-02, RH 1-03 and CP1-03. The base of the deposit was encountered within the rotary boreholes, however due to the open hole drilling technique, only visual confirmation from chipping returns was possible. The base of this deposit was confirmed in cable percussive borehole CP1-03 and was proven to a depth of 14.50m bgl (-0.50m AOD).

The Granular deposits comprised reddish brown to brown, slightly gravelly sand, underlain by brown sandy gravel, or Brown gravelly sand. The granular deposits were encountered underlying cohesive deposits and overlying the bedrock deposits.

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5.4 Low Furness Basal Formation

Bedrock deposits indicative of the Low Furness Basal Formation were encountered at 18.0m bgl (-4.60m AOD) in RH 1-02. The formation comprised reddish brown conglomerate with lithoclasts of mudstone and sandstone and a reddish brown sand matrix. The base of the deposit was not encountered during the investigation.

The bedrock deposit was logged based on the chipping returns from open hole drilling.

No evidence of broken ground or voids were identified.

5.5 Red Hill Limestone Formation

During the initial ground investigation, rotary open hole drilling findings led to the assumption that bedrock comprised of the Martin Limestone Formation encountered as calcareous mudstone deposits. However, additional investigation using a cable percussive rig, confirmed that the bedrock underlying the development site is consistent with the Red Hill Limestone Formation encountered as grey limestone. This initial misidentification of the bedrock strata has likely arisen from the inherent limitations of rotary open hole drilling, which provides limited arising which can be inspected.

Bedrocks deposits consistent with the Red Hill Limestone Formation were encountered from depths ranging between 9.00m to 15.00m bgl (5.46m to -1.60m AOD) for the top of these deposits. This deposit was encountered as a grey limestone. The extent of this deposit was not proven during the ground investigation.

5.6 Obstructions Encountered

Several obstructions were recorded within the Made Ground during the investigation, within DSBH 1-02, DSBH 1-03, DSBH 1-05, TP 1-02, SA 1-01 and SA 1-03.

The obstructions were recorded DSBH 1-02 at 1.40m bgl (unknown), DSBH 1-03 at 1.80m bgl (tyre), DSBH 1-05 at 4.00m bgl (unknown), TP 1-02 at 1.20m bgl (hard ground, unable to penetrate), SA 1-01 at 1.65m bgl (hard ground, unable to penetrate), and SA 1-03 at 1.00m bgl (hard ground, unable to penetrate).

5.7 Groundwater

Groundwater was encountered within the initial ground investigation within DSBH 1-01 at 2.50m bgl, TP 1-02 at 0.65m bgl, TP 1-04 at 1.90m bgl, TT 1-02 at 2.50m bgl, TT 1-2A at 2.50m bgl, TT 1-03 at 2.50m bgl, SA 1-02 at 0.23m bgl, SA1-03 at 0.40m bgl and RH 1-03 at 1.10m bgl. Deep groundwater infiltration within rotary open boreholes could not be noted or monitored due to the use of the air mist technique.

During the additional ground investigation water strikes were recorded within the cohesive Glacial Till at 13.50m bgl (CP1-01C), 6.00m bgl (CP1-02) and 9.40m bgl (CP1-03). An additional groundwater strike was recorded in the granular Glacial Till at 14.10m bgl (CP1-03). Groundwater encountered during the additional ground investigation is likely perched water and not representative of an aquifer.

Groundwater levels were monitored during the return monitoring visits as summarised in Table 13.

Table 13 – Groundwater Monitoring Results

Initial Groundwater Monitoring						
Exploratory Hole	**Installation Strata**	**Response Zone m bgl**	**Depth (m bgl)**			
			29/04/24	**14/05/24**	**23/05/24**	**03/06/24**
DSBH 1-01	Made Ground	1.00 – 2.00 (12.75 – 11.75)	DRY	DRY	DRY	DRY
DSBH 1-02	Made Ground	0.50 – 1.00 (13.97 – 13.47)	1.00	0.75	1.01	DRY
DSBH 1-03	Made Ground	0.80 – 1.80 (12.47 – 11.47)	1.50	1.50	1.36	1.49
DSBH 1-05	Made Ground	1.00 – 2.00 (14.75 – 13.75)	DRY	DRY	2.71	DRY

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Additional Groundwater Monitoring				
Exploratory Hole	**Installation Strata**	**Response Zone m bgl**	**Depth (m bgl)**	
			09/01/2025	**22/01/2025**
DSBH 1-01	Made Ground	1.00 – 2.00 (12.75 – 11.75)	DRY	DRY
DSBH 1-02	Made Ground	0.50 – 1.00 (13.97 – 13.47)	0.91	DRY
DSBH 1-03	Made Ground	0.80 – 1.80 (12.47 – 11.47)	DRY	DRY
DSBH 1-05	Made Ground	1.00 – 2.00 (14.75 – 13.75)	DRY	DRY
CP1-02	Glacial Till	6.00 – 8.00 (8.46 – 6.46)	0.99	1.08
CP1-03	Glacial Till	8.00 – 11.00 (6.00 – 3.00)	4.31	4.29

5.8 Observed Potential Contamination

The following visual or olfactory contamination was observed during the investigation within the Made Ground deposits in Table 14:

Table 14 - Summary of visual or olfactory contamination

Exploratory Hole	Installation Strata	Depth of observed contamination m bgl	Description
TT 1-02	Made Ground	2.50	Perched water strike with fast infiltration rate and a greenish brown colour. No odour noted.
TT 1-02A	Made Ground	2.50	Perched water strike with fast infiltration rate and a greenish brown colour. No odour noted.
TT 1-03	Made Ground	2.50	Perched water strike with fast infiltration rate and a greenish brown colour. No odour noted.
SA 1-02	Made Ground	0.24 – 1.50	Slight sulphur smell
TP 1-04	Made Ground	0.20 – 1.90	Slight sulphur smell
CP1-01	Made Ground	0.30 – 0.40	ACMs observed in Made Ground
CP1-01B	Made Ground	0.70 – 0.80	ACMs observed in Made Ground

Varied anthropogenic constituents associated with landfill soils were also noted throughout Made Ground soils as detailed in section 5.2.2.

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6 GROUND MODEL

6.1 Made Ground

Made Ground was encountered in all exploratory hole locations, it was encountered at ground level to proven depths ranging between 0.40m and 4.00m bgl. The Made Ground is described in Section 6.2.

Due to the variable nature of Made Ground in terms of strength and composition, this layer is not deemed to be a suitable founding stratum. As such, limited geotechnical testing was undertaken on this stratum and geotechnical designer parameters have not been derived for the Made Ground.

The geotechnical test results recorded within the Made Ground deposits are summarised in Table 15.

Table 15 – Summary of Geotechnical Test Results – Made Ground

Parameter	No. of Tests	Results	
		Min	Max
In Situ Tests			
SPT 'N' Value (uncorrected)	11	2	>50
Point Load tests	4	Tests results in Appendix C	
DCP Tests	8	Tests results in Appendix C	
Soakaway Tests	3	Tests results in Appendix C	
Laboratory Tests – General			
pH	18	7.25	10.86
Water Soluble Sulphate (mg/l)	18	<10	34
Maximum Expansion of Slag	1	0	

(1) Includes pH and water-soluble sulphate values derived from environmental testing.

Ten SPT tests were undertaken within the Made Ground deposits, all of which achieved full penetration. The remaining SPT test value was recorded as >50 (refusal) indicating denser deposits or else the presence of an obstruction.

A bulk Made Ground sample of gravel and cobble sized slag arisings did not exhibit any expansion during analysis, which determined the expansion of slag over a 28-day period.

6.2 Superficial Deposits

6.2.1 Cohesive Deposits

Cohesive Superficial Deposits were encountered in ten exploratory holes directly beneath the Made Ground deposits. This deposit was proven to depths of 9.00m and 15.00m bgl.

The geotechnical test results recorded within the Cohesive Superficial Deposits are summarised in Table 16.

Table 16 - Summary of Geotechnical Test Results – Cohesive Superficial Deposits

Parameter	No. of Tests	Results	
		Min	Max
In Situ Tests			

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Parameter		No. of Tests	Results Min	Results Max
SPT 'N' Value (uncorrected)		17	8	44
Laboratory Tests – General				
Atterberg Tests	Liquid Limit (%)[1]	9	30	45
	Plastic Limit (%)[1]	9	16	21
	Plasticity Index (%)[1]	9	12	24
	Modified Plasticity Index (%)[2]	9	12	20
Moisture Content (%)		10	6.1	23.8
pH		9	8.00	8.65
Water Soluble Sulphate (mg/l)		9	<10	164

(1) Excludes non-plastic results
(2) Modified plasticity index in accordance with NHBC Chapter 4.2.

The results of the Atterberg Limits are presented in *Figure 6.* The samples indicated typically low medium plasticity clay.

The SPT N results are presented on *Figure 7.*

The Undrained Shear Strength, C_u, of cohesive soils can be estimated from the correlation between Plasticity Indices (PI) and SPT N values (Ref. 11) using Equation 1:

$$c_u = f_1 \times \text{SPT N} \qquad \textbf{Equation 1}$$

Where:
c_u is the Undrained Shear Strength
f_1 is the Stroud Factor determined from Figure 1.5 (Ref. 11)
SPT N is Characteristic Standard Penetration Test Result

Using an f_1 factor of 6 based upon the average plasticity index result of 17%, c_u values ranging between 48 and 264 kPa were determined. The estimated results indicate medium to very high strength clay, generally increasing in strength with depth. The majority of results indicate high strength cohesive soil.

Four Quick Undrained Single Stage Triaxial Tests have been undertaken recoding soil strengths of 32 kPa to 215 kPa at approximate overburden pressure. The results indicate medium to very high strength clay and are generally consistent with estimated undrained shear strengths, illustrated in Figure 8.

A moderately conservative unit weight of 20 kN/m^3 is deemed suitable for the cohesive soils above the groundwater table in accordance with BS8004 (Ref. 12).

The Coefficient of Consolidation, Mv, of the cohesive soils can be estimated from the correlation between Plasticity Indices (PI) and SPT N values (Ref. 13) described by Equation 2.

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$$Mv=1/(f_2 \times SPT\ N) \qquad \textbf{Equation 2}$$

Where:
Mv is the coefficient of consolidation
f_2 is the Stroud Factor determined from Figure 1.5
SPT N is Characteristic Standard Penetration Test Result

Using an f_2 factor of 0.6 for an average plasticity index of 17%, Mv values range between 0.04 and 0.21 m^2/MN. The results suggest a very low to medium compressibility clay.

Two Oedometer tests were undertaken on an undisturbed sample taken at a depth of 3.00m and 9.00m bgl. A coefficient of volume compressibility of 0.32 m^2/MN and 0.15 m^2/MN was reported, suggesting that the clay was of medium to high compressibility.

The Angle of Shearing Resistance (φ), for the cohesive Glacial Till has been derived from a correlation with Plasticity Indices (Ref. 14). An undrained Angle of Shearing Resistance (φ') of 22° to 25º is appropriate.

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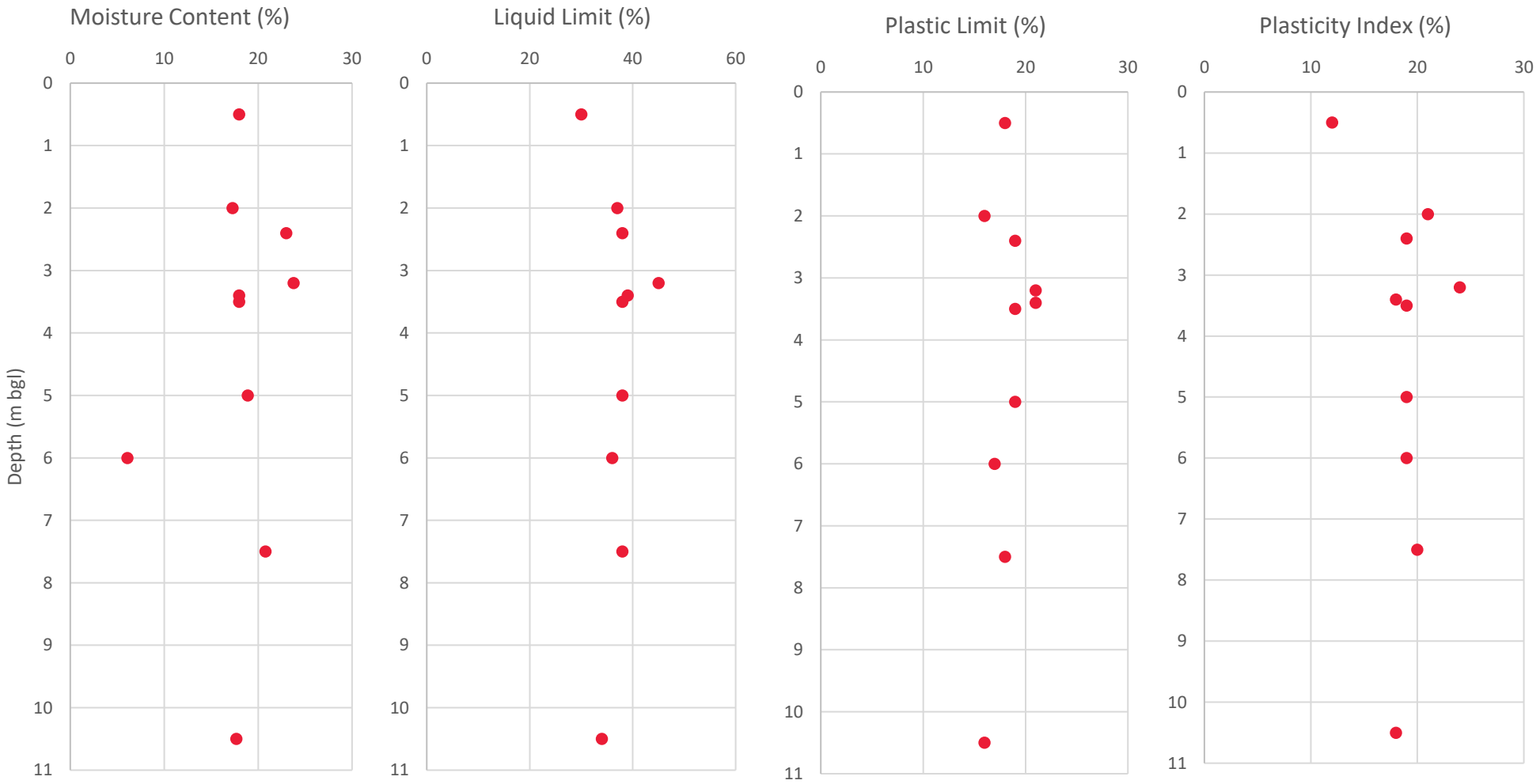

Figure 6 – Atterberg Limit Results vs. Depth (m bgl)

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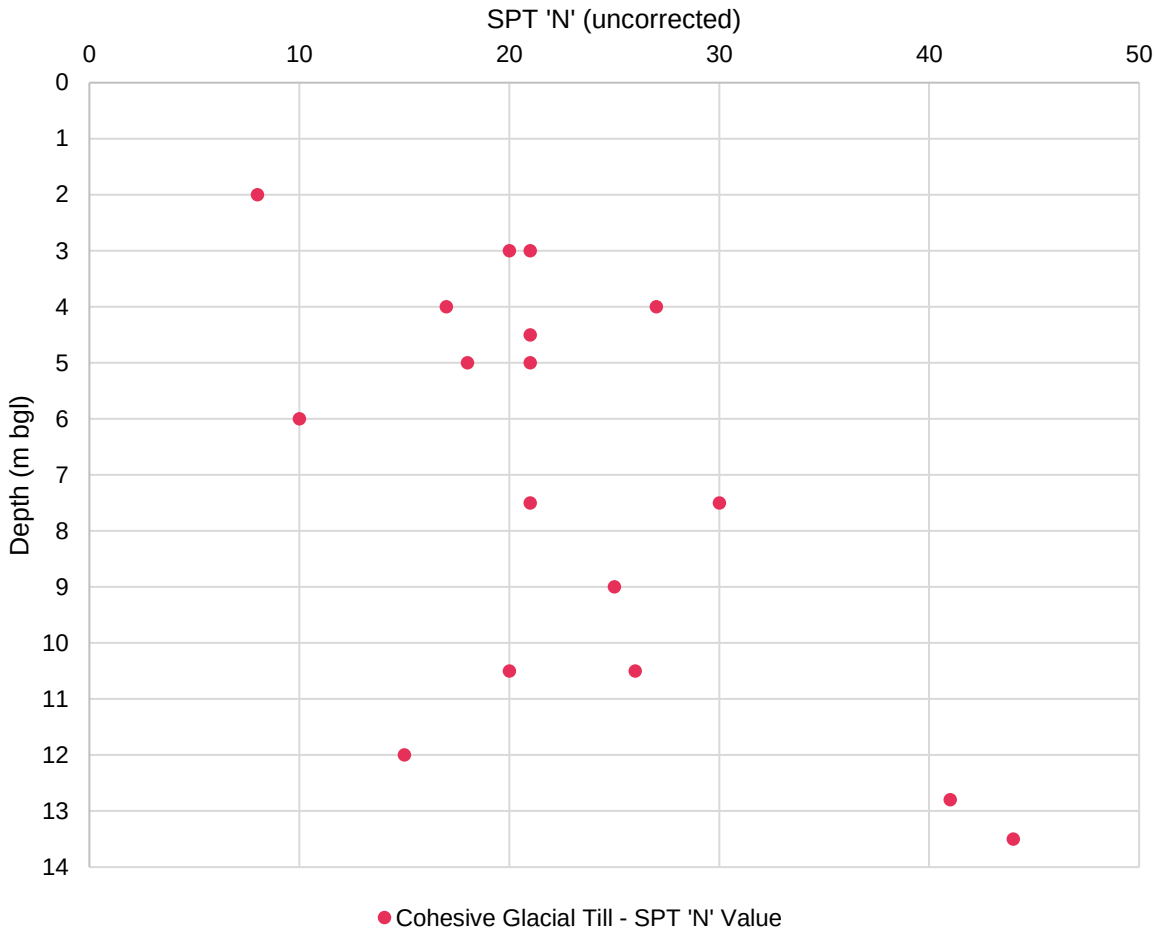

Figure 7 - SPT 'N' Values (uncorrected) vs. Depth (m bgl)

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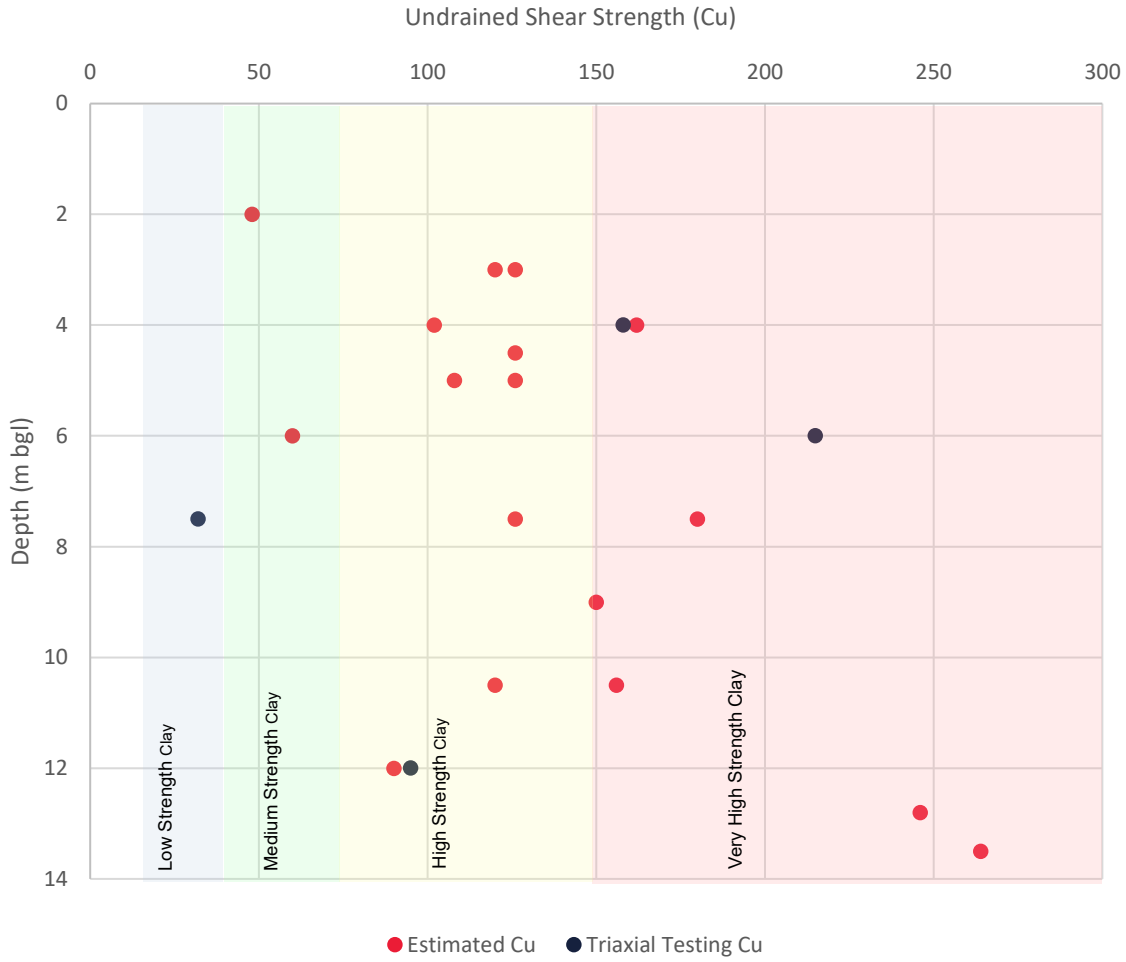

Figure 8 – Relationship between Undrained Shear Strength vs. Depth (m bgl)

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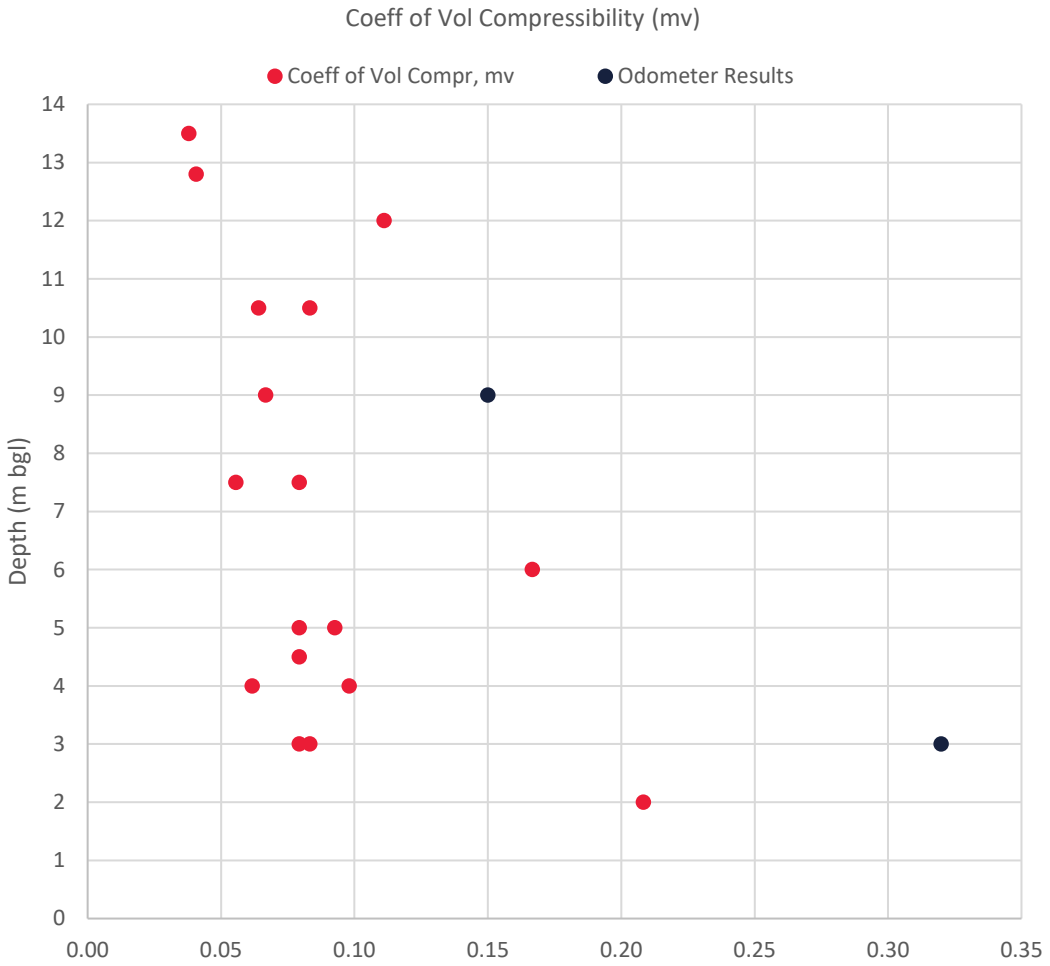

Figure 9 – Relationship between Coefficient of Volume Compressibility vs. Depth

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6.2.2 Granular Deposits

Granular deposits were only encountered in the rotary open and cable percussive boreholes RH 1-01, RH 1-02, RH 1-03 and CP1-03. No sampling was possible from the rotary open hole boreholes and granular deposit were encountered as a thin horizon within the cable percussive borehole. Therefore, geotechnical parameters have not been derived for this stratum.

6.3 Bedrock Deposits

Bedrock deposits encountered during the ground investigation generally comprised of the Red Hill Limestone formation which was encountered from depths ranging between 9.00m to 15.00m bgl (5.46m to -1.60m AOD).

The geotechnical test results recorded within the Red Hill Limestone Formation are summarised in Table 17.

Table 17 - Summary of Geotechnical Test Results – Cohesive Superficial Deposits

Parameter	No. of Tests	Results	
		Min	Max
In Situ Tests			
SPT 'N' Value (uncorrected)	5	>50	
Laboratory Tests – General			
pH	2	8.70	8.80
Water Soluble Sulphate (mg/l)	2	27.4	36.7

Locally, within the southeast of the site bedrock was encountered as the Low Furness Basal Formation from 18.00m bgl (-4.60m AOD). No geotechnical SPT testing was undertaking on this stratum.

6.4 Aggressive Ground Conditions

The classification of the site in terms of concrete in aggressive ground is based on the guidance provided in Table C2 of the Building Research Establishment (BRE) Special Digest 1, 3rd edition of 2005 (Ref. 15). A summary of the results obtained during are summarised in Table 18, and Table 19 details the classification.

Table 18 - Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Quantity	Range
Made Ground	pH	7.25 – 10.86
	Water Soluble Sulphate (mg/l)	<10 - 34
Cohesive Glacial Till	pH	8.00 – 8.65
	Water Soluble Sulphate (mg/l)	<10 - 164
Red Hill Limestone Formation	pH	8.70 – 8.80
	Water Soluble Sulphate (mg/l)	27.4 – 36.7

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Table 19 - Aggressive Chemical Environment for Concrete (ACEC) Site Classification

Stratum	Design Sulphate Class	ACEC Class (1)
Made Ground*	DS-1	AC-1
Cohesive Glacial Till	DS-1	AC-1
Red Hill Limestone Formation	DS-1	AC-1

(1) ACEC assessment was based on the mobile groundwater condition in a brownfield scheme area.

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7 GROUND AND GROUNDWATER CONTAMINATION ASSESSMENT

This section of the report includes the assessment of the potential contamination, solid, liquid and gas, identified on the subject site which may present a risk to the proposed end users, associated utilities, and the wider environment.

In guidance published by the Environment Agency, the risk to human health or controlled waters is determined through an assessment of pollutant linkages between a source of contamination (within the ground or groundwater either on or off site) and a sensitive receptor such as end users of the site, building materials, edible plants grown in gardens or groundwater abstracted for drinking. This is termed a source-pathway-receptor relationship. The same model is applied to the assessment of risk arising from ground gases as detailed within BS8576:2013 (Ref. 16).

These models have a common approach, which is one of a tiered assessment. At each stage of the assessment further detail can be applied to the conceptual site model to provide a detailed interpretation on a site by site basis. As part of the planning process this approach is adopted to establish either if the site is 'suitable for use' or whether additional work or else remedial work is required for the site to be deemed so.

The sub-sections hereafter therefore incorporate the first tier (Tier 1) of this approach otherwise referred to as the Generic Quantitative Risk Assessment (GQRA). The GQRA builds on the qualitative risk assessment presented in the Phase 1 Mining Risk Assessment (Ref. 2) in conjunction with observations made during the ground investigation and is based solely on the results of the chemical and other testing data obtained as part of Curtins ground investigation. The GQRA is used to build/refine the Conceptual Site Model (CSM) for the site as detailed and presented in Section 9.0 of this report.

The following sections present more detail on the risk assessment methodology rationale for the main receptors.

7.1 Human Health GQRA

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency and Defra. Guidance includes Contaminated Land Exposure Assessment (CLEA) v1.071 model (Ref. 17) Report SC050021/SR2: Human Health Toxicological Assessment of Contaminants in Soil (Ref. 18) and Report SC059921/SR3: Updated Technical Background to the CLEA Model (Ref. 19).

A generic quantitative risk assessment (GQRA) has been carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria (GAC) where available, including:

i) **Soil Guideline Values (SGVs):** These have been published by the Environment Agency and are trigger values for screening out low risk areas of land contamination. SGV's give an indication of representative average concentrations of chemicals in soil, below which long-term health risks are likely to be minimal. SGVs have been published for several contaminants including arsenic, cadmium, mercury, nickel, selenium, BTEX, phenols and dioxins, furans and dioxin-like PCB substances for land uses including residential, allotments and commercial. The SGVs have been developed for a sandy loam soil with 6% soil organic matter (SOM) content;

ii) **Supplementary Screening Values (SSVs):** In addition to the SGVs developed by the EA, other third-party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed by Atkins AtriskSoil™, the LQM/CIEH Suitable for Use Levels (S4UL) and EIC/AGS/CL:AIRE published thresholds;

iii) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 (Ref. 17) in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). C4SLs are not representative of significant possibility of significant harm (SPoSH) and are low risk levels which, and therefore where the C4SLs are not exceeded, land can be demonstrated to be in Category 4 and cannot be determined as contaminated land.

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7.1.1 Adopted Soil Human Health GACs Screening Methodology

The proposed development comprises, access improvements, car parking, new paths, repairs to existing structures and the construction of a new visitors centre. This is most analogous with a *Commercial* end-use scenario and so the assessment has been undertaken against the following GACs, in order of preference for the development:

1. Environment Agency Soil Guideline Values,
2. CL:AIRE, AGS, EIC. Soil Generic Assessment Criteria for Human Health Risk Assessments,
3. LQM/CIEH 2015 S4ULs for Human Health Risk Assessment, and
4. DEFRA Category 4 Screening Levels.

The soil organic matter (SOM) content has an influence on the volatilisation of organic contaminants (i.e., the higher the SOM, the lower the volatilisation rate and therefore inhalation exposure risk). Soil organic matter (SOM) values for the site soils ranged from 0.90% to 41.4%. Consideration of the geometric mean results in a calculated value of 7.6%. However, the organic matter value of 41.1%, recorded in DSBH 1-05 is an outlier and is therefore not considered for the geometric mean. The updated geometric mean without the outlier result is 6.2%.

As there is a reasonably large range of organic matter values a relatively conservative comparison against Tier 1 thresholds for a SOM of 2.5% for all the samples has been adopted for *Commercial* end-use because of the lower soil organic matter values within two of the samples. The adopted GAC's are listed in *Appendix F*.

7.1.2 Generic Assessment Criteria Screening of Soil Chemical Laboratory Results

The results of the environmental testing can be referred to in Appendix D, with testing undertaken on a total of 19 No. soil samples across the site.

With respect to the proposed '*Commercial'* end use, soil chemical analysis results record no exceedances within the soil, environmental testing results are shown within Appendix C.

All soil samples were screened for asbestos, with five positive identifications obtained. Two bulk cement sheets were recorded within the shallow Made Ground soils of CP1-01 and CP1-01B and were screened for asbestos. The results of asbestos screening and quantification are summarised in Table 20.

Table 20 - Positive Asbestos Identification

Location	Depth (m bgl)	Type	Matrix	Asbestos in soil Quantification (%)	Asbestos Bulk Fibre Quantification (%)
TP 1-03	0.40 – 0.50	Chrysotile	Loose Insulation	<0.001	-
TP 1-04	0.10 – 0.20	Chrysotile	Loose Fibres	<0.001	-
DSBH 1-01	0.20 – 0.30	Amosite	Loose Insulation	0.038	-
DSBH 1-03	0.30 – 0.40	Chrysotile	Cement	0.513	-
CP1-01	0.30 – 0.40	Chrysotile	Cement	0.087	-
CP1-01	0.30 – 0.40	Chrysotile	Cement	-	15
CP1-01B	0.70 – 0.80	Chrysotile	Cement	-	15

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8 GROUND GAS ASSESSMENT

The assessment of risk presented by ground gases is assessed with reference to guidance published by CIRIA (Assessing Risks Posed by Hazardous Ground Gases to Buildings, C665 (Ref. 21), BSI Publication Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings BS8485:2015 (Ref. 22) and other broadly accepted references such as the Ground Gas Handbook 2009 (Ref. 23).

The ground gas risk assessment adopts a tiered approach. In the first instance this involves a re-evaluation of the Conceptual Site Model described within the Phase 1 Preliminary Site Assessment and thereafter validating this conceptual model with the ground gas data, the semi-quantitative risk assessment.

8.1 Ground Gas Monitoring Results

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk standpipe installations were incorporated within four window sample borehole locations within Made Ground and two cable percussive borehole within Glacial Till. The details of the response zone of each monitoring installation are outlined in Section 3.2.

The Preliminary Conceptual Site Model highlighted a Moderate risk from ground gases potentially arising from organic/ putrescible content in Made Ground soils and infilled reservoir and land.

The initial ground investigation proposed a programme of four monitoring visits over two months, These visits were undertaken between 29th April and 30th May 2024, with barometric pressure recorded between 998 mb and 1007 mb. Monitoring visits were undertaken during rising, falling, and steady atmospheric pressure conditions.

A further two monitoring visits were undertaken between the 09th January and 22nd January 2025, following the additional ground investigation works. During the additional monitoring period atmospheric pressure ranged between 1001mb and 1005mb with visits undertaken during rising and falling atmospheric conditions.

The result logs sheets are contained within Appendix G and summarised in Table 21.

Table 21 - Summary of Ground Gas Monitoring Results

Exploratory Hole ID	Maximum Methane Concentration (%)	Maximum Carbon Dioxide Concentration (%)	Minimum Steady Oxygen Concentration (%)	Air Flow Rate (l/hr)	
				Peak	Steady State
DSBH 1-01	<0.1	2.1	17.0	-27.7	<0.1
DSBH 1-02	<0.1	3.9	16.4	<0.1	<0.1
DSBH 1-03	<0.1	0.4	18.1	<0.1	<0.1
DSBH 1-05	<0.1	6.1	12.2	0.7	<0.1
CP1-02	<0.1	2.1	14.3	-0.3	<0.1
CP1-03	<0.1	0.1	17.6	1.3	<0.1

Methane concentrations were recorded below the limit of detection of the monitoring instrument throughout the monitoring period in all locations.

Maximum carbon dioxide concentrations were recorded at 6.10% $^{v}/_{v}$ in DSBH 1-05 on the third monitoring visit.

Carbon Monoxide and Hydrogen Sulphide were recorded below the limit of detection in all wells throughout the monitoring period.

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The greatest peak air flow rate was recorded in DSBH 1-01 at -27.7 l/hr on the third monitoring visit however, this instantly reduced to <0.1l/hr. Steady state air flow rates recorded during the monitoring period remained at <0.1 within all boreholes.

8.2 Ground Gas Assessment

The Preliminary Conceptual Site Model presented within the Phase 1 PRA, identified Made Ground deposits as a potential source of Ground Gas generation both on-site and off-site resulting from historical development on site and the infilling of reservoirs and landfill(s). The report suggests potential organic rich drift deposits (e.g., peat) being present within marshland and reclaimed land. Noxious and asphyxiate gases were attributed to include, but not limited to, carbon dioxide, carbon monoxide, methane, and hydrogen sulphide. The consequence was evaluated as a Moderate risk.

The Mining Risk Assessment identified the potential source of Mine Gas Emissions as Moderate / Low. The report suggests there is a potential source of mine gasses due to shallow mine workings, with potential migration pathways through the underground roadway at depth beneath the site, followed by vertical migration through bedrock and superficial deposits. Or from any unrecorded shallow mine workings with potential pathways through bedrock and superficial deposits. A gas monitor was installed onto the rotary open-hole rig during drilling to record any potential mine gasses.

Monitoring wells were initially installed in 4 No. borehole locations within Made Ground (DSBH 1-01, DSBH 1-02, DSBH 1-03 and DSBH 1-05), to assess the gassing potential and associated risk in these materials. An additional two Cable Percussive borehole locations were installed in the Glacial Till deposits (CP1-02 and CP1-03) to assess the ground gas risk associated with the superficial deposits.

Gas monitoring during rotary drilling did not indicate any presence of mine gases.

Current development plans indicate the construction of a new Visitors Centre building with associated car parks, roadway and paths and therefore gas assessments in accordance with BS8485:2019 (Ref. 22) have been undertaken.

8.2.1 BS8485:2019 Classification

Using the available data set including air flow rates and gas concentrations, the hazardous gas flow rates (Q_{hg}) can be evaluated. Q_{hg} can be derived for both individual ‘borehole’ and ‘worst case check’ scenarios and a comparison made in support of an appropriate assessment of ground gas risk. For a ‘borehole’ scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) steady state flow rates and peak gas concentrations are adopted, whilst for a ‘worst case check’ scenario (highest Q_{hg} across the entire dataset for well screens in the same strata irrespective of location and discrete monitoring events) peak flows and gas concentrations are adopted (discounting any deemed to be unrepresentative such as peak flows).

Due to the potential ground gas sources identified conservatively, the ‘worst case check’ scenario, described in BS8485:2019 (Ref. 22) has been adopted for hazardous gas screening value calculations.

The highest peak flow rate recorded during the monitoring visits was -27.7 l/hr within DSBH 1-01, however this value has been discounted for the worst-case scenario as the gas dissipated to 0.0 l/hr instantly and was only recorded within a single visit. DSBH 1-01 did not record any flow rates on the other visits. Similarly, the peak flow rate value of 0.7 l/hr recorded in DSBH 1-05, dissipated instantly to 0.0 l/hr and was only recorded within a single visit.

8.2.2 Made Ground

Accounting for a maximum steady state air flow rate of <0.1 l/hr and maximum carbon dioxide concentrations of 6.1% $^{v}/_{v}$, the worst case Q_{hg} for carbon dioxide for made ground soils is taken as 0.0061 l/hr and 0.0273l/hr for natural soils. Both values correspond with a CS-1 classification, however accounting for the elevated concentrations (>5% $^{v}/_{v}$) recorded in DSBH-1-05 throughout the monitoring period, and the potential local sources of ground gas identified (infilled land), it is recommended that the characteristic gas regime classification is increased to CS-2, requiring gas protection measures.

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8.2.3 Summary

The worst-case gas regime at the site is taken as CS-2, and on this basis gas protection measures will be required for the proposed development. It is anticipated that full radon gas protection measures should be sufficient at mitigating the risk associated with carbon dioxide, design should be co-ordinated accordingly. The adopted ground gas protection measures should be detailed within a Phase 3 Remediation Strategy.

The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. Appropriate ground gas monitoring and safety measures should be in place during the works, as the potential presence of ground gases could pose a risk in any confined spaces of deep excavations.

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9 REVISED CONCEPTUAL SITE MODEL

The Preliminary Conceptual Site Model (PCSM) presented and discussed in Section 2.7 of this report has been revised following the GQRA in Section 7.0 above. The Revised Conceptual Site Model (CSM) is summarised in the table overleaf.

The CSM details the source-pathway-receptor linkages or potential pollutant linkages (PPL) that have been identified as relevant for the site. The GQRA details the associated level of risk relating to these potential pollutant linkages.

The CSM follows the framework outlined within CIRIA C552 (Ref. 24) which is summarised within Appendix H.

The 'risk rating' within the CSM refers to the risk that the source, pathway, receptor linkage or PPL is complete. Unless specifically stated it does not necessarily refer to an immediate risk and is intended to be used as a tool to assess the necessity for further assessment/investigation.

Risks presented by Mining are discussed and assessed within Section 2.5 and the Curtins Mining Riak Assessment (Ref. 2).

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors, and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulations, 2015 (Ref. 22) which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk.

It has been assumed that any future construction works on site will be undertaken in compliance with these requirements and therefore construction workers involved in the building works at the site have been discounted as a human receptor in the conceptual site model.

Reference should be given to the environmental testing results discussed within Section 8.0 and presented within Appendix D.

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Qualitative Risk Assessment → **Generic Quantitative Risk Assessment** → Detailed Quantitative Risk Assessment or; Remedial Action

- The table below represents the Second stage in the land quality risk assessment process; the Revised Conceptual Site Model following the Quantitative Risk Assessment.
- For a development site to be deemed 'suitable for use' the level of risk needs to be brought down to acceptable levels, i.e. low to very low risk. The purpose of each stage of risk assessment is ultimately to establish if there is a requirement for additional levels of assessment to be made to have sufficient confidence to support a risk characterisation or management decision, e.g., remedial action.

Table 22 - Revised Conceptual Site Model

Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions	Actions
Source	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**		
Significant sources of on-site contamination: • Made Ground of unknown composition from uncontrolled deposition of materials on site during the infilling of land and the historic reservoir. • Uncontrolled deposition of Made Ground during the construction and demolition previously undertaken on site • Uncontrolled deposition of spoil associated with mining and mineral extraction. • Unknown contamination associated with the sites former industrial use, may include leakages and spillages from plant and machinery. Significant sources of off-site contamination: • Various landfills off-site • Uncontrolled deposition of Made Ground during the construction and demolition previously undertaken on site • Uncontrolled deposition of spoil associated with mining and mineral extraction. • Unknown contamination associated with the sites former industrial use, may include leakages and spillages from plant and machinery..	Direct contact and dermal uptake, soil and dust ingestion, dust and migration inhalation	**Site end-users** (Site Staff) **Construction and maintenance workers**	**Medium** Chronic health risk.	**Likely**	**Moderate**	Environmental chemical analysis recorded no exceedances during the investigation when compared against '*Commercial'* end use scenario GACs Five positive identifications of asbestos or fibres have been identified in this investigation. Bulk asbestos cement sheet pieces observed with shallow Made Ground soils and confirmed to contain up to 15% asbestos. Visual evidence of contamination was noted in the perched groundwater of the Made Ground within the infilled historic reservoir.	Installation of engineered capping layer in areas of soft landscaping, described in a Remediation Strategy. Asbestos management plan during construction works due to presence of asbestos fibres in shallow Made Ground. Health & Safety precautions to be used by workers. Construction and maintenance workers should be provided with suitable PPE with respect to environmental chemical results presented herein. Should unexpected contamination be observed during demolition/construction, works should be stopped with advice obtained from an appropriate specialist.
		Controlled Waters (Surface Water) Nearest surface water feature is the RSPB Hodbarrow nature reserve lakes, a River feature in the south west and the tidal Duddon river approximately 16m south of the site.	**Medium** Pollution of sensitive water resources.	**Low**	**Low**		
	Vertical and horizontal migration through weathered bedrock (soils)	**Controlled Waters (Groundwater)** Bedrock hosts Secondary A aquifer	**Medium** Pollution of sensitive water resources.	**Low** Granular soils noted above the Bedrock, acting as a potential pathway.	**Low**	No evidence of gross or free phase contamination found in ground investigation. Monitoring wells within the proposed building footprint are recorded as dry or have very little water throughout the monitoring period. No water strikes were noted within granular superficial deposits during the investigation. Significant cohesive deposits present overlying the granular deposits acting as a potential barrier to vertical migration Groundwater in area likely to be of reduced quality and sensitivity due to mining legacy.	No further action required unless evidence of gross contamination identified in further phases of investigation.

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Conceptual Site Model			Qualitative Risk Assessment			Recommended Actions	Actions
Source	**Pathway(s)**	**Receptor(s)**	**Consequence**	**Likelihood of Occurrence**	**Risk Rating**		
Significant sources of ground gas: • Made Ground deposits on and off site mostly related to phases of redevelopment in the surrounding area. • Organic deposits within the marshland and reclaimed land • Infilled reservoirs and areas of potential infilled land. • Six landfills within 250m of the site boundary including landfills on the site.	Vertical and Horizontal migration through the superficial and bedrock deposits	**End users of site** (Site staff and visitors) Construction and maintenance workers	**Medium** Chronic health risk.	**Low**	**Moderate/ Low**	The BS8485:2019 Classification indicates the site is classified as a CS-2 site, requiring gas protection measures. No mine gasses were identified during monitoring of the open-hole boreholes. The site is located in an radon affected area where 10-30% of houses are at or above the radon action level.	Initial assessment indicates CS-2 Gas protection measures will be required, to be detailed in a Remediation Strategy. The potential risks from ground gases to the excavations are to be dealt with by the Contractor, in accordance with the Confined Space Regulations, during construction. The proposed development will require full radon protection measures.

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10 ENGINEERING ASSESSMENT AND RECOMMENDATIONS

10.1 Introduction

This section will assess the relevant geotechnical issues for the current development proposals, these comprise access improvements, car parking, new paths, repairs to existing structures and the construction of a new visitors centre.

It should be noted that detail may change in the development of designs beyond the issue of this Phase 2 Report and the Construction Designer should satisfy themselves regarding the adequacy of their design and proposed approach to construction by reference to the on-going project design proposals, the ground investigation information, and their own examination of the site.

In addition, at the time of writing, information on proposed levels and structural loads was not available. Therefore, this report should be reviewed once this information is provided.

10.2 Summary of Ground Conditions

Ground conditions encountered generally comprise of Made Ground deposits overlying cohesive Glacial Till deposits (with localised granular Glacial Till deposits). Bedrock at the site generally comprises of the Red Hill Limestone Formation however, localised conglomerates consistent with the Low Furness Basal Formation are present (RH1-02 only).

Made Ground deposits comprised of both granular and cohesive soils and were encountered to prove depths of 0.40m and 4.00m bgl (13.00m to 9.40m AOD). The site is identified as a BGS and historic landfill site.

Cohesive Glacial Till deposits were recorded underlying the Made Ground from depths ranging between 2.00m and 13.50m bgl (12.00m to -0.10m AOD). Where proven, thickness of this deposit ranged between 6.0m and 12.10m and was typically described as a reddish-brown to brown mottled grey slightly sandy slightly gravelly clay.

Granular Superficial deposits were typically encountered underlying the cohesive deposits in RH1-01, RH1-02, RH1-03 and CP1-03. This deposit typically comprised brown, slightly gravelly sand, underlain by brown sandy gravel, or Brown gravelly sand.

The Low Furness Basal Formation Bedrock deposit was encountered at 18.0m bgl in RH 1-02. The formation comprised reddish brown conglomerate with lithoclasts of mudstone and sandstone and a reddish brown sand matrix. The base of the deposit was not encountered during the investigation.

Bedrocks deposits consistent with the Red Hill Limestone Formation were encountered from depths ranging between 9.00m to 15.00m bgl (5.46m to -1.60m AOD. This deposit was encountered as a grey limestone. The extent of this deposit was not proven during the ground investigation.

Groundwater level monitoring for this ground investigation has shown that perched water may be present within Made Ground, typically at 2.5m bgl.

10.3 Geotechnical Considerations

10.3.1 Presence of Existing / Relic Structures

The infilled reservoir identified within the Phase 1 preliminary risk assessment was identified during the investigation as an area of deep Made Ground progressively getting shallower towards the west, seen in Figure 13 below. This feature was bound by a grey sandy clay and comprised dark brown and dark grey Made Ground. No relict structure was identified during the investigation. Depths within the historic reservoir ranged from 0.40m bgl (in the west) to 4.00m bgl. Deeper areas of Made Ground may be present locally.

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Figure 10 - Zone 1 Borehole location plan with the indicative historical reservoir location

The historic reservoir encroaches onto the footprint of the proposed building. Due to the thickness of Made Ground it is recommended that the foundations are piled. No structure was identified during the investigation however it is recommended that pre-boring is used as there is a potential risk of obstruction due to the nature of sites Made Ground.

10.3.2 Presence of Existing Services

The presence of existing services may require capping and/or diversion associated with the development, which should be managed through the appropriate utility suppliers during the construction phase. The Principal Contractor should ensure that appropriate mitigation measures are put in place during the construction phase (i.e. during excavation of the Made Ground).

10.3.3 Obstructions

Given the site history, further obstructions within the Made Ground cannot be discounted in un-investigated areas. Railway girders and sleepers were identified across the site and may be present within other areas during excavation.

It is recommended that all obstructions are removed during the enabling works or their location accurately recorded, to avoid delays during piling works.

10.3.4 Volume Change

The cohesive superficial deposits are classified as a low to medium volume change potential and therefore the guidance contained in NHBC Tech Standards Chapter 4.2 should be reviewed in this context with regards to trees / vegetation being removed, retained or proposed.

Clinker and slag deposits were identified within made ground generally in relatively limited volumes. A expansivity test of these deposits confirmed a low expansivity potential.

10.3.5 Waterlogged Ground

Areas of land where ‘swamp’ environments are present may need to undergo dewatering and drainage put in place to mitigate further flooding.

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10.3.6 Ecological Constraints

The Zone 1 Visitors Centre building site is located within areas of protected land, including Priority Lowland Meadow habitats, and is located immediately outside the RSPB and SSSI, RSPB Hodbarrow. Rare species such as Natterjack Toad are known to present along with and nuisance plant species such as Mares Tail observed on site.

Greengage's Ecological Impact Assessment (Ref.27) should be consulted for ecological constraints and construction mitigation measures.

Specialist ecologist advice should be sought for all construction works.

10.3.7 Drainage

Three soakaways were undertaken SA 1-01 and SA 1-02 were undertaken within the Made Ground and completed three successful soakaway tests. SA 1-03 was undertaken in the south of the site next to the 'swamp' area and failed to soakaway after 3 hours of testing.

Soakaway drainage is unlikely to be feasible due the depth of Made Ground on site. Drainage systems are likely to be required including areas surrounding the 'swamp'.

10.4 Foundation Options

Loadings are unknown at present and are likely to pre-determine the suitability of the foundations to be adopted at the site.

Made Ground deposits have been recorded to a maximum depth of 4.0m bgl and this would make shallow conventional foundations unsuitable for the proposed development.

Therefore, it is recommended that a piled foundation should be adopted as the chosen foundation method.

The carrying capacity of piles depends not only on their size and the ground conditions but also on their method of installation. Pile design and installation are continuously evolving processes, it is therefore recommended that specialist Piling Contractors be contacted as to the suitability and carrying capacity of their piles in the ground conditions pertaining to the site.

There will be a requirement for an appropriately designed pile mat.

Pile types should be considered which present minimal risk to driving contaminants down into the aquifer.

10.5 Floor Slabs

Based on observations onsite, significant thickness of Made Ground of variable nature, together with the results of laboratory tests, it is recommended that consideration is given to a suspended ground floor slab.

As piled foundations are anticipated, a suspended slab is recommended to bear on the pile caps by a network of beams which will minimize any differential settlement between the floor and the piled structure.

10.6 Road and Hardstanding Assessment

The structural design of a road or hardstanding is based on the strength of the subgrade, which is assessed by the California Bearing Ratio (CBR). The results of testing have been enclosed for your reference Appendix A3.

In-situ Plate Load Testing recorded approximate estimated CBR values ranging between 1.9% and 26%, shown in Table 23 below. The values were all recorded within the Made Ground strata for the proposed new road development.

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Table 23 - CBR Test Results

Location	Depth (m bgl)	Approximate Equivalent CBR Value (%)
CBR 1-01	0.50	26
CBR 1-02	0.40	13
CBR 1-03	0.40	8.2
CBR 1-04	0.30	1.9

In addition, eight TRL Dynamic Cone Penetrometer (DCP) tests (CBR 1-08 to CBR 1-15), were undertaken to determine CBR values in the shallow soils. The tests began below the existing tarmac and sub-base at depths ranging between 0.19m and 0.92m bgl on the superficial and Made Ground deposits.

The TRL CBR results are included within Appendix E.

The TRL results are highly variable, it is considered likely that the cobbles and boulders identified within the granular Made Ground deposits encountered elsewhere onsite have influenced the estimated CBR results, evidenced by unusually high CBR values (>20%).

As the Made Ground is variable, it is suggested that the formation is thoroughly proof rolled to identify any areas of soft or deleterious material. If present, these should be excavated and replaced with a thoroughly compacted granular fill.

A characteristic CBR value of 2.5% should be assumed in preliminary designs and the subgrade should be validated accordingly by undertaking additional testing prior to construction. Should validation CBRs record values >2.5% it may be possible to reduce the construction layer thicknesses accordingly.

10.7 Excavations

Based on observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to <1.20m bgl should stand unsupported in the short term. Side support for safety purposes should of course be provided to all excavations which appear unstable, and those >1.20m deep, in accordance with Health and Safety Regulations.

Suitable side slope angles must be checked and provided by a suitably qualified temporary works contractor for any excavations.

Perched water may be encountered as seepages in shallow excavations for foundations or services. It is considered that water inflows, if encountered, may be controlled by pumping from sumps.

Excavation through layers of Made Ground encountered across the site should be feasible using conventional site plant.

10.8 Chemical Attack on Buried Concrete

The site has been classified in accordance with BRE Special Digest (Ref. 15) and laboratory testing undertaken accordingly in *Section 6.4*.

In the consideration of sulphate attack on buried concrete, reference has been made to BRE SD1 (2005 Ed), which classifies the site as a brownfield site with a mobile groundwater condition.

The results of the concrete classification tests received have indicated a DS-1, AC-1 classification for the Made Ground and a DS-1, AC-1 classification for the natural superficial deposits.

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10.9 Mining Risk

The intrusive investigation works did not identify any evidence of shallow mine workings or mining related features, such as voids or broken ground, excluding the presence of Made Ground indicative of the historical reservoir.

However, as the proposed building location has moved towards the possible location of underground roadway in the most recent development plan, additional ground investigation is recommended to ensure the roadway doesn't exist within influencing distance of the building/foundations.

No mine gas emissions were recorded during the investigation.

No mine entries or potential mine shafts were identified during the investigation.

Slag mining waste was identified within the Made Ground deposits of the historical reservoir. Expansivity potential has been concluded as low through laboratory testing.

The recommendations from the mining risk assessment and mining risk mitigation strategy report should be adhered to.

10.10 Slope Stability

A steep slope is identified at the northern site boundary and the presence of dense woodland restricted the feasibility of a topographical survey in this area. As a result, slope heights and gradients are currently unknown.

It is understood that development proposals currently indicate that the Visitors Centre car park will be located within adjacent to the slope, requiring a slope stability assessment. Value engineering assessment is currently being undertaken to assess whether the car park can be constructed elsewhere. If proposed structures/infrastructure is to be relocated, then a slope stability assessment may not be required.

10.11 Geotechnical Risk Register

A number of hazards have been identified for the site, a geotechnical risk associated with the proposed development is included within Appendix I. This encompasses risk on the Zone 1 Visitors Centre Site as well as the wider site.

The list of geotechnical risks may not be exhaustive, and it does not consider potential constraints/ risks that may relate to other factors e.g. contamination, ecology, heritage, archaeology, planning etc.

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11 CONCLUSIONS & RECOMMENDATIONS

11.1 Conclusions

A revised tabulated revised Conceptual Site Model has been derived following the findings on the Generic Quantitative Risk Assessment risk assessment and is presented in *Section 10.0*.

11.1.1 Ground and Groundwater Contamination

With respect to the proposed Commercial end-use of the site, no exceedances were recorded during the investigation.

Asbestos was present in 5 No. soil samples, recorded as loose fibres of chrysotile (<0.001% $^{w}/_{w}$ to 0.034 % $^{w}/_{w}$) and amosite (0.003% $^{w}/_{w}$) and chrysotile cement (0.087% $^{w}/_{w}$). Additionally, fragments of bulk asbestos cement were encountered in CP1-01 and CP1-01B Made Ground soils. Two samples of asbestos cement were taken and confirmed that it was chrysotile cement (15%).

Visual and olfactory evidence was encountered including green off-coloured water in the Made Ground deposits within the historical reservoir footprint as well as numerous anthropogenic constituents of Made Ground. Made Ground encountered may represent the 'landfill' materials identified to have been deposited on the site.

A **Moderate**-risk rating is therefore identified to proposed site end-users and construction workers from direct contact, inhalation, and ingestion of contaminants within Made Ground soils accounting for appropriate PPE and sanitary facilities are utilised during groundworks and construction works.

The following is recommended to mitigate against future human health risks:

- Installation of engineered capping layer in areas of soft landscaping, described in a Remediation Strategy.
- Asbestos management plan during construction works due to presence of asbestos fibres in shallow Made Ground.
- Standard Health & Safety precautions likely to be used by workers. Construction and maintenance workers should be provided with suitable PPE with respect to environmental chemical results presented herein.
- Should unexpected contamination be observed during demolition/construction, works should be stopped with advice obtained from an appropriate specialist.

A **Low** risk rating is currently identified to controlled waters in relation to groundwater and surface water receptors accounting for the presence of the cohesive Glacial Till preventing the lateral and downwards migration of contaminants to controlled waters. Pile types should be considered which present minimal risk to driving contaminants down into the aquifer.

11.1.2 Ground Gas Assessment

Accounting for a maximum steady state air flow rate of <0.1 l/hr and maximum carbon dioxide concentrations of 6.1% $^{v}/_{v}$ (DSBH 1-05), the worst case Q_{hg} for carbon dioxide for the site is taken as 0.0061 l/hr. This corresponds with a CS-1 classification, however accounting for the elevated concentrations (>5% $^{v}/_{v}$) recorded in this monitoring well throughout the monitoring period, to date, it is recommended that the characteristic gas regime classification is increased to CS-2, requiring gas protection measures.

The Envirocheck Report (Ref. 3), Radon Mapping (Ref. 4) and the BGS Radon Geo Report (Ref. 26) confirm that the site is within a radon affected area where 10 – 30% of homes are to be at or above the action level and will require full radon protective measures in the construction of new dwellings or extensions.

If the new development incorporates a basement the advice of a specialist Radon assessor must be obtained.

11.2 Geotechnical

The Made Ground is considered to be an unsuitable founding stratum.

It is recommended that piled foundations should be adopted. It is recommended that suspended ground floor slabs are adopted.

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Soft, loose or deleterious materials should be removed and replaced with compacted granular fill.

The preliminary design of buried concrete according to Table C2 of BRE Special Digest 1:2005 should be in accordance with a DS-1, AC-1 classification for the Made Ground, decreasing to DS-1, AC-1 in natural soils.

11.3 Recommendations

Based on the findings of the ground investigation, the following recommendations are made in relation to Zone 1 (Visitors Centre Site):

1) Additional ground investigation is required following an updated site plan. Due to the close proximity of the Visitors Centre to the Mine Road it is recommended that a deep rotary borehole is undertaken. The additional borehole should be undertaken in the area between the feature and the proposed structure.
2) Installation of engineered capping layer in areas of soft landscaping, described in a Remediation Strategy.
3) Asbestos management plan to be put in place during construction works due to presence of asbestos fibres in shallow Made Ground.
4) Install gas protection measures in line with a CS-2 classification.
5) Install full radon protection in new buildings.
6) Construction and maintenance workers should be provided with suitable PPE with respect to environmental chemical results presented herein.
7) Should unexpected contamination be observed during construction advice should be obtained from a Geo-environmental Engineer.
8) Consideration of slope stability risk with respect to the steep slope on northern boundary (subject to value engineering assessment).
9) The ventilation borehole on site should be located as part of construction works and decommissioned in accordance with EA guidance.
10) Watching brief to be carried out during groundworks by geotechnical engineer to monitor for evidence of shafts. If any are recorded construction works should be stopped and further risk assessment carried out. A remedial specification and capping measures may then need to be provided.
11) The engineering recommendations contained within the report should be reviewed once the final development proposals and site levels are confirmed.

A Remediation Strategy and Mining Risk Mitigation Strategy should be produced to further detail respective requirements on the site.

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13 APPENDICES

Appendix A – Drawings

Appendix B – BGS Radon Report

Appendix C – Exploratory Hole Logs

Appendix D – Chemical Laboratory Test Results

Appendix E – Geotechnical Laboratory Test Results

Appendix F – Ground Gas Monitoring Results

Appendix G –GAC Screening Thresholds

Appendix H – Risk Assessment Rationale

Appendix I – Geotechnical Risk Register

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Appendix A – Drawings

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Legend

Exploratory Hole Locations

- CBR
- HP
- ROBH
- SA
- TP
- WS
- TT
- CP

Development Plans (April 2025)

289-LYR-XX-ZZ-DWG-L-1000

Site Boundary

Google Satellite

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Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Zone 1 - Visitors Centre** **Exploratory Hole Location Plan with Development Plan Overlay**

Scale:	Size:	Issue Date:	Drawn:	Checked:
See scale bar above	A3	08/04/2025	LW	NF

Drg No:	Rev:
080874-CUR-XX-XX-DR-GE-80010	P02

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Legend

Exploratory Hole Locations

- CBR
- HP
- ROBH
- SA
- TP
- WS
- TT
- CP

Development Plans (April 2025)

289-LYR-XX-ZZ-DWG-L-1000

Site Boundary

Google Satellite

0 7.5 15 m

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Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Zone 1 - Visitors Centre (Wider Area) Exploratory Hole Location Plan with Development Plan Overlay**

Scale:	Size:	Issue Date:	Drawn:	Checked:
See scale bar above	A3	08/04/2025	LW	NF

Drg No:	Rev:
080874-CUR-XX-XX-DR-GE-80021	P01

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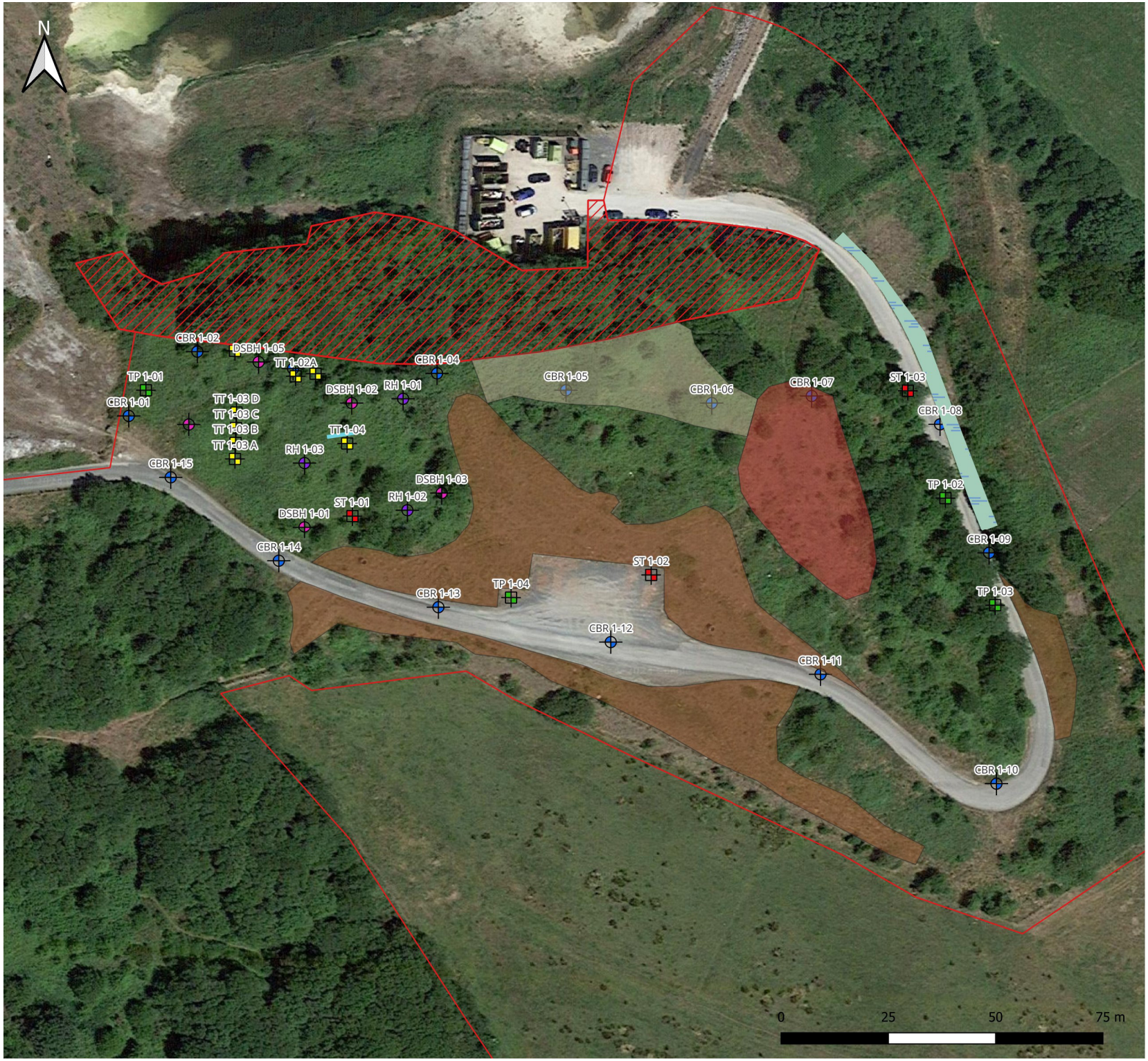

Legend

Services
- Water Pipe

Constraints
- Inaccessible
- Swamp
- Grassland
- Accessible by Foot
- Invasive Species

Proposed BH Locations
- CBR
- HP
- ROBH
- SA
- TP
- WS
- TT
- Site Boundary

Notes

- A water pipe encountered within the made ground of TT 1-04 aligned ENE-WSW.
- Approximate allignment of Water pipe running towards the recycling centre.
- Grassland and swamp areas are not able to be traversed.
- Invasive species require a 3m exclusion zone.
- Additional vegetation clearence needed.

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Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Zone 1 - Welcome Building Exploratory Hole Constraints During GI Plan**

Scale:	Size:	Issue Date:	Drawn:	Checked:
See scale bar above	A3	26/03/2024	JP	NF

Drg No:	Rev:
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Proposed BH Locations

CP

0 5 10 15 20 m

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Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Zone 1 - Iron Line Exploratory Hole Location Plan**

Scale:	Size:	Issue Date:	Drawn:	Checked:
See scale bar above	**A3**	**20/11/2024**	**RT**	**NF**

Drg No:	Rev:
080874-CUR-XX-XX-D-GE-80013	**P01**

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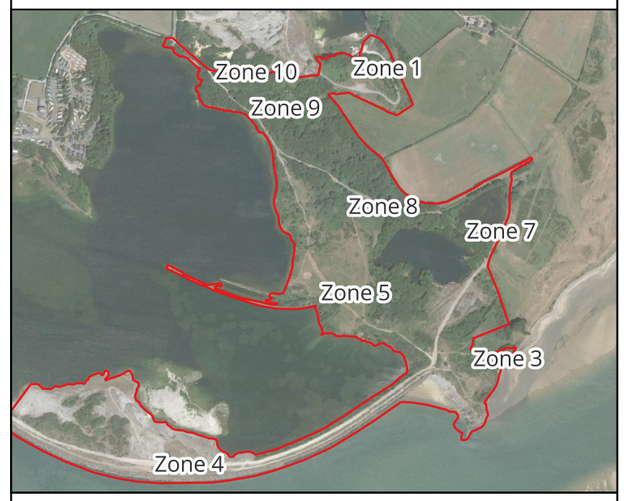
Legend

Proposed BH Locations

- TP
- WS
- CP

0 7.5 15 m



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Structures - Civils - Envrionmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status	INFORMATION
Project:	**Iron Line, Millom**
Drg Title:	**Exploratory Hole Locations Where Asbestos has been Identified**

Scale:	Size:	Issue Date:	Drawn:	Checked:
See scale bar above	**A3**	**21/01/2024**	**RT**	**NF**

Drg No:	Rev:
080874-CUR-XX-XX-DR-GE-80019	**P01**

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FURNITURE / BOUNDARIES

F1.0 – PICNIC TABLE
Location: Site wide
Material: Corten Steel / Timber / Concrete

F2.0 – BENCH
Location: Site wide
Material: Corten Steel / Timber / Concrete

F2.1 – BENCH (EXISTING)
Location: Site wide
Material: Timber

F3.0 – WAYFINDING – SITE NAVIGATION
Location: Site wide
Material: Corten Steel w/ laser cuttings

F4.0 – WAYFINDING – ARRIVAL
Location: Site wide
Material: Corten Steel w/ laser cuttings

F5.0 – INFO BOARD: ECOLOGY
Location: Site wide
Material: Corten Steel w/ laser cuttings

F5.1 – INFO BOARD: MAP LOCATION
Location: Site wide
Material: Corten Steel w/ laser cuttings

F5.2 – INFO BOARD: HERITAGE
Location: Site wide
Material: Corten Steel w/ laser cuttings

F6.0 – VIEWING SCREEN
Location: To Hidden Lagoon
Material: Timber

F7.0 – DOUBLE LEAF GATE
Location: Road to Welcome Building / HWRC
Material: Subject to future detail

F7.1 – SINGLE LEAF GATE
Location: To RSPB BOAT boundary
Material: Subject to future detail

F8.0 – FEATURE FENCE
Location: Site wide
Material: Timber

F8.1 – EXISTING FENCE
Location: Site wide
Material: Timber

F9.0 – FEATURE ARTWORK
Location: Site wide
Refer to Design & Access Statement Chapter 7

F10.0 – CAR PARK PAY MACHINE
Location: To Visitor Centre car park
Material: -

F11.0 – FEATURE CONC BENCH w/ TIMBER TOP
Location: Site wide
Material: Concrete / Timber

F12.0 – CYCLE PARKING
Location: Site wide
Material: Steel

F13.0 – TIMBER LOGS
Location: To car parking spaces
Material: Timber

F14.0 – EV CHARGING LOCATIONS
Location: To welcome building car park
Material: -

F15.0 – THRESHOLD DETAIL
Location: To key thresholds
Material: Corten

F16.0 – BIRD HIDE
Location: To Hidden Lagoon / Lagoon
Material: Timber

F17.0 – PV CANOPY
Location: To welcome building car park
Material: Subject to future detail

F18.0 – WASTE BIN
Location: Site wide
Material: Subject to future detail

F19.0 – HAND RAIL
Location: To entrance steps
Material: Subject to future detail

F20.0 – BOLLARD
Location: To Byway Entrances
Material: Timber

0m 25m 50m 100m 200m 500m

NOTES:

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THIS DRAWING WAS PLOTTED ON:
07/04/2025

REVISION HISTORY

DATE	REV	ZONE	DESCRIPTION	CHK
26/03/25	P01		Stage 03 draft issue - for coordination	MDM
07/04/25	P02		Issued for planning	MDM

KEY

GENERAL INFORMATION

APPLICATION BOUNDARY

HARDWORKS

S1.0 **S1.0 – SELF BINDING GRAVEL WITHOUT EDGINGS EXCEPT ON STEEP GRADIENTS (P)**
Location: To primary pedestrian routes
Dims: 1.5m wide

S2.0 **S2.0 – STONE TO DUST SURFACE (V)**
Assumed: Existing surface planed - pot holes filled - Type 1 dressing with Grano Dust surface finish
Location: To Byway
Dims: As existing

S3.0 **S3.0 – TIMBER BOARDWALK (P)**
Location: To sand dune raised walkway
Dims: 1.8m wide w/ low upstand

S4.0 **S4.0 – VEHICULAR MACADAM (V)**
Location: Visitor Centre car park / Access Road Trench
Dims: 1.5m wide trench cover w/ passing places

S5.0 **S5.0 – VEHICULAR ROUTE (MACADAM) (V)**
Assumed: Some resurfacing as per S4.0 specification
Location: To access road from Mainsgate Road to visitor centre - existing surface made good
Dims: 4.8m wide

S6.0 **S6.0 – NATURAL STONE PAVING (P)**
Location: To Towsey Hole Windmill

S7.0 **S7.0 – INSITU CONCRETE w/ SMOOTH FINISH (P)**
Location: To in ground railway details / Visitor Centre / Hodbarrow Lighthouse

S7.1 **S7.1 – INSITU CONCRETE w/ EXPOSED AGGREGATE FINISH (P / V)**
Location: To Visitor Centre / Whiterock Junction

S8.0 **S8.0 – REINFORCED GRAVEL (P)**
Location: To Visitor Centre car park / Annie Lowther Hide

S9.0 **S9.0 – RAISED STEEL WALKWAY w TIMBER EDGE (P)**
Location: To Visitor Centre

SE **SE – SURFACE EXISTING**
Location: As noted

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Client
Cumberland Council

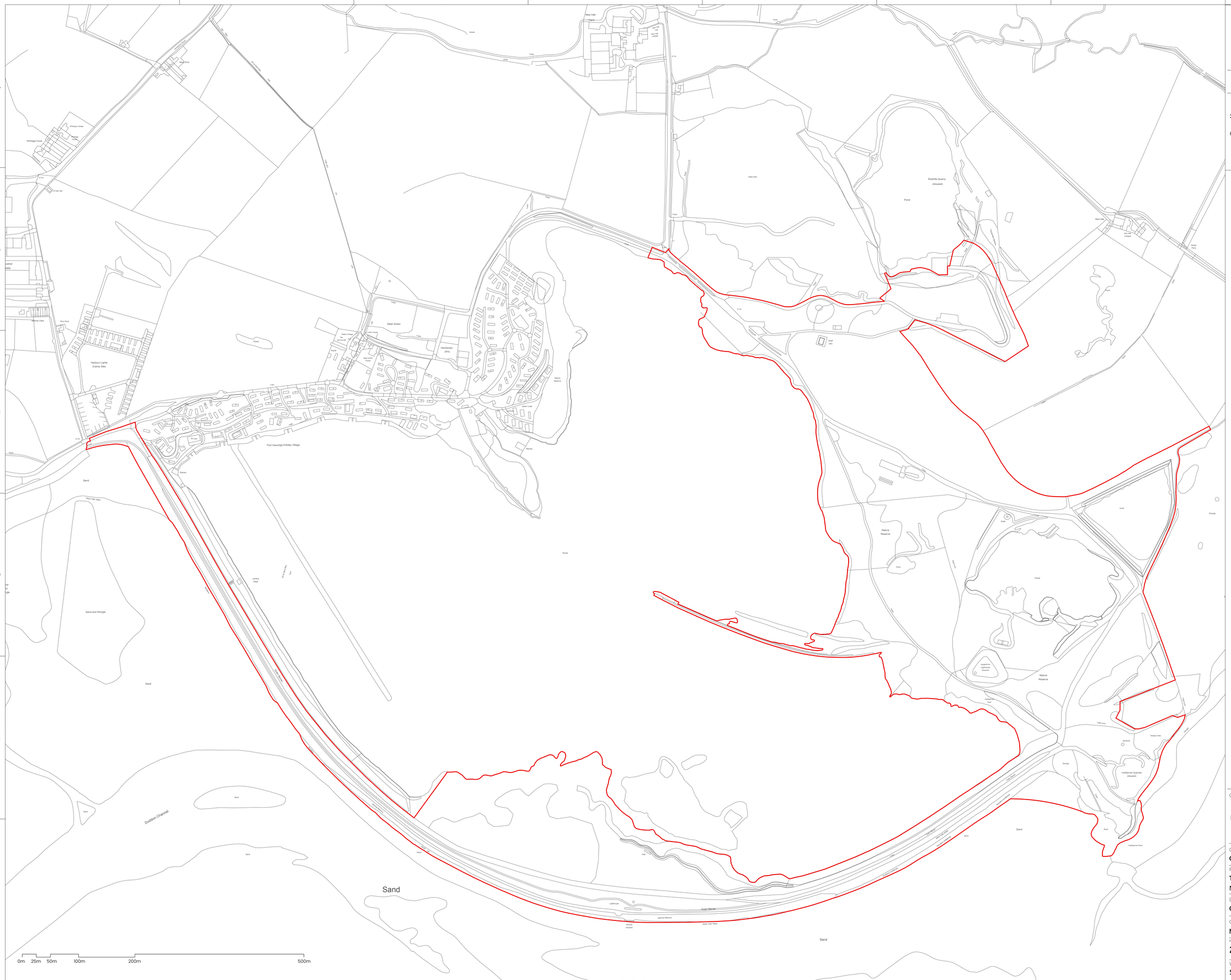
Project
The Iron Line
Millom, Cumbria

Drawing Title
GA | Site Masterplan

Created By	Checked By	Scale	Sheet Size
MDM	CL	1:3000	A1

Project Number	Originator	Volume	Level	File Type	Discipline	Number
289	LYR	XX	ZZ	DWG	L	1000

Work Stage	Status	Revision
Stage 3	Planning	P02



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07/04/2025

REVISION HISTORY

DATE	REV	ZONE	DESCRIPTION	CHK
26/03/25	P01		Stage 03 draft issue - for coordination	MDM
07/04/25	P02		Issued for planning	MDM

KEY

GENERAL INFORMATION

APPLICATION BOUNDARY

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NE1 1EW

Client

Cumberland Council

Project

The Iron Line

Millom, Cumbria

Drawing Title

GA | Application Boundary

Created By	Checked By	Scale	Sheet Size
MDM	CL	1:3000	A1

Project Number	Originator	Volume	Level	File Type	Discipline	Number
289	LYR	XX	ZZ	DWG	L	1001

Work Stage	Status	Revision
Stage 3	Planning	P02

FURNITURE / BOUNDARIES

F1.0 – PICNIC TABLE
Location: Site wide
Material: Corten Steel / Timber / Concrete

F2.0 – BENCH
Location: Site wide
Material: Corten Steel / Timber / Concrete

F2.1 – BENCH (EXISTING)
Location: Site wide
Material: Timber

F3.0 – WAYFINDING - SITE NAVIGATION
Location: Site wide
Material: Corten Steel w/ laser cuttings

F4.0 – WAYFINDING - ARRIVAL
Location: Site wide
Material: Corten Steel w/ laser cuttings

F5.0 – INFO BOARD: ECOLOGY
Location: Site wide
Material: Corten Steel w/ laser cuttings

F5.1 – INFO BOARD: MAP LOCATION
Location: Site wide
Material: Corten Steel w/ laser cuttings

F5.2 – INFO BOARD: HERITAGE
Location: Site wide
Material: Corten Steel w/ laser cuttings

F6.0 – VIEWING SCREEN
Location: To Hidden Lagoon
Material: Timber

F7.0 – DOUBLE LEAF GATE
Location: Road to Welcome Building / HWRC
Material: Subject to future detail

F7.1 – SINGLE LEAF GATE
Location: To RSPB BOAT boundary
Material: Subject to future detail

F8.0 – FEATURE FENCE
Location: Site wide
Material: Timber

F8.1 – EXISTING FENCE
Location: Site wide
Material: Timber

F9.0 – FEATURE ARTWORK
Location: Site wide
Refer to Design & Access Statement Chapter 7

F10.0 – CAR PARK PAY MACHINE
Location: To Visitor Centre car park
Material: -

F11.0 – FEATURE CONC BENCH w/ TIMBER TOP
Location: Site wide
Material: Concrete / Timber

F12.0 – CYCLE PARKING
Location: Site wide
Material: Steel

F13.0 – TIMBER LOGS
Location: To car parking spaces
Material: Timber

F14.0 – EV CHARGING LOCATIONS
Location: To welcome building car park
Material: -

F15.0 – THRESHOLD DETAIL
Location: To key thresholds
Material: Corten

F16.0 – BIRD HIDE
Location: To Hidden Lagoon / Lagoon
Material: Timber

F17.0 – PV CANOPY
Location: To welcome building car park
Material: Subject to future detail

F18.0 – WASTE BIN
Location: Site wide
Material: Subject to future detail

F19.0 – HAND RAIL
Location: To entrance steps
Material: Subject to future detail

F20.0 – BOLLARD
Location: To Byway Entrances
Material: Timber

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REVISION HISTORY

DATE	REV	ZONE	DESCRIPTION	CHK
26/03/25	P01		Stage 03 draft issue - for coordination	MDM
07/04/25	P02		Issued for planning	MDM

KEY

GENERAL INFORMATION

APPLICATION BOUNDARY

HARDWORKS

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Location: To primary pedestrian routes
Dims: 1.5m wide

S2.0 **S2.0 – STONE TO DUST SURFACE (V)**
Assumed: Existing surface planed - pot holes filled - Type 1 dressing with Grano Dust surface finish
Location: To Byway
Dims: As existing

S3.0 **S3.0 – TIMBER BOARDWALK (P)**
Location: To sand dune raised walkway
Dims: 1.8m wide w/ low upstand

S4.0 **S4.0 – VEHICULAR MACADAM (V)**
Location: Visitor Centre car park / Access Road Trench
Dims: 1.5m wide trench cover w/ passing places

S5.0 **S5.0 – VEHICULAR ROUTE (MACADAM) (V)**
Assumed: Some resurfacing as per S4.0 specification
Location: To access road from Mainsgate Road to visitor centre - existing surface made good
Dims: 4.8m wide

S6.0 **S6.0 – NATURAL STONE PAVING (P)**
Location: To Towsey Hole Windmill

S7.0 **S7.0 – INSITU CONCRETE w/ SMOOTH FINISH (P)**
Location: To in ground railway details / Visitor Centre / Hodbarrow Lighthouse

S7.1 **S7.1 – INSITU CONCRETE w/ EXPOSED AGGREGATE FINISH (P / V)**
Location: To Visitor Centre / Whitehorse Junction

S8.0 **S8.0 – REINFORCED GRAVEL (P)**
Location: To Visitor Centre car park / Annie Lowther Hide

S9.0 **S9.0 – RAISED STEEL WALKWAY w TIMBER EDGE (P)**
Location: To Visitor Centre

SE **SE – SURFACE EXISTING**
Location: As noted

ORIGINATOR
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Client
Cumberland Council

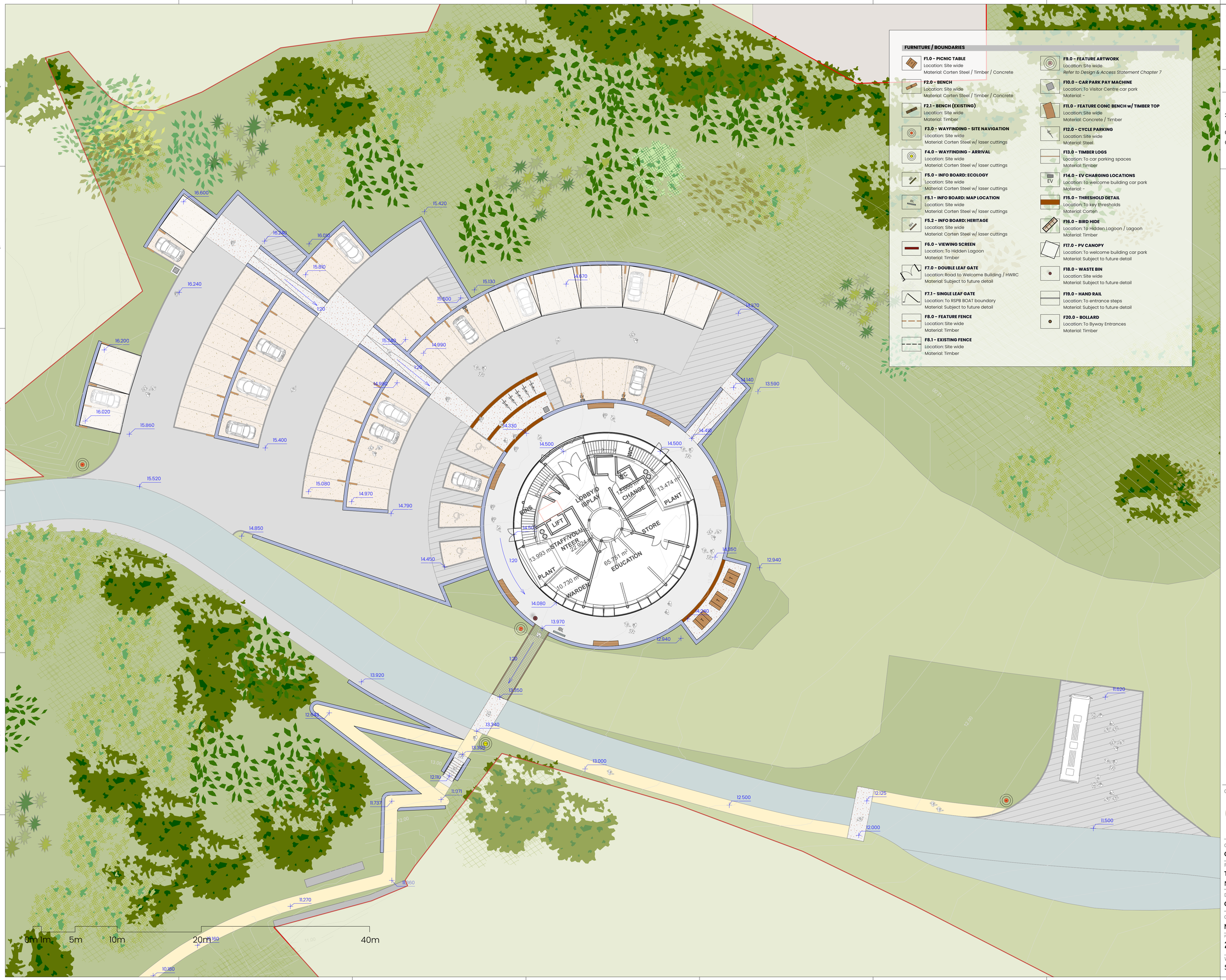
Project
The Iron Line
Millom, Cumbria

Drawing Title
GA | Visitor Centre 1:500

Created By	Checked By	Scale	Sheet Size
MDM	CL	1:500	A1

Project Number	Originator	Volume	Level	File Type	Discipline	Number
289	LYR	XX	ZZ	DWG	L	1202

Work Stage	Status	Revision
Stage 3	Planning	P02



FURNITURE / BOUNDARIES

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Location: Site wide
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Location: Site wide
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Location: Site wide
Material: Corten Steel w/ laser cuttings

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Location: Site wide
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F8.0 – FEATURE FENCE
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Location: Site wide
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F9.0 – FEATURE ARTWORK
Location: Site Wide
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Location: To Visitor Centre car park
Material: -

F11.0 – FEATURE CONC BENCH w/ TIMBER TOP
Location: Site wide
Material: Concrete / Timber

F12.0 – CYCLE PARKING
Location: Site wide
Material: Steel

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Location: To car parking spaces
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F14.0 – EV CHARGING LOCATIONS
Location: To welcome building car park
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F16.0 – BIRD HIDE
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F18.0 – WASTE BIN
Location: Site wide
Material: Subject to future detail

F19.0 – HAND RAIL
Location: To entrance steps
Material: Subject to future detail

F20.0 – BOLLARD
Location: To Byway Entrances
Material: Timber

NOTES:

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THIS DRAWING WAS PLOTTED ON:
07/04/2025

REVISION HISTORY

DATE	REV	ZONE	DESCRIPTION	CHK
26/03/25	P01		Stage 03 draft issue - for coordination	MDM
03/04/25	P02		Updates	MDM
07/04/25	P02		Issued for planning	MDM

KEY

GENERAL INFORMATION

APPLICATION BOUNDARY

HARDWORKS

S1.0 **S1.0 – SELF BINDING GRAVEL WITHOUT EDGINGS EXCEPT ON STEEP GRADIENTS (P)**
Location: To primary pedestrian routes
Dims: 1.5m wide

S2.0 **S2.0 – STONE TO DUST SURFACE (V)**
Assumed: Existing surface planed - pot holes filled - Type 1 dressing with Grano Dust surface finish
Location: To Byway
Dims: As existing

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Location: To sand dune raised walkway
Dims: 1.8m wide w/ low upstand

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Location: Visitor Centre car park / Access Road Trench
Dims: 1.5m wide trench cover w/ passing places

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S7.1 **S7.1 – INSITU CONCRETE w/ EXPOSED AGGREGATE FINISH (P / V)**
Location: To Visitor Centre / Whitehorse Junction

S8.0 **S8.0 – REINFORCED GRAVEL (P)**
Location: To Visitor Centre car park / Annie Lowther Hide

S9.0 **S9.0 – RAISED STEEL WALKWAY w TIMBER EDGE (P)**
Location: To Visitor Centre

SE **SE – SURFACE EXISTING**
Location: As noted

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Client
Cumberland Council

Project
The Iron Line
Millom, Cumbria

Drawing Title
GA | Visitor Centre 1:200

Created By	Checked By	Scale	Sheet Size
MDM	CL	1:200	A1

Project Number	Originator	Volume	Level	File Type	Discipline	Number
289	LYR	XX	ZZ	DWG	L	1203

Work Stage	Status	Revision
Stage 3	Planning	P02

Appendix B – BGS Radon Report

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GeoReports

British Geological Survey

Jonathan Provis
Curtins Consulting
17-19 Whitworth Street West
Manchester
M1 5WG

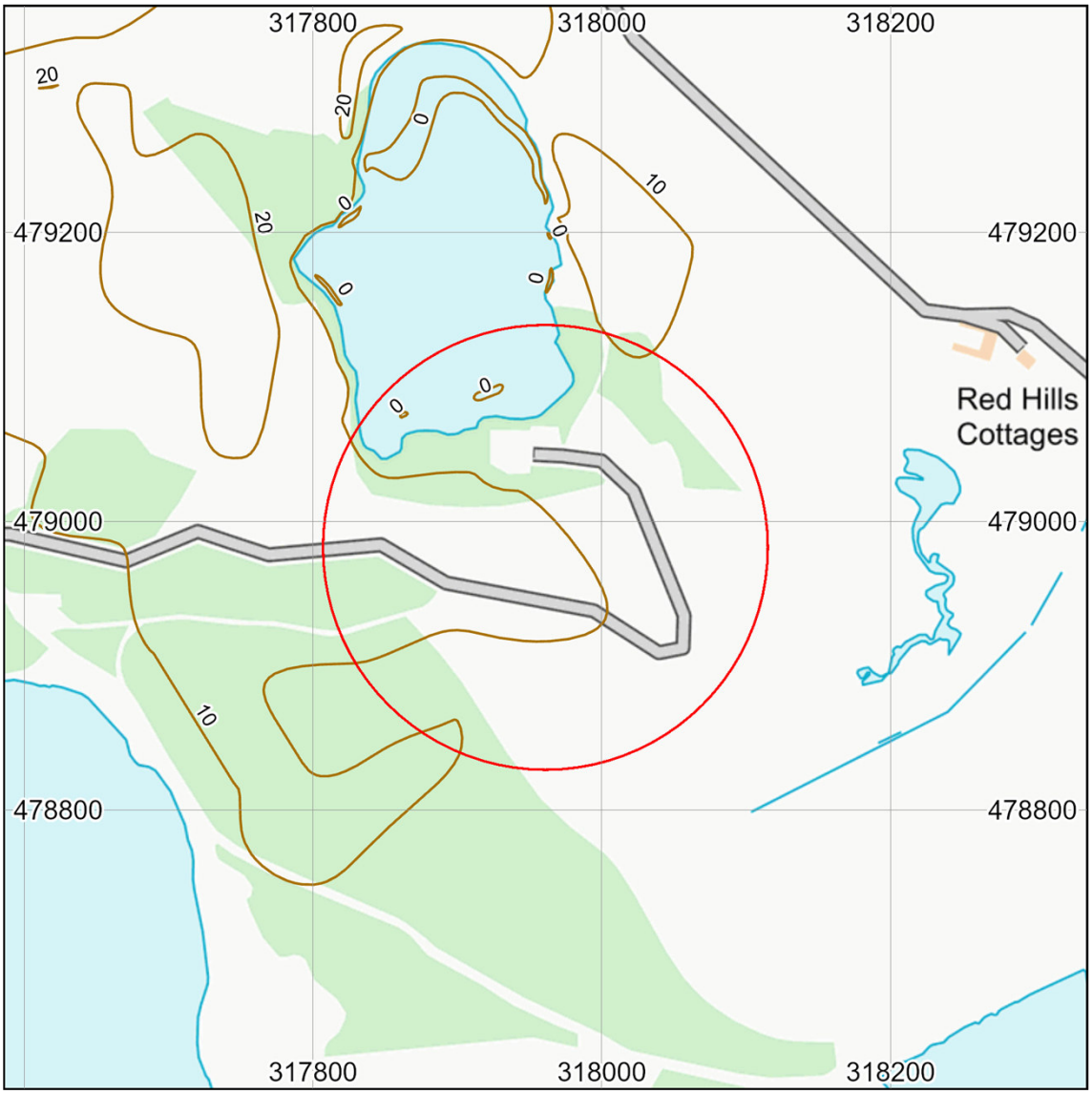
Radon Report

Advisory report on the requirement for radon protective measures in new buildings, conversions and extensions to existing buildings. The report also indicates whether a site is located within a radon Affected Area

Report Id: ***BGS_338589/54476***

Client reference: 080874

Search location



Contains OS data © Crown Copyright and database right 2024. OS OpenMap Local: Scale: 1:5 000 (1cm = 50 m)
Search location indicated in red

Area centred at: 317961,478982
Radius of site area: 154 metres

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Radon Report: UK

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales, Scotland and Northern Ireland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

This is an advisory report on the requirement for radon protective measures in new buildings, conversions and extensions. The report also indicates whether a site is located within a radon Affected Area

Requirement for radon protective measures

The determination below follows advice in *BR211 Radon: Guidance on protective measures for new buildings (2023 edition), which also provides guidance on what to do if the* result *indicates that protective measures are required.*

Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2023 edition) Radon: Guidance on protective measures for new buildings?

FULL RADON PROTECTIVE MEASURES ARE REQUIRED FOR THE REPORT AREA.

More details of the protective measures required are available in *BR211 Radon: Guidance on protective measures for new buildings (2023 Edition)*.

Whether or not the radon level in a building is above or below the radon Action Level can only be established by having the building tested. The UKHSA provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622).

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

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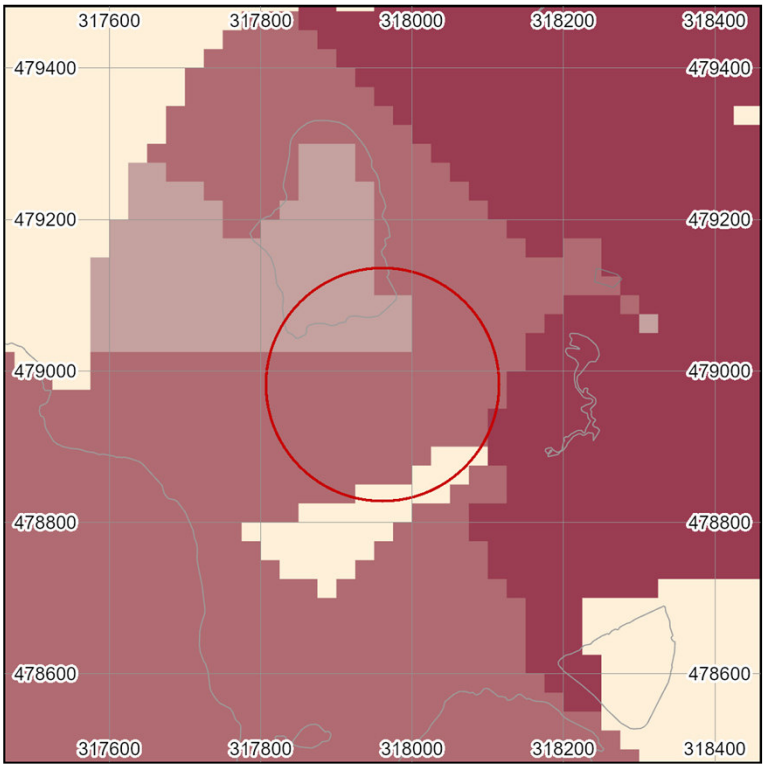
Radon Affected Area



	% Homes estimated to be at or above the action level
	0-1%
	1-3%
	3-5%
	5-10%
	10-30%
	30-100%

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Scale: 1:10 000 (1cm = 100 m)
Search area indicated in red

Is the property in a radon Affected Area as defined by the UK Health Security Agency (UKHSA) and if so what percentage of homes are estimated to be at or above the Action Level? **YES**

Additional Information

THE PROPERTY IS IN A RADON AFFECTED AREA WHERE 10 TO 30% OF HOMES ARE ESTIMATED TO BE AT OR ABOVE THE ACTION LEVEL.

The UKHSA recommends a radon 'Action Level' of 200 Becquerels per cubic metre of air (Bq m^{-3}) for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to be at or above the Action Level the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level at this location. Being in an Affected Area does not necessarily mean there is a high radon level within the property; the only way to determine the radon level is to carry out a radon measurement.

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The UKHSA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels at or above the Action Level (200 Bq m^{-3}) should be remediated. Householders with levels between the Target Level (100 Bq m^{-3}) and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. The UKHSA provides a validated radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as Law Society CON29 Enquiries of the Local Authority (2016); 3.14 Radon Gas: Do records indicate that the property is in a “Radon Affected Area” as identified by the UKHSA. The data can also be used to advise house buyers and sellers in Scotland and Northern Ireland.

If you are buying a new build property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

If you are buying a currently occupied property in a radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were at or above the radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from the UKHSA at www.ukradon.org.

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What is radon?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary according to how particular buildings and spaces are used.

Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level is at or above the Action Level, measures should be taken to reduce the concentration.

Radon in workplaces

The Ionising Radiation Regulations 2017 require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293)**: Radon in the workplace.** BRE publications may be obtained from the BRE Bookshop, Tel: 01923 664262, email: bookshop@bre.co.uk website: www.brebookshop.com

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Appendix C – Exploratory Hole Logs

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Trial Pit Log

Trialpit No
CBR 1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317844.00 - 478998.00 Level: 15.93	Date 21/03/2024
Location: Millom		Dimensions (m): 2 x 1.5 Depth 0.30	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	15.68		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
				0.30	15.63		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, ceramic and slag. Cobbles are subangular of brick, slate, and sandstone.
							End of pit at 0.30 m

Remarks: Machine Excavated Trial Pit for CBR in-situ testing to 0.3m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation. CBR test results located within Structural Soils report 785592_plt_2024.03.21, test PLTCBR01.

Stability: Stable

Trial Pit Log

Trialpit No
CBR 1-02
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317860.00 - 479013.00 Level: 16.35	Date 21/03/2024
Location: Millom		Dimensions (m): 2 × 1.5 Depth 0.35	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	16.05		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
				0.35	16.00		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, ceramic and slag. Cobbles are subangular of brick, slate, and sandstone. End of pit at 0.35 m

Remarks: Machine Excavated Trial Pit for CBR in-situ testing to 0.35m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation. CBR test results located within Structural Soils report 785592_plt_2024.03.21, test PLTCBR01.

Stability: Stable

Trial Pit Log

Trialpit No
CBR 1-03
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317878.00 - 479022.00 Level: 15.40	Date 21/03/2024
Location: Millom		Dimensions (m): 2 × 1.5 Depth 0.25	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20 0.25	15.20 15.15		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots. MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, ceramic and slag. Cobbles are subangular of brick, slate, and sandstone. End of pit at 0.25 m

Remarks: Machine Excavated Trial Pit for CBR in-situ testing to 0.25m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation. CBR test results located within Structural Soils report 785592_plt_2024.03.21, test PLTCBR01.

Stability: Stable

Trial Pit Log

Trialpit No
CBR 1-04
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317903.00 - 479014.00 Level: 13.49	Date 21/03/2024
Location: Millom		Dimensions (m): 2 × 1.5 Depth 0.30	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.25	13.24		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
				0.30	13.19		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, ceramic and slag. Cobbles are subangular of brick, slate, and sandstone.
							End of pit at 0.30 m

Remarks: Machine Excavated Trial Pit for CBR in-situ testing to 0.3m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation. CBR test results located within Structural Soils report 785592_plt_2024.03.21, test PLTCBR01.

Stability: Stable

Borehole Log

Borehole No.
DSBH 1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317885.00 - 478972.00	Hole Type WS
Location: Millom		Level: 13.75	Scale 1:50
Client: Cumberland Council		Dates: 20/03/2024 - 20/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.10	13.65		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
					0.40	13.35		MADE GROUND: Brown sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal and slag.
		0.90 - 1.00	ES					
		1.20		N=7 (1,1/2,2,1,2)				MADE GROUND: Greyish brown slightly clayey very gravelly sand. Gravel is subangular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, slag and glass.
		2.00		N=17 (4,8/8,5,2,2)	2.00	11.75		MADE GROUND: Reddish brown sandy gravel. Gravel is subangular to subrounded fine to coarse of sandstone, mudstone and brick.
		3.00		N=21 (11,6/4,5,6,6)	3.00	10.75		Stiff brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone.
		3.50 - 3.60	D					
		4.00		N=27 (4,4/4,7,7,9)				
					4.45	9.30		End of borehole at 4.45 m

Remarks
Window Sample Borehole to 4.45m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl.
Groundwater encountered at 2.5m bgl.

Borehole Log

Borehole No.
DSBH 1-02
Sheet 1 of 1

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317896.00 - 479001.00	Hole Type WS
Location:	Millom		Level:	14.47	Scale 1:50
Client:	Cumberland Council		Dates:	20/03/2024 - 20/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.10 - 0.20	ES		0.20	14.27		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
		1.20		50 (1,1/50 for 200mm)	1.40	13.07		MADE GROUND: Brown sandy gravelly clay. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal and slag.
								End of borehole at 1.40 m

Remarks
Window Sample Borehole to 1.4m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling.

Borehole Log

Borehole No.
DSBH 1-03
Sheet 1 of 1

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317917.00 - 478980.00	Hole Type WS
Location:	Millom		Level:	13.27	Scale 1:50
Client:	Cumberland Council		Dates:	20/03/2024 - 20/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.60 - 0.70	ES		0.15	13.12		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
		1.20		N=3 (1,0/1,1,1,1,0)				MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, plastic, wood, glass, rubber and slag. Cobbles are subangular of brick, wood, concrete and slate.
					1.80	11.47		End of borehole at 1.80 m

Remarks
Window Sample Borehole to 1.8m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling.

Borehole Log

Borehole No.
DSBH 1-05
Sheet 1 of 1

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317878.00 - 479009.00	Hole Type WS
Location:	Millom		Level:	15.75	Scale 1:50
Client:	Cumberland Council		Dates:	20/03/2024 - 20/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	15.55		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
					0.70	15.05		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is angular to subrounded fine to coarse of brick, slate, concrete, sandstone, mudstone, coal, ceramic and slag. Cobbles are subangular of brick, wood, concrete and slate.
		1.20		N=8 (5,3/2,3,1,2)				MADE GROUND: Brown and dark brown very gravelly sand. Gravel is angular to subrounded fine to coarse of glass, ceramic, slate, mudstone, limestone, brick, coal and slag.
		2.00		N=7 (1,0/0,1,0,6)				
		3.00		N=34 (25 for 85mm/27,4,2,1)				
					4.00	11.75		End of borehole at 4.00 m

Remarks
Window Sample Borehole to 4.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling.

Borehole Log

Borehole No. **RH 1-01**

Sheet 1 of 2

Project Name: The Iron Line	Project No. 080874	Co-ords: 317907.95 - 479000.65	Hole Type BH
Location: Millom		Level: 14.00	Scale 1:50
Client: Cumberland Council		Dates: 16/04/2024 - 17/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Bramble and moss cover over brown slightly gravelly sandy clayey TOPSOIL with abundant rootlets and occasional roots. Sand is fine to coarse. Gravel is subangular to subrouned fine to coarse of mudstone, brick, ash and coal.
					0.70	13.30		MADE GROUND: Dark brown sandy gravelly clay with occational cobbles. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of brick, coal, ash and mudstone. Cobbles are subangular of brick.
					2.50	11.50		Brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone.
					9.70	4.30		Light brown sandy slightly gravelly clay. Gravel is subangular to subrounded fine to coare of mudstone and sandstone.

Continued on next sheet

Remarks

Rotary Open Hole Borehole to 18.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling.

Borehole Log

Borehole No.
RH 1-01
Sheet 2 of 2

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317907.95 - 479000.65	Hole Type BH
Location:	Millom		Level:	14.00	Scale 1:50
Client:	Cumberland Council		Dates:	16/04/2024 - 17/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					13.50	0.50		Brown gravelly sand. Gravel is subangular to subrounded fine to coarse of mudstone.
					14.70	-0.70		Grey LIMESTONE.
					18.00	-4.00		End of borehole at 18.00 m

Remarks
Rotary Open Hole Borehole to 18.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling.

Borehole Log

Borehole No. **RH 1-02**

Sheet 1 of 4

Project Name: The Iron Line	Project No. 080874	Co-ords: 317909.00 - 478976.00	Hole Type BH
Location: Millom		Level: 13.40	Scale 1:50
Client: Cumberland Council		Dates: 12/03/2024 - 13/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					0.20	13.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
					1.20	12.20		MADE GROUND: Dark brown slightly clayey gravelly sand with occational cobbles. Sand is fine to coarse. Gravel is angular to subangular fine to coarse of brick, glass, metal, ceramic, slag, coal, mudstone, limestone and sandstone. Cobbles are angular to subangular of brick. Assumed MADE GROUND of dark brown gravelly sand.
					4.00	9.40		Brown gravelly CLAY. Gravel fragments of mudstone and sandstone observed.
					8.50	4.90		Brown gravelly sand. Gravel fragments of mudstone observed.
								Continued on next sheet

1 2 3 4 5 6 7 8 9 10

Remarks

Rotary Open Hole Borehole to 40.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling. No evidence of voids, broken ground or loss of flush was recorded during drilling. No evidence of mine gas emissions were recorded during drilling.

AGS

Borehole Log

Borehole No.
RH 1-02
Sheet 2 of 4

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317909.00 - 478976.00	Hole Type BH
Location:	Millom		Level:	13.40	Scale 1:50
Client:	Cumberland Council		Dates:	12/03/2024 - 13/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					13.50	-0.10		Brown sandy gravelly CLAY. Gravel fragments of mudstone and sandstone observed.
					17.00	-3.60		Brown sandy GRAVEL. Gravel fragments of mudstone and sandstone observed.
					18.00	-4.60		Reddish brown CONGLOMERATE with inclusions of mudstone and sandstone and a reddish brown sand matrix. Conglomerate recovered as a fragments of conglomerate, mudstone and sandstone. *From 18.00m to 28.40m bgl: Rotary drilling took approximately 30 minutes per run.*

Continued on next sheet

Remarks
Rotary Open Hole Borehole to 40.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling. No evidence of voids, broken ground or loss of flush was recorded during drilling. No evidence of mine gas emissions were recorded during drilling.

Borehole Log

Borehole No.
RH 1-02
Sheet 3 of 4

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317909.00 - 478976.00	Hole Type BH
Location:	Millom		Level:	13.40	Scale 1:50
Client:	Cumberland Council		Dates:	12/03/2024 - 13/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								From 28.40m to 33.80m bgl: Rotary drilling took approximately 15 minutes per run.
								Continued on next sheet

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Remarks
Rotary Open Hole Borehole to 40.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling. No evidence of voids, broken ground or loss of flush was recorded during drilling. No evidence of mine gas emissions were recorded during drilling.

AGS

Borehole Log

Borehole No.
RH 1-02
Sheet 4 of 4

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317909.00 - 478976.00	Hole Type BH
Location:	Millom		Level:	13.40	Scale 1:50
Client:	Cumberland Council		Dates:	12/03/2024 - 13/03/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								From 33.80m to 40.00m bgl: Rotary drilling took approximately 40 minutes per run.
					40.00	-26.60		End of borehole at 40.00 m

31 32 33 34 35 36 37 38 39 40

Remarks
Rotary Open Hole Borehole to 40.0m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl. No groundwater encountered during drilling. No evidence of voids, broken ground or loss of flush was recorded during drilling. No evidence of mine gas emissions were recorded during drilling.

AGS

Borehole Log

Borehole No.
RH 1-03
Sheet 1 of 5

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317884.92 - 478986.95	Hole Type BH
Location:	Millom		Level:	14.46	Scale 1:50
Client:	Cumberland Council		Dates:	17/04/2024 - 18/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
	▼				0.25	14.21		Bramble and moss cover over brown slightly gravelly sandy clayey TOPSOIL with abundant rootlets and occasional roots. Sand is fine to coarse. Gravel is subangular to subrouned fine to coarse of mudstone, brick, ash and coal.
								MADE GROUND: Dark brown and black gravelly sand. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of brick, metal, glass, ceramic, ash, clinker, coal, concrete, mudstone and sandstone.
					1.80	12.66		Brown slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of mudstone and sandstone.
					9.50	4.96		Brown gravelly sand. Gravel is subangular to subrounded fine to coarse of mudstone.
					10.00	4.46		

Continued on next sheet

Remarks
Rotary Open Hole Borehole to 40.5m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl.
Groundwater encountered at 1.1m within the hand pit with a moderate infiltration rate.

Borehole Log

Borehole No.
RH 1-03
Sheet 2 of 5

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317884.92 - 478986.95	Hole Type BH
Location:	Millom		Level:	14.46	Scale 1:50
Client:	Cumberland Council		Dates:	17/04/2024 - 18/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
								Grey LIMESTONE.
								Continued on next sheet

11 12 13 14 15 16 17 18 19 20

Remarks
Rotary Open Hole Borehole to 40.5m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl.
Groundwater encountered at 1.1m within the hand pit with a moderate infiltration rate.

AGS

Borehole Log

Borehole No.
RH 1-03
Sheet 3 of 5

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317884.92 - 478986.95	Hole Type BH
Location:	Millom		Level:	14.46	Scale 1:50
Client:	Cumberland Council		Dates:	17/04/2024 - 18/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				

21
22
23
24
25
26
27
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30

Continued on next sheet

Remarks
Rotary Open Hole Borehole to 40.5m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl.
Groundwater encountered at 1.1m within the hand pit with a moderate infiltration rate.

AGS

Borehole Log

Borehole No.
RH 1-03
Sheet 4 of 5

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317884.92 - 478986.95	Hole Type BH
Location:	Millom		Level:	14.46	Scale 1:50
Client:	Cumberland Council		Dates:	17/04/2024 - 18/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				

31
32
33
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Continued on next sheet

Remarks
Rotary Open Hole Borehole to 40.5m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl.
Groundwater encountered at 1.1m within the hand pit with a moderate infiltration rate.

AGS

Borehole Log

Borehole No.
RH 1-03
Sheet 5 of 5

Project Name:	The Iron Line	Project No. 080874	Co-ords:	317884.92 - 478986.95	Hole Type BH
Location:	Millom		Level:	14.46	Scale 1:50
Client:	Cumberland Council		Dates:	17/04/2024 - 18/04/2024	Logged By JP

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
					40.50	-26.04		End of borehole at 40.50 m

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Remarks
Rotary Open Hole Borehole to 40.5m bgl. Position was CAT scanned before breaking ground and at 0.4m bgl.
Groundwater encountered at 1.1m within the hand pit with a moderate infiltration rate.

Trial Pit Log

Trialpit No
SA1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317886.60 - 478953.10 Level: 13.56	Date 21/03/2024
Location: Millom		Dimensions (m): 2 × 0.8, Depth 1.65	Scale 1:50
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.50	13.06		Grass and brambles over dark greyish brown, sandy, gravelly clay with frequent roots/rootlets and occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone, brick and metal. Cobbles of subangular limestone and whole brick. (Topsoil)
				1.20	12.36		MADE GROUND: Brown, sandy, gravelly clay with frequent roots/rootlets and cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of metal, brick and limestone. Cobbles of subangular limestone.
				1.65	11.91		MADE GROUND: Red/reddish brown, sandy, slightly clayey gravel with cobbles and occasional boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone. Cobbles of subangular limestone. Boulders of subangular limestone.
							End of pit at 1.65 m

Remarks: Machine excavated trial pit to 1.65m bgl for soakaway testing. No groundwater encountered. Trial pit unstable, collapsing in on itself at depth, undermining the ground surface. Soak away test results located within Structural Soils report 785592_soaks_2024.03.21, test SA101.

Stability: Unstable

Trial Pit Log

Trialpit No
SA1-02
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317951.46 - 478966.88 Level: 11.65	Date 20/03/2024
Location: Millom		Dimensions (m): 2.1 × 0.7, Depth 2.70	Scale 1:50
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
▼				0.09	11.56		MADE GROUND: Dark grey, slightly clayey gravel. Gravel is fine to coarse, subangular to angular of slate, wood, plastic, metal and limestone.
				0.24	11.41		MADE GROUND: Reddish brown, slightly sandy, slightly clayey gravel with occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone. Cobbles of subangular limestone.
	1.00	ES					MADE GROUND: Dark brown/black, slightly clayey, very gravelly sand with cobbles and occasional boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of slate, limestone, wood and brick. Cobbles of subangular limestone. Boulders of subangular limestone.
							Slight sulphur smell noted between 0.24m - 1.50m bgl.
							Larger cobble and boulder content from 2.40m bgl.
				2.70	8.95		End of pit at 2.70 m

1 2 3 4 5 6 7 8 9 10

Remarks: Machine excavated trial pit to 2.70m bgl for soakaway testing. Groundwater encountered at 0.23m bgl, described as a slow seepage from Made Ground. Soak away test results located within Structural Soils report 785592_soaks_2024.03.21, test SA102.

Stability: Stable

AGS

Trial Pit Log

Trialpit No
SA1-03
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 318039.00 - 478980.00 Level: 3.32	Date 20/03/2024
Location: Millom		Dimensions (m): 2.1 × 0.65, Depth 1.00	Scale 1:50
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.10	ES		0.13	3.19		Grass and brambles over dark brown, slightly sandy, slightly gravelly clay with frequent rootlets. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone, brick, glass, metal and plastic. (Topsoil)
▼	0.25	ES		0.30	3.02		MADE GROUND: Reddish brown, slightly sandy, slightly gravelly clay. Sand is fine to coarse. Gravel is fine to coarse, subangular to angylar oof limestone, brick, metal and glass.
				1.00	2.32		MADE GROUND: Dark grey, sandy, clayey gravel with cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to anglar of brick, limestone and metal. Cobbles of subangular to angular whole brick and limestone.
							End of pit at 1.00 m

Remarks: Machine excavated trial pit to 1.00m bgl for soakaway testing. Position was terminated due to obstruction at 1.00m bgl. Groundwater encountered at 0.40m bgl described as a fast inflow, rising to 0.30m bgl within 1 minute and stabilising at this level. Soak away test results located within Structural Soils report 785592_soaks_2024.03.21, test SA103.

Stability: Stable

Trial Pit Log

Trialpit No
TP 1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317848.00 - 479004.00 Level: 16.20	Date 21/03/2024
Location: Millom		Dimensions (m): 3.2 × 0.6, Depth 2.50	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.15	16.05		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
				0.25	15.95		MADE GROUND: Dark gravelly clay. Gravel is angular to subangular fine to coarse of brick, slag, coal, mudstone, sandstone and glass.
				0.55	15.65		MADE GROUND: Greyish brown gravelly slighty sandy clay. Gravel is angular to subangular fine to coarse of brick, slag, coal, mudstone, sandstone and glass.
							MADE GROUND: Soft reddish brown slightly sandy clay.
				1.50	14.70		MADE GROUND: Dark grey very gravelly sand. Gravel is angular to subangular fine to coarse of coal and slag.
	2.00 - 2.10	ES					
	2.40 - 2.50	D		2.40	13.80		
				2.50	13.70		Firm brown slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of mudstone.
							End of pit at 2.50 m

Remarks: Machine Excavated Trial Pit to 2.5m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation.

Stability: Stable

Trial Pit Log

Trialpit No
TP 1-03
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 318048.00 - 478954.00 Level: 3.28	Date 22/03/2024
Location: Millom		Dimensions (m): 3.3 x 1.4, Depth 2.00	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
	0.40 - 0.50	ES		0.20	3.08		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
							MADE GROUND: Brown slightly clayey gravelly sand with frequent cobbles. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone, brick, rope, glass and slag.
				1.80	1.48		MADE GROUND: Greyish brown slightly clayey very gravelly sand with abundant cobbles. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone, brick, glass and slag. Cobbles are subangular of brick and sandstone.
				2.00	1.28		End of pit at 2.00 m

Remarks: Machine Excavated Trial Pit to 2.0m bgl. Position was terminated due to obstruction at 2.00m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation.

Stability: Stable

AGS

Trial Pit Log

Trialpit No
TP1-02
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 318028.00 - 479004.00 Level: 3.66	Date 20/03/2024
Location: Millom		Dimensions (m): 2.1 × 0.65, Depth 1.20	Scale 1:50
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	3.36		Grass and brambles over reddish brown, slightly sandy, gravelly, cobbly clay with frequent roots/rootlets and occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of brick, limestone, glass bottles. Cobbles of subangular limestone. (Topsoil)
▼	0.75	ES					MADE GROUND: Dark grey, slightly sandy, clayey gravel with cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of brick, metal, glass, wood and limestone. Cobbles of angular whole brick, limestone and a metal pole with a concrete base.
				1.20	2.46		End of pit at 1.20 m

Remarks: Machine excavated trial pit to 1.20m bgl. Position was terminated due to obstruction at 1.20m bgl. Groundwater encountered at 0.65m bgl described as a very fast inflow, rising to 0.30m bgl within 1 minute and stabilising at this level.

Stability: Stable

Trial Pit Log

Trialpit No
TP1-04
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317917.00 - 478970.00 Level: 12.32	Date 20/03/2024
Location: Millom		Dimensions (m): 3 × 0.7 Depth 2.90	Scale 1:50
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.07	12.25		MADE GROUND: Light grey and grey, slghtly clayey, slightly sandy gravel. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of slate, limestone, wood and plastic.
				0.20	12.12		MADE GROUND: Reddish brown, slightly sandy, slightly clayey gravel with cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone. Cobbles of subangular limestone.
▼				1.90	10.42		MADE GROUND: Dark greyish brown/black, slightly clayey, very gravelly sand with cobbles and occasional boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone, wood and brick. Cobbles of subangular limestone, whole brick and wood. Boulders of subangular limestone. *Slight sulphur smell noted from 0.20m - 1.90m bgl.* *Wooden railway sleeper at 1.40m bgl.*
				2.90	9.42		MADE GROUND: Reddish brown, slightly sandy, slightly clayey, gravelly cobble with boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone. Cobbles of subangular limestone. Boulders of subangular limestone. End of pit at 2.90 m

Remarks: Machine excavated trial pit to 2.90m bgl. Groundwater encountered at 1.90m described as a slow seepage. Trial pit unstable, collapsing in on itself at depth, undermining the ground surface.

Stability: Unstable

Trial Pit Log

Trialpit No
TT 1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 479013.00 Level: 15.86	Date 22/03/2024
Location: Millom		Dimensions (m): 3.4 × 5.1, Depth 3.50	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	15.76		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
	0.50 - 0.60	ES		0.40	15.46		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is subangualr to subrounded fine to coarse of mudstone, sandstone and concrete. Cobbles are subangular to subrounded fine to coarse of mudstone and sandstone.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal, slag, railway grider, fabric and polystyrene.
			HVP=130 HVP=135	2.50	13.36		Stiff brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone and coal.
			HVP=136 HVP=140				
	3.40 - 3.50	D					
			HVP=140 HVP=140	3.50	12.36		End of pit at 3.50 m

Remarks: Machine Excavated Trial Trench to 3.5m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-02
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317887.00 - 479007.00 Level: 15.16	Date 22/03/2024
Location: Millom		Dimensions (m): 3.6 x 1.2 Depth 2.50	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	14.96		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
	1.30 - 1.40	ES					MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
▼				2.50	12.66		End of pit at 2.50 m

Remarks: Machine Excavated Trial Trench to 2.5m bgl. Position was CAT scanned before breaking ground. Groundwater with a very fast infiltration rate was encountered at 2.5m bgl. Position was moved to new location due to water ingress.

Stability: Not Stable

Trial Pit Log

Trialpit No
TT 1-02A
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317882.00 - 479007.00 Level: 15.16	Date 22/03/2024
Location: Millom		Dimensions (m): 3.5 x 1.2 Depth 2.70	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	15.06		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
				0.30	14.86		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is subangualr to subrounded fine to coarse of mudstone, sandstone and concrete. Cobbles are subangular to subrounded fine to coarse of mudstone and sandstone.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
▼				2.70	12.46		End of pit at 2.70 m

1 2 3 4 5 6 7 8 9 10

Remarks: Machine Excavated Trial Trench to 2.7m bgl. Position was CAT scanned before breaking ground. Groundwater with a fast infiltration rate was encountered at 2.5m bgl.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-03 A
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478987.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2 Depth 1.70	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	15.30		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
				0.20	15.20		MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				0.40	15.00		MADE GROUND: Grey sandy clay.
			HVP=140 HVP=140 HVP=140				Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
				1.70	13.70		End of pit at 1.70 m

Remarks: Machine Excavated Trial Trench to 3.9m bgl. Position was CAT scanned before breaking ground. Trial trench log split into 4 sections to show the change in ground conditions, log split into TT103A-TT103D.

Stability: Not Stable

Trial Pit Log

Trialpit No: **TT 1-03 B**

Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478991.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2, Depth 2.20	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	15.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				1.20	14.20		MADE GROUND: Grey sandy clay.
				1.40	14.00		Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
			HVP=137 HVP=140 HVP=140	2.20	13.20		End of pit at 2.20 m

Remarks: Machine Excavated Trial Trench to 2.2m bgl. Position was CAT scanned before breaking ground. Groundwater with slow ingress was encountered at 2.5m bgl.

Stability: Not Stable

Trial Pit Log

Trialpit No
TT 1-03 C
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478994.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2, Depth 3.20	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	15.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				2.60	12.80		MADE GROUND: Grey sandy clay.
				2.80	12.60		Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
			HVP=140 HVP=140 HVP=140	3.20	12.20		End of pit at 3.20 m

1 2 3 4 5 6 7 8 9 10

Remarks: Machine Excavated Trial Trench to 3.2m bgl. Position was CAT scanned before breaking ground. Groundwater with slow ingress was encountered at 2.5m bgl.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-03 D
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478998.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2 Depth 3.90	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	15.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				3.00	12.40		MADE GROUND: Grey sandy clay.
				3.20	12.20		Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
			HVP=126 HVP=140 HVP=140	3.90	11.50		End of pit at 3.90 m

Remarks: Machine Excavated Trial Trench to 3.9m bgl. Position was CAT scanned before breaking ground. Groundwater with slow ingress was encountered at 2.5m bgl. HSV tests were undertaken in natural clay

Stability: Not Stable

Trial Pit Log

Trialpit No
TT 1-04
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317894.00 - 478991.00 Level: 14.56	Date 22/03/2024
Location: Millom	Dimensions (m): Depth 1.60	3.8 × 2.7	Scale 1:50
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	14.36		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
▼							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				1.60	12.96		End of pit at 1.60 m

Remarks: Machine Excavated Trial Trench to 1.6m bgl. Position was CAT scanned before breaking ground. An unrecorded water pipe was encountered at 0.7m bgl. Position was moved 1m to the south where groundwater with a fast infiltration rate was encountered at 1.5m bgl.

Stability: Not Stable

Trial Pit Log

Trialpit No
TP 1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317848.00 - 479004.00 Level: 16.20	Date 21/03/2024
Location: Millom		Dimensions (m): 3.2 × 0.6, Depth 2.50	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.15	16.05		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
				0.25	15.95		MADE GROUND: Dark gravelly clay. Gravel is angular to subangular fine to coarse of brick, slag, coal, mudstone, sandstone and glass.
				0.55	15.65		MADE GROUND: Greyish brown gravelly slighty sandy clay. Gravel is angular to subangular fine to coarse of brick, slag, coal, mudstone, sandstone and glass.
							MADE GROUND: Soft reddish brown slightly sandy clay.
				1.50	14.70		MADE GROUND: Dark grey very gravelly sand. Gravel is angular to subangular fine to coarse of coal and slag.
	2.00 - 2.10	ES					
	2.40 - 2.50	D		2.40	13.80		Firm brown slightly sandy slightly gravelly CLAY. Gravel is subrounded fine to coarse of mudstone.
				2.50	13.70		End of pit at 2.50 m

Remarks: Machine Excavated Trial Pit to 2.5m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation.

Stability: Stable

Trial Pit Log

Trialpit No
TP1-02
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 318028.00 - 479004.00 Level: 3.66	Date 20/03/2024
Location: Millom		Dimensions (m): 2.1 × 0.65, Depth 1.20	Scale 1:40
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.30	3.36		Grass and brambles over reddish brown, slightly sandy, gravelly, cobbly clay with frequent roots/rootlets and occasional cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of brick, limestone, glass bottles. Cobbles of subangular limestone. (Topsoil)
▼	0.75	ES					MADE GROUND: Dark grey, slightly sandy, clayey gravel with cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of brick, metal, glass, wood and limestone. Cobbles of angular whole brick, limestone and a metal pole with a concrete base.
				1.20	2.46		End of pit at 1.20 m

Remarks: Machine excavated trial pit to 1.20m bgl. Position was terminated due to obstruction at 1.20m bgl. Groundwater encountered at 0.65m bgl described as a very fast inflow, rising to 0.30m bgl within 1 minute and stabilising at this level.

Stability: Stable

Trial Pit Log

Trialpit No
TP 1-03
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 318048.00 - 478954.00 Level: 3.28	Date 22/03/2024
Location: Millom		Dimensions (m): 3.3 x 1.4, Depth 2.00	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	3.08		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets and occasional roots.
	0.40 - 0.50	ES					MADE GROUND: Brown slightly clayey gravelly sand with frequent cobbles. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone, brick, rope, glass and slag.
				1.80	1.48		MADE GROUND: Greyish brown slightly clayey very gravelly sand with abundant cobbles. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone, brick, glass and slag. Cobbles are subangular of brick and sandstone.
				2.00	1.28		End of pit at 2.00 m

Remarks: Machine Excavated Trial Pit to 2.0m bgl. Position was terminated due to obstruction at 2.00m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation.

Stability: Stable

Trial Pit Log

Trialpit No
TP1-04
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317917.00 - 478970.00 Level: 12.32	Date 20/03/2024
Location: Millom		Dimensions (m): 3 × 0.7, Depth 2.90	Scale 1:40
Client: Cumberland Council			Logged LW

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.07	12.25		MADE GROUND: Light grey and grey, slghtly clayey, slightly sandy gravel. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of slate, limestone, wood and plastic.
				0.20	12.12		MADE GROUND: Reddish brown, slightly sandy, slightly clayey gravel with cobbles. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone. Cobbles of subangular limestone.
							MADE GROUND: Dark greyish brown/black, slightly clayey, very gravelly sand with cobbles and occasional boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone, wood and brick. Cobbles of subangular limestone, whole brick and wood. Boulders of subangular limestone.
▼							*Slight sulphur smell noted from 0.20m - 1.90m bgl.*
							Wooden railway sleeper at 1.40m bgl.
				1.90	10.42		MADE GROUND: Reddish brown, slightly sandy, slightly clayey, gravelly cobble with boulders. Sand is fine to coarse. Gravel is fine to coarse, subangular to angular of limestone. Cobbles of subangular limestone. Boulders of subangular limestone.
				2.90	9.42		End of pit at 2.90 m

Remarks: Machine excavated trial pit to 2.90m bgl. Groundwater encountered at 1.90m described as a slow seepage. Trial pit unstable, collapsing in on itself at depth, undermining the ground surface.

Stability: Unstable

Trial Pit Log

Trialpit No
TT 1-01
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 479013.00 Level: 15.86	Date 22/03/2024
Location: Millom		Dimensions (m): 3.4 x 5.1 Depth 3.50	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	15.76		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
	0.50 - 0.60	ES		0.40	15.46		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is subangualr to subrounded fine to coarse of mudstone, sandstone and concrete. Cobbles are subangular to subrounded fine to coarse of mudstone and sandstone.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal, slag, railway grider, fabric and polystyrene.
			HVP=130 HVP=135	2.50	13.36		Stiff brown mottled grey slightly sandy slightly gravelly CLAY. Sand is fine to coarse. Gravel is subangular to subrounded fine to coarse of mudstone, sandstone and coal.
			HVP=136 HVP=140				
	3.40 - 3.50	D					
			HVP=140 HVP=140	3.50	12.36		End of pit at 3.50 m

Remarks: Machine Excavated Trial Trench to 3.5m bgl. Position was CAT scanned before breaking ground. No groundwater was encountered during excavation.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-02
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317887.00 - 479007.00 Level: 15.16	Date 22/03/2024
Location: Millom		Dimensions (m): 3.6 x 1.2 Depth 2.50	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	14.96		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
	1.30 - 1.40	ES					MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
▼				2.50	12.66		End of pit at 2.50 m

Remarks: Machine Excavated Trial Trench to 2.5m bgl. Position was CAT scanned before breaking ground. Groundwater with a very fast infiltration rate was encountered at 2.5m bgl. Position was moved to new location due to water ingress.

Stability: Not Stable

Trial Pit Log

Trialpit No
TT 1-02A
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317882.00 - 479007.00 Level: 15.16	Date 22/03/2024
Location: Millom		Dimensions (m): 3.5 x 1.2 Depth 2.70	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	15.06		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
				0.30	14.86		MADE GROUND: Brown sandy gravelly clay with frequent cobbles. Gravel is subangualr to subrounded fine to coarse of mudstone, sandstone and concrete. Cobbles are subangular to subrounded fine to coarse of mudstone and sandstone.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
▼				2.70	12.46		End of pit at 2.70 m

1 2 3 4 5 6 7 8

Remarks: Machine Excavated Trial Trench to 2.7m bgl. Position was CAT scanned before breaking ground. Groundwater with a fast infiltration rate was encountered at 2.5m bgl.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-03 A
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478987.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2, Depth 1.70	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.10	15.30		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
				0.20	15.20		MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				0.40	15.00		MADE GROUND: Grey sandy clay.
			HVP=140 HVP=140 HVP=140				Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
				1.70	13.70		End of pit at 1.70 m

Remarks: Machine Excavated Trial Trench to 3.9m bgl. Position was CAT scanned before breaking ground. Trial trench log split into 4 sections to show the change in ground conditions, log split into TT103A-TT103D.

Stability: Not Stable

Trial Pit Log

Trialpit No
TT 1-03 B
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478991.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2 Depth 2.20	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	15.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				1.20	14.20		MADE GROUND: Grey sandy clay.
				1.40	14.00		Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
			HVP=137 HVP=140 HVP=140	2.20	13.20		End of pit at 2.20 m

1 2 3 4 5 6 7 8

Remarks: Machine Excavated Trial Trench to 2.2m bgl. Position was CAT scanned before breaking ground. Groundwater with slow ingress was encountered at 2.5m bgl.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-03 C
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478994.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2 Depth 3.20	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	15.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				2.60	12.80		MADE GROUND: Grey sandy clay.
				2.80	12.60		Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
			HVP=140 HVP=140 HVP=140	3.20	12.20		End of pit at 3.20 m

1 2 3 4 5 6 7 8

Remarks: Machine Excavated Trial Trench to 3.2m bgl. Position was CAT scanned before breaking ground. Groundwater with slow ingress was encountered at 2.5m bgl.

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No: **TT 1-03 D**

Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317868.00 - 478998.00 Level: 15.40	Date 22/03/2024
Location: Millom		Dimensions (m): 11 × 1.2 Depth 3.90	Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	15.20		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
				3.00	12.40		MADE GROUND: Grey sandy clay.
				3.20	12.20		Stiff brown mottled grey sandy slightly gravelly CLAY. Gravel is subangular to subrounded fine to coarse of coal and mudstone.
			HVP=126 HVP=140 HVP=140	3.90	11.50		End of pit at 3.90 m

1 2 3 4 5 6 7 8

Remarks: Machine Excavated Trial Trench to 3.9m bgl. Position was CAT scanned before breaking ground. Groundwater with slow ingress was encountered at 2.5m bgl. HSV tests were undertaken in natural clay

Stability: Not Stable

AGS

Trial Pit Log

Trialpit No
TT 1-04
Sheet 1 of 1

Project Name: The Iron Line	Project No. 080874	Co-ords: 317894.00 - 478991.00 Level: 14.56	Date 22/03/2024
Location: Millom	Dimensions (m): 3.8 × 2.7, Depth 1.60		Scale 1:40
Client: Cumberland Council			Logged JP

Water Strike	Samples and In Situ Testing: Depth	Type	Results	Depth (m)	Level (m)	Legend	Stratum Description
				0.20	14.36		Brush and moss cover over brown sandy clayey TOPSOIL with abundant rootlets.
							MADE GROUND: Dark greyish brown very gravelly sand. Gravel is angular to subangular fine to coarse of glass, ceramic, plastic, metal, rope, mudstone, sandstone, brick, coal and slag.
▼				1.60	12.96		End of pit at 1.60 m

Remarks: Machine Excavated Trial Trench to 1.6m bgl. Position was CAT scanned before breaking ground. An unrecorded water pipe was encountered at 0.7m bgl. Position was moved 1m to the south where groundwater with a fast infiltration rate was encountered at 1.5m bgl.

Stability: Not Stable

Borehole Log

Borehole No.
CP1-01
Sheet 1 of 1

Project Name: Millom Iron Line	Project No. 080874.302	Co-ords: 317909.32 - 478972.97	Hole Type CP
Location: Millom		Level: 13.40	Scale 1:50
Client: Cumberland Council		Dates: 11/12/2024 - 11/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30 - 0.40 0.30 - 0.40	ES ES		0.40	13.00		MADE GROUND: Brown very clayey, very gravelly, cobbly fine to coarse sand. Gravel is fine to coarse slag, coal, limestone, brick and suspected asbestos cement. Cobbles are subangular brick and suspected asbestos cement sheet. End of borehole at 0.40 m

Remarks
Service inspection pit hand excavated from GL to 0.40m. No groundwater encountered. Terminated due to the presence of possible asbestos.

Borehole Log

Borehole No.
CP1-01B
Sheet 1 of 1

Project Name:	Millom Iron Line	Project No. 080874.302	Co-ords: 317909.30 - 478986.96	Hole Type CP
Location:	Millom		Level: 13.40	Scale 1:50
Client:	Cumberland Council		Dates: 11/12/2024 - 11/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.00 - 0.50	B					MADE GROUND: Brown very clayey, gravelly, cobbly fine to coarse sand. Gravel is fine to coarse subangular to angular limestone, brick and slag. Cobbles are subangular limestone.
		0.30 - 0.40	ES					
					0.57	12.83		MADE GROUND: Brown very clayey, very gravelly, cobbly fine to coarse sand. Gravel is fine to coarse slag, coal, limestone, brick and suspected asbestos cement. Cobbles are subangular brick and suspected asbestos cement sheet.
		0.70 - 0.80	ES					
					0.90	12.50		End of borehole at 0.90 m

Remarks
Service inspection pit hand excavated from GL to 0.90m. No groundwater encountered. Terminated due to the presence of possible asbestos.

Borehole Log

Borehole No. **CP1-01C**

Sheet 1 of 2

Project Name: Millom Iron Line	Project No. 080874.302	Co-ords: 317907.22 - 478985.09	Hole Type CP
Location: Millom		Level: 13.40	Scale 1:50
Client: Cumberland Council		Dates: 12/12/2024 - 12/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		1.50		N=2 (1,0/1,0,1,0)	1.50	11.90		MADE GROUND: Brown very clayey, gravelly fine to coarse sand. Gravel is fine to coarse subangular to subrounded limestone, plastic, steel, slate and brick. Cobbles are subangular slag and brick.
		3.00		N=11 (12,5/3,3,2,3)				MADE GROUND: Black very gravelly, slightly bouldery fine to coarse sand. Gravel is fine to coarse subangular to angular glass, slag and tarmac. Boulders are subangular concrete.
		3.20 - 3.45	D		3.20	10.20		Firm to stiff reddish brown very sandy, gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded to rounded mudstone, siltstone, sandstone and quartzite.
		4.50		N=21 (2,3/5,5,5,6)				
		4.50 - 4.95	D					
		7.50		N=30 (2,3/5,5,8,12)				
		7.50 - 7.95	D					
		9.00 - 9.45	U	Ublow=38				

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 13.50m bgl rising to 9.50m bgl after 20 minutes.

Borehole Log

Borehole No.
CP1-01C
Sheet 2 of 2

Project Name: Millom Iron Line	Project No. 080874.302	Co-ords: 317907.22 - 478985.09	Hole Type CP
Location: Millom		Level: 13.40	Scale 1:50
Client: Cumberland Council		Dates: 12/12/2024 - 12/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.50 10.50 - 10.95	D	N=26 (1,2/3,5,6,12)				
		12.00 - 12.45	U	Ublow=37				
		13.50		N=44 (4,8/8,12,12,12)				
		15.00		50 (4,12/50 for 180mm)	15.00 15.10	-1.60 -1.70		Grey LIMESTONE. End of borehole at 15.10 m

Remarks
Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 13.50m bgl rising to 9.50m bgl after 20 minutes.

Borehole Log

Borehole No. **CP1-02**

Sheet 1 of 1

Project Name: Millom Iron Line	Project No. 080874.302	Co-ords: 317888.45 - 478986.96	Hole Type CP
Location: Millom		Level: 14.40	Scale 1:50
Client: Cumberland Council		Dates: 09/12/2024 - 10/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.30 - 0.40	ES		0.30	14.10		MADE GROUND: Brown very clayey, gravelly, cobbly fine to coarse sand. Gravel is fine to coarse subrounded to angular brick, limestone and clinker. Cobbles are angular brick.
		0.30 - 1.20	B					MADE GROUND: Black and brown mottled very gravelly, silty fine to coarse sand. Gravel is fine to coarse subangular to angular slag, clinker, glass, coal and steel.
		0.60 - 0.70	ES					
		1.20		N=24 (2,3/3,3,8,10)				
		3.00		N=20 (1,4/5,5,5,5)	3.00	11.40		Firm to stiff reddish brown very sandy, gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded to rounded mudstone, siltstone, sandstone and quartzite.
		3.00 - 3.45	D					
		4.00 - 4.45	U	Ublow=28				
		5.00		N=21 (3,3/4,5,5,7)				
		5.00 - 5.45	D					
		6.00		N=10 (1,1/2,3,3,2)				
		6.00 - 6.45	D					
		7.50 - 7.95	U	Ublow=31				
		9.00		50 (25 for 70mm/50 for 10mm)	9.00	5.40		Grey LIMESTONE.
		9.00 - 9.20	D					
		9.50		50 (25 for 0mm/50 for 0mm)	9.50	4.90		End of borehole at 9.50 m

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 6.00m bgl rising to 2.70m bgl after 20 minutes.

Borehole Log

Borehole No. **CP1-03**

Sheet 1 of 2

Project Name: Millom Iron Line	Project No. 080874.302	Co-ords: 317902.86 - 479000.82	Hole Type CP
Location: Millom		Level: 14.00	Scale 1:50
Client: Cumberland Council		Dates: 10/12/2024 - 11/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		0.20 - 1.50	B		0.20	13.80		MADE GROUND: Brown very clayey, gravelly fine to coarse sand. Gravel is fine to coarse subangular brick and concrete.
		0.40 - 0.50	ES					MADE GROUND: Brown very clayey, gravelly, cobbly fine to coarse sand. Gravel is fine to coarse subrounded to subangular slag, clinker, limestone, glass and coal. Cobbles are subangular limestone. (Made Ground content contains approx 20% ash).
		1.00 - 1.10	ES					
		1.20		N=20 (2,2/3,5,6,6)				
					1.50	12.50		MADE GROUND: Brown very sandy, very gravelly clay. Sand is fine to coarse. Gravel is fine to coarse brick, mudstone, sandstone and siltstone.
		2.00		N=8 (2,2/2,2,2,2)	2.00	12.00		Firm to stiff reddish brown very sandy, gravelly CLAY. Sand is fine to coarse. Gravel is fine to coarse subrounded to rounded mudstone, siltstone, sandstone and quartzite.
		2.00 - 2.45	D					
		3.00 - 3.45	U	Ublow=30				
		4.00		N=17 (1,2/3,4,5,5)				
		4.00 - 4.45	D					
		5.00		N=18 (1,2/3,3,6,6)				
		5.00 - 5.45	D					
		6.00 - 6.45	U	Ublow=50				
		7.50		N=21 (2,4/4,5,5,7)				
		7.50 - 7.95	D					
		9.00		N=25 (2,3/5,6,7,7)				

Continued on next sheet

Remarks

Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 9.40m bgl rising to 8.20m bgl and 14.10m bgl rising to 13.50m bgl after 20 minutes.

Borehole Log

Borehole No. **CP1-03**
Sheet 2 of 2

Project Name: Millom Iron Line	Project No. 080874.302	Co-ords: 317902.86 - 479000.82	Hole Type CP
Location: Millom		Level: 14.00	Scale 1:50
Client: Cumberland Council		Dates: 10/12/2024 - 11/12/2024	Logged By RT

Well	Water Strikes	Samples and In Situ Testing			Depth (m)	Level (m)	Legend	Stratum Description
		Depth (m)	Type	Results				
		10.50		N=20 (2,3/5,5,5,5)				
		10.50 - 10.95	D					
		12.00		N=15 (1,1/2,2,5,6)				
		12.80		N=41 (25 for 40mm/21,6,6,8)				
					14.10	-0.10		Very dense reddish brown very sandy GRAVEL of fine to coarse subangular to angular limestone. Sand is fine to coarse.
		14.50		50 (25 for 40mm/50 for 25mm)	14.50	-0.50		Grey LIMESTONE.
		14.50 - 14.95	D					
		15.00		50 (25 for 30mm/50 for 30mm)	15.10	-1.10		End of borehole at 15.10 m

Remarks
Service inspection pit hand excavated from GL to 1.20m. Groundwater encountered at 9.40m bgl rising to 8.20m bgl and 14.10m bgl rising to 13.50m bgl after 20 minutes.

Appendix D – Chemical Laboratory Test Results

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envirolab
Hattersley Science & Technology Park
Stockport Road, Hattersley, SK14 3QU

FINAL ANALYTICAL TEST REPORT
SUPPLEMENT TO TEST REPORT 24/03122/1

Amendments: Request for Additional Analysis

Envirolab Job Number: 24/03122
Issue Number: 2 S1 **Date:** 26 April, 2024

Client: Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Jonathan Provis/Niall Farnworth
Project Name: The Iron Line
Project Ref: 080874
Order No: 13868
Date Samples Received: 25/03/24
Date Instructions Received: 26/03/24
Date Analysis Completed: 25/04/24

Approved by:

[redacted]

Danielle Brierley
Client Services Supervisor

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/1	24/03122/2	24/03122/3	24/03122/4	24/03122/5	24/03122/6	24/03122/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SA1-02	TP1-02	SA1-03	TP1-04	DSBH1-03	DSBH1-01	DSBH1-02			
Depth to Top	1.00	0.75	0.25	0.10	0.60	0.90	0.10			
Depth To Bottom					0.70	1.00	0.20			
Date Sampled	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	4A	4AE	6AE	4A	6ACE	4AB	6AE			
% Moisture at <40C$_A$	15.6	26.5	16.4	18.5	17.0	14.5	27.3	% w/w	0.1	A-T-044
% Stones >10mm$_A$	18.4	17.8	1.8	<0.1	<0.1	<0.1	3.3	% w/w	0.1	A-T-044
pH$_D$$^{M\#}$	10.86	8.78	8.73	8.78	8.56	8.53	7.25	pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$$^{M\#}$	0.34	0.12	<0.01	0.01	<0.01	<0.01	<0.01	g/l	0.01	A-T-026s
Cyanide (total)$_A$$^{M\#}$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	0.4	<0.2	mg/kg	0.2	A-T-050s
Organic Matter$_D$$^{M\#}$	11.9	23.3	0.9	8.4	8.5	4.1	4.4	% w/w	0.1	A-T-032s
Arsenic$_D$$^{M\#}$	10	28	26	29	11	12	24	mg/kg	1	A-T-024s
Boron (water soluble)$_D$$^{M\#}$	5.6	1.5	<1.0	<1.0	<1.0	<1.0	<1.0	mg/kg	1	A-T-027s
Cadmium$_D$$^{M\#}$	1.4	0.7	0.6	1.3	0.7	0.6	<0.5	mg/kg	0.5	A-T-024s
Copper$_D$$^{M\#}$	85	79	18	82	33	53	23	mg/kg	1	A-T-024s
Chromium$_D$$^{M\#}$	22	16	26	16	24	24	36	mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1	<1	mg/kg	1	A-T-040s
Lead$_D$$^{M\#}$	69	151	24	57	446	347	18	mg/kg	1	A-T-024s
Mercury$_D$	2.16	<0.17	<0.17	0.64	<0.17	<0.17	<0.17	mg/kg	0.17	A-T-024s
Nickel$_D$$^{M\#}$	13	32	25	15	19	19	20	mg/kg	1	A-T-024s
Selenium$_D$$^{M\#}$	3	2	<1	3	<1	<1	<1	mg/kg	1	A-T-024s
Zinc$_D$$^{M\#}$	154	132	43	130	378	187	61	mg/kg	5	A-T-024s

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/1	24/03122/2	24/03122/3	24/03122/4	24/03122/5	24/03122/6	24/03122/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SA1-02	TP1-02	SA1-03	TP1-04	DSBH1-03	DSBH1-01	DSBH1-02			
Depth to Top	1.00	0.75	0.25	0.10	0.60	0.90	0.10			
Depth To Bottom					0.70	1.00	0.20			
Date Sampled	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	4A	4AE	6AE	4A	6ACE	4AB	6AE			
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	NAD	Chrysotile	Chrysotile	Amosite	NAD			A-T-045
Asbestos Matrix (visual)$_{D}$	-	-	-	-	-	-	-			A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	Loose Fibres	Cement	Loose Insulation	-			A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A	N/A	No	N/A	N/A			A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	-	<0.001	0.513	0.038	-	% w/w	0.001	A-T-054

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/1	24/03122/2	24/03122/3	24/03122/4	24/03122/5	24/03122/6	24/03122/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SA1-02	TP1-02	SA1-03	TP1-04	DSBH1-03	DSBH1-01	DSBH1-02			
Depth to Top	1.00	0.75	0.25	0.10	0.60	0.90	0.10			
Depth To Bottom					0.70	1.00	0.20			
Date Sampled	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	4A	4AE	6AE	4A	6ACE	4AB	6AE			
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	0.07	<0.01	<0.01	1.54	6.75	0.35	mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	0.04	0.01	<0.01	0.02	0.18	0.64	0.08	mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	0.10	0.10	<0.02	<0.02	2.20	8.65	1.16	mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	0.64	0.57	0.08	0.28	5.08	23.9	5.87	mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	0.45	0.57	0.06	0.33	4.17	20.7	4.99	mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	0.64	0.78	0.07	0.38	4.75	28.1	5.80	mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	0.38	0.37	<0.05	0.21	1.77	9.27	1.72	mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	0.19	0.26	<0.07	0.12	1.81	12.5	2.33	mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	0.74	0.73	0.07	0.29	4.76	30.3	4.93	mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A$	0.07	0.07	<0.04	0.05	0.42	2.84	0.43	mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	1.85	1.32	0.11	0.22	12.5	55.9	11.3	mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	<0.01	0.06	<0.01	<0.01	1.86	6.61	0.36	mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	0.37	0.44	0.04	0.27	2.33	10.9	2.18	mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	0.09	0.04	<0.03	<0.03	0.61	2.41	0.04	mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	0.30	0.63	0.05	0.09	10.4	50.4	4.08	mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	1.51	1.05	0.08	0.18	9.33	44	8.85	mg/kg	0.07	A-T-019s
Total PAH-16MS$_A$	7.37	7.07	0.56	2.44	63.7	314	54.5	mg/kg	0.01	A-T-019s

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/1	24/03122/2	24/03122/3	24/03122/4	24/03122/5	24/03122/6	24/03122/7	Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	SA1-02	TP1-02	SA1-03	TP1-04	DSBH1-03	DSBH1-01	DSBH1-02			
Depth to Top	1.00	0.75	0.25	0.10	0.60	0.90	0.10			
Depth To Bottom					0.70	1.00	0.20			
Date Sampled	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24	20-Mar-24			
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES			
Sample Matrix Code	4A	4AE	6AE	4A	6ACE	4AB	6AE			
TPH CWG with Clean Up										
Ali >C5-C6$_A$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
Ali >C6-C8$_A$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	2	<1	<1	<1	<10	<1	mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	1	<1	<1	<1	<10	<1	mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	5	2	<1	<1	1	<10	<1	mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	19	2	<1	<1	5	13	1	mg/kg	1	A-T-055s
Ali >C21-C35$_A^{M\#}$	120	27	1	32	16	75	11	mg/kg	1	A-T-055s
Total Aliphatics$_A$	144	35	1	32	22	88	12	mg/kg	1	Calc-As Recd
Aro >C5-C7$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	2	2	<1	<1	<1	<10	<1	mg/kg	1	A-T-055s
Aro >C10-C12$_A$	<1	2	<1	<1	2	<10	<1	mg/kg	1	A-T-055s
Aro >C12-C16$_A$	5	9	<1	<1	20	129	15	mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	17	29	4	2	125	1120	112	mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	35	69	11	7	271	2570	382	mg/kg	1	A-T-055s
Total Aromatics$_A$	60	112	14	10	419	3830	508	mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35)$_A$	204	147	15	42	441	3910	520	mg/kg	1	Calc-As Recd
BTEX - Benzene$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.01	<0.05	<0.01	<0.01	<0.01	<0.05	<0.01	mg/kg	0.01	A-T-022s

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/8	24/03122/9	24/03122/10	24/03122/11	24/03122/12	24/03122/13		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DSBH1-05	TP1-01	TP1-03	TT1-01	TT1-03	TT1-02				
Depth to Top	1.70	2.00	0.40	0.50	2.90	1.30				
Depth To Bottom	1.80	2.10	0.50	0.60	3.00	1.40				
Date Sampled	20-Mar-24	21-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24				
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES				
Sample Matrix Code	4A	5A	5AE	4AE	6A	4AD				
% Moisture at <40C$_A$	30.9	14.5	14.5	16.6	42.7	35.8		% w/w	0.1	A-T-044
% Stones >10mm$_A$	12.7	33.1	<0.1	10.5	1.3	3.1		% w/w	0.1	A-T-044
pH$_D$ M#	7.89	8.42	8.45	8.17	8.23	8.17		pH	0.01	A-T-031s
Sulphate (water sol 2:1)$_D$ M#	0.20	0.01	0.01	0.03	0.10	0.07		g/l	0.01	A-T-026s
Cyanide (total)$_A$ M#	<1	<1	<1	2	<1	<1		mg/kg	1	A-T-042sTCN
Phenols - Total by HPLC$_A$	<0.2	<0.2	<0.2	<0.2	<0.2	<0.2		mg/kg	0.2	A-T-050s
Organic Matter$_D$ M#	41.4	10.8	1.7	9.5	5.5	9.5		% w/w	0.1	A-T-032s
Arsenic$_D$ M#	46	11	13	30	20	33		mg/kg	1	A-T-024s
Boron (water soluble)$_D$ M#	1.6	<1.0	<1.0	<1.0	1.5	1.5		mg/kg	1	A-T-027s
Cadmium$_D$ M#	2.8	0.5	<0.5	1.4	1.0	4.6		mg/kg	0.5	A-T-024s
Copper$_D$ M#	177	44	21	99	38	186		mg/kg	1	A-T-024s
Chromium$_D$ M#	39	14	16	39	16	55		mg/kg	1	A-T-024s
Chromium (hexavalent)$_D$	<1	<1	<1	<1	<1	<1		mg/kg	1	A-T-040s
Lead$_D$ M#	182	99	36	191	92	389		mg/kg	1	A-T-024s
Mercury$_D$	<0.17	<0.17	<0.17	<0.17	0.31	<0.17		mg/kg	0.17	A-T-024s
Nickel$_D$ M#	113	33	15	64	22	96		mg/kg	1	A-T-024s
Selenium$_D$ M#	2	<1	<1	<1	2	2		mg/kg	1	A-T-024s
Zinc$_D$ M#	448	91	78	299	175	956		mg/kg	5	A-T-024s

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/8	24/03122/9	24/03122/10	24/03122/11	24/03122/12	24/03122/13		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DSBH1-05	TP1-01	TP1-03	TT1-01	TT1-03	TT1-02				
Depth to Top	1.70	2.00	0.40	0.50	2.90	1.30				
Depth To Bottom	1.80	2.10	0.50	0.60	3.00	1.40				
Date Sampled	20-Mar-24	21-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24				
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES				
Sample Matrix Code	4A	5A	5AE	4AE	6A	4AD				
Asbestos in Soil (inc. matrix)										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	Chrysotile	NAD	NAD	NAD				A-T-045
Asbestos Matrix (visual)$_{D}$	-	-	-	-	-	-				A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	Loose Insulation	-	-	-				A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	N/A	N/A	N/A	N/A				A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	<0.001	-	-	-		% w/w	0.001	A-T-054

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/8	24/03122/9	24/03122/10	24/03122/11	24/03122/12	24/03122/13		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DSBH1-05	TP1-01	TP1-03	TT1-01	TT1-03	TT1-02				
Depth to Top	1.70	2.00	0.40	0.50	2.90	1.30				
Depth To Bottom	1.80	2.10	0.50	0.60	3.00	1.40				
Date Sampled	20-Mar-24	21-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24				
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES				
Sample Matrix Code	4A	5A	5AE	4AE	6A	4AD				
PAH-16MS										
Acenaphthene$_A^{M\#}$	<0.01	0.02	4.90	0.59	<0.01	<0.01		mg/kg	0.01	A-T-019s
Acenaphthylene$_A^{M\#}$	<0.01	0.02	0.21	0.04	<0.01	<0.01		mg/kg	0.01	A-T-019s
Anthracene$_A^{M\#}$	<0.02	0.09	5.96	1.07	<0.02	<0.02		mg/kg	0.02	A-T-019s
Benzo(a)anthracene$_A^{M\#}$	<0.04	0.37	21.6	5.12	0.07	<0.04		mg/kg	0.04	A-T-019s
Benzo(a)pyrene$_A^{M\#}$	<0.04	0.31	18.9	4.53	0.09	<0.04		mg/kg	0.04	A-T-019s
Benzo(b)fluoranthene$_A^{M\#}$	<0.05	0.34	27.2	5.10	0.14	<0.05		mg/kg	0.05	A-T-019s
Benzo(ghi)perylene$_A^{M\#}$	<0.05	0.16	8.62	1.85	0.12	<0.05		mg/kg	0.05	A-T-019s
Benzo(k)fluoranthene$_A^{M\#}$	<0.07	0.13	10.9	2.05	<0.07	<0.07		mg/kg	0.07	A-T-019s
Chrysene$_A^{M\#}$	<0.06	0.38	28.1	5.26	0.12	<0.06		mg/kg	0.06	A-T-019s
Dibenzo(ah)anthracene$_A$	<0.04	<0.04	2.60	0.41	<0.04	<0.04		mg/kg	0.04	A-T-019s
Fluoranthene$_A^{M\#}$	<0.08	0.62	67.1	12.5	0.21	<0.08		mg/kg	0.08	A-T-019s
Fluorene$_A^{M\#}$	<0.01	0.03	4.75	0.53	<0.01	<0.01		mg/kg	0.01	A-T-019s
Indeno(123-cd)pyrene$_A^{M\#}$	<0.03	0.19	10.5	2.25	0.14	<0.03		mg/kg	0.03	A-T-019s
Naphthalene $_A^{M\#}$	<0.03	<0.03	0.69	<0.03	<0.03	<0.03		mg/kg	0.03	A-T-019s
Phenanthrene$_A^{M\#}$	<0.03	0.39	58	6.79	0.09	<0.03		mg/kg	0.03	A-T-019s
Pyrene$_A^{M\#}$	<0.07	0.49	52.2	9.16	<0.07	<0.07		mg/kg	0.07	A-T-019s
Total PAH-16MS$_A$	<0.08	3.54	322	57.2	0.98	<0.08		mg/kg	0.01	A-T-019s

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/8	24/03122/9	24/03122/10	24/03122/11	24/03122/12	24/03122/13		Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DSBH1-05	TP1-01	TP1-03	TT1-01	TT1-03	TT1-02				
Depth to Top	1.70	2.00	0.40	0.50	2.90	1.30				
Depth To Bottom	1.80	2.10	0.50	0.60	3.00	1.40				
Date Sampled	20-Mar-24	21-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24				
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES	SOIL - ES				
Sample Matrix Code	4A	5A	5AE	4AE	6A	4AD				
TPH CWG with Clean Up										
Ali >C5-C6$_A$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
Ali >C6-C8$_A$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
Ali >C8-C10$_A$	<1	<1	<10	<1	<1	<1		mg/kg	1	A-T-055s
Ali >C10-C12$_A^{M\#}$	<1	<1	<10	<1	<1	<1		mg/kg	1	A-T-055s
Ali >C12-C16$_A^{M\#}$	<1	<1	<10	<1	<1	<1		mg/kg	1	A-T-055s
Ali >C16-C21$_A^{M\#}$	<1	<1	<10	3	7	<1		mg/kg	1	A-T-055s
Ali >C21-C35$_A^{M\#}$	14	5	46	41	50	2		mg/kg	1	A-T-055s
Total Aliphatics$_A$	14	5	46	44	57	2		mg/kg	1	Calc-As Recd
Aro >C5-C7$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
Aro >C7-C8$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
Aro >C8-C10$_A$	<1	<1	<10	<1	<1	<1		mg/kg	1	A-T-055s
Aro >C10-C12$_A$	<1	<1	16	<1	<1	<1		mg/kg	1	A-T-055s
Aro >C12-C16$_A$	<1	3	119	13	3	<1		mg/kg	1	A-T-055s
Aro >C16-C21$_A^{M\#}$	1	20	738	121	7	<1		mg/kg	1	A-T-055s
Aro >C21-C35$_A^{M\#}$	6	56	988	340	19	5		mg/kg	1	A-T-055s
Total Aromatics$_A$	8	79	1860	474	29	5		mg/kg	1	Calc-As Recd
TPH (Ali & Aro >C5-C35)$_A$	21	85	1910	518	86	6		mg/kg	1	Calc-As Recd
BTEX - Benzene$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
BTEX - Toluene$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
BTEX - Ethyl Benzene$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
BTEX - m & p Xylene$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
BTEX - o Xylene$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s
MTBE$_A^{\#}$	<0.05	<0.05	<0.01	<0.05	<0.05	<0.05		mg/kg	0.01	A-T-022s

Report Notes

General
This report shall not be reproduced, except in full, without written approval from Envirolab.
The results reported herein relate only to the material supplied to the laboratory.
The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and Interpretations expressed are outside our scope of accreditation.
The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.
A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs
Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.					

Soil Chemical Analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH by method A-T-007:
For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:
EPH CWG results have humics mathematically subtracted through instrument calculation.
Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:
Results greater than 12900µS/cm @ 25ºC / 11550µS/cm @ 20ºC fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: The Iron Line

Clients Project No: 080874

Project No: 24/03122

Date Received: 26/03/2024 (am)

Cool Box Temperatures (°C): 12.0 - 13.0

Lab Sample ID	24/03122/2	24/03122/6	24/03122/8	24/03122/9	24/03122/11	24/03122/12	24/03122/13
Client Sample No							
Client Sample ID/Depth	TP1-02 0.75m	DSBH1-01 0.90-1.00m	DSBH1-05 1.70-1.80m	TP1-01 2.00-2.10m	TT1-01 0.50-0.60m	TT1-03 2.90-3.00m	TT1-02 1.30-1.40m
Date Sampled	20/03/24	20/03/24	20/03/24	21/03/24	22/03/24	22/03/24	22/03/24
Deviation Code							
F	✓	✓	✓	✓	✓	✓	✓

Key
F *Maximum holding time exceeded between sampling date and analysis for analytes listed below*

HOLDING TIME EXCEEDANCES

Lab Sample ID	24/03122/2	24/03122/6	24/03122/8	24/03122/9	24/03122/11	24/03122/12	24/03122/13
Client Sample No							
Client Sample ID/Depth	TP1-02 0.75m	DSBH1-01 0.90-1.00m	DSBH1-05 1.70-1.80m	TP1-01 2.00-2.10m	TT1-01 0.50-0.60m	TT1-03 2.90-3.00m	TT1-02 1.30-1.40m
Date Sampled	20/03/24	20/03/24	20/03/24	21/03/24	22/03/24	22/03/24	22/03/24
VPHCWG	✓	✓	✓	✓	✓	✓	✓

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples 5 ± 3°C), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/03122/1	24/03122/2	24/03122/3	24/03122/4	24/03122/5	24/03122/6	24/03122/7	24/03122/8	24/03122/9	24/03122/10	24/03122/11	24/03122/12
Client Sample No												
Client Sample ID/Depth	SA1-02 1.00m	TP1-02 0.75m	SA1-03 0.25m	TP1-04 0.10m	DSBH1-03 0.60-0.70m	DSBH1-01 0.90-1.00m	DSBH1-02 0.10-0.20m	DSBH1-05 1.70-1.80m	TP1-01 2.00-2.10m	TP1-03 0.40-0.50m	TT1-01 0.50-0.60m	TT1-03 2.90-3.00m
Date Sampled	20/03/24	20/03/24	20/03/24	20/03/24	20/03/24	20/03/24	20/03/24	20/03/24	21/03/24	22/03/24	22/03/24	22/03/24
A-T-019s	08/04/2024	08/04/2024	08/04/2024	08/04/2024	08/04/2024	10/04/2024	08/04/2024	08/04/2024	08/04/2024	10/04/2024	08/04/2024	08/04/2024
A-T-022s	08/04/2024	09/04/2024	08/04/2024	08/04/2024	08/04/2024	09/04/2024	08/04/2024	09/04/2024	09/04/2024	08/04/2024	09/04/2024	09/04/2024
A-T-024s	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024
A-T-026s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-027s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-028s												
A-T-031s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-032s	03/04/2024	03/04/2024	03/04/2024	04/04/2024	04/04/2024	04/04/2024	03/04/2024	03/04/2024	03/04/2024	04/04/2024	03/04/2024	03/04/2024
A-T-033s												
A-T-040s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-042sTCN	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
A-T-044	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
A-T-045	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024	30/03/2024
A-T-050s	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
A-T-054				25/04/2024	25/04/2024	25/04/2024				25/04/2024		
A-T-055s	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024	03/04/2024	02/04/2024	02/04/2024	02/04/2024	03/04/2024	02/04/2024	02/04/2024
A-T-SOLMETS												
Calc-As Recd	08/04/2024	09/04/2024	08/04/2024	08/04/2024	08/04/2024	09/04/2024	08/04/2024	09/04/2024	09/04/2024	08/04/2024	09/04/2024	09/04/2024

Lab Sample ID	24/03122/13
Client Sample No	
Client Sample ID/Depth	TT1-02 1.30-1.40m
Date Sampled	22/03/24
A-T-019s	08/04/2024
A-T-022s	09/04/2024
A-T-024s	03/04/2024
A-T-026s	04/04/2024
A-T-027s	04/04/2024
A-T-028s	
A-T-031s	04/04/2024
A-T-032s	03/04/2024
A-T-033s	
A-T-040s	04/04/2024
A-T-042sTCN	02/04/2024
A-T-044	02/04/2024
A-T-045	30/03/2024
A-T-050s	02/04/2024
A-T-054	
A-T-055s	02/04/2024
A-T-SOLMETS	
Calc-As Recd	09/04/2024

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

envirolab
Hattersley Science & Technology Park
Stockport Road, Hattersley, SK14 3QU

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 24/12226
Issue Number: 1 **Date:** 18 December, 2024

Client:
Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: Niall Farnworth/Russell Taylor
Project Name: Millom
Project Ref: B080874
Order No: 20033
Date Samples Received: 16/12/24
Date Instructions Received: 16/12/24
Date Analysis Completed: 18/12/24

Approved by:

[redacted]

Gemma Berrisford
Deputy Client Services Supervisor

UKAS TESTING
1247

Envirolab Job Number: 24/12226

Client Project Name: Millom

Client Project Ref: B080874

Lab Sample ID	24/12226/1	24/12226/4	24/12226/5	24/12226/6	24/12226/7	24/12226/8		Units	Limit of Detection	Method ref
Client Sample No	ES01	ES02	ES01	ES02	ES01	ES02				
Client Sample ID	CP1-02	CP1-03	CP1-01	CP1-01	CP1-01B	CP1-01B				
Depth to Top	0.3	1	0.3	0.3	0.3	0.7				
Depth To Bottom	0.4	1.1	0.4	0.4	0.4	0.8				
Date Sampled	09-Dec-24	10-Dec-24	11-Dec-24	11-Dec-24	11-Dec-24	11-Dec-24				
Sample Type	SOIL - ES	SOIL - ES	SOIL - ES	SOLID - BULK	SOIL - ES	SOLID - BULK				
Sample Matrix Code	5A	4AE	6AE	8	4AD	8				
Asbestos in Soil (inc. matrix) ^										
Asbestos in soil$_{D}^{\#}$	NAD	NAD	Chrysotile	-	NAD	-				A-T-045
Asbestos Matrix (visual)$_{D}$	-	-	Cement	-	-	-				A-T-045
Asbestos Matrix (microscope)$_{D}$	-	-	-	-	-	-				A-T-045
Asbestos ACM - Suitable for Water Absorption Test?$_{D}$	N/A	N/A	No	-	N/A	-				A-T-045
Asbestos in Soil Quantification % (Hand Picking & Weighing)										
Asbestos in soil % composition (hand picking and weighing)$_{D}$	-	-	0.087	-	-	-		% w/w	0.001	A-T-054
Bulk Fibre ID (inc. matrix) ^										
Bulk Fibre Identification$_{D}^{\#}$	-	-	-	Chrysotile	-	Chrysotile				A-T-045
Bulk Fibre Identification Matrix (visual)$_{D}$	-	-	-	Cement	-	Cement				A-T-045
Bulk Fibre Identification - Suitable for Water Absorption Test?$_{D}$	-	-	-	Yes	-	Yes				A-T-045
Bulk Fibre Quantification % Asbestos in ACM										
Bulk Fibre - % Asbestos in ACM (HSG264)$_{D}$	-	-	-	15.000	-	15.000		% w/w	0.001	A-T-054

Report Notes

General

•This report shall not be reproduced, except in full, without written approval from Envirolab.
•The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client and can affect the validity of results.
•The results reported herein relate only to the material supplied to the laboratory.
•The residue of any samples contained within this report, and any received within the same delivery, will be disposed of **four weeks** after the initial scheduling. For samples tested for Asbestos we will retain a portion of the dried sample for a minimum of **six months** after the initial Asbestos testing is completed.
•Analytical results reflect the quality of the sample at the time of analysis only.
•Opinions and Interpretations expressed are outside our scope of accreditation.
•A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.
•If a sample is outside of the calibration range or affected by interferences then it may need diluting. This will result in the limit of detection (LOD) being raised.
•Subcontracted Analysis: Please see the appended report for any deviations, current LODs and accreditation status of the test.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "D" on Asbestos	Analysis performed on a dried aliquot of sample provided.
Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
Trace	Asbestos found not suitable for Gravimetric Quantification – not enough to accurately weigh.
N/A	Not applicable

Asbestos

Identification: Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis
"Trace Asbestos Identified" will be reported if there is not enough present to verify the type.
Quantification: Generally a 2 stage process including visual identification, hand picking and weighing, and fibre counting. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres). "TRACE" will be reported as a quantification result.
PLEASE INFORM THE LABORATORY IF YOU WOULD LIKE THE STAGE 3 SEDIMENTATION PROCESS CARRIED OUT. Note this will be subcontracted.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs
Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.					

Soil Chemical Analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH by method A-T-007:
For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:
EPH CWG results have humics mathematically subtracted through instrument calculation.
Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:
Results greater than 12900µS/cm @ 25^0C / 11550µS/cm @ 20^0C fall outside the calibration range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: Millom

Clients Project No: B080874

Project No: 24/12226

Date Received: 16/12/2024 (pm)

Cool Box Temperatures (°C): 14.2

NO DEVIATIONS IDENTIFIED

If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3, ISO 18400-102:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/12226/1	24/12226/4	24/12226/5	24/12226/6	24/12226/7	24/12226/8
Client Sample No	ES01	ES02	ES01	ES02	ES01	ES02
Client Sample ID/Depth	CP1-02 0.3-0.4m	CP1-03 1-1.1m	CP1-01 0.3-0.4m	CP1-01 0.3-0.4m	CP1-01B 0.3-0.4m	CP1-01B 0.7-0.8m
Date Sampled	09/12/24	10/12/24	11/12/24	11/12/24	11/12/24	11/12/24
A-T-045	17/12/2024	17/12/2024	17/12/2024	17/12/2024	17/12/2024	17/12/2024
A-T-054			18/12/2024	18/12/2024		18/12/2024

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

Appendix E – Geotechnical Laboratory Test Results

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IAN FARMER ASSOCIATES

Unit 4, Faraday Close, Pattinson North Industrial Estate, Washington, NE38 8QJ Tel: 0191 482 8500
washington@ianfarmer.co.uk www.ianfarmer.co.uk

Envirolab
Envirolab Ltd,
Housesteads,
Off Stockport Road,
Hattersley,
SK14 3QU

F.A.O.

Final Test Report - 2281950 / 1

Site:	80874
Job Number:	2281950
Originating Client:	Envirolab
Originating Reference:	24/03122
Date Sampled:	Not Given
Date Scheduled:	28/03/2024
Date Testing Started:	03/04/2024
Date Testing Finished:	15/04/2024

Previous Reports		Amendments	Date Issued

Amendments:

Authorised By: [redacted]

Tim Robinson
Quality Supervisor

Report Issue Date: 15/04/2024

Constructionline Part of Capita plc

Ian Farmer Associates (1998) Limited. Registered in England and Wales, No. 3661447.
Registered Office: Spring Lodge 172 Chester Road, Helsby, Frodsham, England, WA6 0AR.
Offices in: Cornwall (01872) 261775. Coventry (024) 7630 3422. Harpenden (01582) 460018. Llanelli (01554) 566566.
Newcastle upon Tyne (0191) 482 8500. Motherwell (01698) 230231. Warrington (01925) 855440. Washington (0191) 482 8500.

AGS

IAN FARMER ASSOCIATES

Laboratory Test Report 2281950 / 1

Site: 80874 **Job Number:** 2281950

Client: Envirolab **Page:** 2

Determination of Moisture Content, Liquid Limit and Plastic Limit and Derivation of Plasticity and Liquidity Index

Borehole / Trial Pit	Depth (m)	Sample	Natural Moisture Content %	Natural - Stones removed by hand Sieved - Washed on 425 µm sieve			Liquid Limit %	Plastic Limit %	Plasticity Index %	Liquidity Index	Class	Description / Remarks
				Natural / Sieved	Percentage Passing %	Moisture Content %						
DSBH1-01	3.50	D	18	Natural	100	18	38	19	19	-0.05	CI	Brown silty CLAY
TP1-01	2.40	D	23	Natural	100	23	38	19	19	0.21	CI	Brown silty CLAY
TT1-01	3.40	D	17	Sieved	95	18	39	21	18	-0.19	CI	Brown slightly gravelly, silty CLAY
TT1-03	0.50	D	18	Natural	100	18	30	18	12	0.00	CL	Brown slightly gravelly, silty CLAY
TT1-03	3.10	D	24	Sieved				NP				Grey gravelly, sandy SILT

Method of Preparation: BS 1377 : Part 1 : 1990 : Clause 7 Preparation of disturbed samples for testing
BS 1377 : Part 1 : 2016 : Clause 8.4.3 Preparation of samples for plasticity tests
BS 1377 : Part 2 : 1990 : Clause 4.2 Preparation of samples for plastic limit tests

Method of Test: BS 1377 : Part 2 : 1990 : Clause 3.2 Determination of moisture content
BS 1377 : Part 2 : 1990 : Clause 4.3 or 4.4 Determination of the liquid limit
BS 1377 : Part 2 : 1990 : Clause 5.3 Determination of the plastic limit and plasticity index

UKAS TESTING 1464

Results reported relate only to the samples tested.

IAN FARMER ASSOCIATES

Final Test Report - 2281950 / 1

Site:	80874
Job Number:	2281950
Originating Client:	Envirolab

All opinions and interpretations contained within this report are outside of our Scope of Accreditation.

This test report shall not be reproduced, except in full and only with the written permission of Ian Farmer Associates Ltd.

Samples will be retained for 28 days from date of issue of the final test report before being disposed of, unless we receive written instruction to the contrary.

Report End

Report Issue Date: 15/04/2024

envirolab
Hattersley Science & Technology Park
Stockport Road, Hattersley, SK14 3QU

FINAL ANALYTICAL TEST REPORT
SUPPLEMENT TO TEST REPORT 24/03122/1

Amendments: Request for Additional Analysis

Envirolab Job Number: 24/03122
Issue Number: 2 S2 **Date:** 26 April, 2024

Client:
Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Jonathan Provis/Niall Farnworth
Project Name: The Iron Line
Project Ref: 080874
Order No: 13869
Date Samples Received: 25/03/24
Date Instructions Received: 26/03/24
Date Analysis Completed: 25/04/24

Approved by:

[redacted]

Danielle Brierley
Client Services Supervisor

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/14	24/03122/15	24/03122/16	24/03122/17	24/03122/18			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DSBH1-01	TP1-01	TT1-01	TT1-03	TT1-03					
Depth to Top	3.50	2.40	3.40	0.50	3.10					
Depth To Bottom	3.60	2.50	3.50	0.60	3.20					
Date Sampled	20-Mar-24	21-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24					
Sample Type	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D					
Sample Matrix Code	6AE	3A	6A	5A	5A					
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1	18.1			% w/w	0.1	A-T-044
pH BRE$_D^{M\#}$	8.62	8.40	8.62	8.31	8.65			pH	0.01	A-T-031s
Ammonium NH4 BRE (water sol 2:1)$_D$	<1.00	<1.00	<1.00	<1.00	16.1			mg/l	1	A-T-033s
Chloride BRE, SO4 equiv. (water sol 2:1)$_D^{M\#}$	<7	<7	<7	<7	7			mg/l	7	A-T-026s
Nitrate BRE, SO4 equiv. (water sol 2:1)$_D$	<0.4	<0.4	0.5	<0.4	<0.4			mg/l	0.4	A-T-026s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	<10	<10	23	29	<10			mg/l	10	A-T-026s
Sulphate BRE (acid sol)$_D^{M\#}$	<0.02	<0.02	<0.02	<0.02	<0.02			% w/w	0.02	A-T-028s
Sulphur BRE (total)$_D$	<0.01	<0.01	<0.01	<0.01	<0.01			% w/w	0.01	A-T-024s
Magnesium BRE (water sol 2:1)$_D$	5	2	7	1	2			mg/l	1	A-T-SOLMETS
(1.02) Item 2.4 4 Point Liquid & Plastic Limit by Cone Penetrometer$_A^{\#}$	Appended	Appended	Appended	Appended	Appended					Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method)$_A^{\#}$	Appended	Appended	Appended	Appended	Appended					Subcon IFA

Report Notes

General
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Analytical results reflect the quality of the sample at the time of analysis only.
Opinions and Interpretations expressed are outside our scope of accreditation.
The client Sample No, Client Sample ID, Depth to top, Depth to Bottom and Date Sampled are all provided by the client.
A deviating sample report is appended and will indicate if samples or tests have been found to be deviating. Any test results affected may not be an accurate record of the concentration at the time of sampling and, as a result, may be invalid.

Key

Superscript "#"	Accredited to ISO 17025
Superscript "M"	Accredited to MCertS
Superscript "U"	Individual result not accredited
None of the above symbols	Analysis unaccredited
Subscript "A"	Analysis performed on as-received Sample
Subscript "D"	Analysis performed on the dried sample, crushed to pass 2mm sieve.
Subscript "^"	Analysis has dependant options against results. Details appear in the comments of your Sample receipt
IS	Insufficient Sample for analysis
US	Unsuitable Sample for analysis
NDP	No Determination Possible
NAD	No Asbestos Detected
N/A	Not applicable

Asbestos
Asbestos in soil analysis is performed on a dried aliquot of the submitted sample and cannot guarantee to identify asbestos if only present in small numbers as discrete fibres/fragments in the original sample.
Stones etc. are not removed from the sample prior to analysis
Quantification of asbestos is a 3 stage process including visual identification, hand picking and weighing, and fibre counting by sedimentation/phase contrast optical microscopy if required. If asbestos is identified as being present but is not in a form that is suitable for analysis by hand picking and weighing (normally if the asbestos is present as free fibres) quantification by sedimentation is performed. Where ACMs are found a percentage asbestos is assigned to each with reference to 'HSG264, Asbestos: The survey guide' and the calculated asbestos content is expressed as a percentage of the dried soil sample aliquot used.

Assigned Matrix Codes

1	SAND	6	CLAY/LOAM	A	Contains Stones
2	LOAM	7	OTHER	B	Contains Construction Rubble
3	CLAY	8	Asbestos Bulk (Only Asbestos ID accredited)	C	Contains visible hydrocarbons
4	LOAM/SAND	9	Incinerator Ash (some Metals accredited)	D	Contains glass / metal
5	SAND/CLAY			E	Contains roots / twigs
Note: 7,8,9 matrices are not covered by our ISO 17025 or MCertS accreditation, unless stated above.					

Soil Chemical Analysis:
All results are reported as dry weight (<40°C).
For samples with Matrix Codes 1 - 6 natural stones, brick and concrete fragments >10mm and any extraneous material (visible glass, metal or twigs) are removed and excluded from the sample prior to analysis and reported results corrected to a whole sample basis. This is reported as '% stones >10mm'.
For samples with Matrix Code 7 the whole sample is dried and crushed prior to analysis and this supersedes any "A" subscripts
All analysis is performed on the sample as received for soil samples which are positive for asbestos or the client has informed asbestos may be present and/or if they are from outside the European Union and this supersedes any "D" subscripts.

TPH by method A-T-007:
For waters, free and visible oils are excluded from the sample used for analysis, so the reported result represents the dissolved phase only.
Results "with Clean up" indicates samples cleaned up with Silica during extraction.

EPH CWG (method A-T-055) from TPH CWG:
EPH CWG results have humics mathematically subtracted through instrument calculation.
Where these humic substances have been identified in any IDs from "TPH CWG with clean up" please note that the concentration is **NOT** included in the quantified results but present in the ID for information.

Electrical Conductivity of water by method A-T-037:
Results greater than 12900µS/cm @ 25ºC / 11550µS/cm @ 20ºC fall outside the accreditation range and as such are unaccredited.

Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: The Iron Line

Clients Project No: 080874

Project No: 24/03122

Date Received: 26/03/2024 (am)

Cool Box Temperatures (°C): 12.0 - 13.0

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples 5 ± 3°C), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/03122/14	24/03122/15	24/03122/16	24/03122/17	24/03122/18
Client Sample No					
Client Sample ID/Depth	DSBH1-01 3.50-3.60m	TP1-01 2.40-2.50m	TT1-01 3.40-3.50m	TT1-03 0.50-0.60m	TT1-03 3.10-3.20m
Date Sampled	20/03/24	21/03/24	22/03/24	22/03/24	22/03/24
A-T-019s					
A-T-022s					
A-T-024s	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024
A-T-026s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-027s					
A-T-028s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-031s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-032s					
A-T-033s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-040s					
A-T-042sTCN					
A-T-044	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
A-T-045					
A-T-050s					
A-T-054					
A-T-055s					
A-T-SOLMETS	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
Calc-As Recd					

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

envirolab
Hattersley Science & Technology Park
Stockport Road, Hattersley, SK14 3QU

FINAL ANALYTICAL TEST REPORT

Envirolab Job Number: 24/03122
Issue Number: 1 S2 **Date:** 17 April, 2024

Client:
Curtins Consulting (Manchester)
Merchant Exchange
17-19 Whitworth Street
Manchester
UK
M1 5WG

Project Manager: EBMA/Jonathan Provis/Niall Farnworth
Project Name: The Iron Line
Project Ref: 080874
Order No: 13869
Date Samples Received: 25/03/24
Date Instructions Received: 26/03/24
Date Analysis Completed: 15/04/24

Approved by:

[redacted]

Danielle Brierley
Client Services Supervisor

Envirolab Job Number: 24/03122

Client Project Name: The Iron Line

Client Project Ref: 080874

Lab Sample ID	24/03122/14	24/03122/15	24/03122/16	24/03122/17	24/03122/18			Units	Limit of Detection	Method ref
Client Sample No										
Client Sample ID	DSBH1-01	TP1-01	TT1-01	TT1-03	TT1-03					
Depth to Top	3.50	2.40	3.40	0.50	3.10					
Depth To Bottom	3.60	2.50	3.50	0.60	3.20					
Date Sampled	20-Mar-24	21-Mar-24	22-Mar-24	22-Mar-24	22-Mar-24					
Sample Type	SOIL - D	SOIL - D	SOIL - D	SOIL - D	SOIL - D					
Sample Matrix Code	6AE	3A	6A	5A	5A					
% Stones >10mm$_A$	<0.1	<0.1	<0.1	<0.1	18.1			% w/w	0.1	A-T-044
pH BRE$_D^{M\#}$	8.62	8.40	8.62	8.31	8.65			pH	0.01	A-T-031s
Ammonium NH4 BRE (water sol 2:1)$_D$	<1.00	<1.00	<1.00	<1.00	16.1			mg/l	1	A-T-033s
Chloride BRE, SO4 equiv. (water sol 2:1)$_D^{M\#}$	<7	<7	<7	<7	7			mg/l	7	A-T-026s
Nitrate BRE, SO4 equiv. (water sol 2:1)$_D$	<0.4	<0.4	0.5	<0.4	<0.4			mg/l	0.4	A-T-026s
Sulphate BRE (water sol 2:1)$_D^{M\#}$	<10	<10	23	29	<10			mg/l	10	A-T-026s
Sulphate BRE (acid sol)$_D^{M\#}$	<0.02	<0.02	<0.02	<0.02	<0.02			% w/w	0.02	A-T-028s
Sulphur BRE (total)$_D$	<0.01	<0.01	<0.01	<0.01	<0.01			% w/w	0.01	A-T-024s
Magnesium BRE (water sol 2:1)$_D$	5	2	7	1	2			mg/l	1	A-T-SOLMETS
(1.02) Item 2.4 4 Point Liquid & Plastic Limit by Cone Penetrometer$_A^{\#}$	Appended	Appended	Appended	Appended	Appended					Subcon IFA
(1.01) Item 1a Moisture Content of Soil (Oven Dried Method)$_A^{\#}$	Appended	Appended	Appended	Appended	Appended					Subcon IFA

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N/A	Not applicable

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Please contact your client manager if you require any further information.

Envirolab Deviating Samples Report

Hattersley Science & Technology Park, Stockport Road, Hattersley, SK14 3QU
Tel. 0161 368 4921 email. ask@envlab.co.uk

Client: Curtins Consulting (Manchester), Merchant Exchange, 17-19 Whitworth Street , Manchester, UK, M1 5WG

Project: The Iron Line

Clients Project No: 080874

Project No: 24/03122

Date Received: 26/03/2024 (am)

Cool Box Temperatures (°C): 12.0 - 13.0

NO DEVIATIONS IDENTIFIED with respect to sampling dates or containers received.

Note: If, at any point before reaching the laboratory, the temperature of the samples has breached those set in published standards, e.g. BS-EN 5667-3 (for water samples 5 ± 3°C), ISO 18400-105:2017, then the concentration of any affected analytes may differ from that at the time of sampling.

Envirolab Analysis Dates

Lab Sample ID	24/03122/14	24/03122/15	24/03122/16	24/03122/17	24/03122/18
Client Sample No					
Client Sample ID/Depth	DSBH1-01 3.50-3.60m	TP1-01 2.40-2.50m	TT1-01 3.40-3.50m	TT1-03 0.50-0.60m	TT1-03 3.10-3.20m
Date Sampled	20/03/24	21/03/24	22/03/24	22/03/24	22/03/24
A-T-019s					
A-T-022s					
A-T-024s	03/04/2024	03/04/2024	03/04/2024	03/04/2024	03/04/2024
A-T-026s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-027s					
A-T-028s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-031s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-032s					
A-T-033s	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
A-T-040s					
A-T-042sTCN					
A-T-044	02/04/2024	02/04/2024	02/04/2024	02/04/2024	02/04/2024
A-T-045					
A-T-050s					
A-T-055s					
A-T-SOLMETS	04/04/2024	04/04/2024	04/04/2024	04/04/2024	04/04/2024
Calc-As Recd					

The above dates are the analysis completion dates, please note that these are not necessarily the date that the analysis was weighed/extracted.

End of Report

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

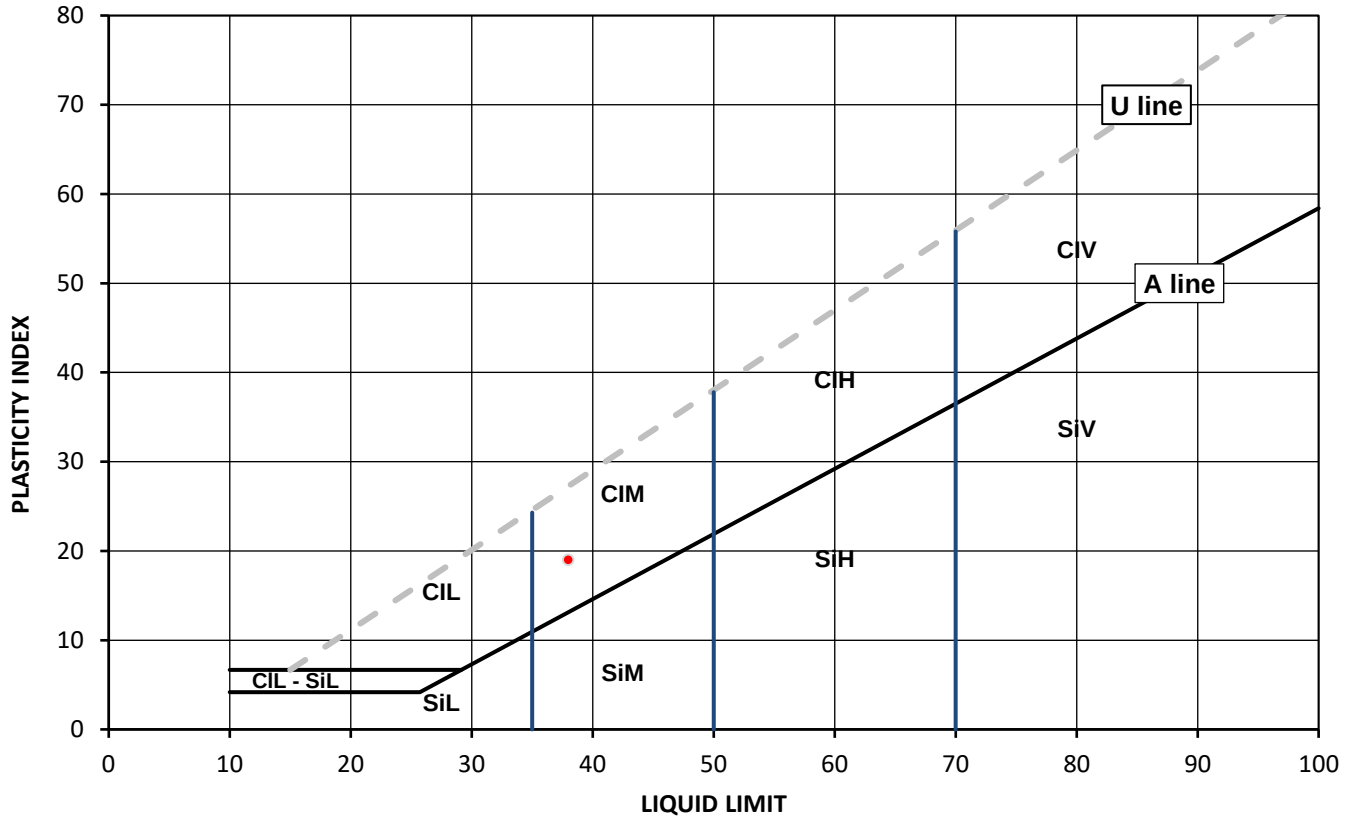
Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	09/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	23/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409880	Depth Top [m]:	5.00
Hole No.:	CP1-02	Depth Base [m]:	5.45
Sample Reference:	D2	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly sandy CLAY		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
18.9	38	19	19	0.00	1.00	86



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 337.14

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

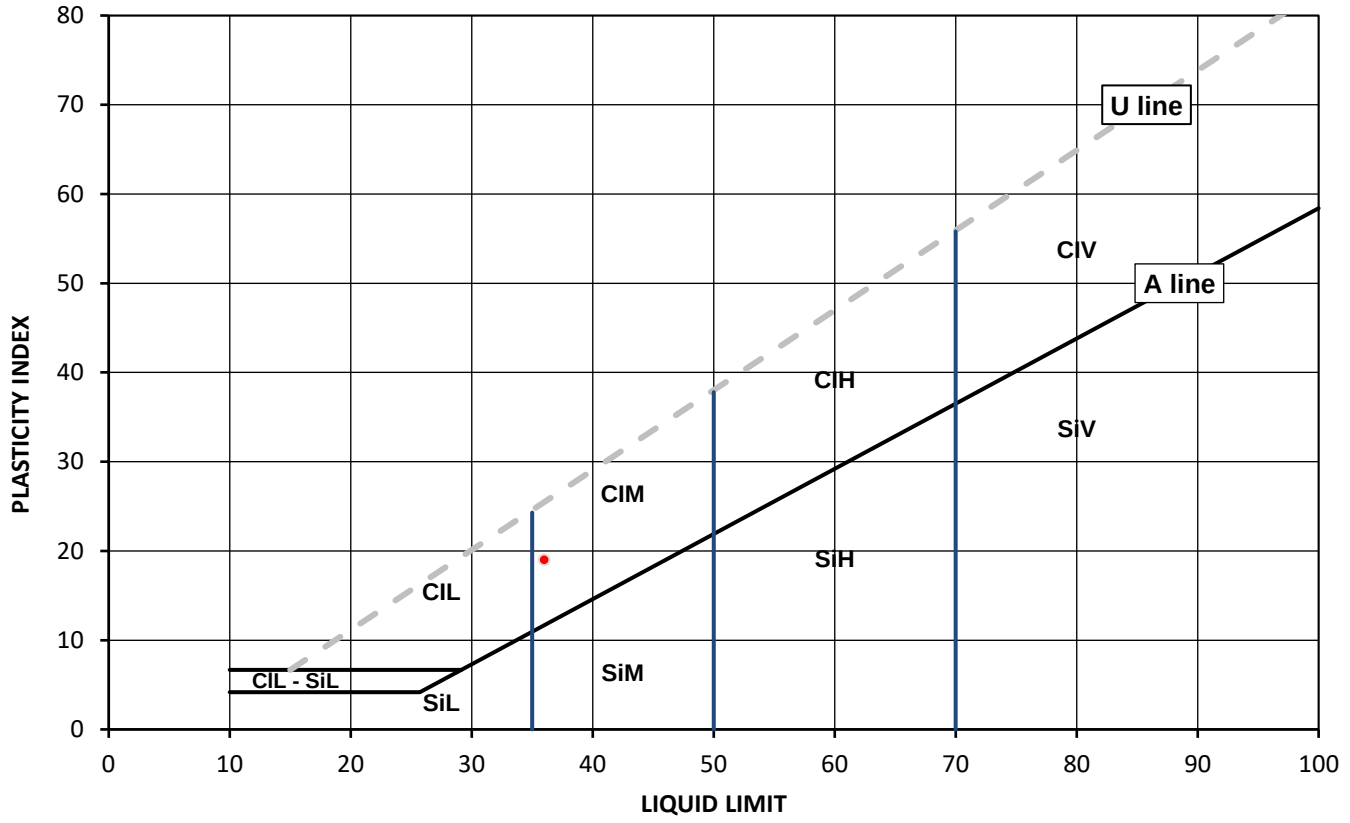
Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	09/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	23/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409881	Depth Top [m]:	6.00
Hole No.:	CP1-02	Depth Base [m]:	6.45
Sample Reference:	D3	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly sandy CLAY		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
6.1	36	17	19	-0.58	1.58	79



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 337.14

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

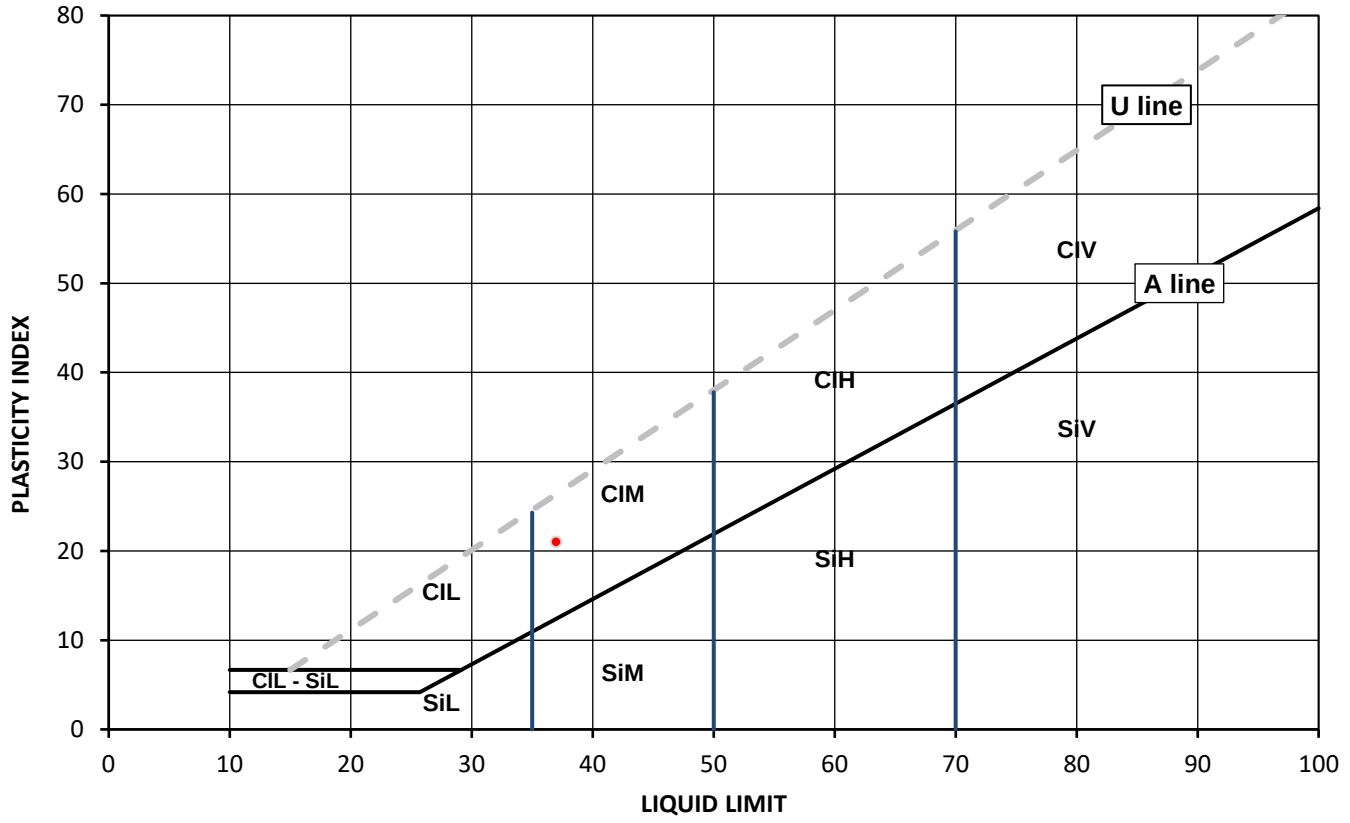
Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	10/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	23/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409883	Depth Top [m]:	2.00
Hole No.:	CP1-03	Depth Base [m]:	2.45
Sample Reference:	D1	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly sandy CLAY		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
17.3	37	16	21	0.05	0.95	86



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TEST CERTIFICATE

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Northampton NN4 7EB

4041

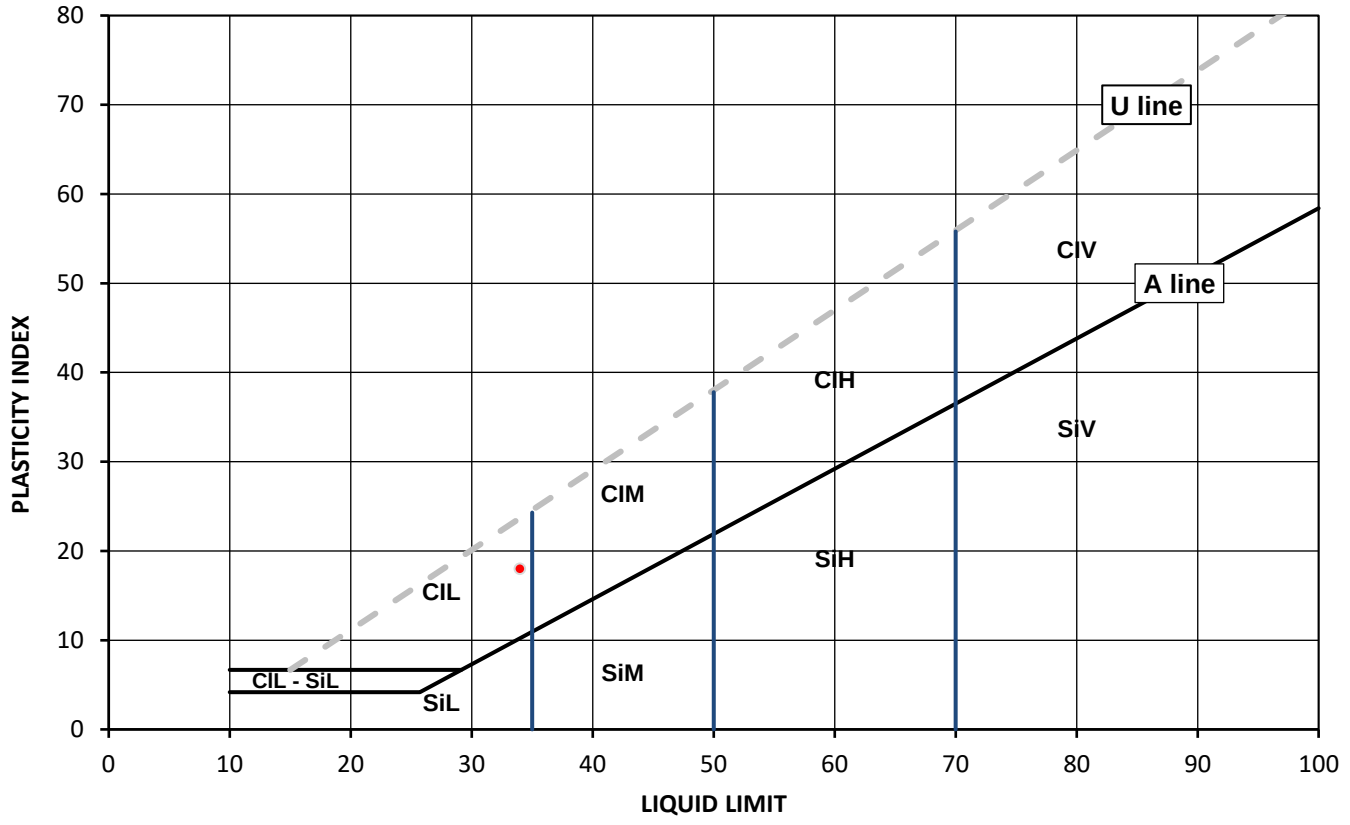
Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	11/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	23/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409886	Depth Top [m]:	10.50
Hole No.:	CP1-03	Depth Base [m]:	10.95
Sample Reference:	D5	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly very sandy CLAY		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
17.7	34	16	18	0.11	0.89	86



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 337.14

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

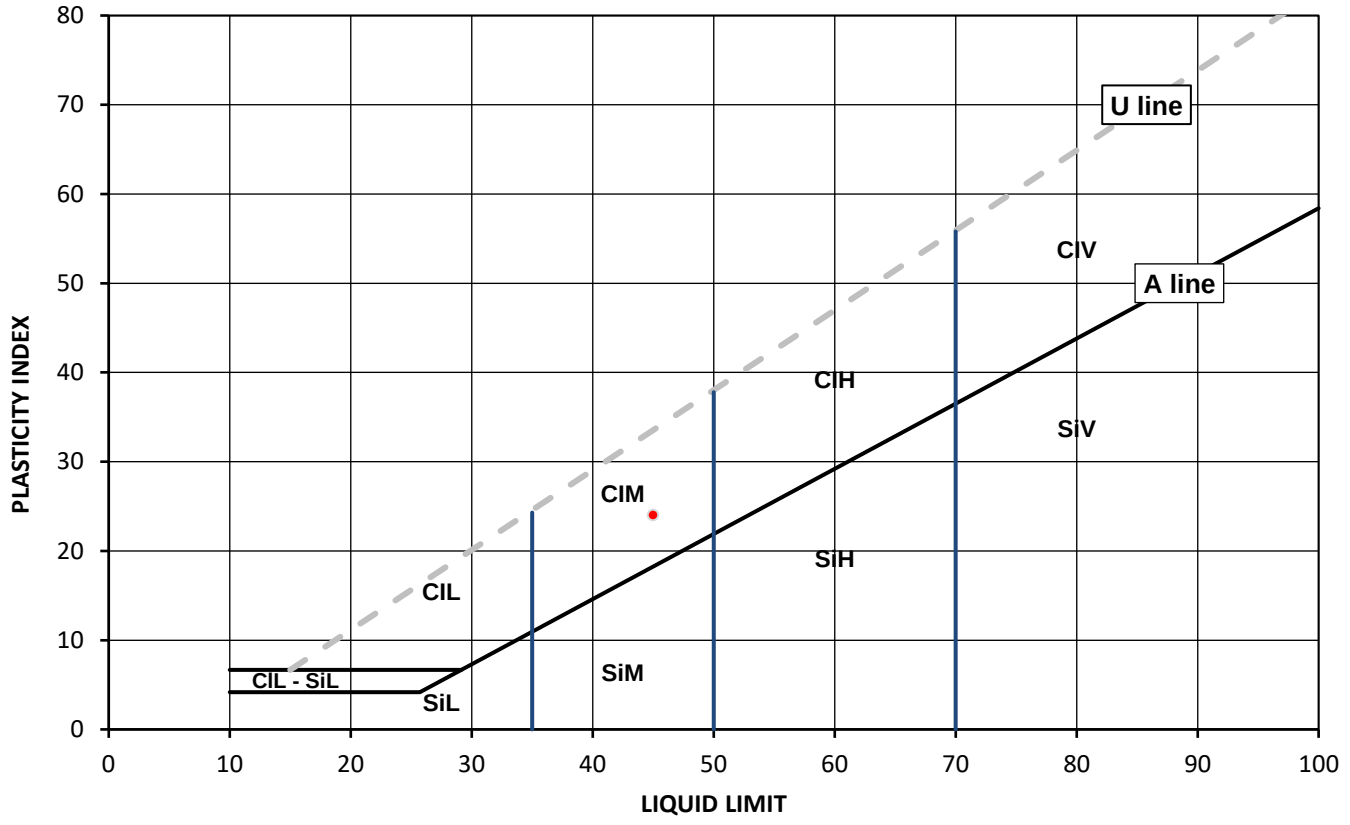
Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	12/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	23/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409887	Depth Top [m]:	3.20
Hole No.:	CP-01C	Depth Base [m]:	3.45
Sample Reference:	D1	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly slightly sandy CLAY		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
23.8	45	21	24	0.13	0.88	87



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 337.14

TEST CERTIFICATE

DETERMINATION OF LIQUID AND PLASTIC LIMITS

Tested in Accordance with: BS EN ISO 17892-12:2018+A2:2022, cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

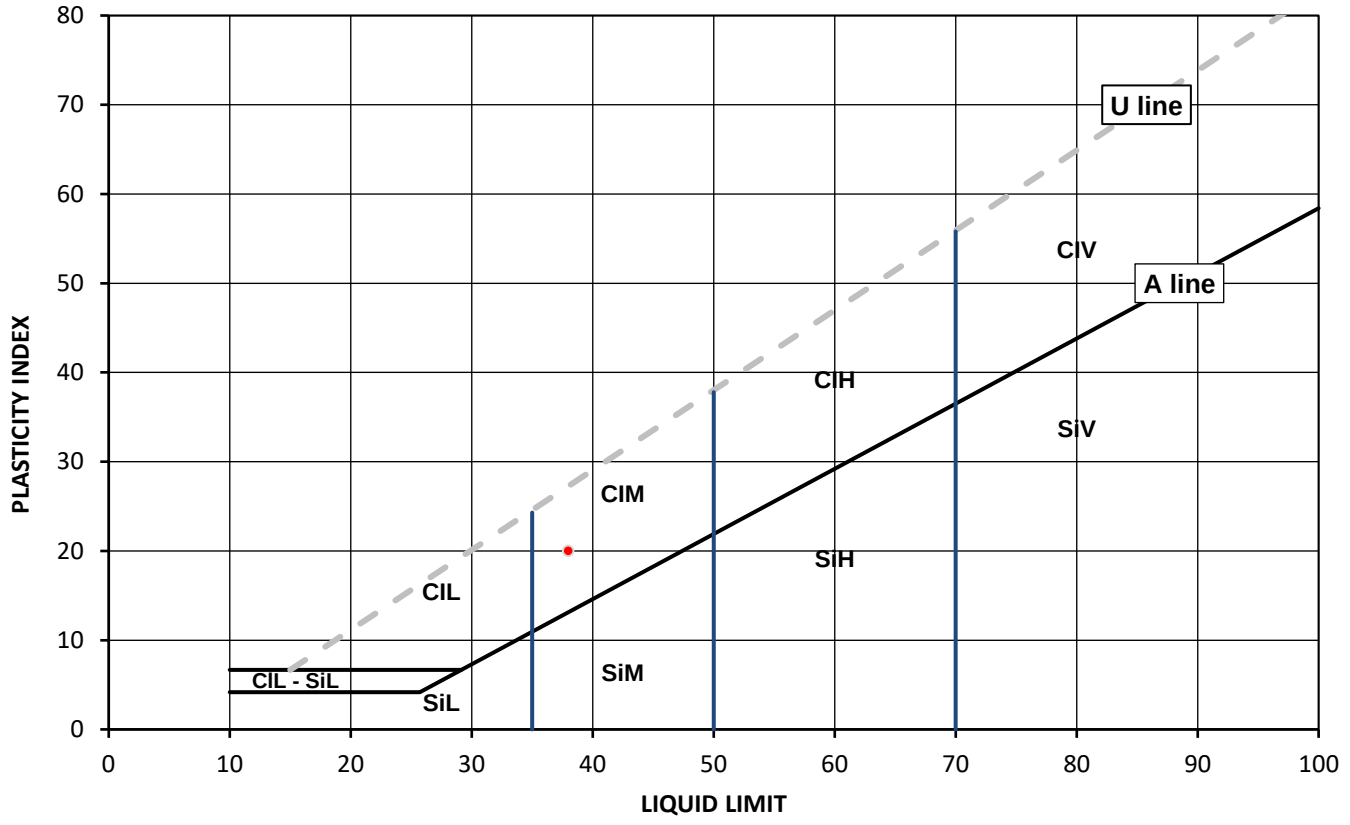
Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	12/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	23/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409888	Depth Top [m]:	7.50
Hole No.:	CP-01C	Depth Base [m]:	7.95
Sample Reference:	D3	Sample Type:	D
Sample Description:	Reddish brown slightly gravelly sandy CLAY		
Sample Preparation:	Tested after >0.425mm removed by hand; The water content in the sample was increased		
Cone Type:	80g/30deg		

As Received Water Content [W] %	Liquid Limit [WL] %	Plastic Limit [Wp] %	Plasticity Index [Ip] %	Liquidity Index [IL] % #	Consistency Index [IC] % #	% Passing 425µm BS Test Sieve
20.8	38	18	20	0.15	0.85	92



Legend, based on BS EN ISO 14688 2:2018 Geotechnical investigation and testing – Identification and classification of soil

		Plasticity		Liquid Limit
Cl	Clay	L	Low	below 35
Si	Silt	M	Medium	35 to 50
		H	High	50 to 70
		V	Very high	exceeding 70
		O	Organic	append to classification for organic material (eg ClHO)

Note: Water Content by BS EN ISO 17892-1:2014+A1:2022, BS 1377-2:2022; # Non accredited

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 337.14

SUMMARY REPORT

SUMMARY OF CLASSIFICATION TEST RESULTS

Tested in Accordance with:

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Environmental Science

4041

Client: Curtins

Client Address: Merchant Exchange, 17-19 Whitworth Street West,
Manchester

Contact: Russell Taylor

Site Address: Millom

BS EN ISO 17892-12:2018+A2:2022 cl 5.3 and 5.5, Fall Cone Method, 4 Pt Test, BS 1377-2:2022, cl 5.2 and 6. W by BS EN ISO 17892-1:2014+A1:2022.

Client Reference: B080874
Job Number: 24-059801-1
Date Sampled: 09/12 - 12/12/2024
Date Received: 16/12/2024
Date Tested: 23/12/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	W	Liquid & Plastic Limit							Density		
		Reference	Depth Top m	Depth Base m	Type			%	% Passing 425um %	WL* %	Correlation Factor	Wp %	Ip %	Cone type	Sample Preparation	bulk Mg/m3	dry Mg/m3	PD Mg/m3
409880	CP1-02	D2	5.00	5.45	D	Reddish brown slightly gravelly sandy CLAY	Atterberg 4 Point	18.9	86	38	-	19	19	80g/30 deg	R / I			
409881	CP1-02	D3	6.00	6.45	D	Reddish brown slightly gravelly sandy CLAY	Atterberg 4 Point	6.1	79	36	-	17	19	80g/30 deg	R / I			
409883	CP1-03	D1	2.00	2.45	D	Reddish brown slightly gravelly sandy CLAY	Atterberg 4 Point	17.3	86	37	-	16	21	80g/30 deg	R / I			
409886	CP1-03	D5	10.50	10.95	D	Reddish brown slightly gravelly very sandy CLAY	Atterberg 4 Point	17.7	86	34	-	16	18	80g/30 deg	R / I			
409887	CP-01C	D1	3.20	3.45	D	Reddish brown slightly gravelly slightly sandy CLAY	Atterberg 4 Point	23.8	87	45	-	21	24	80g/30 deg	R / I			
409888	CP-01C	D3	7.50	7.95	D	Reddish brown slightly gravelly sandy CLAY	Atterberg 4 Point	20.8	92	38	-	18	20	80g/30 deg	R / I			

Note: # Non accredited; NP - Non plastic; N - Tested in natural condition, R - Tested after >0,425mm removed by hand, WR - Tested after washing to remove >425mm; I - The water content in the sample was increased , D - The water content in the sample was decreased; * - One point liquid limit corrected as per the report Correlation Factor by Clayton C.R.I and Jukes A.W (1978)

Comments:

Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

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Date Reported: 09/01/2025 **GF 362.16**

SUMMARY REPORT

DETERMINATION OF WATER CONTENT

Tested in Accordance with: BS EN ISO 17892-1:2014+A1:2022, BS 1377-2: 2022, clause 4.1

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client: Curtins

Client Address: Merchant Exchange, 17-19 Whitworth Street West, Manchester

Contact: Russell Taylor

Site Address: Millom

Client Reference: B080874
Job Number: 24-059801-1
Date Sampled: 09/12 - 12/12/2024
Date Received: 16/12/2024
Date Tested: 23/12/2024
Sampled By: Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test results

Laboratory Reference	Hole No.	Sample				Description	Remarks	WC											
		Reference	Depth Top m	Depth Base m	Type			%											
409880	CP1-02	D2	5.00	5.45	D	Reddish brown slightly gravelly sandy CLAY		18.9											
409881	CP1-02	D3	6.00	6.45	D	Reddish brown slightly gravelly sandy CLAY		6.1											
409883	CP1-03	D1	2.00	2.45	D	Reddish brown slightly gravelly sandy CLAY		17.3											
409886	CP1-03	D5	10.50	10.95	D	Reddish brown slightly gravelly very sandy CLAY		17.7											
409887	CP-01C	D1	3.20	3.45	D	Reddish brown slightly gravelly slightly sandy CLAY		23.8											
409888	CP-01C	D3	7.50	7.95	D	Reddish brown slightly gravelly sandy CLAY		20.8											

Comments:

Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

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Date Reported: 09/01/2025

GF 126.18

4041

TEST CERTIFICATE

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Tested in Accordance with: BS EN ISO 17982-8:2018, BS 1377-2 Cl. 28:2022

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Environmental Science

Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	09/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	03/01/2025
Site Address:	Millom	Sampled By:	Not Given

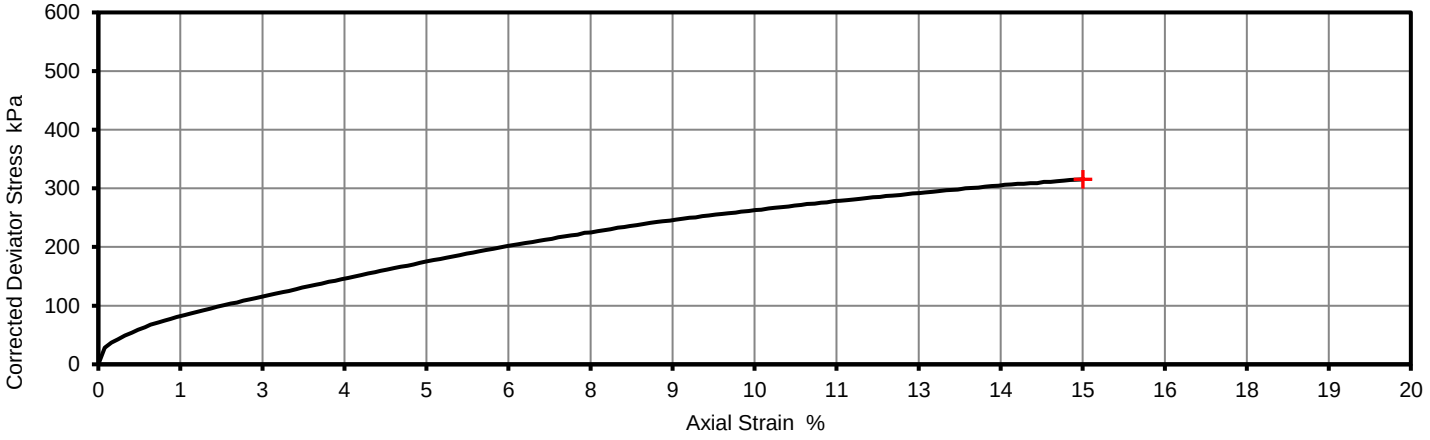
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

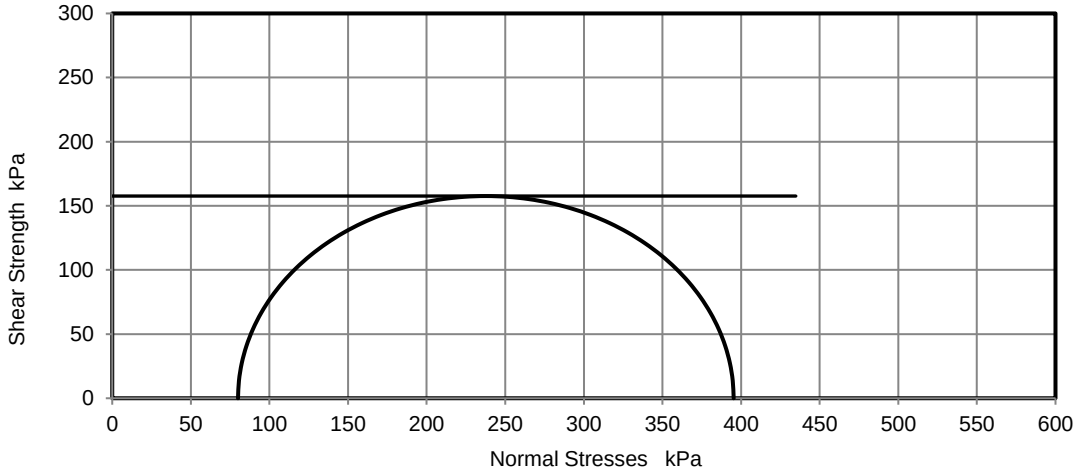
Laboratory Reference:	409879	Depth Top [m]:	4.00
Hole No.:	CP1-02	Depth Base [m]:	4.45
Sample Reference:	U1	Sample Type:	U
Sample Description:	Brown CLAY		
Sample Preparation:	Sample prepared in accordance with BS EN ISO 17892-8: 2018 Clause 6.2.		

Test Number	1		Rate of Strain	2.00	%/min	
Depth within Sample	-	m	Cell Pressure	80	kPa	
Length	198.25	mm	Axial Strain at Failure	15.0	%	
Diameter	103.33	mm	Deviator Stress, (σ1 - σ3)f	315	kPa	
Length Prior to Shearing	198.24	mm	Undrained Shear Strength, cu	158	kPa	½(σ1 - σ3)f
Bulk Density	2.16	Mg/m3	Mode of Failure	Compound		
Initial Water Content	18.9	%	Membrane Thickness	0.30	mm	
Final Water Content	18.7	%	Membrane Correction	2.52	kPa	
Dry Density	1.82	Mg/m3				

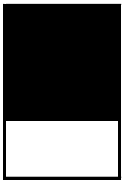
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects.

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 463.4

TEST CERTIFICATE

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Tested in Accordance with: BS EN ISO 17982-8:2018, BS 1377-2 Cl. 28:2022

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	09/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	03/01/2025
Site Address:	Millom	Sampled By:	Not Given

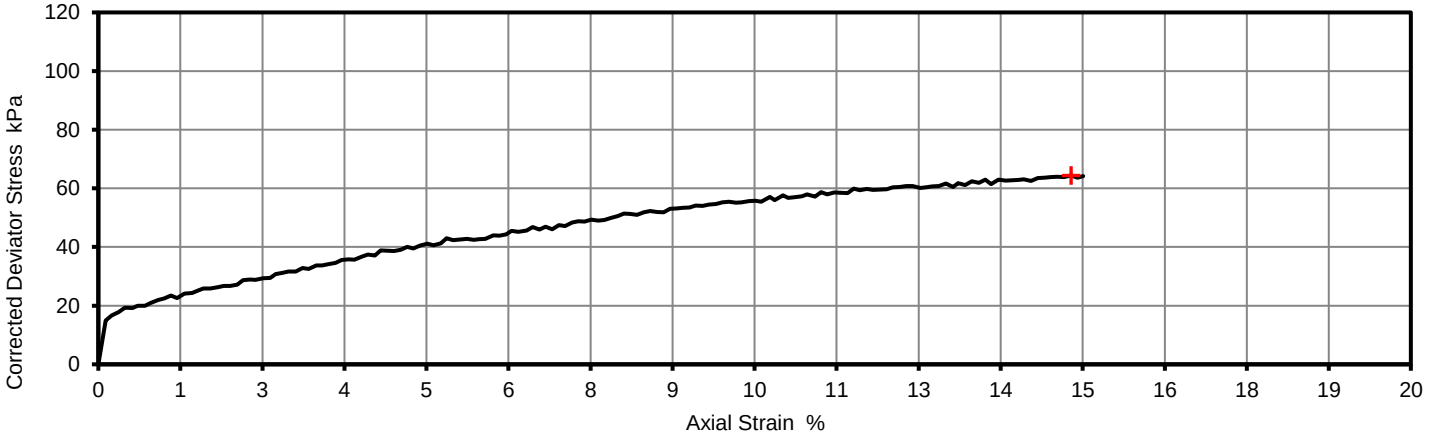
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

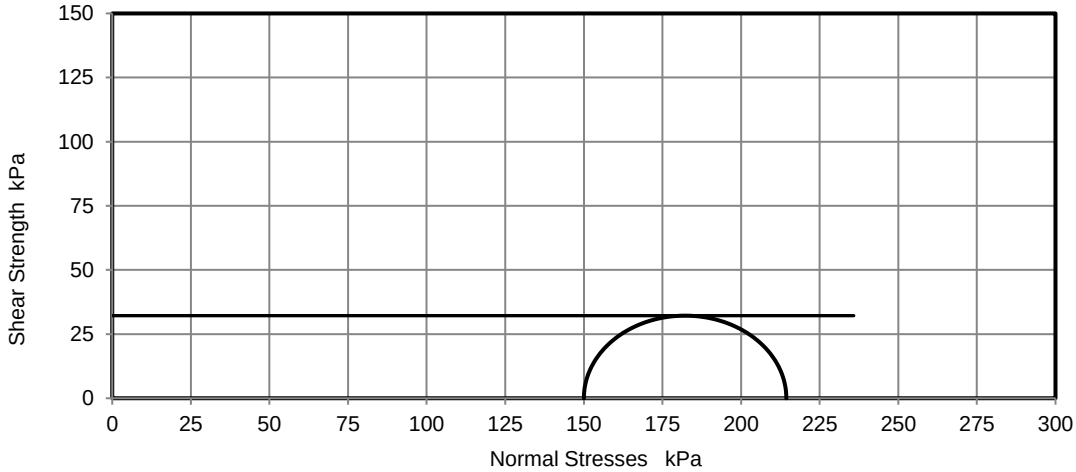
Laboratory Reference:	409882	Depth Top [m]:	7.50
Hole No.:	CP1-02	Depth Base [m]:	7.95
Sample Reference:	U2	Sample Type:	U
Sample Description:	Brown CLAY		
Sample Preparation:	Sample prepared in accordance with BS EN ISO 17892-8: 2018 Clause 6.2.		

Test Number	1		Rate of Strain	2.00	%/min	
Depth within Sample	-	m	Cell Pressure	150	kPa	
Length	140.22	mm	Axial Strain at Failure	14.8	%	
Diameter	69.32	mm	Deviator Stress, (σ1 - σ3)f	64	kPa	
Length Prior to Shearing	140.20	mm	Undrained Shear Strength, cu	32	kPa	½(σ1 - σ3)f
Bulk Density	2.11	Mg/m3	Mode of Failure	Compound		
Initial Water Content	21.3	%	Membrane Thickness	0.24	mm	
Final Water Content	20.7	%	Membrane Correction	2.96	kPa	
Dry Density	1.74	Mg/m3				

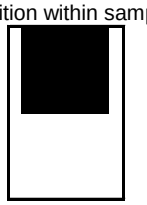
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects.

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 463.4

4041

TEST CERTIFICATE

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Tested in Accordance with: BS EN ISO 17982-8:2018, BS 1377-2 Cl. 28:2022

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

Environmental Science

Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	10/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	03/01/2025
Site Address:	Millom	Sampled By:	Not Given

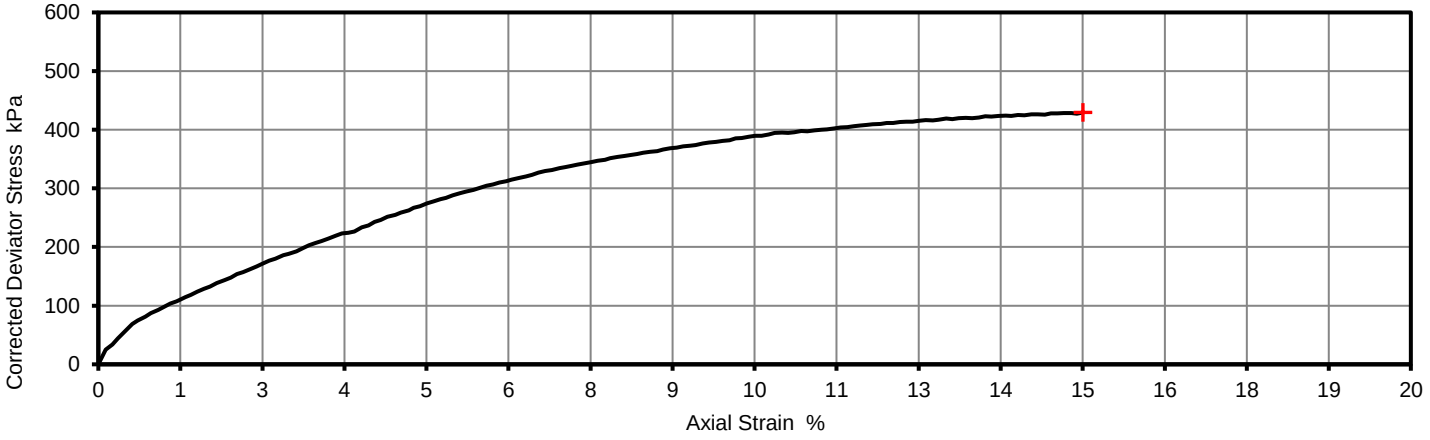
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

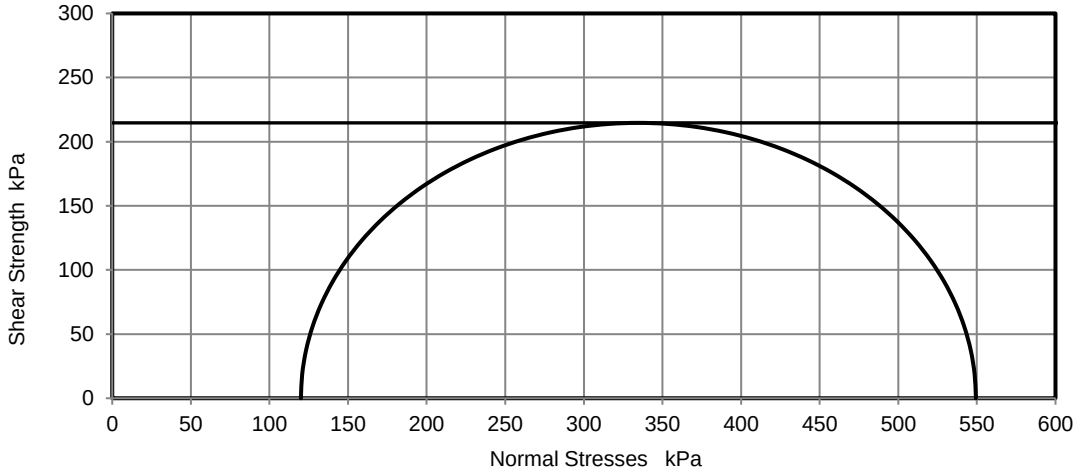
Laboratory Reference:	409885	Depth Top [m]:	6.00
Hole No.:	CP1-03	Depth Base [m]:	6.45
Sample Reference:	U2	Sample Type:	U
Sample Description:	Brown CLAY		
Sample Preparation:	Sample prepared in accordance with BS EN ISO 17892-8: 2018 Clause 6.2.		

Test Number	1		Rate of Strain	2.00	%/min	
Depth within Sample	-	m	Cell Pressure	120	kPa	
Length	141.20	mm	Axial Strain at Failure	15.0	%	
Diameter	69.07	mm	Deviator Stress, (σ1 - σ3)f	429	kPa	
Length Prior to Shearing	141.18	mm	Undrained Shear Strength, cu	215	kPa	½(σ1 - σ3)f
Bulk Density	2.16	Mg/m3	Mode of Failure	Compound		
Initial Water Content	18.4	%	Membrane Thickness	0.26	mm	
Final Water Content	18.0	%	Membrane Correction	3.26	kPa	
Dry Density	1.83	Mg/m3				

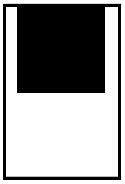
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects.

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 463.4

TEST CERTIFICATE

UNCONSOLIDATED UNDRAINED TRIAXIAL TEST

Tested in Accordance with: BS EN ISO 17982-8:2018, BS 1377-2 Cl. 28:2022

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	12/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	03/01/2025
Site Address:	Millom	Sampled By:	Not Given

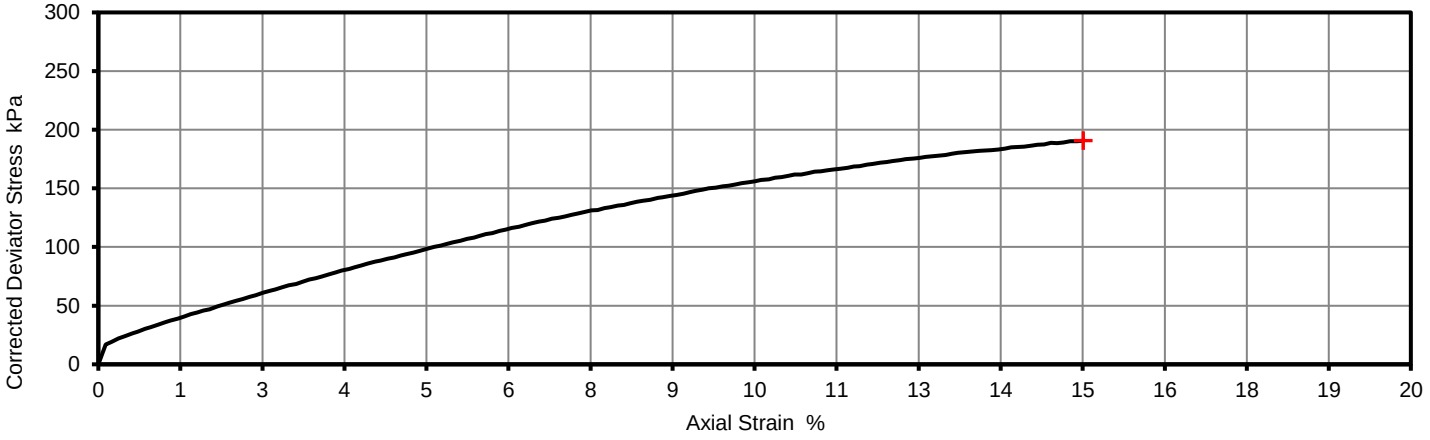
Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

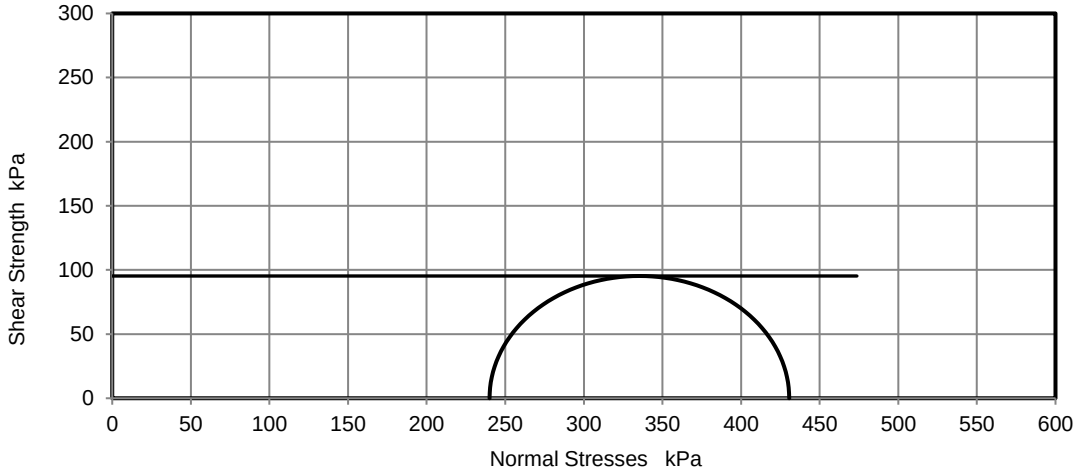
Laboratory Reference:	409890	Depth Top [m]:	12.00
Hole No.:	CP-01C	Depth Base [m]:	12.45
Sample Reference:	U3	Sample Type:	U
Sample Description:	Brown CLAY		
Sample Preparation:	Sample prepared in accordance with BS EN ISO 17892-8: 2018 Clause 6.2.		

Test Number	1		Rate of Strain	2.00	%/min	
Depth within Sample	-	m	Cell Pressure	240	kPa	
Length	198.48	mm	Axial Strain at Failure	15.0	%	
Diameter	102.66	mm	Deviator Stress, (σ1 - σ3)f	191	kPa	
Length Prior to Shearing	198.46	mm	Undrained Shear Strength, cu	95	kPa	½(σ1 - σ3)f
Bulk Density	2.21	Mg/m3	Mode of Failure	Compound		
Initial Water Content	18.4	%	Membrane Thickness	0.28	mm	
Final Water Content	16.6	%	Membrane Correction	2.36	kPa	
Dry Density	1.87	Mg/m3				

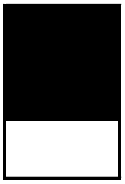
Deviator Stress v Axial Strain



Mohr Circles



Position within sample



Note: Deviator stress corrected for area change and membrane effects.

Remarks:

Opinions and interpretations expressed herein are outside of the scope of the UKAS Accreditation. This report may not be reproduced other than in full without the prior written approval of the issuing laboratory. The results included within the report relate only to the sample(s) submitted for testing.

Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 463.4

TEST CERTIFICATE

INCREMENTAL LOADING OEDOMETER TEST

Tested in Accordance with: BS EN ISO 17892-5:2017, BS 1377-2:2022 Cl. 16 & 17

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

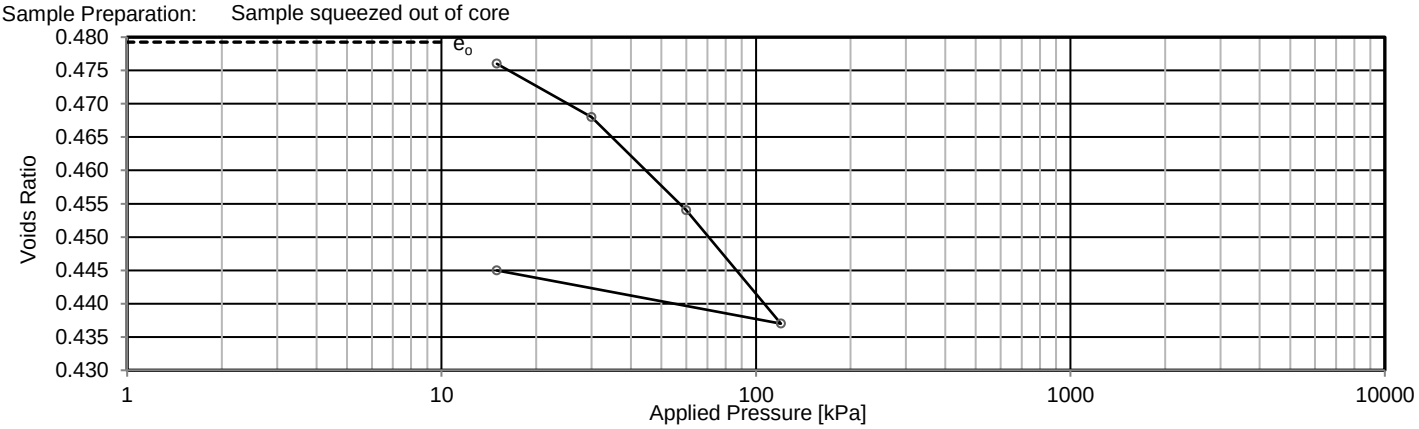
4041

Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	10/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	31/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409884	Depth Top [m]:	3.00
Hole No.:	CP1-03	Depth Base [m]:	3.45
Sample Reference:	U1	Sample Type:	U
Sample Description:	Brown slightly gravelly CLAY		
Sample Preparation:	Sample squeezed out of core		



Specimen details	Diameter [mm]	Height [mm]	Water content * [%]	Bulk density [Mg/m3]	Dry density [Mg/m3]	Voids ratio -	Degree of saturation [%]	Avg. temp for test [°C]	Swelling pressure [kPa]	Total test time [days]
Initial	50.02	20.10	18.0	2.11	1.79	0.479	99	22	Not measured	5
Final	-	19.63	18.4	2.17	1.83	0.445	110			

Sample orientation: Vertical

Particle density: assumed 2.65 Mg/m3

Pressure [kPa]	Voids ratio -	Eoed [MPa]	Mv [m2/MN]	Cv (t50, log) [m2/yr]	Cv (t90, root) [m2/yr]	Cα ## -
0	0.479	-	-	-	-	-
15	0.476	6	0.17	23	1.8	0.00026
30	0.468	3	0.33	2	0.85	0.0017
60	0.454	3.1	0.32	3.5	0.85	0.00062
120	0.437	5	0.2	5	0.81	0.00043
15	0.445	19	0.054			

Note: Cv corrected to 20°C, results have been corrected for equipment deformation; * Initial WC calculated from trimmings; ## The parameter has been determined based on an approximate estimation and falls outside the scope of UKAS accreditation

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

TEST CERTIFICATE

INCREMENTAL LOADING OEDOMETER TEST

Tested in Accordance with: BS EN ISO 17892-5:2017, BS 1377-2:2022 Cl. 16 & 17

i2 Analytical Ltd
Unit 8 Harrowden Road
Brackmills Industrial Estate
Northampton NN4 7EB

4041

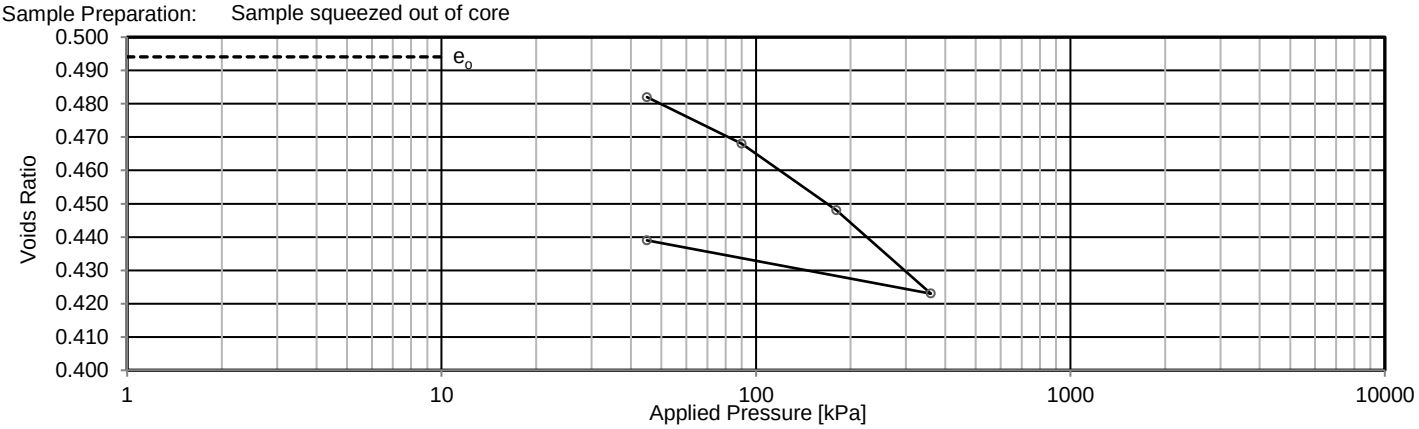
Environmental Science

Client:	Curtins	Client Reference:	B080874
Client Address:	Merchant Exchange, 17-19 Whitworth Street West, Manchester	Job Number:	24-059801-1
		Date Sampled:	12/12/2024
		Date Received:	16/12/2024
Contact:	Russell Taylor	Date Tested:	31/12/2024
Site Address:	Millom	Sampled By:	Not Given

Testing carried out at i2 Analytical Limited, ul. Pionierow, 41-711 Ruda Slaska, Poland

Test Results:

Laboratory Reference:	409889	Depth Top [m]:	9.00
Hole No.:	CP-01C	Depth Base [m]:	9.45
Sample Reference:	U1	Sample Type:	U
Sample Description:	Brown CLAY		
Sample Preparation:	Sample squeezed out of core		



Specimen details	Diameter [mm]	Height [mm]	Water content * [%]	Bulk density [Mg/m3]	Dry density [Mg/m3]	Voids ratio -	Degree of saturation [%]	Avg. temp for test [°C]	Swelling pressure [kPa]	Total test time [days]
Initial	50.02	20.07	18.8	2.11	1.77	0.494	101	22	Not measured	5
Final	-	19.33	18.1	2.18	1.84	0.439	109			

Sample orientation: Vertical

Particle density: assumed 2.65 Mg/m3

Pressure [kPa]	Voids ratio -	Eoed [MPa]	Mv [m2/MN]	Cv (t50, log) [m2/yr]	Cv (t90, root) [m2/yr]	Cα ## -
0	0.494	-	-	-	-	-
45	0.482	5.3	0.19	1.9	0.87	0.00056
90	0.468	5.1	0.2	5.9	0.77	0.0015
180	0.448	6.6	0.15	2.1	0.8	0.00065
360	0.423	11	0.094	2.5	0.92	0.00082
45	0.439	30.4	0.035			

Note: Cv corrected to 20°C, results have been corrected for equipment deformation; * Initial WC calculated from trimmings; ## The parameter has been determined based on an approximate estimation and falls outside the scope of UKAS accreditation

Remarks:

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Signed: [redacted]

Katarzyna Banys
Reporting Specialist
for and on behalf of i2 Analytical Ltd

Date Reported: 09/01/2025

GF 448.8

Appendix F – Ground Gas Monitoring Results

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Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	om	**Date:**	29/04/2024
Job Number:		**Visit:**	1
Client:		**Weather:**	Rain
Baro		**Ground Conditions:**	Wet

Bore Reference	mb					n		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
									0	0	Dry	2.03	**1**
									0	0	1.00	1.02	1
										0	1.50	1.60	1
										0	Dry	2.06	1

Notes

1 Steady state gas flow achieved instantly.

Logged by

RT

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	om	**Date:**	14/05/2024
Job Number:		**Visit:**	2
Client:		**Weather:**	Raining
Baro		**Ground Conditions:**	Wet

Bore Reference	mb					n		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
									0	0	Dry	2.04	
									-	-	0.75	1.02	1,2
										0	1.5	1.57	
										0	Dry	2.07	3

Notes

Logged by

JP

1 Borehole flooded, no gas monitoring possible
2 Water in base of borehole may be due to surface waters infiltrating standpipe
3 Steady state gas flow of 0 achieved instantly

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	om	**Date:**	23/05/2024
Job Number:		**Visit:**	3
Client:		**Weather:**	Rain
Baro		**Ground Conditions:**	Wet

Bore Reference	mb					n		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
									0	0	Dry	2.04	**2**
									0	0	1.01	1.03	1
										0	1.36	1.58	1
										0	Dry	2.06	1

Notes

1 Steady state gas flow achieved instantly.
2 Steady state gas flow achieved after 1 second.

Logged by

RT

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins
Merchant Exchange, 17-19 Whitworth Street West, Manchester, M1 5WG
Tel: 0161 236 2394
Fax: 0161 228 7902

GAS MONITORING LOG SHEET

Project:	om	**Date:**	03/06/2024
Job Number:		**Visit:**	4
Client:		**Weather:**	Sunny
Baro		**Ground Conditions:**	Dry

Bore Reference	mb					n		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
									0	0	DRY	2.06	
									0	0	DRY	1.01	
										0	1.49	1.58	
										0	DRY	2.05	

Notes

Logged by

RT

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

GAS MONITORING LOG SHEET

Curtins

Project:	Millom Iron Line	**Date:**	09/01/2025
Job Number:	B080874	**Visit:**	5
Client:	Cumberland Council	**Weather:**	Sunny
Barometric State:	Rising	**Ground Conditions:**	Snow

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
DSBH1-01	1005	0.0	0.0	0.0	0.0	0.7	0.7	18.2	0	0	Dry	2.02	**1**
DSBH1-02	1005	0.0	0.0	0.0	0.0	0.8	0.8	17.2	0	0	0.91	1.03	**1**
DSBH-03	1005	0.0	0.0	0.0	0.0	0.1	0.0	18.5	0	0	Dry	1.60	**1**
DSBH-05	1003	0.0	0.0	0.0	0.0	3.9	3.9	14.4	0	0	Dry	2.03	**1**
CP1-02	1004	0.0	0.0	0.0	0.0	2.1	2.1	14.3	0	0	0.99	8.22	**1**
CP1-03	1005	0.0	0.0	0.0	0.0	0.1	0.0	17.6	0	0	4.31	10.65	**1**

Notes

1 Steady state gas flow achieved instantly

Logged by

RT

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Curtins

GAS MONITORING LOG SHEET

Project:	Millom Iron Line	**Date:**	22/01/2024
Job Number:	B080874	**Visit:**	6
Client:	Cumberland Council	**Weather:**	Rain
Barometric State:	Falling	**Ground Conditions:**	Wet

Borehole Reference	Barometric Pressure mb	Flow l/hr		Methane %		Carbon Dioxide %		Oxygen %	Hydrogen Sulphide ppm	Carbon Monoxide ppm	Water Level m bgl	Borehole Base m bgl	Note
		Max	SS	Max	SS	Max	SS						
DSBH1-01	1001	0.0	0.0	0.0	0.0	0.4	0.4	17.60	0	0	dry	2.01	
DSBH1-02	1001	0.0	0.0	0.0	0.0	1.6	1.6	16.70	0	0	dry	1.02	**1**
DSBH-03	1001	0.0	0.0	0.0	0.0	0.2	0.2	18.10	0	0	dry	1.55	**1**
DSBH-05	1001	0.0	0.0	0.0	0.0	3.8	3.8	13.90	0	0	dry	2.03	**1**
CP1-02	1001	-0.3	0.0	0.0	0.0	1.3	1.3	16.00	0	0	1.08	8.29	**2**
CP1-03	1001	1.3	0.0	0.0	0.0	0.1	0.0	17.6	0	0	4.29	10.69	2

Notes

1 Steady state gas flow achieved instantly
1 Steady state gas flow achieved after 1 second

Logged by

RT

1% gas volume = 10,000 ppm
Flow rate, methane and carbon dioxide reported as 'maximum' (max) and 'steady state' (SS) readings.
All other gases recorded at 'steady state' unless otherwise stated

Appendix G – GAC Screening Thresholds

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Human Health GQRA Rationale and Hierarchy

Curtins

Background

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency, Defra, CL:AIRE, LQM/CIEH and Public Health England as referenced below (references a-h).

A Generic Quantitative Risk Assessment (GQRA) is carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria where available.

Generic Assessment Criteria are available for a range of different land use scenarios, soil organic matter (SOM) and soil types. Curtins have adopted available GACs for a sandy loam soil at 1%, 2.5% and 6% SOM using various sources.

GAC Hierarchy

A summary of and hierarchy for adopted GACs is identified below:

i) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead as part of the 'Phase 1 Project'. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). In 2018 the 'Phase 2 Project' commenced which aims to develop C4SLs for a range of further contaminants. Currently available Phase 2 C4SLs include vinyl chloride, trichloroethene, tetrachloroethene, naphthalene, cis-1,2 dichloroethene, trans 1, 2 dichloroethene and per / polyfluoroalkyl substances (PFAS) . Where contaminant concentrations do not exceed C4SLs, there is no risk that the land poses a significant possibility of significant harm (SPoSH) or the level of risk is low, as such land can be demonstrated to be in Category 4 and cannot be determined as contaminated land. The C4SLs are proposed to be more pragmatic (whilst still strongly precautionary) in comparison with SGVs and S4UL's outlined below.

ii) **Suitable for Use Levels (S4ULs):** In 2015 LQM and the Chartered Institute of Environmental Health published generic assessment criteria for 89 substances including metals, BTEX, TPH, polycyclic aromatic hydrocarbons, phenols, chlorinated solvents and other volatile organic compounds. The S4ULs represent a minimal risk to long term human health, derived using health criteria values. The methodology for deriving the S4ULs is based on the Environment Agency CLEA model with consideration of developments in UK human health exposure assessment, in particular the additional land uses and exposure assumptions.

iii) **Other Supplementary Screening Criteria:** In addition to those developed by LQM/CIEH (outlined above), other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed EIC/AGS/CL:AIRE and SoBRA published thresholds.

Alternative Assessment Approaches

PAH – Benzo(a)pyrene Surrogate Marker Assessment

In September 2017 Public Health England (PHE) (Ref. h) published guidance for the use of a surrogate marker approach to assess the risk posed by soil contamination with the genotoxic polycyclic aromatic hydrocarbons (PAHs). The guidance indicates that the use of a marker compound, such as Benzo(a)pyrene, provides a consistent indicator of the amount of 7 other genotoxic PAHs commonly tested for in soil including benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(123cd)pyrene and benzo(ghi)perylene.

Where PAH concentrations of these 8 no. PAHs are present within pre-determined ratios in soil, provided in the guidance, this approach is used, comparing soil concentrations of the marker compound with a Category 4 Screening Level, or site specific assessment criteria. An individual compound assessment is carried out for other PAH compounds not considered in the PHE guidance.

An individual compound assessment is carried out for all PAH compounds where pre-determined ratios are not met for the surrogate marker approach.

Notes

Curtins Generic Assessment Criteria provide further information and notes to be read in conjunction with this assessment rationale.

Human Health GQRA Rationale and Hierarchy

Curtins

References

a) Environmental Agency. (2009) Contaminated Land Exposure Assessment (CLEA) v1.071 model.

b) Environment Agency. (2009) Human Health Toxicological Assessment of Contaminants in Soil (report no. SC050021/SR2).

c) Environment Agency. (2009) Updated Technical Background to the CLEA Model (report no.SC050021/SR3).

d) Environment Agency (2005) The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils Science Report P5-080/TR3.

e) Department of Environment Food and Rural Affairs (DEFRA). (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).

f) CL:AIRE (2014) Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, SP1010 Rev 2.

g) LQM & CIEH (2015) S4ULs for Human Health Risk Assessment.

h) Public Health England (2017) Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs

Curtins

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

*Refer to Note 13 where Solubility and Vapour Saturation Limits are Exceeded. These values are not GAC and are not to be used as GAC.

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS_{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony	-	550	-	7500	-	-		
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	42	42	730	3200	570000	95000	304	
Aliphatic EC>6 - EC8 TPHs	100	100	2300	7800	600000	150000		
Aliphatic EC>8 - EC10 TPHs	27	27	320	2000	13000	14000		
Aliphatic EC>10-EC12 TPHs	130	130	2200	9700	13000	21000	48	
Aliphatic EC>12-EC16 TPHs	1100	1100	11000	59000	13000	25000	24	
Aliphatic EC>16 - EC35 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aliphatic EC>35 - EC44 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	70	370	13	26000	56000	76000	1220	
Aromatic EC>7 - EC8 TPHs	130	860	22	56000	56000	87000		869
Aromatic EC>8 - EC10 TPHs	34	47	8.6	3500	5000	7200		613
Aromatic EC10 - EC12 TPHs	74	250	13	16000	5000	9200	364	
Aromatic EC12 - EC16 TPHs	140	1800	23	36000	5100	10000	169	
Aromatic EC>16 - EC21 TPHs	260	1900	46	28000	3800	7600		
Aromatic EC>21 - EC35 TPHs	1100	1900	370	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1100	1900	370	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1600	1900	1200	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.2	0.89	0.039	27	140	190		
Ethyl benzene	47	83	16	5700	24000	17000		518
Toluene	130	880	22	56000	56000	87000		869
Xylene	56	79	28	5900	41000	17000	478 (o-xylene) 576 (p-xylene)	625 (m-xylene)
MTBE	49	73	23	7900			20400	
Phenol	280	750	66	760	760	760		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Benzo(a)anthracene	7.2	11	2.9	170	29	49		
Chrysene	15	30	4.1	350	57	93		
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13		
Benzo(k)fluoranthene	77	110	37	1200	190	370		
Benzo(a)pyrene (only)	2.2	3.2	0.97	35	5.7	11		
Indeno(123cd)pyrene	27	45	9.5	500	82	150		
Dibenzo(ah)anthracene	0.24	0.31	0.14	3.5	0.57	1.1		
Benzo(ghi)perylene	320	360	290	3900	640	1400		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.0064	0.015	0.0017	1.1	7.8	18		
1,1-Dichloroethene (DCE)	0.23	0.23	2.8	26			2230	
Cis 1,2, Dichloroethene (DCE)	0.46	0.5	0.89	38	3800	2800	3940	
Trans 1,2, Dichloroethene (DCE)	0.9	0.93	3.7	69	13000	5600	3420	
Trichloroethene (TCE)	0.0093	0.0097	0.032	0.73	76	41		
Tetrachlorethene (PCE)	0.31	0.32	2	24	3200	1400		
1,1,1,2 Tetrachlorethane	1.2	1.5	0.79	110	1400	1500		
1,1,1 Trichlorethane	8.8	9	48	660	140000	57000		1425
1,2-Dichloroethane (Ethylene Dichloride)	0.11	0.16	0.054	12	300	300		
Tetrachloromethane	0.026	0.026	0.45	2.9	890	190		
Trichloromethane (Chloroform)	0.91	1.2	0.42	99	2500	2600		
Per- and Polyfluoroalkyl Substances (PFAS)								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073				9	0.17		

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Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM

*Refer to Note 13 where Solubility and Vapour Saturation Limits are Exceeded. These values are not GAC and are not to be used as GAC.

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS$_{park}$	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
dmium	22	150	3.9	410	220	880		
um III	910	910	18000	8600	1500	33000		
C VI	21	21	170	49	21	250		
	2400	7100	520	68000	12000	44000		
Le	200	310	80	2300	630	1300		
Mercury (ele	1.2	1.2	21	58	16	30		25.8
Mercury (inorg	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs		78	1700	5900	590000	130000	558	
Aliphatic EC>6 - EC8 TPHs	23	230	5600	17000	610000	220000		
Aliphatic EC>8 - EC10 TPHs	65	65	770	4800	13000	18000		190
Aliphatic EC>10-EC12 TPHs	330	330	4400	23000	13000	23000		118
Aliphatic EC>12-EC16 TPHs	2400	2400	13000	82000	13000	25000	59	
Aliphatic EC>16 - EC35 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aliphatic EC>35 - EC44 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	140	0	27	46000	56000	84000	2260	
Aromatic EC>7 - EC8 TPHs	290		51	110000	56000	95000	1920	
Aromatic EC>8 - EC10 TPHs	83	1	21	8100	5000	8500		1500
Aromatic EC10 - EC12 TPHs	180	590	31	28000	5000	9700	899	
Aromatic EC12 - EC16 TPHs	330	2300	57	37000	5100	10000	419	
Aromatic EC>16 - EC21 TPHs	540	1900	110	28000	3800	7700		
Aromatic EC>21 - EC35 TPHs	1500	1900	820	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1500	1900	820	28000	3800	7800		
Lo hain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1800	1900	00	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.17	0.7	0.0	47	72	100		
Ethyl benzene	110	190	39	13000	24000	22000		1220
Toluene	290	1900	51	110000	56000	95000		1920
Xylene	130	180	67	14000	42000	23000	1120	1470
MTBE	84	120	44	13000			33100	
Phenol	550	1300	140	1500	1500	1500		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	36	36	130	3	15000	1200	183	
Acenaphthylene	420	4600	69	9700	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000		
Fluorene	400	3800	67	68000	9900	20000		
Phenanthrene	220	1500	38	22000	3100	6200		
Anthracene	5400	35000	950	540000	74000	150000		
Fluoranthene	560	1600	130	23000	3100	6300		
Pyrene	1200	3800	270	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Asses ent								
Naphthalene	36	36	130	3700	15 0	1200	183	
Acenaphthylene	420	4600	69	97000	1500	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
Phenanthrene	220	1500	38	22000	3100	6200		
Anthracene	5400	35000	950	540000	74000	150000		
Fluoranthene	560	1600	130	23000	3100	6300		
Pyrene	1200	3800	270	54000	7400	15000		
Benzo(a)anthracene	11	14	6.5	170	29	56		
Chrysene	22	31	9.4	350	57	10		
Benzo(b)fluoranthene	3.3	4	2.1	44	7.2	15		
Benzo(k)fluoranthene	93	110	75	1200	190	410		
Benzo(a)pyrene (only)	2.7	3.2	2	35	5.7	12		
Indeno(123cd)pyrene	36	46	21	510	82	170		
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3		
Benzo(ghi)perylene	340	360	470	4000	640	1500		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.01	0.019	0.0031	1.4	7.8	19		
1,1-Dichloroethene (DCE)	0.4	0.41	5.6	46			3940	
Cis 1,2, Dichloroethene (DCE)	0.78	0.84	1.7	64	3800	2400	6610	
Trans 1,2, Dichloroethene (DCE)	1.6	1.7	0.75	120	13000	7000	6170	
Trichloroethene (TCE)	0.02	0.02	0.072	1.5	78	54		
Tetrachlorethene (PCE)	0.7	0.71	4.8	55	3300	1900		
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800		
1,1,1 Trichlorethane	18	18	110	1300	140000	76000		2915
1,2-Dichloroethane (Ethylene Dichloride)	0.18	0.24	0.1	17	210	330		
Tetrachloromethane	0.056	0.056	1	6.3	920	270		
Trichloromethane	1.7	2.1	0.83	170	2500	2800		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

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Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM

*Refer to Note 13 where Solubility and Vapour Saturation Limits are Exceeded. These values are not GAC and are not to be used as GAC.

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS$_{park}$	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	40	56	19	1100	120	240		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic Compounds								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	160	160	3900	12000	600000	180000	1150	
Aliphatic EC>6 - EC8 TPHs	530	530	13000	40000	620000	320000		
Aliphatic EC>8 - EC10 TPHs	150	150	1700	11000	13000	21000		451
Aliphatic EC>10-EC12 TPHs	760	770	7300	47000	13000	24000		283
Aliphatic EC>12-EC16 TPHs	4300	4400	13000	90000	13000	26000	142	
Aliphatic EC>16 - EC35 TPHs	110000	110000	270000	1800000	250000	490000		
Aliphatic EC>35 - EC44 TPHs	110000	110000	270000	1800000	250000	490000		
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	300	1400	57	86000	56000	92000	4710	
Aromatic EC>7 - EC8 TPHs	660	3900	120	180000	56000	100000		4360
Aromatic EC>8 - EC10 TPHs	190	270	51	17000	5000	9300		3580
Aromatic EC10 - EC12 TPHs	380	1200	74	34000	5000	10000	2150	
Aromatic EC12 - EC16 TPHs	660	2500	130	38000	5000	10000		
Aromatic EC>16 - EC21 TPHs	930	1900	260	28000	3800	7800		
Aromatic EC>21 - EC35 TPHs	1700	1900	1600	28000	3800	7900		
Aromatic EC>35 - EC44 TPHs	1700	1900	1600	28000	3800	7900		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1900	1900	3000	28000	3800	7900		
Aromatic Hydrocarbons								
Benzene	0.87	3.3	0.18	98	140	230		
Ethyl benzene	260	440	91	27000	25000	27000		2840
Toluene	690	3900	120	180000	56000	100000		4360
Xylene	310	430	160	30000	43000	31000	2620	
MTBE	160	220	90	24000			62700	
Phenol	420	2300	280	3200	3200	3200		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
Phenanthrene	440	1500	90	23000	3100	6300		
Anthracene	11000	37000	2200	540000	74000	150000		
Fluoranthene	890	1600	290	23000	3100	6400		
Pyrene	2000	3800	620	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
Phenanthrene	440	1500	90	23000	3100	6300		
Anthracene	11000	37000	2200	540000	74000	150000		
Fluoranthene	890	1600	290	23000	3100	6400		
Pyrene	2000	3800	620	54000	7400	15000		
Benzo(a)anthracene	13	15	13	180	29	62		
Chrysene	27	32	19	350	57	120		
Benzo(b)fluoranthene	3.7	4	3.9	45	7.2	16		
Benzo(k)fluoranthene	100	110	130	1200	190	440		
Benzo(a)pyrene (only)	3	3.2	3.5	36	5.7	13		
Indeno(123cd)pyrene	41	46	39	510	82	180		
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4		
Benzo(ghi)perylene	350	360	640	4000	640	1600		
Chlorinated Aliphatic Hydrocarbons								
Chloroethene (Vinyl chloride)	0.017	0.029	0.0058	2.2	7.8	19		
1,1-Dichloroethene (DCE)	0.82	0.82	12	92			7940	
Cis 1,2, Dichloroethene (DCE)	1.5	1.6	3.6	120	3900	3100	12900	
Trans 1,2, Dichloroethene (DCE)	3.3	3.4	16	260	13000	9100	12600	
Trichloroethene (TCE)	0.043	0.045	0.16	3.4	79	69		
Tetrachlorethene (PCE)	1.6	1.6	11	130	3400	2500		
1,1,1,2 Tetrachlorethane	6.4	8.2	4.4	560	1400	2100		
1,1,1 Trichlorethane	39	40	240	3000	140000	100000		6392
1,2-Dichloroethane (Ethylene Dichloride)	0.31	0.41	0.19	29	310	380		
Tetrachloromethane	0.13	0.13	2.4	14	950	400		
Trichloromethane	3.4	4.2	1.7	350	2500	3100		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073				9	0.17		

Notes

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1) All Values are in mg/kg, reported to 2 significant figures.
2) Numbers in bold are C4SLs, Numbers in italics are S4ULs, Numbers underlined are EIC/AGS/CL:AIRE GACs, Numbers in red are SoBRA Acute Generic Assessment Criteria.
3) Assumptions and key notes made when deriving the Generic Assessment Criteria are contained within the relevant guidance documents, references:
   a) Contaminated Land: Applications in Real Environments (2014) SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Final Project Report (Revision 2b)
   b) Land Quality Management Ltd. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment.
   c) CL:AIRE, EIC, AGS (2010) Soil Generic Assessment Criteria for Human Health Risk Assessment.
   d) Society of Brownfield Risk Assessment (2020) Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil.
   e) Environment Agency (2009) Human Health Toxicological Assessment of Contaminants in Soil, Science Report - SC050021/SR2.
4) Generic Assessment Criteria listed in the following order of preference: C4SLs, S4ULs, CL:AIRE/AGS/EIC Generic Assessment Criteria, Other relevant Generic Assessment Criteria where GACS associated with the prioritised GACs are not available as outlined further in Curtins Rationale and Hierarchy notes.
5) To use Benzo(a)pyrene as a surrogate marker for PAH contamination, the assumptions set out in the relevant C4SL documentation must be met. A C4SL PAH surrogate marker checklist is appended.
6) Naphthalene is a volatile PAH. The C4SL values are derived on the basis of chronic exposure and risks to human health, and do not explicitly account for acute risks (e.g. a one off ingestion of a significant amount of soil by a young child) where the inhalation pathway is the main risk driver. Further consideration of the acute risk may be required in external settings (POS_{park} and POS_{resi}) where the GAC is substantially greater than the residential equivalent, to account for the possibility of acute exposure to the ingestion of naphthalene. The theoretical solubility saturation limit of naphthalene in soil is substantially lower than the GAC value, and therefore it is likely that free phase contamination would be present where the GAC is exceeded. In such a situation, it is unlikely that the product would remain in-situ untreated, and consideration of remediation / mitigation methods would be required.
7) Where the C4SL surrogate marker checklist indicates the PAH ratios are not suitable, individual PAH compounds must be assessed individually against the relevant contaminant specific assessment criteria.
8) Risk associated with additive effects of TPH contamination needs to be assessed in addition to the individual bandings, using the following equation:

$$HI = \sum HQ\ Fi = \sum \frac{Measured\ concentration, Fi\ (mg/kg)}{Relevant\ GAC\ (mg/kg)} Fi$$

   Where:

   HI = Hazard Index

   HQ = Hazard Quotient

   Fi = Fraction i

   Where the HI > 1, there may be a risk to human health.
9) Exposure to all xylene isomers to be considered together. Values detailed in this table are the lowest (most conservative) of o-, m- and p- xylene isomers.
10) PFAS assessment also uses a hazard index approach to ensure the total exposure from all four PFAS compounds combined does not exceed the $LLTC_{oral}$. Where the hazard index exceeds 1, further consideration or assessment of the risk is required, even where none of the individual C4SL values are exceeded.
11) PFAS C4SL values are interim. The C4SL has been derived using the sum of the four PFAS compounds as the basis of the low level of toxicological concern. The term interim reflects concerns raised by the Committee on Toxicity (COT) and the fact that further work by the COT and others may results in the need for the LLTC to be updated.
12) Generic Assessment Criteria assume no free phase contamination is present. Where free phase contamination is present, further assessment may be required.
13) Solubility Saturation Limit and Vapour Saturation Limit are provided in accordance with relevant guidance documents. Where these values are exceeded, and the vapour pathway is an important contributing pathway to exposure, then the following should be considered:
   - Free phase contamination may be present
   - Exposure from vapour pathways will be over predicted.
   - Where the vapour pathway is >90% of exposure then it is unlikely that the relevant HCV will be exceeded at soul concentrations at least a factor of ten higher than the relevant HCV.

   Additional assessment should be undertaken where this is the case, with consideration that:
   - Exposure is unlikely to reach the relevant HCV and the risk based on the assumed conceptual model is likely to be negligible.
   - Vapour pathway exposure should be calculated using algorithms suitable for free phase or NAPL sources
   - Screening could be considered using the lower saturation limit, which is the approach adopted by the USEPA. However, this may not be practical in many cases because of very low limits and is in any case highly conservative.

   Where the vapour pathway is the only exposure pathway considered then effective assessment criteria should be derived manually in accordance with guidance outlined in CLEA Science Report SC050021/SR4

Appendix H – Risk Assessment Rationale

The site-specific risk assessment, presented in this report, follows the principle of establishing whether there is a viable linkage between a contaminant source to a potential receptor, via an exposure pathway.

The risk assessment corresponds with the total site area and incorporates both descriptive (qualitative) and, where available, numerical (quantitative) lines of evidence.

Risk assessment is the process of collating known information on a hazard or set of hazards to estimate actual or potential risk to receptors. The receptor may be humans, a water resource, a sensitive local ecosystem, or future construction materials. Receptors can be connected to the source by one or several exposure pathways such as direct contact for example. Risks are managed by isolating the receptor or intercepting the exposure pathway or by isolating or removing the hazard.

Without the three essential components of a source, pathway, and receptor there can be no risk. Therefore, the presence of contaminant source on a site does not necessarily mean there is a risk.

The risk assessment considers the likelihood of a particular event taking place (accounting for the presence of the source and receptor and the viability of the exposure pathway) in conjunction with the severity of the potential consequence (accounting for the potential severity of the hazard and the sensitivity of the receptor).

In the risk assessment the consequence of the hazard has been classified as severe, medium, mild, or minor and the probability (likelihood) of the circumstances occurring classified as high likelihood or low likelihood or unlikely.

The consequences and probabilities are subsequently cross correlated to give a qualitative estimation of the risk using Department of the Environment risk classifications as detailed in the table below and as referenced in CIRIA C552.

		Consequence			
		Severe	**Medium**	**Mild**	**Minor**
Probability (Likelihood)	**High Likelihood**	Very High Risk	High Risk	Moderate Risk	Moderate/Low Risk
	Likely	High Risk	Moderate Risk	Moderate/Low Risk	Low Risk
	Low Likelihood	Moderate Risk	Moderate/Low Risk	Low Risk	Very Low Risk
	Unlikely	Moderate/Low Risk	Low Risk	Very Low Risk	Very Low Risk

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In accordance with DoE guidance, the following categorisation of **consequence** has been developed.

Classification	Definition	Examples
Severe	Short-term (acute) risk to human health likely to result in "significant harm" as defined by the Environment Protection Act 1990, Part IIA. Short-term risk of pollution of sensitive water resource. Catastrophic damage to buildings/property. A short-term risk to an ecosystem or organisation forming part of such ecosystem.	High concentrations of cyanide on the surface of an informal recreation area. Major spillage of contaminants from site into controlled water. Explosion, causing building collapse (can also equate to a short-term human health risk if buildings are occupied).
Medium	Chronic damage to Human Health. Pollution of sensitive water resources. A significant change in an ecosystem or organism forming part of such ecosystem.	Concentration of a contaminant from site exceeds the generic or site-specific assessment criteria. Leaching of contaminants from a site to a Principal or Secondary A aquifer. Death of a species within a designated nature reserve. Lesser toxic and asphyxiate effects
Mild	Pollution of non-sensitive water resources. Significant damage to crops, buildings, structures, and services. Damage to sensitive buildings/structures/services or the environment.	Pollution of non-classified groundwater (Inc. Secondary B aquifers). Damage to building rendering it unsafe to occupy (e.g. foundation damage resulting in instability).
Minor	Harm, although not necessarily significant harm, which may result in a financial loss or expenditure to resolve. Non-permanent health effects to human health (easily prevented by means such as personal protective clothing, etc). Easily repairable effects of damage to buildings, structures, and services.	The presence of contaminants at such concentrations that protective equipment is required during site works. The loss of plants in a landscaping scheme. Discoloration of concrete.

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In accordance with DoE guidance, the following categorisation of **probability** has been developed.

Classification	Definition
High Likelihood	There is a pollution linkage and an event that either appears very likely in the short term and almost inevitable over the long term or there is evidence at the receptor of harm or pollution.
Likely	There is a pollution 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 over the long term.
Low Likelihood	There is a pollution linkage, and circumstances are possible under which an event could occur. However, it is by no means certain that even over a longer period such event would take place and is less likely in the shorter term.
Unlikely	There is a pollution linkage, but circumstances are such that it is improbable that an event would occur even in the very long term.

In accordance with DoE guidance, the following categorisation of **risk** has been developed.

Classification	Definition
Very High Risk	There is a *high probability* that *severe harm* could arise to a designated receptor from an identified hazard at the site without appropriate further action.
High Risk	*Harm* is *likely to arise* to a designated receptor from an identified hazard at the site without appropriate further action.
Moderate Risk	*It is possible* that without appropriate further action *harm could arise* to a designated receptor. It is relatively *unlikely* that any such harm would be *severe,* and if any harm were to occur it is *more likely* that such harm would be *relatively mild.*
Low Risk	*It is possible* that *harm could arise* to a designated receptor from an identified hazard. It is *likely* that, at worst, if any harm was realised any effects would be *mild.*
Negligible Risk	The presence of an identified hazard does not give rise to the potential to cause harm to a designated receptor.

The term ‘risk’ in this instance refers to the risk that the source, pathway, receptor linkage for a given source of contamination is complete. It does not refer to immediate risk to individuals or features present on the site from potential contaminants and is intended to be used as a tool to assess the necessity of further investigation.

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Appendix I – Geotechnical Risk Register

A geotechnical risk register has been produced to identify potential hazards, the probability of the hazard occurring, impact and risk rating.

This risk assessment is a qualitative risk assessment and should not be viewed as definitive. This risk assessment reflects the current level of understanding of the geotechnical aspects of the scheme and will be subject to revision. Risk rating is defined by the following relationship.

Risk rating (R) = Probability (P) x Impact (I)

Risk Assessment Criteria and Rating						
>		**Impact (I)**		**Indicative Time (if applicable)**	**Indicative Cost (if applicable)**	**Indicative Outcome**
Very Likely	5	Very High	5	>10 weeks on completion	> £1M	Risk of death on global catastrophic failure
Probable	4	High	4	>1 weeks on completion	£100k - £1M	Risk of serious injury on global catastrophic failure
Possible	3	Medium	3	>4 weeks; <1 week on completion	£10k - £100k	Risk of accident on global failure or major damage
Unlikely	2	Low	2	1 to 4 weeks; none on completion	£1k – £10k	Serviceability issues and impacting 3rd parties
Negligible	1	Very Low	1	<1 week to activity; none on completion	<£1000	Minor to negligible

Risk Assessment Rating Matrix						
		Probability (P)				
		Very Likely	**Probable**	**Possible**	**Unlikely**	**Negligible**
Impact (I)	**Very High**	25	20	15	10	5
	High	20	16	12	8	4
	Medium	15	12	9	6	3
	Low	10	8	6	4	2
	Very Low	5	4	3	2	1

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Geotechnical Risk Register

Hazard/Risk	Cause	Location	Consequence	Pre-Control			Recommended Actions	Post Control		
				P	I	R		P	I	R
Risk of proposed car park being impacted by high wall collapse	Instability of the rock mass	Proposed visitor centre car park	Serviceability issues. Health & Safety of site users.	3	5	15	Information required to inform next steps: • Distance between edge of car park and cliff face; • Proposed car park construction; • Proposed slope information (heights/ gradients). Consider relocating the proposed car park. Depending on the information above a rock mass stability and/ or slope stability assessment may be required to determine if remedial measures are required.	1	2	3
Collapse of shallow mine workings	Voids/ broken ground associated with shallow workings.	Site wide	Subsidence/ collapse at the ground service. Pile design affected.	3	5	15	Curtins intrusive investigation works to date have not identified any evidence of shallow mine workings in the location of the proposed visitor centre. See Mining Risk Assessment and Phase 2 Ground Investigation Report.	1	2	2
Collapse of unrecorded mine shafts	Unrecorded mine shafts	Site wide	Subsidence/ collapse at the ground service. Health & Safety of site users. Delays to programme during construction.	3	4	12	Curtins intrusive investigation works to date have not identified any evidence of mine shafts. A residual risk remains associated with the potential for unrecorded mine shafts and a watching brief during ground works and construction has been recommended within the Mining Risk Assessment and Curtins Phase 2 Ground Investigation Report.	2	3	6
Deep Made Ground	Infilled reservoir/ landfill/ former site use.	Proposed visitor centre and car park	Shallow foundations may be unfeasible and there is a risk of excessive total and differential settlement and subsidence.	4	3	12	During Curtins intrusive investigation work Made Ground was encountered in all exploratory borehole locations from ground level to depths of between 0.40m and 4.00m bgl. Local ground improvement below proposed hardstanding, and a piled foundation solution is recommended. See Phase 2 Ground Investigation Report.	2	2	4
Depth to Rockhead	Variable depth to bedrock	Proposed visitor centre and car park	May affect pile design. Differential settlement.	3	3	9	During the March/ April 2024 site investigation the Low Furness Basal Formation was encountered at 18.0m below ground level (bgl) in borehole RH 1-02. The Martin Limestone Formation was encountered at 18.0m, and 10.0m bgl in boreholes RH 1-01 and RH 1-03 respectively. Seek advice/ input from a piling specialist at an early stage of the project to ensure existing information is suitable for pile design. If any ground bearing structures are proposed, settlement assessments may be required to determine if remedial measures are required. See Phase 2 Ground Investigation Report.	3	2	6
Obstructions within Made Ground	Infilled reservoir/ landfill/ former site use.	Proposed visitor centre and car park	Programme and financial implications associated with delays during piling.	5	2	10	Several obstructions were recorded within the Made Ground during Curtins intrusive site investigations including tyres, railway girders and sleepers. It is recommended that all obstructions are removed during the enabling works or their location accurately recorded, to avoid delays during piling works. Alternatively pile locations could be pre-bored. See Phase 2 Ground Investigation Report.	4	1	4
Shallow groundwater	Perched groundwater	Site wide	Construction difficulties during excavations/ earthworks.	4	2	8	Groundwater level monitoring undertaken as part of Curtins site investigations has shown that perched water may be present within Made Ground, typically at 2.5m below ground level (bgl). Dewatering techniques may be required to ensure dry/ stable excavations. See Phase 2 Ground Investigation Report.	3	2	6
Chemical attack on buried concrete	Sulphates in the ground.	Proposed visitor centre and car park	Integrity and durability of concrete affected resulting in serviceability issues.	3	2	6	Following an assessment of laboratory results in accordance with BRE Special Digest 1 Design Sulphate Class DS-1 has been determined. See Phase 2 Ground Investigation Report.	2	1	2

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Hazard/Risk	Cause	Location	Consequence	Pre-Control			Recommended Actions	Post Control		
				P	I	R		P	I	R
Cut material unsuitable for re-use in earthworks	Chemical and geotechnical properties of the soils	Proposed visitor centre and car park	Off-site disposal required and imported material required.	4	3	12	The suitability of the re-use of the material is discussed in Curtins Phase 2 Ground Investigation Report. Import material.	1	2	2
Utility strikes	Unrecorded Utilities	Sitewide	Delays and additional costs during construction	3	5	15	An unrecorded water pipe was encountered during the Phase 2 ground investigation in the vicinity of the proposed visitor centre. It's location was communicated to Cumberland Council and is referred to in the Phase 2 Ground Investigation Report. Other unrecorded utilities cannot be discounted. Utility clearance in advance of any excavations onsite is recommended.	2	2	4
Slopes and excavations	Loose materials / groundwater	Proposed visitor centre and car park	Excavation instability	3	5	15	Based on observations on site, together with the results of in-situ and laboratory tests, it is considered that excavations to <1.20m bgl should stand unsupported in the short term. Side support for safety purposes should be provided to all excavations which appear unstable, and those >1.20m deep, in accordance with Health and Safety Regulations. Suitable side slope angles must be checked and provided by a suitably qualified temporary works contractor for any excavations. Perched water may be encountered as seepages in shallow excavations for foundations or services. It is considered that water inflows, if encountered, may be controlled by pumping from sumps.	2	2	4
Soft, compressible ground	Groundwater/ surface water	Site wide	Trafficking issues during construction.	3	3	9	Soft, boggy and waterlogged ground was observed during the site visit particularly in Zones 3 and 5. Plant capable of traversing this type of ground is recommended. Construction during the drier months could be considered to avoid delays due to access.	3	2	6
Shrinking or swelling clay	Moisture content changes due to new vegetation or the removal of existing vegetation.	Site wide	Heave and subsidence resulting in damage to structures, road surfaces etc.	3	3	9	The cohesive superficial deposits are classified as having a Low Volume Change Potential and the guidance contained in BRE Digest 240 should be reviewed in this context with regards to trees / vegetation being removed, retained or proposed and proposed structures.	2	2	4

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