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Strategic Business Centre
Blue Ridge Park
Thunderhead Ridge
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KE/CLC/45466-001 (Issue 4)

21 January 2026

Former Akzo Nobel Site, Hollingworth Road, Littleborough

The approximately 7.8 hectare site is located to the west of Hollingworth Road in Littleborough, Lancashire.

The site comprises Area A (proposed residential development) and Area C (a recreational 'Events Area') as indicated on the plan below.



For above outlined site which comprises Areas A and C, we have undertaken a high level review of the following documents:

- CELTIC's Outline Foundation Option Plan, dated February 2008, reference P10008/09001/10;

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- CELTIC's Phase 2 Remediation Validation Report, Draft for Regulator Comment, March 2009;
- NHBC LQE certificate, 20 August 2009;
- CELTIC's Letter to Rochdale MBC, 21 October 2011;
- WYG's Geo-environmental Review Report, October 2017;
- RSK's Coal Mining Risk Assessment, August 2020;
- RSK's Additional Gap Analysis, 14 August 2020; and
- RSK's Additional Soil Sampling Report, 19 November 2020;
- Arc Environmental Ltd.'s (Arc) Ground Investigation Report (Factual), referenced 21-763 and dated 20 December 2021;
- Arc's Hazardous Ground Gas Addendum Report, referenced 21-763.01L and dated 1 June 2022; and
- Arc's Remediation Statement & Validation Proposal Sheets, referenced 21-763 (not dated).

Review of Desk Based Information

Site Description & History

At the time of compiling the initial review in 2021, the main development area currently comprised an area of derelict land surfaced by scrub vegetation. A small lake is present in the south of the site within the 'Events Area'. The Rochdale Canal forms the northern boundary of the site, and a railway line is located around 60 m beyond it; a landfill lies between the canal and the railway. The Hollingworth Lake Conduit is culverted below the eastern half of the site, connecting Hollingworth Lake (located around 300 m to the south) to the canal.

The main development area was previously occupied by a chemical manufacturing works operated by Akzo Nobel, which included the processing of animal fats and tallow for use in soaps and detergents. The works comprised numerous buildings including offices, labs, warehouses, storage and substations as well as featuring underground tanks and interceptors. Removal of the buildings and remediation of the site was undertaken in 2008.

In addition, an oil distillery was located in the north of the site during the late 19th Century prior to the development of the chemical works. A sandstone quarry and two shafts (associated with Cleggswood Colliery) are also shown to have been present in the north and



north east of the site during the mid-19th Century – the shallowest coal workings below the site are expected to be associated with the Lower Mountain Mine Coal at a depth of around 72 m. The CA note the two shafts present on site to have been treated to industry standards.

Historically, the 'Events Area' predominantly comprised greenfield land.

The lake in the south was constructed during the late 19th Century, and the car park in the north west corner was constructed in the early 1990s.

The topography of the site generally slopes down towards the north or north east, including several steps and stockpiles which remain from the original remediation works, and also steep slopes along the northern and southern boundaries. The main development area of the site is located between 162 m AOD (above ordnance datum) at the south east corner, and 148 m AOD along the northern boundary.

Geology

The solid geology below the site comprises the Pennine Lower Coal Measures, with the eastern half of the site underlain by the Milnrow Sandstone Group. Superficial Till is shown to cover the majority of the site, with a thin band of Head deposits possibly extending onto the centre-south of the site.

Two faults trending north west to south east are inferred to cross the site on the eastern and western boundaries.

The solid bedrock is classified as a Secondary A Aquifer. The superficial glaciofluvial deposits are classified as a Secondary Undifferentiated Aquifer, and the Head deposits are classified as a Secondary B Aquifer.

The site does not lie within a Groundwater Source Protection Zone.

Hydrogeology and Hydrology

A surface water abstraction licence relating to the former Akzo Nobel chemical plant is recorded in the north east of the site, although this is likely to be redundant since the removal of the works. A well is expected in the south western corner of the site.

The Rochdale Canal which forms the northern boundary of the site; the Hollingworth Lake Conduit is culverted below the eastern half of the site, trending north to south, connecting Hollingworth Lake (located around 300 m to the south) to the canal. A smaller lake is located in the south of the 'Events Area' (at around 160 m AOD), and the closest 'flowing' watercourse (the River Roch) lies around 120 m to the north (at around 140 m AOD).

The site is not at risk of flooding from rivers. The majority of the development area is recorded as having a potential for groundwater flooding to occur at the surface; the south west corner (~5% of the site) is recorded as having either a limited potential, or a potential for flooding or property situated below ground level. Various localised 'channels' in the north west, centre and south east of the site are shown to be at risk of flooding from surface water, covering around 10% of the total site area, including one zone (<5% of the site area) which has a high risk (30-year return).

Given the proximity of surface water features to the site, it is anticipated that the groundwater table will lie within the upper few metres of the site surface, and the groundwater flow direction is expected to be down to the north.

Ground Gas

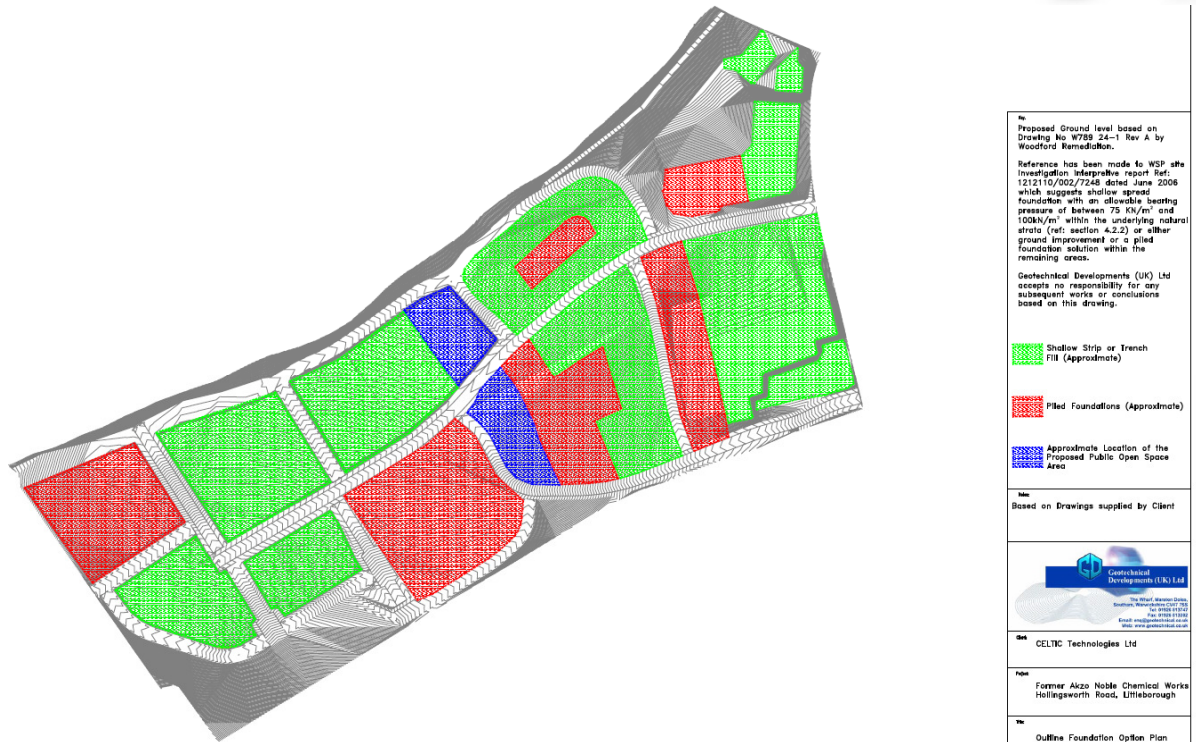
Land 18 m north west is identified as a historical landfill. No other landfills have been identified within 250 m of the site. The site lies within an area where no radon measures are required. Other gas measures will still be necessary.

Remedial Works

Remediation of the site is understood to have been completed in 2008; this comprised removal of underground structures, turning over the made ground within minimum 2.0 m of finished ground levels and replacement of arisings as engineered fill. A further phase of remediation was planned in 2011, but is not believed to have been undertaken.

CELTIC's Outline Foundation Option Plan, dated February 2008, reference P10008/09001/10

The plan notes the 2006 WSP allows for a safe bearing pressure of 75 to 100 kPa in natural strata. The areas where 'shallow strip and trench fill' footings are expected to be appropriate are shaded in green, whilst piled foundations are in red. Blue is POS area (designated at that time):



CELTIC's Phase 2 Remediation Validation Report, Draft for Regulator Comment, March 2009

The remedial strategy included removal and crushing of surface concrete, removal of contamination sources and turnover to identify extent, on site bio-physical treatment of hydrocarbon impacted soils, removal of ACMs and chemical validation of hard to dig layer placed between 600 and 800 mm below final development level, as well as chemical validation of soils to be placed between 800 and 1,000 mm below final ground level.

Capping system was to comprise the upper 600 mm to be placed by the developer, a 200 mm thick hard to dig layer to be placed during remediation and compliance with remediation target values for the soils placed between 800 and 1,000 mm depth (also to be done during remediation).

Turnover

Relic foundations (including piles) were grubbed out to a depth of 2.0 m below remediation level i.e. top of hard to dig layer. The upper 2.0 m of ground below remediation level was also turned over to inspect for signs of impacted ground. Drawing D1247/3436/A5 denotes depth of turnover; where natural ground was found, turnover was terminated apart from in a few select locations.

Where sandstone bedrock was found at shallow depth below roads, this was excavated to allow for ease of drainage excavations, and sandstone arisings used to bulk up the hard to dig layer material.

Bio-physical Treatment

18 no. contaminant sources were excavated, as shown on drawing D1247/3436/A4.

The report notes that all samples taken from sides and base of the excavations returned results which were below the Site Specific Acceptance Criteria (SSAC), as detailed in Table 2 below, extracted from the Validation Report.

Table 2- Site Specific Acceptance Criteria for Site Soils Below Cap

ANALYTE	Soil Acceptance Guideline
Asbestos Presence	No visible asbestos
Total Petroleum Hydrocarbons (TPH CWG)	5,000mg/kg ¹
TPH Aromatic EC5 to EC7	88mg/kg ¹
TPH Aromatic EC7 to EC8	100mg/kg ¹
TPH Aromatic EC8 to EC10	340mg/kg ¹
Ethylbenzene	9mg/kg ²
Toluene	3mg/kg ²
Benzene	None Detected

¹ Derived from WSP Environmental Remediation Strategy.

² Soil Guideline Value (SGV).

Arisings (~1,340 m³) were placed into biopiles on a bunded concrete pad, aerated periodically. Biological nutrients were added regularly. Treated arisings were then used as fill, placed where a 1,000 mm thick cover system is to be installed.

As detailed in Table 2, the SSAC for total TPH (aliphatic and aromatics C5-C35) was 5,000 mg/kg. This was used for the excavation validation sampling and bio-remediated soils, which were replaced as fill below the site.

The SSAC for TPH was provided as a total TPH (EC5-35) concentration, which is higher than the heaviest aromatic TPH assessment value (1,100 mg/kg for aromatic EC>35-44), and as analysis of the remediated soils and excavations did not include full fractionation of aliphatic and aromatic TPH it is not possible to confirm if lighter TPH was present in exceedance of the current residential assessment values.

Given the 1,000 mm thick cover system, the TPH contaminated soils should not present a risk to human health. It is assumed the latest remedial strategy has considered vapour risk to houses.

Hard to Dig Layer

38 no. samples of crushed concrete were tested and the material was deemed suitable for use.

Crushed concrete placed to form roadways has not been chemically validated and should not be re-used within the upper 1,000 mm of final ground level without further assessment.

Post Remediation Constraints

Cells 4 and 6 have been left 'uncapped' due to a shortfall in site won soils. When soil is available, material should be placed to within 200 mm of proposed remediation level and capped with a hard to dig layer.

During times of heavy rainfall, there is significant surface run off from the fields off the southern boundary and from the southwestern site corner where springs were encountered. These springs emerged from sand layers within the Glacial Till.

Culvert was diverted through Phase 2; part of abandoned run remains in place below Phase 1; this remaining section has been sealed and backfilled with site won material.

A methane vent serving one of the capped mine shaft remains on site.

Gas main remains below southern boundary, may need diverting as part of the development.

Former site entrance in northeastern site corner has not been remediated due to close by underground services.

Post remediation gas monitoring wells were installed on a 75 m grid. Four rounds of monitoring were undertaken. Amber 1 gas measures were recommended.

Controlled Waters

As detailed in Table 2, the SSAC for TPH (aliphatic and aromatics C5-C35) was 5,000 mg/kg. This was used for the excavation validation sampling and bio-remediated soils, which were replaced as fill below the site.

Notably Excavation No.'s 1, 4/10, 5, 17 and 18 returned verification sampling with total TPH concentrations exceeding 1,000 mg/kg.

There was no leachate analysis of the soil or analysis of groundwater samples post remediation.

NHBC LQE certificate, 20 August 2009

This LQE includes a review of a number of reports from 2003 to 2008, including CELTIC's 'Remediation Validation Report for Phase 2 (draft for regulator comment)' from March 2009.

CELTIC's Site Set Up Plan included in their March 2009 report notes the area of the site proposed for housing west of the culvert is titled 'Phase 2' whilst the area east of the culvert and south of the proposed residential area is 'Phase 1':



It is now understood that the 2011 remediation works planned were to revert the Phase 1 area to a residential end use.

The southern part of the site is formerly referred to as the 'Events Area' (also known as Area C by Celtic and Area D by WSP). For ease of reference, we will refer to this area as the 'Events Area' in this review.

The Events Area is noted to have been predominantly greenfield since the 1850s with the existing lake being constructed in the later part of the 19th century. The 1851 historical map notes the culvert (labelled to be a 'conduit') to cross the site. The majority of the site appears to have remained undeveloped until a car park was constructed in the north western corner in the early 1990s.

The LQE notes the investigation into the Events Area was reported by WSP in their Ground Investigation Report (May 2006) and later by Woodford in 2007 who also undertook sampling. Exploratory holes included 5 window sample holes to maximum 5 m (including

3 monitoring well installations), 11 trial pits to maximum 4 m, 1 rotary hole to 40 m and 22 monitoring rounds. The LQE notes one soil sample recorded a nickel concentration of 66 mg/kg – further testing was proposed to confirm material from the Events Area was suitable for reuse, however this 66 mg/kg concentration does not exceed current assessment value of 180 mg/kg (derived for a residential with home-grown produce end use). The monitoring wells did not report methane concentrations over 1% or carbon dioxide concentrations over 5%. No significant risks were therefore considered to be posed from the Events Area to site end users.

Woodford's 2008 Remediation Statement notes both the car park and the grassland areas of this part of the site have been investigated and do not require remediation except for the removal of the car park hardstanding and subbase.

The document also notes:

No significant observations of soil contamination were identified in the eastern area of the development site, the POS land or the car park area. The EA and EHO have confirmed that the investigations completed to date and including the WSP remediation strategy are acceptable for the POS and car park area. Refer to Appendix A.

As part of Celtic's 2009 works, and reported in their report for Phase 1 (dated July 2009), the LQE notes 7 samples were tested from near surface soils and/or stockpiled topsoil. Although testing recorded one very slightly elevated concentration of Aromatic C12-16 (5.79 ppm compared to 5.60 ppm threshold), no significant concerns were considered to be present.

The LQE summarises the following environmental and geotechnical/engineering outstanding issues:

Environmental	Geotechnical/Engineering
Gas protection strategy required – minimum CS2 or Amber 1 Events Area – CS1	Submit proposals for existing groundwater and surface water drainage system.
Validate placement of lower 600 to 1000 mm of capping in Cells 4 and 6 including placement of 200 mm of anti-dig layer, and chemical test results of material used from 800 to 1000 mm below finished level.	Remediation of Cells 4 and 6 to planning levels to agreed specification with validation testing. Remove all softened surface materials first.
Validate placement of upper 600 mm of capping in all landscaping.	Submit foundation designs.

The LQE notes that at the time, Rochdale MBC had confirmed acceptance of the Phase 2 Validation Report's conclusions and had no concerns relating to Phase 1.

A temporary drain is believed to have been installed on southern boundary but may not have been approved by the local authority as a permanent structure. A temporary drain is also understood to have been installed along the northern boundary to stop surface run off from entering the canal.

CELTIC's Letter to Rochdale MBC, 21 October 2011

This letter notes the eastern part of the site was remediated in 2008 for a commercial end use; it was then recognised that the area should instead be submitted for residential development, meaning additional remediation may have been required. The letter states the original remedial targets were set assuming a residential development applied to the whole site, not just Phase 2.

The strategy was to remediate hydrocarbon impacted soils for re-use below a 1,000 mm cover system, provide a 200 mm thick anti-dig layer, following which a 600 mm or 800 mm thick capping would be installed in landscaped areas (800 mm was where a 1,000 mm of clean cover is proposed over hydrocarbon impacted soils). A 200 mm thick band of soil below the anti-dig layer was also to be validated.

Regrading of the development platform was recommended for the former Phase 1 area and proposed works included removal of anti-dig layer, regrade underlying soils (expected to comprise Glacial Till) and use excess arisings on Phase 2, test soils which will be located below the anti-dig layer i.e. between 800 and 1,000 mm below final ground level and then replace the anti-dig layer.

Planning conditions dated 20 December 2011 includes condition 4 which notes the 2008 Remediation Statement and the 2011 Celtic proposals should be adhered to. Condition 5 also notes gas protective measures should be installed. These conditions are also included on the planning conditions dated 3 October 2017.

WYG's Geo-environmental Review Report, October 2017

This report was prepared for Homes & Communities Agency and provides a summary of the remediation undertaken on the former Akzo Nobel site and a desk study for the farmland to the east and south of the site.

The report notes elevated concentrations of hydrocarbons and metals were recorded in the west of the site, associated with former process/storage areas. Odours and impacted ground were noted here, extending into the Glacial Till. Asbestos was also identified across the site. Groundwater impacted with hydrocarbons and ammonia was encountered in the north west corner.

The early investigations recommended a 600 mm clean capping in all landscaped areas and the incorporation of DS-4 AC-4 sulphate measures in below ground concrete. No treatment of groundwater was recommended, and the gassing regime was classified as Characteristic Situation 3 (CS3).

Post investigation, demolition of various structures was carried out including removal/flushing of storage vessels and tanks as well as the removal of 'nearly all' asbestos from buildings, eleven months of gas monitoring, drainage investigation including into the mine sump.

The WSP report notes the remediation strategy included 'removal of buildings and foundations with a site wide turnover of site soils to a nominal depth of 2.0 m below proposed finished levels.' Easements were left either side of the canal, culvert and the mine shafts (approximately 5 m).

Contaminants of concern included asbestos, metals, TPH, VOCs and ground gas. Mitigation measures proposed included a 200 mm thick anti-dig layer below a minimum 600 mm clean capping in gardens, with a 200 mm capillary break layer below the anti-dig layer *[this capillary break layer was refuted in other reports as no longer being required, although the lower 200 mm of material below the anti-dig layer still needed to be below site specific assessment criteria]*. Gas/vapour protective measures were also recommended, as well as keeping all services within the capping layer.

After consultation with the EA, a perimeter interceptor drain was to be installed along the western and southern boundaries to limit offsite run off, post remediation groundwater and surface water sampling was to be undertaken, and an interceptor/bund to be installed along the northern boundary during the remediation works.

The WSP report notes 'the remediation strategy was designed to ensure the site was suitable for a commercial and residential development'. Post remediation constraints include:

- Construction works/service installers must ensure no contact between impacted arisings and capping material (200 to 400 mm anti-dig layer with or without a capillary break);
- Site will be engineered to allow for 2 to 3 storey plots with semi-stiff rafts;
- Gas measures required;
- Obstructions may be left in situ >1.5 m below plots and >3 m below roads;
- 600 mm capping with basal geogrid/geotextile required in all landscaping;

- DS3/DS-4 AC4 sulphate measures;
- Permanent land drains and groundwater control may be required on northern and southern boundaries;
- No development within 5 m of canal. Easements also required around shafts and culvert, or culvert diversion undertaken;
- Well on south western slope to be retained;
- All future extensions to plots, ponds, trees etc must not extend below the anti-dig layer, and must include gas measures where appropriate.

The WYG report notes the 2011 CELTIC letter confirmed the site had been remediated in 2008 (Phase 1 for commercial end use, Phase 2 for residential) and that further remediation needs to take place to allow for Phase 1 to now be residential as well. The strategy included remediation of hydrocarbon contamination to enable material to be re-used below a 1.0 m thick capping system, regrading of ground levels, installation of 200 mm thick anti-dig layer and validation of 200 mm of soil below the anti-dig layer.

WYG have subsequently identified a number of 'data gaps':

- A review is required of all reports pertaining to the 2008 and 2011 CELTIC remediation works to see if additional site investigation is required and confirm if previously agreed remedial targets meet current guidance;
- Update gas risk assessment to see if CS3 regime is still applicable.

RSK's Coal Mining Risk Assessment, August 2020

This report was prepared for Homes England and includes a summary of WYG's 2006 'Report on Past Mining Activities', as well as consultation of abandonment plans, geological maps and a Consultant Coal Mining Report. The Littleborough Civic Trust have advised that clay extraction took place in the local area.

Historically, the 1851 map shows an 'old shaft' near the northern boundary. By the 1890s, Cleggswood Works (possible oil distillery) and Clough Field Works are shown on site, but no reference to a shaft. Several coal pits and shafts are evident in the surrounding area. Cleggswood Hill's pits are labelled 'clay' from 1910.

Pennine Lower Coal Measures strata underlie the site, with eastern half of the site underlain by the Milnrow Sandstone group. Superficial Till is also shown to cover the majority of the site, with a thin band of Head deposits possibly extending onto the centre-south of the site.

Two faults trending north west to south east cross the site on the eastern and western boundaries. The strata are inferred to dip to the south and west between 7 and 20 degrees.

The BGS hold a record for the on-site shaft associated with Cleggswood Colliery. This record notes the shaft is around 115 m deep and the following stratigraphic sequence:

Drift deposits (clay and gravel, sand and loam)	Surface to 6.4 m
Milnrow Sandstone	To 19.8 m
Coal Measures	To 46.7 m
Inch Coal	To 46.7 m (0.02 m thick)
Coal Measures	To 71.9 m
Upper Mountain Mine coal	To 72.3 m (0.41 m thick)
Coal Measures	To 82 m
Inch Mine coal	To 82 m (0.03 m thick)
Coal Measures	To 102.8 m
Bullion coal	To 103.1 m (0.31 m thick)
Coal Measures	To 114 m
Lower Mountain Mine coal	To 114.7 m (0.66 m thick)
Coal Measures	To >115 m

The Lower Mountain Mine coal was economically the most valuable seam in the area, and was found to be underlain by a 0.44 m thick layer of ganister. The overlying Bullion, Inch Mine and Inch coals were not worked. The Upper Mountain Mine coal along with an underlying bed of fireclay (thought to be around 1.5 m thick) were known to be worked in the area, including Cleggswood Colliery.

The Consultants Coal Mining Report, obtained in July 2020, notes there is not likely to be unrecorded shallow workings (i.e. within the upper 30 m), but past workings are recorded in the Upper Mountain coal (0.3 m thick, 59 m depth) and Lower Mountain coal (0.6 to 1 m thick, 84 to 96 m deep).

RSK's review of the information obtained concludes there are no recorded workings in the Upper Mountain Mine (anticipated to lie from at least around 72 m depth) or Lower Mountain Mine coal (anticipated to lie at around 90 to 139 m below the site) which extend below the site.

Clay extraction may have also taken place alongside the Upper Mountain Mine and Lower Mountain Mine coal seams, although since the CA plans indicate no coal was worked below the site the likelihood of clay workings being present would be low. A 2.5 m thick band of fireclay may be present below the Inch coal but even if workings are present, they should have at least 40 m of competent cover above.

Precautions against the effects of shallow coal workings are therefore not considered to be required.

Two shafts are recorded on site, with an adit recorded offsite at Cleggswood Hill. The RSK report notes the following:

CA Reference	Details
393415-008	On site shaft. Cleggswood Colliery downcast shaft, ovoid shape, 2.7 by 4.3 m dia, brick lined, 112.7 m deep to Lower Mountain seam. Possibly capped in 1935. Later treated November 1984, filled with 'fatty waste material' and capped by Akzo Nobel; cap detail shows a 1.15 m thick reinforced concrete plug founded on bedrock, overlain by 4 m of 'compressed infill material' and a 0.35 m thick concrete cap. CCMR notes '<i>shaft was excavated to a depth of 5.2 m, through 2 m of bedrock. A reinforced concrete cap 12 m² at the base increasing to 12.5 and 1.2 m thick formed over shaft. Excavation backfilled and compressed.</i>' Located in vicinity of former boiler house. A pipe extends 6 m into shaft is connected to a concrete duct which connects to the culvert. The 'off-take pipe' located 6 m below the top of the shaft is positioned to restrict fatty deposits from blocking the discharge pipework. Water flow from the shaft estimated at 3 litres/sec. A second pipe joins the shaft discharge pipe, draining water from weathered bedrock at a rate of 2.8 litres/sec. Combined discharge into River Roch is up to 5.8 litres/sec
393415-009	On site shaft. Cleggswood Colliery upcast shaft, brick lined, 2.4 or 3 m dia, 114.5 m deep. Filled with 'fatty waste material'. Possibly capped in 1952. Akzo Nobel also capped shaft in same spec as downcast shaft, but at a higher level and with no drainage. CCMR notes '<i>excavated to a depth of 7.8 m removing 2.6 m of bedrock where a reinforced concrete cap was formed. The cap measures 8.5 m² at the base increasing to 10 m² at the top by 1.2 m thick. The excavation was backfilled to the surface with compressed fill. An inspection pipe was installed passing through the cap and incorporating an inspection plate at the surface. Branching from this is a ventilated pipe fitted with a flame arrestor.</i>' Located in vicinity of former boiler house.
393415-010	Offsite adit, approx. 50 m east of site from Hollingworth Road to the Upper Mountain workings. No treatment details recorded.

The RSK report notes chemical residue is present in the shafts and this is prevented from discharging into the river by the design of the drainage system.

RSK's Additional Gap Analysis, 14 August 2020

This report was prepared for Homes England and was aimed to confirm the integrity of the existing monitoring wells, determine the thickness of anti-dig layer, confirm if asbestos fibres were present, and discuss the site with regulators. The area covers excludes the Events Area.

Monitoring Wells

RSK noted historical gas monitoring data was incomplete and that it was uncertain if additional monitoring would be required. RSK found 15 monitoring wells, 10 of which were deemed suitable for re-use subject to finding out the well construction details. The depth of the wells ranged between 0.68 and 3.86 m, most were dry except for three which recorded water in the upper 1 m.

Hard Dig Layer

The report notes that the past two remediation phases included placing a 250 to 300 mm thick hard dig layer on the development platform. Eight 'cells' were completed, with two 'cells' to be completed by the developer. Material for use in these two cells is stockpiled; additional material may need to be imported.

The report notes the hard dig layer material originated from crushing and screening processes undertaken during demolition. Since there was potential for asbestos to be present within this material, additional testing was recommended. Using an excavator, RSK carried out 21 shallow trial pits across the eight 'cells', recording an average 380 mm thickness of the hard dig layer, which ranges between 0.1 and at least 0.9 m thick.

A geotextile was encountered below the hard dig layer in most positions.

A concrete obstruction was noted in HD07. In HD08, no hard dig layer was recorded; RSK thought this was due to HD08's location near the southern edge of the cell. RSK also note there was a noticeable thinning of the layer towards the southern boundary and towards the elevated mound in the south east corner.

Five pits were also excavated in two stockpiles, finding coarse limestone aggregate.

27 samples of the hard dig layer were tested and RSK noted 'numerous' fragments of possible asbestos containing material (ACM) at the site surface. Five samples recorded amosite or chrysotile fibres, 0.003% or less. Of the fragments tested, two were identified as ACM.

Regulators

RSK contacted Rochdale in July 2020 who confirmed the past report recommendations should still be relevant, but that a new 'review' will likely be required for a new application to confirm the reports comply with current guidance.

The EA confirmed to RSK in July 2020 that there are no outstanding permit related issues.

The Coal Authority confirmed the two mine entries have been treated to industry standards and development will be advised to avoid these features.

Summary

Some remedial work is required for the 10 wells found before they can be suitable for use. It is unclear if additional gas monitoring is required.

The hard dig layer is between 100 mm and >900 mm thick, occasionally underlain by a geotextile, and its base may be difficult to differentiate. Asbestos was encountered in the material and in ACM fragments noted at site surface.

A formal review of past reports will be required by Rochdale for a new planning application.

RSK's Additional Soil Sampling Report, 19 November 2020

This is a factual report on soil sampling and asbestos analysis. The report mentions additional sampling is ongoing. RSK's July 2020 report noted visible ACM at the site surface, and fibres up to 0.003% in the hard to dig layer (at depths of up to 0.9 m) in 5 out of 27 samples tested.

This investigation included a walkover by an asbestos consultant to identify suspected ACM, and sampling and analysis of 8 bulk bags and 55 samples taken between site surface and 0.3 m. The hard to dig layer comprised sandy cobbles of concrete and brick with fragments of wood, plastic and rebar, and was found up to 0.2 to 0.6 m thick. Three locations found a geotextile below the layer and in seven locations, the layer appeared more cohesive. The report notes the hard to dig layer was absent in selected pits. Concrete obstructions were also noted in five holes.

Visible ACM was noted in four surface locations, and 27 of 55 samples recorded up to 0.019%. Of the 8 bulk bags, 4 contained ACM.

Two trial pits, TP14 and TP30, were terminated upon encountering concrete obstructions at depths of 2.0 and 2.3 m, respectively. A concrete obstruction was also recorded in TP16 at 0.5 m. Concrete obstructions were also encountered in five trial pits during RSK's 2020 investigation.

Where encountered, the underlying natural ground typically comprises firm to stiff sandy gravelly clay. The clay was noted to be locally soft, including in TP13, TP16, TP20, TP21, TP31 and CP7. Residual natural sand was recorded below the made ground in five exploratory holes, typically located in the western half of the site.

Sandstone bedrock was recorded to underlie the shallow residual soils in five exploratory holes, typically in the centre-east and north east, at depths of between 1.7 and 4.0 m. Mudstone bedrock was recorded in six exploratory holes (CP3 to CP7 and TP1) at depths ranging between 2.1 and 8.0 m.

Groundwater

No significant groundwater ingresses were recorded in the trial pits; ten of the pits recorded slight ingresses either within or at the base of the made ground at depths of between 0.5 and 2.1 m.

Groundwater strikes were recorded in the mudstone bedrock in CP4 at 8.0 m (147.9 m AOD) and CP7 at 7.0 m (150.4 m AOD). A water strike was also recorded in CP6 at an expected depth of 4.2 m (152.35 m AOD) – the log noted 5.2 m but the borehole was only drilled to 4.25 m.

Arc Environmental installed monitoring wells in the seven cable percussive boreholes to depths of between 4.0 and 7.0 m, and in the five dynamic sampling boreholes to depths of 0.8 and 4.7 m (although three of these wells were installed to between 0.8 and 1.1 m bgl) – all but two of the wells (MW3 and MW5) extended into the natural strata. Six rounds of monitoring were completed between November 2021 and February 2022.

The shallowest groundwater was recorded at 0.42 m in MW1 during the third round of monitoring. Groundwater was recorded within the upper 1.0 m on at least one occasion in six of the wells (CP3, CP4, CP6, CP7, MW1 and MW2). The equivalent level of the groundwater in the wells roughly varies between 149 and 157 m AOD, and generally lowers towards the north (average groundwater levels were recorded to be lowest in CP5 and highest in CP7).

In two of Arc's trial pits, the made ground in TP24 and TP25 was noted to contain ash. However, no other visual or olfactory evidence of contamination was recorded. No samples were submitted for chemical testing.

Arc's Hazardous Ground Gas Addendum Report, dated 1 June 2022

Arc Environmental installed twelve gas monitoring wells across the site, and six rounds of monitoring were completed between November 2021 and February 2022. A summary of the results is given below:

- A maximum methane concentration of 2.8% was recorded in CP5, with the same well recording concentrations between 1.9 and 2.4% on three other occasions. No methane was recorded in the remaining wells;
- A maximum carbon dioxide concentration of 4.3% was recorded in CP2 on two occasions. In the remaining wells, concentrations were typically below 1.0%;
- Zero hydrogen sulphide or carbon monoxide was recorded in the wells;
- Flow was recorded to be below the limit of the monitor (0.1 l/hr);
- The shallowest groundwater was recorded at 0.42 m in MW1 during the third round of monitoring. Groundwater was recorded within the upper 1.0 m on at least one occasion in six of the wells (CP3, CP4, CP6, CP7, MW1 and MW2).

Arc's Remediation Statement & Validation Proposal Sheets, not dated

Arc reviewed the remedial works detailed in all of the previous reports as detailed above, and provided validation proposals to meet the requirements.

E&P Summary

- Asbestos fibres and ACM have been noted at site surface of the main development area and in the material placed to act as an anti-dig layer. Safe methods of working should be implemented when investigating and excavating through this material;
- Further remediation is required to trim the area east of the culvert to a residential end use;
- Capping to be placed in landscaped areas to be 1,000 mm thick; this should comprise 600 mm of clean cover, 200 mm anti-dig layer, 200 mm of material below a certain site specific threshold. Levels in Cells 4 and 6 have been left low due to a shortfall of material; lowest layer of capping still to be placed;
- Should any landscaped areas be present in the Events Area, no capping is at this stage assumed to be required based on previous testing. However, should material from the main development area be moved to the Events Area, a capping will then need to be provided;

- Regrade in ground levels to be reviewed to ensure impacted ground still has sufficient cover; further investigation required to assess if material is suitable to remain below 800 to 1000 mm;
- Level of gas measures to be CS2 for main development area, and CS1 for Events Area;
- Permanent drainage works required along the southern and western site boundaries;
- A well is expected in the south western site corner; structure will need exposing if still in use by farmer;
- Slope stability assessments required for offsite slopes, including northern boundary adjacent to the canal;
- Regulatory discussion required to confirm remediation proposals are still appropriate;
- No build easements required on northern boundary, around mine shafts and either side of the culvert.

Given the potential risk to controlled waters from the post-remedial TPH concentrations in the soil, further site investigation has been requested by the Environment Agency to confirm the current ground conditions model. The further site investigation would include the following:

- 8 dynamic sampler boreholes to 10 m. The boreholes would aim to target Excavation #4/10, #5, #17 and #18 where post remedial total TPH soil concentrations were reported to remain in excess of 1,000 mg/kg. We note that Excavation #1, which also returned high TPH concentrations, is within an area of the site where construction has been completed. Boreholes will also be located on the northern edge of the site, down gradient of the anticipated groundwater flow direction to capture any possible mobile contamination;
- Soil analysis should include total and leachate analysis for TPH criteria working group (CWG), VOCs and SVOCs, with sampling targeting any observable hydrocarbon contamination (olfactory, visual and PID evidence) and/or the groundwater table;
- Three groundwater monitoring visits will be undertaken. The wells will be developed during the first visit and an interface probe will be used to confirm the presence and thickness of any free product, and a PID to confirm if any hydrocarbon vapours are present. The groundwater will be visually assessed for signs of contamination;



- During the second and third visit, eight samples of groundwater will be obtained and analysed for a chemical suite including TPH CWG, VOC SVOCs, metals/metalloids, pH and PAHs.

Yours sincerely,

Kate Edwards

Kate Edwards

Director

Enc Proposed Monitoring Well Plan, drawing 45466/700A



INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.

NOTES

- This drawing is to be read in conjunction with all relevant Eastwood & Partners drawings prefixed 45466 as well as all relevant Vistry Homes planning layouts and house type drawings.
- The site layout is taken from Watson Batty Architects, Site Plan, drawing number HOLLIN-WBA-XX-XX-DR-A-20, 1001, revision P11.
- The topographical survey is taken from PM Surveys UK LTD, drawing number PMS20133, dated 27.07.2020

- Key:
- Approximate position of trial pit excavated by ARC Environmental on 11/09/2024.
 - Approximate position of trial pit excavated by ARC Environmental on 29/09/2023.
 - Approximate position of trial pit excavated by ARC Environmental on 26/10/2021 & 27/10/2021.
 - Approximate position of cable percussive borehole and monitoring well carried out by ARC Environmental between 01/11/2021 & 04/11/2021.
 - Approximate position of window sample holes drilled by ARC Environmental on 27/10/2021.
 - Approximate position of trial pit excavated by Geotechnical Developments in 2008.
 - Approximate position of dynamic sampler holes drilled by Geotechnical Developments in 2008.
 - Ground level of exploratory hole (m AOD).
 - Thickness of stratum (mm).
 - Vane readings (shear strength).
 - Indicates plots that are complete / already under construction.
 - Approximate extent of excavation, taken from Celtic's 'Remedial Excavation Location Drawing'.
 - Approximate position of proposed monitoring well. Please note, positions of monitoring wells are subject to service locations.
 - Indicative mine shaft location and stand off zone, taken from Pell Frischmann, Existing Ground Model.

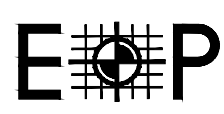
A	First Issue.			
REV	DESCRIPTION	SIG	CHK	DATE

VISTRY PARTNERSHIPS

LITTLEBOROUGH

PROPOSED MONITORING WELL PLAN

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SCALE WHEN PLOTTED AT A1		DRAWING STATUS		
1:500		PRELIMINARY		
DRAWN	CHECKED	DATE	DRAWING NUMBER	REV
JL	KE	21.01.2026	45466/700	A