



Russells South Heywood (Residential)
Limited

SOUTH HEYWOOD PRIMARY SUBSTATION

Interpretative Ground Investigation Report



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Interpretative Ground Investigation Report

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1 INTRODUCTION

1.1 AUTHORISATION

WSP has been instructed by Russells South Heywood (Residential) Limited (the Client), to undertake a geotechnical and geo-environmental assessment for a proposed commercial development on a parcel of land located off Queen Elizabeth Way, South Heywood, Greater Manchester, OL10 2TB (henceforth known as the 'site').

A site location plan is presented as **Figure 1** in **Appendix A**.

It is understood that the development will comprise a strategic 32MVA primary substation which will serve the wider South Heywood scheme, and a small food store.

1.2 OBJECTIVES & SCOPE OF WORKS

The main objectives of the work are to identify potential development constraints with respect to geotechnical design, contamination and ground gas.

The scope of works comprised:

- Targeted intrusive investigation;
- Laboratory geotechnical and chemical testing;
- Groundwater and ground gas monitoring;
- Derivation of a conceptual ground model;
- A Generic Quantitative Risk Assessment (GQRA) for contamination risks to human health and controlled waters receptors;
- Ground gas risk assessment;
- Derivation of geotechnical parameters; and,
- Guidance on the design of foundations, floor slabs and external works.

This report is intended to fulfil the requirements of a Ground Investigation Report (GIR) as detailed in BS EN 1997-2: 2007 (1).

1.3 BACKGROUND & DEVELOPMENT PROPOSALS

Master planning of the proposed substation has not yet been completed however is considered likely to comprise a transformer building and a single storey auxiliary building. WSP understand the substation is currently proposed within the southern extent of the site and will form the first phase of development.

WSP understands the remainder of the site will be developed with a small food store, forming part of a wider local centre.

Outline development proposals are presented in **Appendix B**.

1.4 GEOTECHNICAL CATEGORY

It is considered that the proposed structures fall within Geotechnical Category 2 as defined in BS EN 1997-1:2004+A1:2013 (2). These are conventional types of structures and foundations with no exceptional risk of difficult soil or loading conditions.

1.5 PREVIOUS REPORTS

The following report has been prepared previously for the site and should be read in conjunction with this report:

- WSP, 2023, 'South Heywood Primary Substation – Preliminary Risk Assessment', Report No. 70114074/12124. Referred to as WSP PRA (3).

In addition, a number of reports have been completed over the wider Heywood site (including the footprint of the Hareshill Landfill) by WYG, as detailed below:

- WYG, September 2020 South Heywood Commercial Development, Off Pilsworth Road and Hareshill Road, South Heywood, Rochdale, Ground Investigation Interpretative Report Ref. A117337 (4).
- WYG, October 2020 South Heywood Commercial Development, Off Pilsworth Road and Hareshill Road, South Heywood, Rochdale, Factual Ground Investigation Report Ref. A117337 (5).

1.6 CONFIDENTIALITY

This report is addressed to and may be relied upon by the following:

Russells South Heywood (Residential) Limited

This assessment has been prepared for the sole use of the above-named party. This report shall not be relied upon or transferred to any other parties without the express written authorisation of WSP. No responsibility will be accepted where this report is used in its entirety, or in part, by any other party.

Information provided by others is taken in good faith as being accurate. WSP cannot and will not accept liability for any deficiencies in third party information.

General limitations are presented in **Appendix C**.

2 THE SITE & EXISTING INFORMATION

2.1 SITE DETAILS AND TOPOGRAPHY

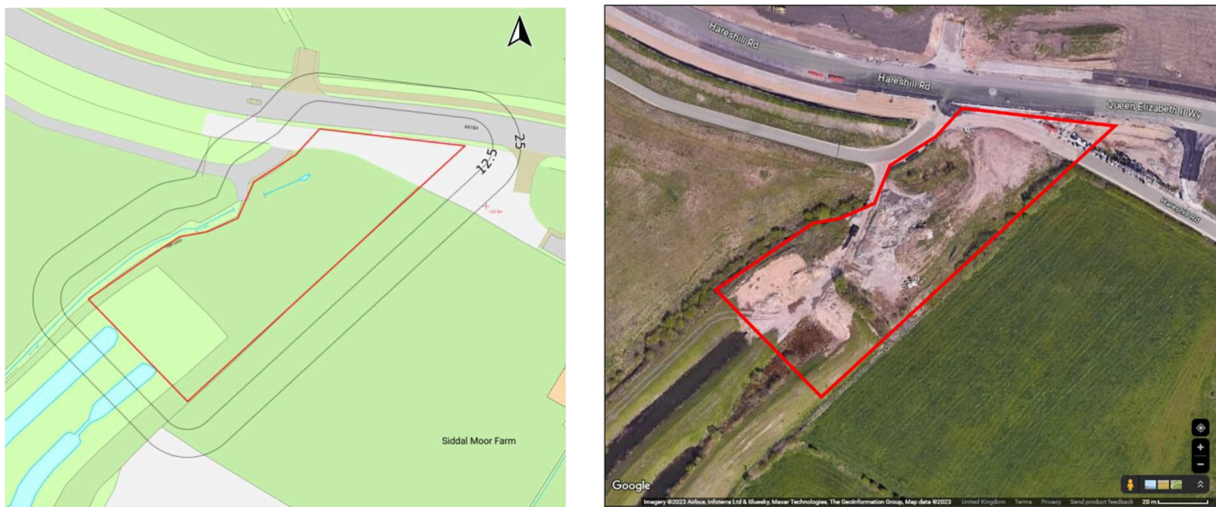
The site lies to the south of the recently constructed Queen Elizabeth Way, approximately 1.7km south of Heywood Town Centre and covers an area of approximately 0.8 hectares.

The site is located at National Grid Reference E385077 N409082.

A site location plan is provided as **Figure 1 in Appendix A**.

The site layout plan is provided as **DWG. SOHW-WSP-PSS-ENAB-SK-D-0005 in Appendix B** and an Ordnance Survey Baseplan and an aerial view are provided as **Figure 2-1** below.

Figure 2-1 – OS Baseplan and Aerial Overview of the Site



An approximately 10m wide grassed verge, with an elevation in the region of 123.5mAOD, separates Queen Elizabeth Way from the main body of the site. This verge overlies the former Hareshill Road, which was truncated to allow the construction of Queen Elizabeth Way.

Beyond the verge, the site is characterised by a grassed mound with some shrubs/small trees, which lies approximately 2-2.5m above the level of the verge. The mound continues for approximately 40-50m into the site then falls steeply south westwards and to a level, which seems to be slightly lower than that of the verge/Queen Elizabeth Way (circa 122mAOD).

An approximately 1.5m deep ditch, flanked by small trees/shrubs, is present on the north-western boundary. This ditch occurs in two sections; a short length close to Queen Elizabeth Way, and a section which commences from approximately the midpoint of the boundary and continues beyond the site. The ditch carries a watercourse which flows to the southwest and is culverted below part of the site and Queen Elizabeth Way.

Beyond the north-western boundary lies a single-track road and an area of undeveloped land, surfaced with tall grass/shrubs, which rises northwards. This land is a former landfill site, known as Hareshill Farm (Ref: EPR/CB3738AC).



A 'U' shaped pond is present directly adjacent to the site in the south with an outfall chamber noted on the northern extent of this feature. WSP understand a 750mm diameter culvert runs beneath the footprint of the site before reaching this outfall.

The depth of the water within this pond is approximately 1m below the top of the surrounding bank. Historical aerial mapping suggests this feature had been constructed by 2013.

3 ENVIRONMENTAL SETTING

3.1 INTRODUCTION

The following section presents a summary of the environmental setting and site history taken from the WSP Preliminary Risk Assessment (3). For a more detailed assessment, reference should be made to the aforementioned report.

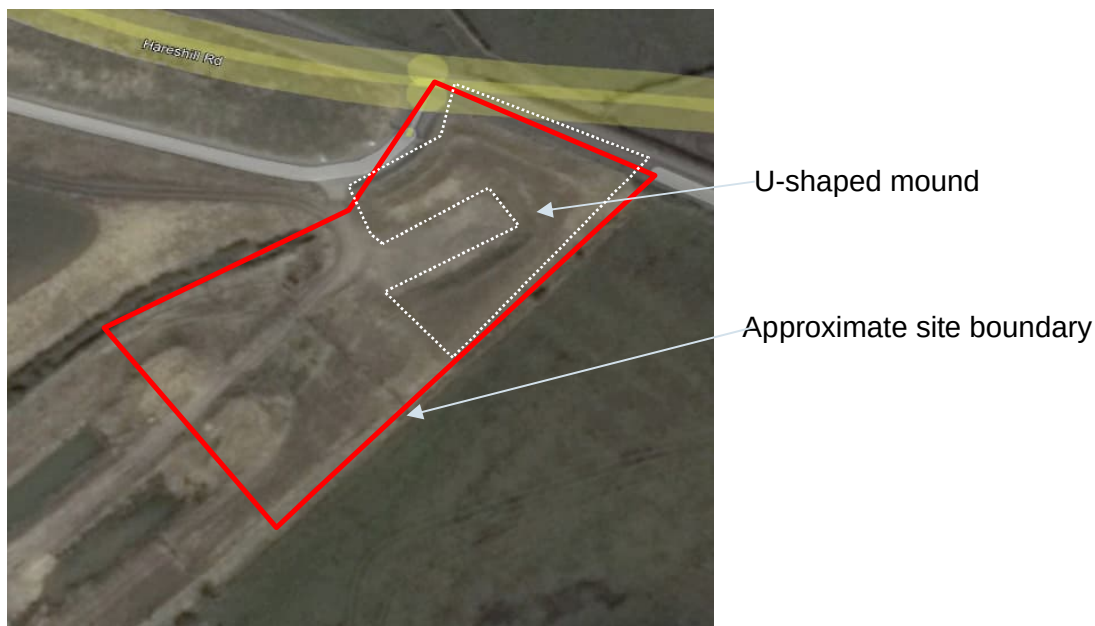
3.2 SITE HISTORY

Other than the former Hareshill Road, the historical maps viewed do not suggest that the site area has any prior history of development. Historically, there was marshland and a pond marked within the site boundaries up to 1890, when the features are presumed to have been infilled.

An inert landfill has been adjacent to the northwest of the site since approximately 2012 (See **Section 3.6**).

Recent onsite earthworks (which may be partly commensurate with landfilling to the west) have clearly resulted in significant modification to site levels. The exact extent and reason for these works is unclear. Google Earth imagery shows the site as an open field in 2005, with a U-shaped mound being created in the north prior to later imagery dated 2013, as indicated in **Figure 3-1**.

Figure 3-1 – Extract from Google Earth showing location of U-shaped mound in 2013



3.3 GROUND CONDITIONS

Published geological mapping records the following.

- Glacial Till, comprising clays, silts, sands and gravels are indicated to underlie the northern part of the site.
- Head deposits (poorly sorted sands and gravels with localised lenses of clay, silt or peat) are indicated to overlie the Glacial Till on the southern part of the site.

- A thin band of Lacustrine Deposits comprising sands and gravels is recorded along the eastern limits of the site.

The underlying bedrock comprises the Pennine Lower Coal Measures Formation (Mudstone, Siltstone, Sandstone which contain coal seams).

3.4 MINING AND GROUND WORKINGS

The site is within a Coal Mining Reporting Area as defined by the Coal Authority; however, the site is not within a Development High Risk Area. A Consultant Coal Mining Report was obtained for the site which indicates the following:

- No past underground mining is recorded;
- No probable unrecorded shallow workings are recorded;
- No mine entries are recorded within 100 m of the site;
- No coal outcrops are recorded; and
- No opencast mines are recorded within 500 m of the site.

The Groundsure report and historical mapping do not indicate any evidence of any non-coal mining activity on site or in proximity to the site.

3.5 HYDROLOGY AND HYDROGEOLOGY

The Glacial Till, Head deposits and Lower Pennine Coal Measures are classified as 'Secondary A Aquifers – Undifferentiated'. The Lacustrine Deposits are classified as an unproductive aquifer. There are no groundwater source protection zones or abstraction wells within 1km radius of the site.

The closest surface water feature is the ditch on the northwestern boundary. This discharges into Brightly Brook, located approximately 1.5km to the west. As discussed above a 'U' shaped pond is located immediately to the south of the site.

The site is located within Flood Zone 1 and therefore has a low probability of flooding from rivers and the sea.

3.6 LANDFILL AND WASTE MANAGEMENT

A permitted inert landfill named Hareshill Farm is present adjacent to the northwest of the site. This was in operation from 2012 and is reported to have taken inert waste, comprising construction materials. Third party investigations have been completed over the footprint of the Hareshill Farm waste site (4). The findings are summarised below:

- Trial pits TP432, TP433 and TP434, located in the eastern part of the landfill (and closest to the current site) report Made Ground to a proven depth of 3.5m bgl (TP432) and unproven depth of >4.0m bgl. The Made Ground (i.e. landfill material) comprised ashy sand / gravelly clay with brick and concrete, consistent with an 'inert' material.
- A high risk to future development from ground gas (both methane and carbon dioxide) in the absence of mitigation (which is noted to be an assessment by WYG utilising a number of phases of data from third parties). It is indicated concentrations of methane of up to 86%v/v were recorded whilst flow rates up to 68l/hr were also recorded as summarised by WYG.
- A low / moderate risk to future site users from asbestos containing materials within the ground.

- A moderate risk to surface waters from groundwater contaminants at the site although off site sources are likely to be contributing to the net contamination loading.
- A low/moderate risk to surface waters from boron.
- A moderate risk to water supply pipes from hydrocarbon compounds.

3.7 RADON

The Groundsure Report records the southern portion of the site to be within an area where the estimated proportion of properties affected by radon is between 10% and 30%. As such 'full' radon protection measures will be required in new developments. It is noted this mapped area generally coincides with the location of the superficial Head Deposits; however, the geological strata to which the classification relates is not clear.

3.8 POTENTIAL SOURCES OF CONTAMINATION

The following potential sources of contamination were identified within the WSP PRA, which are likely associated with the historical use of the site and adjacent sites:

- A range of contaminants within Made Ground materials (including asbestos, heavy metals, polyaromatic hydrocarbons (PAH) and petroleum hydrocarbons (TPH)).
- Contaminants associated with the Hareshill Farm Landfill adjacent to the site in the west (including asbestos and metals), along with hazardous landfill gases.
- Contaminants associated with additional offsite former and current industry including sewerage works, tanks, depot and potential spreading of sludge associated with wider farming activities (ammonia, metals, PAH and TPH).
- Hazardous ground gases associated with organic soils (i.e. former marshland indicated onsite), potentially significant thickness of Made Ground (onsite and offsite).

It is noted whilst the permitted Hareshill Farm landfill adjacent to the west is understood to have received inert materials (i.e. not expected to biodegrade) and therefore the potential for contamination and ground gas would ordinarily be expected to be low, previous investigations of the former landfill site itself (as outlined within **Section 3.6**) have indicated the presence of metals and asbestos in soils and a risk from hazardous ground gases.

3.9 INITIAL CONCEPTUAL SITE MODEL

The initial Conceptual Site Model within the WSP PRA identified several contaminant sources and plausible contaminant linkages that required further assessment. The plausible contaminant linkages are summarised below:

1. Inhalation of asbestos fibres by construction workers during redevelopment and future site users / maintenance workers following development.
2. Direct contact, ingestion and inhalation of soil-bound contamination / dust during redevelopment by construction workers and by future site users following development.
3. Accumulation of hazardous ground gases in excavations and built structures with potential to create an explosive / asphyxiating atmosphere, potentially impacting construction workers and future site workers.
4. Accumulation of radon in built structures with potential for long term exposure by future site workers.

5. Migration of mobile contamination to the surface water (ditch) on the western boundary and the Secondary Undifferentiated Aquifer (Till), Secondary A Aquifer (Bedrock) and wider surface water environment.

Potential contaminant linkages considered to be possible but less likely include the following:

6. Inhalation of vapours associated with volatile ground contamination by construction workers, maintenance users and future site users following development (potential for volatile contamination considered to be low based on development history).

4 GROUND INVESTIGATION

4.1 FIELDWORK

4.1.1 EXPLORATORY HOLES

A ground investigation was scoped by WSP, to provide geotechnical information and aid the development of a ground model to support the cost-effective design of the substructures and data to assess the contamination status of the site.

Ground investigation works were undertaken by LK Consult between the 27 and 28 November 2023.

The works undertaken are summarised in **Table 4-1**.

Table 4-1 – Summary of Fieldworks

Investigation Method	No. of Positions	Depth (m BGL*)	Rationale
Window sampler boreholes, with dynamic probing follow on	4 (WS01 to WS04)	10 (Dynamic probing form 6m to 10m)	General site coverage
Machine excavated trial pit	5 (TP01 to TP05)	4.0-4.3	General site coverage
Hand excavated trial pit	6 (HD01 to HD06)	0.18 – 0.56	Services location and investigation of verge between Queen Elizabeth Way and the site

The procedures followed in the investigation were in general accordance with guidance presented in BS 5930:2015 (6) and BS 10175: 2011 (7).

The results of the ground investigations are presented in the Factual Report, which is presented in **Appendix D**. The Factual Report contains exploratory hole records, in-situ testing data, monitoring results, and laboratory testing results.

An exploratory hole location plan is presented in the Factual Report and as Figure 2 in **Appendix A**.

4.1.2 MONITORING WELL INSTALLATIONS

Groundwater and ground gas monitoring installations were placed in the boreholes as summarised in **Table 4-2**.

Monitoring wells were constructed from 50mm perforated plastic pipe with a pea gravel surround and fitted with air-tight gas valves with a flush cover.

Table 4-2 - Monitoring Well Installations

Exploratory Hole Location	Ground Level	Screen Top and Base Depth (m bgl)	Screen Top and Base Elevation (m AOD)	Screened Strata
WS01	125.204	1.00 – 4.00	124.204 – 121.20	Made Ground
WS02	122.801	1.00 – 4.00	121.801 – 118.80	Made Ground/Glacial Till
WS03	122.685	1.00 – 4.00	121.685 – 118.68	Made Ground/Glacial Till
WS04	124.478	4.00 – 5.00	120.478 – 119.47	Made Ground
WS05	122.090	1.00 – 4.00	121.090 – 118.09	Made Ground/Glacial Till

4.2 SURVEYING

Exploratory holes were surveyed by LK Consult, with the easting, northing, and Ordnance Datum elevation presented on the exploratory hole records.

4.3 GAS AND GROUNDWATER MONITORING

Six ground gas monitoring rounds were undertaken by LK Group between 13 December 2023 and 29 February 2024 in general accordance with the recommendations within guidance CIRIA C665 (8), which suggests six monitoring visits over three months for a low sensitivity development on a site with a moderate gas generation potential (considered to be a conservative assumption for this site).

Ground gas concentrations and flow rates were measured using an infrared analyser (GA5000). Peak and steady concentrations of methane (CH₄), carbon dioxide (CO₂) and oxygen (O₂) and trace gases (including carbon monoxide, hydrogen sulphide) were recorded along with peak and steady gas flow rates. Atmospheric pressure was also recorded. Following gas monitoring, groundwater depths were gauged.

Groundwater samples were obtained from monitoring wells WS02, WS03 and WS04 on 25 January 2024. Samples were not obtained from WS01 and WS05 due to insufficient volumes. Following high concentrations of ammoniacal nitrogen, an additional groundwater sample was obtained from WS02 on 15 February.

The groundwater and ground gas monitoring records are presented in **Table 3-2** and Appendix E of the LK Factual Report (provided in **Appendix D**). The ground gas risk assessment is presented in **Section 8.5**.

4.4 IN-SITU TESTING

Geotechnical

Standard Penetration Tests (SPTs) were performed within the windowless sampler holes and blow counts presented on the exploratory hole records (Appendix D). Results for SPT N_{60} (corrected for hammer efficiency), are presented in **Section 6**.

Plate load tests, utilising a 600mm diameter plate, were undertaken at a depth of 0.3m in TP04 and TP05 (two no. tests undertaken in TP05).

Where practicable, a hand shear vane and a pocket penetrometer were used to determine/asses undrained shear strength in clay soils.

Geo-Environmental

Disturbed soil samples were taken at regular intervals during the advancement of investigation locations for headspace screening using a photo-ionisation detector (PID) for volatile organic compounds (VOC). The results are provided on the exploratory hole logs presented in Appendix D and a discussion of the results is included in **Section 5.5**.

4.5 LABORATORY TESTING

Geotechnical and chemical testing was scheduled by WSP and comprised the following:

4.5.1 GEOTECHNICAL TESTING

- Moisture content;
- Atterberg limits;
- pH;
- Water soluble (WS) sulphate;
- BRE Suite B (WS Sulphate, Acid Soluble Sulphate, Total Sulphur & pH);
- Organic matter;
- California Bearing Ratio (CBR);
- Compaction Testing (2.5kg hammer), and;
- Particle Size Distribution.

4.5.2 GEO-ENVIRONMENTAL TESTING – SOILS & GROUNDWATER

A summary of the chemical laboratory analysis undertaken has been summarised in **Table 4-3**. Soil and groundwater environmental analysis was undertaken at DETS Analytical in general accordance with UKAS / MCERTS accredited methods. The chemical results are presented in the LK Factual Report, presented in **Appendix D**.

Table 4-3 - Summary of Geo-Environmental Analysis

Analysis	Number of samples analysed	
	Soil:	Groundwater:
Asbestos Identification	13	-
Metals	13	4
Speciated Total Petroleum Hydrocarbons (TPH CWG)	9	4
Polycyclic aromatic hydrocarbons (PAH)	13	4
Benzene, Toluene, Ethylbenzene and xylene (BTEX)	9	4
Cyanide (free and total)	10	-

Analysis	Number of samples analysed	
	Soil:	Groundwater:
Soil Organic Matter	13	-
Phenols (total)	9	-
Methyl-tert-butyl-ether (MTBE)	10	-
pH	13	4
Sulphate	13	4
Phenols	9	-
Ammoniacal nitrogen	-	4

5 GROUND SUMMARY

5.1 ADJACENT TO QUEEN ELIZABETH WAY

The following ground summary is provided for the verge between the site and Queen Elizabeth Way.

Table 5.1 – Strata Summary – Adjacent to Queen Elizabeth Way

Strata	Description	Depth to Top (mbgl)	Elevation of Top (m AOD)	Thickness (m)	Notes
Made Ground	Gravelly sandy SILT with fragments, clinker, ash, and brick	0.0	123.30 - 123.50	0.18 – 0.32	Other than (HD06 – Terminated on BT manhole) all trial pits terminate on concrete believed to be associated with the former Hareshill Road

5.2 MAIN SITE

The main body of the site has been split into two separate ground models. One for the northern and eastern parts of the site, where mounded Made Ground is present, and one for the southern and western parts. These are presented in **Table 5.2** and **Table 5.3**.

Table 5.2 – Strata Summary – North and East (Mounds)

Strata	Description	Depth to Top (mbgl)	Elevation of Top (m AOD)	Thickness (m)	Notes
Made Ground	Gravelly sandy SILT with clay lenses, brick fragments, clinker, ash, plastic, glass. Gravel of sandstone. Occasional cobbles of sandstone and concrete. & Sandy silty clayey GRAVEL with brick fragments, ash and clinker. Gravel of sandstone.	0.0	124.48 - 125.37	3.8 – >4.9	Recorded in all WSS and TPs Note. Depth of Made Ground not proven in TP01 & TP03 (>4m)
Glacial Till	Firm and stiff sandy silty CLAY with frequent sand bands.	3.8 – 4.9	119.58 - 121.4	>0.6 - >5.6*	

* base of strata not reached (assumes dynamic probing terminated in Glacial Till)

Table 5.3 – Strata Summary – South and West

Strata	Description	Depth to Top (mbgl)	Elevation of Top (m AOD)	Thickness (m)	Notes
Made Ground	Gravelly sandy SILT with clay lenses, brick fragments, clinker, ash, plastic, glass. Gravel of sandstone. Occasional cobbles of sandstone and concrete.	0.0	122.09 – 123.37	0.7 – 2.2	Recorded in all WSs and TPs
Alluvium	Grey slightly sandy clayey SILT with frequent wood fragments and rootlets. Moderate organic odour.	1.3 – 1.5	120.79 – 121.30	0.30 – 0.70	Recorded in WS02 and WS05
Glacial Till	Soft to firm becoming very stiff sandy silty CLAY with frequent sand bands.	0.7 – 2.2	120.09 - 121.49	1.1 - >4.7*	

* base of strata not reached (assumes dynamic probing terminated in Glacial Till)

5.3 LONG SECTIONS

Two geological long sections through the site are presented in **Appendix A**.

5.4 GROUNDWATER

Groundwater strikes during the fieldworks and the results of the six rounds of groundwater monitoring summarised in **Table 5.4**. Monitoring results are plotted on **Figure 5-1**.

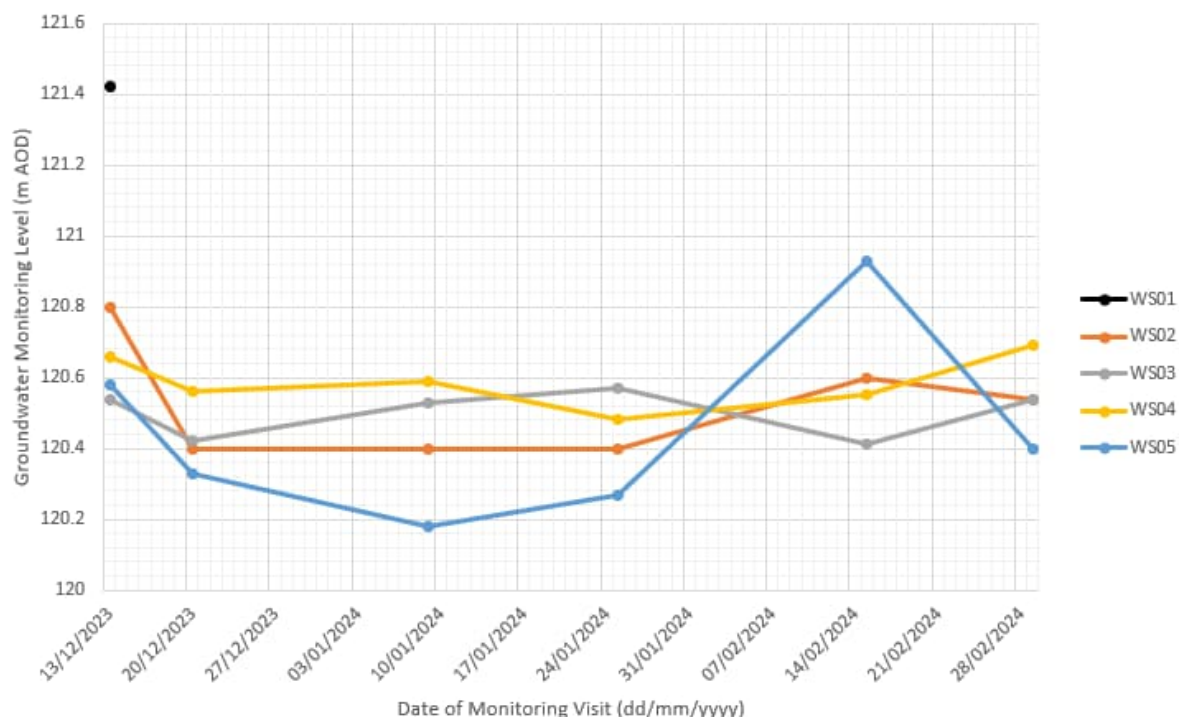
The data suggests that the groundwater table may lie at around 120.5m AOD, and within the Glacial Till. Based on the monitoring, a slight hydraulic gradient to the south is suggested. It should be appreciated that groundwater levels may vary due to climatic conditions and other factors.

Table 5.4 – Summary of Groundwater Strikes & Monitoring Levels

Exploratory Hole	Groundwater Strike Level (mbgl (mAOD))	Monitoring Level (mbgl (mAOD))		Stratum Detail
	Initial	Min.	Max.	
WS01	3.90 (121.30)	3.78 (121.42)	Dry	Glacial Till - Cohesive
WS02	3.00 (119.80)	2.40 (120.40)	2.0 (120.80)	Glacial Till - Cohesive
WS03	3.00 (119.68)	2.27 (120.42)	2.12 (120.57)	Glacial Till - Cohesive
WS04	3.20 (121.27)	4.00 (120.48)	3.79 (120.69)	Made Ground - Granular
WS05	5.50 (116.59)	1.91 (120.18)	1.16 (120.93)	Glacial Till – Granular

Exploratory Hole	Groundwater Strike Level (mbgl (mAOD))	Monitoring Level (mbgl (mAOD))		Stratum Detail
	Initial	Min.	Max.	
TP01	Dry	Not installed		N/A
TP02				
TP03				
TP04	2.20 (121.17)			Glacial Till - Cohesive
TP05	4.00 (118.18)			Glacial Till - Cohesive

Figure 5-1 – Recorded Groundwater Elevation Over Monitoring Period



* WS01 recorded 'dry' on 5 No. visits.

5.5 VISUAL EVIDENCE OF CONTAMINATION

No visual or olfactory evidence of contamination was noted on the exploratory logs. Headspace VOCs measured on site with a PID recorded concentrations of less than 1ppm (maximum 0.4ppm) providing an initial indication that concentrations of volatile compounds in soils are low.

The Made Ground frequently contains brick, mortar, and concrete fragments as well as clinker, and ash. A moderate organic odour was recorded within a layer of silt containing wood / organic material (the deepest layer of Made Ground) within WS01 and WS04, and within a similar material directly beneath the Made Ground within WS02. Based on the groundwater monitoring records, the groundwater from WS01 was observed to be black with a strong organic odour and in WS02 was noted to have a slight organic odour.

It is noted, within WS01, a woven geotextile membrane was encountered at 3.8m bgl between the Made Ground and underlying natural clay.

5.6 GROUND GAS MONITORING RESULTS

Gas monitoring was undertaken at monitoring wells WS01 to WS05 on six occasions. Monitoring well response zones are generally located between depths of 1m bgl and 4m bgl (within the Made Ground or spanning the Made Ground and underlying natural soils), with the exception of WS04, in which the response zone was located at 4-5m bgl within an organic silt Made Ground; as such the response zone was submerged beneath groundwater on all monitoring occasions and therefore the gas monitoring data has been discounted.

During the monitoring, atmospheric pressure ranged between 987mb (Round 6) and 1019mb (Round 4). Regional barometric pressure was falling during Round 1, 2, 3 and 6 and rising during Round 4 and 5. The atmospheric conditions are considered represent a 'worst case' in relation to gas generation (i.e. low and falling atmospheric pressure) during Round 1 and 6.

The results of the gas monitoring are presented in the LK Factual Report in **Appendix D** and are summarised in **Table 5.5** below. The maximum concentrations and flow rates are shown in bold.

Table 5-5 - Summary of Ground Gas Monitoring Results

Monitoring well	Response Zone (RZ) (m bgl)	Maximum CH ₄ (% v/v)		Maximum CO ₂ (% v/v)		Flow Rate (l/hr) (if negative, highest positive flow in brackets)		Frequency of RZ fully flooded
		Steady	Peak	Steady	Peak	Steady	Peak	
WS01	1.0 – 4.0 (Mound Made Ground)	2.6	2.6	0.3	0.3	0	0	0 of 0
WS02	1.0 – 4.0 (Made Ground / clay)	51.2	51.4	18.6	19.7	0	0.1	0 of 0
WS03	1.0 – 4.0 (Made Ground / clay)	5.1	5.1	6.9	6.9	-2.5 (2.4)	-10.1 (5.9)	0 of 0
WS04 *	4.0 – 5.0 (Mound Made Ground)	1.9	1.9	1.7	1.8	0	0.1	6 of 6
WS05	1.0 – 4.0 (Made Ground / sand and clay)	0.1	0.4	4.7	4.7	5.0	8.0	0 of 0

* Discount data due to response zone being submerged / flooded

Based on the above results, the following is noted:

Gas Concentrations

- The recorded peak and steady concentrations were consistently similar for both methane and carbon dioxide.
- Steady elevated concentrations of methane (i.e. above 1%v/v) were detected in all monitoring wells except WS05 (located in the southeast).
- The maximum methane concentration (51.4%v/v (peak) and 51.2%v/v (steady)) was recorded within WS02 during Round 3. Appreciably elevated methane concentrations (36.8%v/v to 51.4%v/v) were consistently recorded in WS02, located in the centre of the site outside of the mounded Made Ground and close to the mapped position of the historical pond. Within the remaining wells (WS01, WS03 and WS05) steady methane concentrations were lower, between 0.4%v/v and 5.1%v/v.
- Elevated steady carbon dioxide concentrations (above 5%v/v) were consistently recorded in WS02 (8.8%v/v to 18.6%v/v) and WS03 (3.8%v/v to 6.9%v/v). The maximum concentration was recorded in WS02 (19.7%v/v peak reading) during Visit 3.

Gas Flow Rates

- Appreciable positive and negative peak gas flow rates were recorded within WS03 and WS05 only, with other wells recording negligible flow rates. WS03 and WS05 are located at the south-western end of the site. WS03 is not reported to contain a potentially gas producing organic silt layer, whilst WS05 reported silt with rootlets at 1.3-2.0m bgl.
- A summary of the peak and steady flow rates recorded in WS03 and WS05 is provided in **Table 5-6**. The occurrence of a positive or negative flow rate does not appear to be consistent between wells during a single visit or correlate with changes in groundwater level between visits.
- The highest positive peak flow was 8 l/hr recorded within WS05 during Round 5. It is noted that within WS05 on this occasion, only 0.16m of the response zone was above the water level.
- The maximum steady gas flow rate is 5.0 l/hr recorded from WS05 during Round 5. The maximum negative steady flow rate was -2.5l/hr (WS03).
- Low carbon monoxide (CO) concentrations have been sporadically recorded with the maximum recorded concentration 29ppmv as an initial reading (WS03, Round 2).
- Hydrogen sulphide was not recorded above the limit of detection of the equipment.

Table 5-6 – Flow Rate Summary for WS03 and WS05

Atmospheric Conditions			Peak Flow Rate (l/hr)		Steady Flow Rate (l/hr)		Available RZ (m)	
Gas Monitoring Visit	Recorded Atmospheric Pressure (mb)	Recorded atmospheric pressure trend	WS03	WS05	WS03	WS05	WS03	WS05
1	993	Falling	-3.2	3.6	-1.7	1.9	1.15	0.51
2	1001	Falling	1.8	-0.1	1.2	-0.1	1.27	0.76
3	1018	Falling	-10.1	-3.9	-2.5	-1.3	1.16	0.91
4	1005	Rising	-5.6	6.0	-0.2	2.1	1.12	0.82
5	988	Rising	5.9	8.0	2.4	5.0	1.28	0.16
6	986	Falling	0.0	7.5	0.0	3.1	1.15	0.69

6 GROUND CONDITIONS & MATERIAL PARAMETERS

6.1 GENERAL

The following section discusses the ground conditions and material properties determined from the ground investigation and geotechnical testing described in **Section 4**.

Where necessary, determination of geotechnical parameters has been based on cautious estimates of laboratory derived results, published correlations and field tests, complemented with engineering judgement.

Where material parameters are assumed, derived by calculation, or taken from published sources, further details are provided as to their derivation.

6.2 MADE GROUND

Made Ground was recorded in all the exploratory holes and was and mainly described as a gravelly sandy silt with clay lenses and brick, ash, clinker, plastic, metal, rootlets and coal fragments, or a very sandy silty clayey gravel with brick, ash and clinker. Gravels are predominantly sandstone, with rare concrete and quartzite.

Moderate organic odours were noted locally.

Sandstone boulders were noted in TP04.

On the mounded areas of the site, Made Ground was proved to a maximum depth of 3.8m bgl (>4.0mbgl in TP01 & TP03). Elsewhere, Made Ground thicknesses were typically <1.5m.

The results of in-situ and laboratory testing undertaken in the Made Ground – Cohesive and Made Ground - Granular are summarised in **Table 6.1** and **Table 6.2** respectively.

Table 6.1 – Summary of In-Situ & Laboratory Testing – Made Ground - Cohesive

Test	Parameter	Symbol	Unit	No. of Tests	Range (Mean)
Standard Penetration	Corrected Blow Count	N_{60}	Blows/300mm	3	8-9 (9)
Index	Moisture Content	W	%	20	12-30 (19)
	Liquid Limit	w_L	%	2*	32 & 37 (35)
	Plastic Limit	w_P	%		13 & 15 (14)
	Plasticity Index	I_P	%		19 & 23 (21)
Particle Size Distribution	Clay/Silt Content	-	%	5	18-40 (26)
	Sand Content	-	%		21-37 (27)
	Gravel Content		%		23-57 (47)
Compaction Test (2.5kg hammer)	Optimum Water Content	-	%	5	11-17 (15)
	Max Dry Density	-	Mg/m ³		1.73-1.94 (1.81)

Test	Parameter	Symbol	Unit	No. of Tests	Range (Mean)
	Particle Density	-	Mg/m ³		2.55-2.64 (2.60)
California Bearing Ratio	California Bearing Ratio	CBR	%	4	0.6-5.4 (2.3)
	California Bearing Ratio	CBR	%	3	0-2%
Chemical Testing	pH	-	-	3	8.1-8.4(8.2)
	Water Soluble SO ₄	-	%	3	31-890 (358)
	Total Sulphur	-	mg/l	3	0.052-0.096 (0.069)
	Organic Matter	-	%	3	2.1-3 (2.5)

* 1 additional No. result shown as Non-Plastic.

Table 6.2 – Summary of In-Situ & Laboratory Testing – Made Ground – Granular

Test	Parameter	Symbol	Unit	No. of Tests	Range (Mean)
Standard Penetration	Corrected Blow Count	N_{60}	Blows/300mm	5	11-29 (20)
Moisture Content	Moisture Content	W	%	2	19 & 21 (20)
Particle Size Distribution	Clay/Silt Content	-	%	2	10 & 21 (16)
	Sand Content	-	%		21 & 36 (28)
	Gravel Content		%		54 & 58 (56)
Compaction Test (2.5kg hammer)	Optimum Water Content	-	%	1	14
	Max Dry Density	-	Mg/m ³		1.80
	Particle Density	-	Mg/m ³		2.55
Chemical Testing	pH	-	-	1	8.1
	Water Soluble SO ₄	-	%		273
	Total Sulphur	-	mg/l		0.058

Material Composition

Particle size distribution (PSD) tests indicate that all the seven samples tested had a significant sand/gravel content. Fines contents ranged from 10% to 40%.

Atterberg testing of the Made Ground suggest that the finer fraction is a clay of low to medium plasticity (rather than the silts described on site).

Six of the seven PSDs would classify as a Class 2C, Stoney Cohesive Material as defined in *Volume 1 Specification for Highways Works – Series 600*” of the Manual of Contract Documents for Highways Works (Series 600 SHW) (9).

One sample would classify as Class 1B 'uniformly graded granular material'.

Based on engineering judgment, it is not considered unreasonable to assume that the majority of the Made Ground would behave as a cohesive soil.

A plot of Made Ground moisture content is presented as **Figure 6-1**.

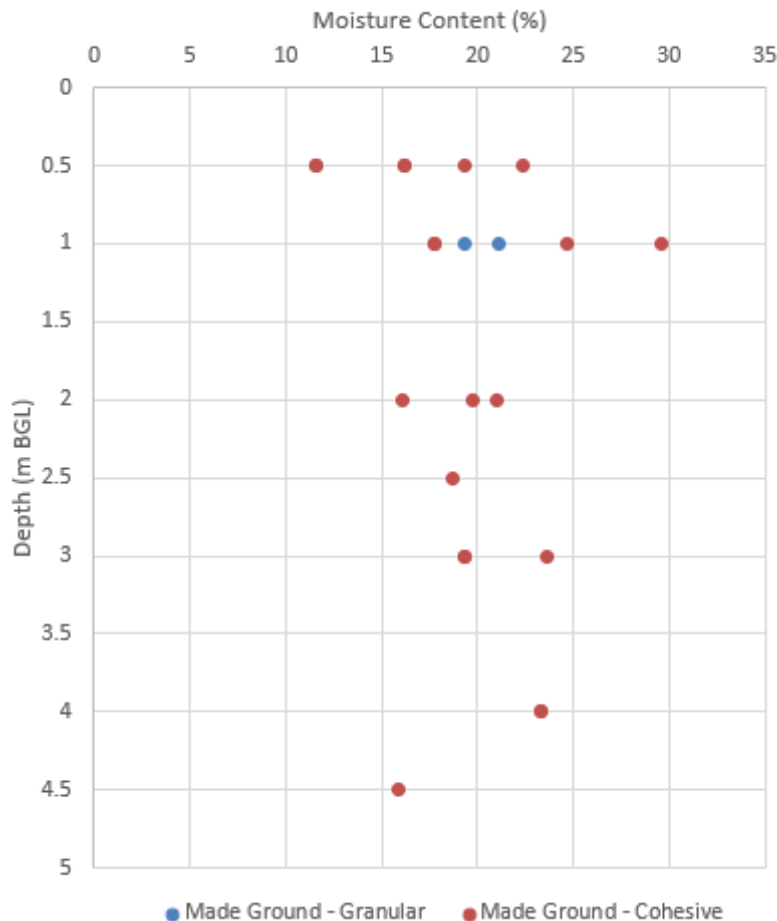


Figure 6-1 – Moisture Content vs Depth for Made Ground

The moisture content for the Made Ground is fairly consistent with depth, and typically between 16% and 25%.

6.2.1 UNIT WEIGHT

From engineering judgement and bulk density from CBR testing, a characteristic Saturated Unit Weight of 19kNm^{-3} is suggested for the Made Ground.

6.2.2 SHEAR STRENGTH

The undrained shear strength, c_u has been considered though the following relationship with SPT N_{60} :

$$c_u = f_1 N_{60} \quad (10)$$

Where f_1 is a factor dependant on the material plasticity, taken as 5.1 for a mean Plasticity Index of 21%.

A plot of SPT N_{60} is shown in **Figure 6-2**.

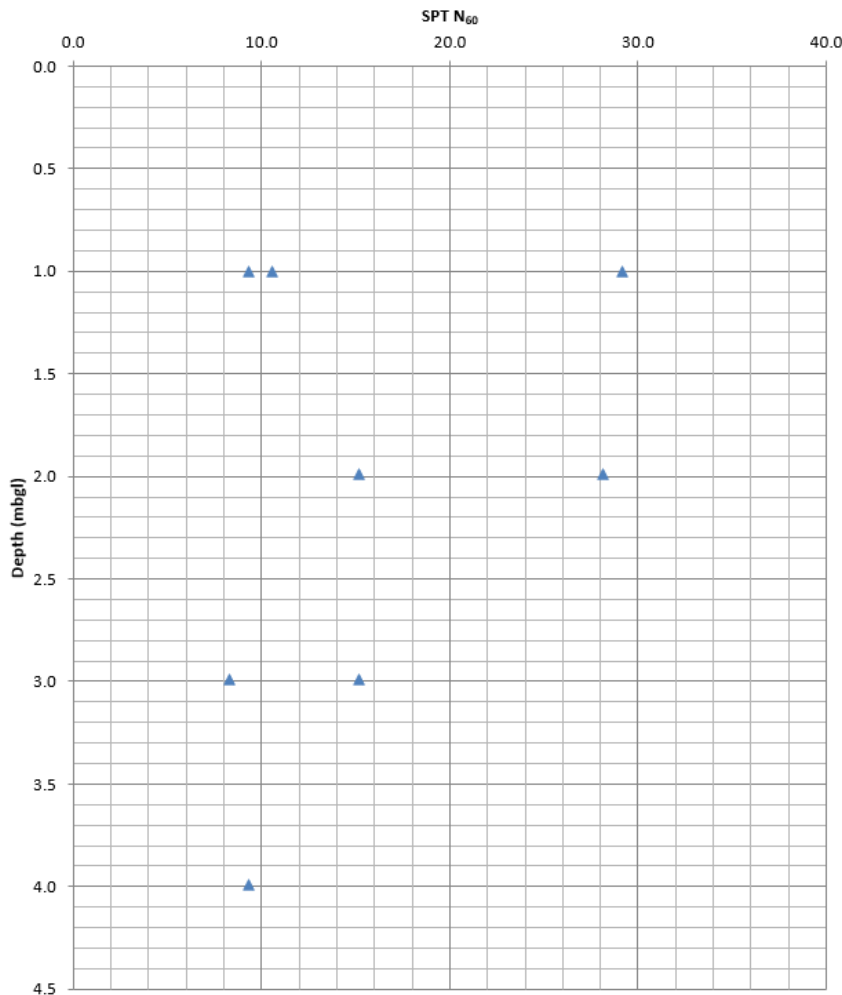


Figure 6-2 – SPT N_{60} – Made Ground

Based on Figure 6-2 and considering the limitations of the material descriptions (consistency was not assessed in the field), the inherent variability of Made Ground, an undrained shear strength in the region of 40kPa is not considered unreasonable.

6.2.3 COMPACTION

Optimum moisture contents ranged between 11% and 17%, with dry densities of between 1.73-1.94Mg/m³. Material reuse is discussed further in **Section 7.3**.

6.2.4 CALIFORNIA BEARING RATIO

Laboratory CBR testing provided values between 0.6% and 5.4%. The higher value is from the verge between the site and Queen Elizabeth Way. The tests from the main body of the site did not provide values greater than 2%, with two of the three tests giving <1%.

One of the three plate load tests provided a CBR value of 2%. The other two provided values of <0.5%

CBR can also be estimated based on the following empirical correlation with c_u :

$$CBR = c_u / 23 \quad (11)$$

Based on the characteristic c_u discussed above, this would give a CBR of 1.7%.

Based on the data obtained, it is considered that in situ and recompacted CBR values for the Made Ground are likely to be very poor and <2.0%.

6.3 ALLUVIUM

A sandy clayey SILT with an organic odour was recorded between 1.5m and 1.8m BGL in WS02 and 1.3 to 2.0m BGL in WS05.

The results of the in-situ and laboratory testing of Alluvium are summarised in **Table 6.3**.

Due to the limited occurrence of the Alluvium, there is limited testing data and material parameters have not been derived.

Table 6.3 – Summary of In-Situ & Laboratory Testing – Alluvium

Test	Parameter	Symbol	Unit	No. of Tests	Range
Standard Penetration	Corrected Blow Count	N_{60}	Blows/300mm	1	9
Pocket penetrometer	Undrained Shear Strength	c_u	kPa	1	44
Chemical Testing	Moisture Content	w	%	1	25
	pH	pH	-	1	7.3
	Organic Matter	-	%	1	6
	Water Soluble SO ₄	-	mg/l	1	165
	Total Sulphur	-	%	1	0.083

6.4 GLACIAL TILL

Glacial Till was recorded in all exploratory holes which penetrated the Made Ground.

The base of the stratum was not proven in the window sampler boreholes, and it is assumed that the dynamic probing terminated in the stratum.

The Glacial Till was typically described as soft and firm becoming stiff and very stiff sandy silty clay with frequent sand bands.

The results of in-situ and laboratory testing for the Glacial Till are summarised in **Table 6.4**.

Table 6.4 – Summary of In-Situ & Laboratory Testing – Glacial Till

Test	Parameter	Symbol	Unit	No. of Tests	Range (Mean)
Standard Penetration	Corrected Blow Count	N ₆₀	Blows/300mm	14	7–32 (17)
Pocket penetrometer	Undrained Shear Strength	c _u	kPa	18	24-220 (71)
Hand Shear Vane	Undrained Shear Strength	c _u	kPa	7	34-46 (40)
Index	Moisture Content	W	%	11	11–25 (18)
	Liquid Limit	w _L	%	3	39-47 (42)
	Plastic Limit	w _P	%		14-18 (16)
	Plasticity Index	I _P	%		24-29 (26)
Chemical Testing	pH	pH	-	2	7.1-8.2 (7.7)
	Water Soluble SO ₄	-	mg/l	2	18-25 (21)
	Total Sulphur	-	%	2	0.017-0.057 (0.037)

6.4.1 MATERIAL COMPOSITION

The index testing and material descriptions indicate the material typically comprises a medium plasticity clay.

Figure 6-3 presents a plot of moisture content versus depth for the Glacial Till. This suggests that moisture content decreases with elevation.

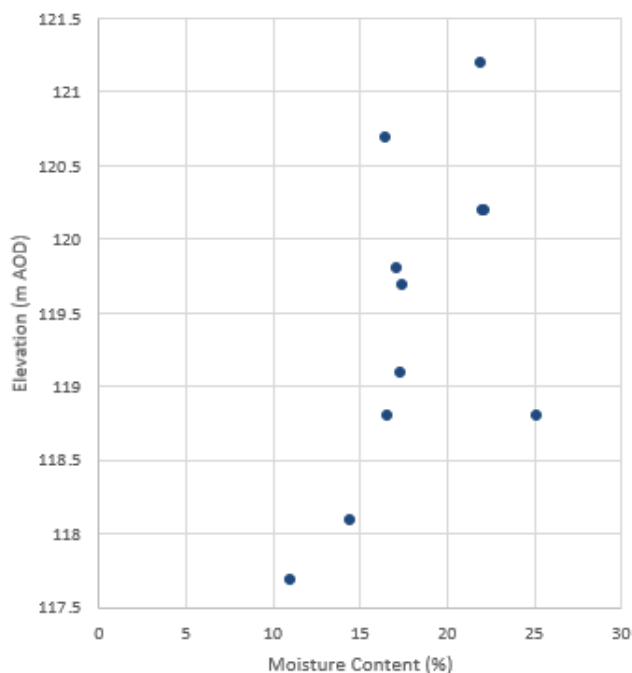


Figure 6-3 – Moisture Content vs Elevation for Glacial Till

6.4.2 UNIT WEIGHT

From engineering judgement and material descriptions a characteristic Saturated Unit Weight of 19kNm^{-3} is suggested for design.

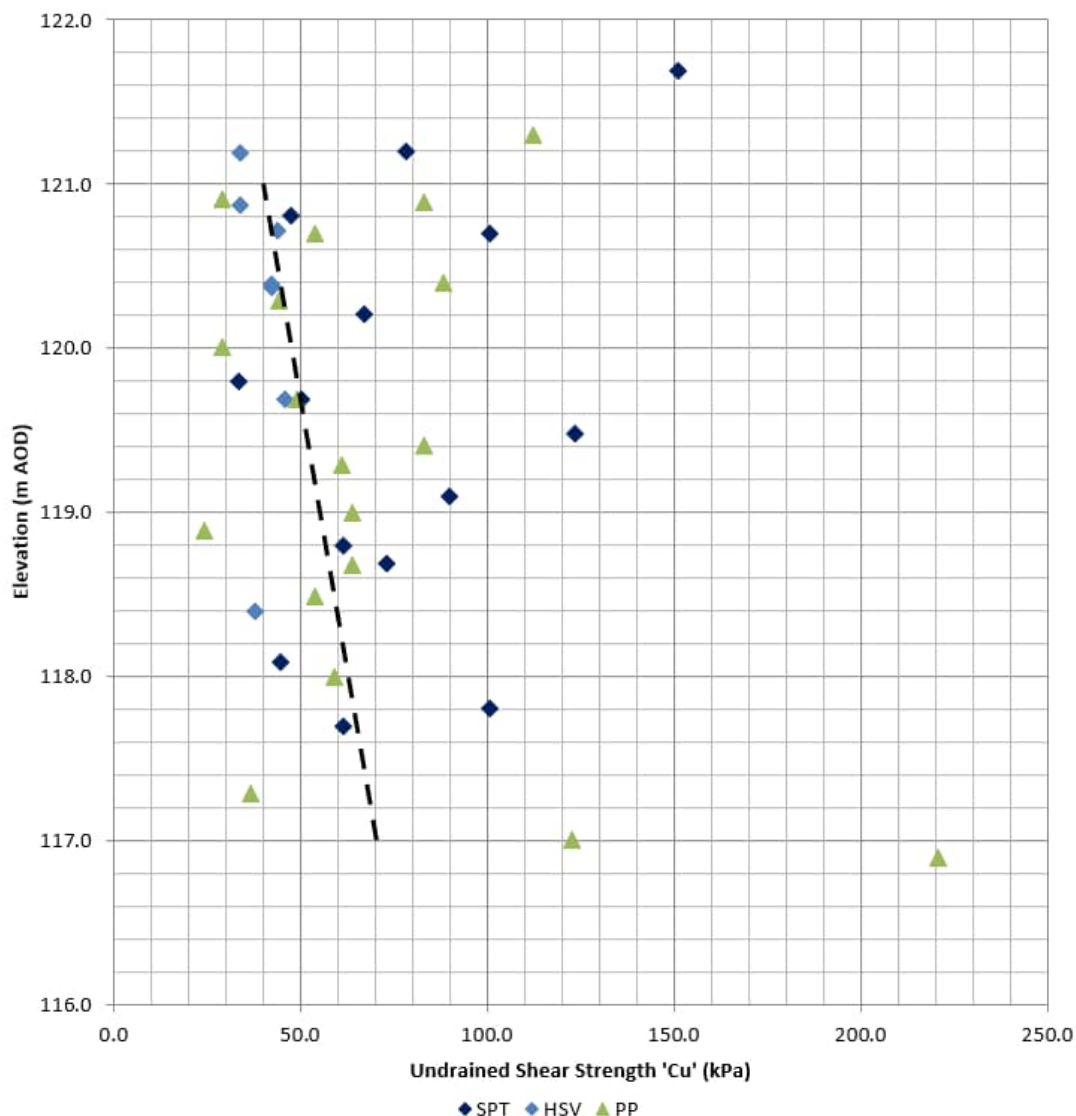
6.4.3 SHEAR STRENGTH

The undrained shear strength, c_u has been estimated from the relationship with SPT N_{60} discussed above (using an $f1$ factor of 4.8 for a plasticity index of 26), and values derived from hand shear vane and pocket penetrometer testing.

The results of the assessment are presented on **Figure 6-4** below and based on this, a characteristic value c_u of the following is suggested:

$$c_u = 40 + 7.5z^* \text{ kPa}$$

*where z = metres below 121m AOD.



6.4.4 STIFFNESS

Using a correlation of $500 \cdot C_u$, an undrained Young's Modulus of

$$E_u = 20 + 3.75z^* \text{ MPa}$$

*where z = metres below 121m AOD.

and a characteristic drained Young's Modulus, E' of:

$$E' = 12 + 2.25z^* \text{ MPa}$$

*where z = metres below 121m AOD.

have been assumed for the Glacial Till.

7 GEOTECHNICAL & ENGINEERING ASSESSMENT

7.1 DEVELOPMENT PROPOSALS

The proposed development will initially comprise the construction of a primary substation, followed by a food store and a local centre.

At this stage, structural loadings and serviceability requirements for either structure is unknown. Therefore, the advice provided below is presented as preliminary and will need to be reviewed at detailed design stage.

Drawing No. **SOHW-WSP-PSS-ENAB-DR-D-0001**, Drawing No. **SOHW-WSP-PSS-ENAB-SK-D-0005** and **Drawing No. SOHW-WSP-PSS-ENAB-SK-D-0006** in **Appendix B** illustrate the general site arrangement and the proposed extent of cut and fill works. Under the mounded area of the site, significant cut is required to reach development platform level. Outwith the mounded area, other than the filling of ditches/low areas, no significant changes in level are anticipated albeit, due to level differences, a retaining wall, (retaining the site), may be required to the east of the primary substation.

7.2 GEOTECHNICAL CATEGORY

It is considered that the proposed structures fall within Geotechnical Category 2 as defined in BS EN 1997-1:2004+A1:2013 (2). These are conventional types of structures and foundations with no exceptional risk of difficult soil or loading conditions.

7.3 EARTHWORKS & MATERIAL SUITABILITY

Re-profiling of the site will result in a surplus of material, and it is understood that this may either be used as fill on the wider development or disposed of to landfill. Re-use of site won materials should be managed through the preparation of a Materials Management Plan (MMP).

Optimum moisture contents for the Made Ground ranged from 11% to 17% (average of 15%). In order to achieve a reasonable degree of compaction, the upper bound moisture content is considered to be in the region of OMC+3%. Based on the compaction tests and the general moisture content testing (**Figure 6-1**), a reasonable proportion of the Made Ground is likely wetter than the suggested upper bound. This is also reflected in the modest shear strength and the low CBR values recorded.

It is considered, that based on their moisture content, the Made Ground soils are unlikely to be suitable for reuse as fill (other than for landscaped areas) in their as dug state. Other issues, such as general grading also need to be addressed.

Drying soils on site may prove problematic and therefore it is considered that could be given to the use of imported granular fills, or the modification cut soils with lime, cement, or both.

In addition, the Made Ground that will remain below the platform level, will likely require re-engineering to support structures and external works. These works are discussed below.

An Earthworks Specification will be required to support the redevelopment of the site.

7.4 STRUCTURES

Primary Substation

Other than the infilling of a ditch, significant earthworks are not anticipated across the primary substation.

It is assumed that the substation will comprise a raft foundation, supporting the transformer(s) and a single storey auxiliary building likely also founded on a raft.

Detailed design of the substation is to be undertaken by others, and loadings are currently unknown. However, based on the prevailing ground conditions and experience of similar structures, it is considered that preparatory works are likely required to facilitate construction, and that the following soils may be unsuitable to remain below the structures:

- Made Ground (likely circa 0.5-1.3m thick based on TP05, WS03 and WS05);
- Organic soils (WS05); and,
- Any softened Glacial Till ($c_u < 40\text{kN/m}^2$).

In addition, the culvert which runs below the substation will require removal, and the resulting excavation appropriately backfilled.

Potential foundation strategies may comprise;

- Deepening the rafts to competent ground with lean mix concrete.
- Excavation and replacement of unsuitable soils with imported, granular fill.
- Excavation and replacement of unsuitable soils with modified (e.g. by the use of lime, cement or both) site won fill. However, if only the substation area is initially completed, then such works may not be economical).
- Adopt other forms of ground improvement.

Excavations to remove the culvert and deeper areas of poor soil (e.g. WS05) may encounter the groundwater table (below).

Bearing Resistance & Settlement

The majority of the load will come from the transformers. Bearing pressures are currently unknown, but may be in the region of 50kPa.

Given the likely raft dimensions the risk of bearing failure is likely negligible.

With appropriate design, ground preparation, and construction the risk of significant settlement occurring is likely low.

Food Store

The form of the food store and design loadings are unknown.

Made Ground depths on the northern part of the structure may be circa 0.6-1m below underside of floor slab (WS01 and TP02 – Refer to long sections in **Appendix A**). On the southern part of the structure, similar depths are suggested by WS02 and WS03. However;

- The base of the Made Ground was not proven in TP01 & TP03 and lies somewhere below approximately 121mAOD.
- In the vicinity of WS04, excavations may be in the region of 2.5m deep (base of Made Ground = 119.6mAOD and potentially below the groundwater table (see below)).

The Made Ground is not considered suitable to support a ground bearing slab and pad foundations. It is not unreasonable to assume that a similar solution as described above for the substation could be delivered; with the Made Ground/unsuitable soils removed and replaced/re-engineered to support the floor slab and, where depths dictate, the foundations.

Again, thicker deposits of Made Ground/softened ground may be present and should be anticipated. Based on the shear strength of the Glacial Till, a safe bearing resistance of 75kN/m² is suggested for preliminary foundation design.

Further consideration will need to be given to foundation and floor slab design once loads, serviceability limits and levels are fully understood. If it is decided that one or more of these factors make conventional construction impractical, then consideration may need to be given to other forms of ground improvement for example the use of vibro replacement stone columns.

7.5 EXTERNAL AREAS

Temporary Haul Road

It is understood that a temporary access road will be provided to facilitate the construction of the substation. It is assumed this will be designed by a specialist, taking into account the prevailing subgrade conditions.

Permanent Paved Areas

Permanent pavement types are unknown but may comprise a mixture of concrete and asphalt.

Laboratory CBR testing of a sample recovered from the verge between the site and Queen Elizabeth Way, recorded a value of 5.4% for the Made Ground. It is noted that the previous Hareshill Road appears to be still in place and at shallow depth (generally <0.3m). Whether the old construction could be partly used to support the new (i.e. as the subgrade) is unclear. However, given the disturbance likely to be caused by the general construction works and the installation of services, it may be prudent to budget for breaking out the existing construction and providing a new pavement.

Within the main body of the site, Made Ground will likely be encountered at subgrade level, and may provide very poor subgrade conditions (CBR <2.0%).

Such low CBR values are generally considered to warrant subgrade remedial works (e.g. excavation and replacement with granular fill and/or use of geogrids).

Again, the use of lime/cement modification could be considered to improve the subgrade, and to provide a CBR of say 3-5%. It is suggested that, subject to detailed design, a minimum of 1000mm of material is improved below subgrade level. It is assumed that such works will not require Local Authority approval, noting that not all such bodies permit the use of lime/cement.

Slopes & Retaining Walls

Where required, retaining walls are to be designed by a specialist and taking into account the prevailing ground and groundwater conditions.

If the mounded area is not fully removed then cut slopes shall not exceed than 1 (vertical) in 2.5 (horizontal).

7.6 OBSTRUCTIONS

The ground investigation recorded the Made Ground to contain brick fragments, sandstone cobbles, boulders and fragments of metal and plastic. It should be assumed that materials which are to be reused as fill will require screening prior to reuse.

Appropriate cost allowances will need to be made for “grubbing out” any obstructions encountered below the anticipated platform level.

7.7 BELOW GROUND EXCAVATIONS

Safe working conditions should be ensured at all times where persons are required to work in any excavations. This can be achieved by the use of ground support or battering excavations back to a safe angle.

The advice of a temporary works designer should be sought, and further reference should be made to CIRIA Report 97 “*Trenching practice*” (12)

Where excavations are undertaken to remove Made Ground, the culvert, softened soils, organic soils, etc. suitable benching details will be required between the areas excavated and the in-situ ground.

Inflows of perched groundwater should be anticipated within the Made Ground. It is considered that these are generally unlikely to be excessive but may be persistent, particularly during periods of inclement weather.

The groundwater table appears to lie within the Glacial Till and based on current monitoring data, lies circa 120.5mAOD. Excavations to remove the Made Ground/poor soils may generally not encounter the groundwater table. However, there are exceptions to this;

- The Made Ground in WS04 appears to extend to approximately 119.6mAOD.
- Based on WS05, excavations to remove the Alluvium may reach an elevation of circa 120mAOD.

Based on the above, it would seem likely that groundwater control may be required to facilitate the removal of poor soils below structures, as well as for the culvert removal and other deep excavations (e.g. drainage runs). It is recommended that the advice of a temporary works designer is sought to determine the optimum dewatering strategy for such areas.

A licence will be required for the disposal of groundwater.

Further reference should be made to CIRIA 97 (13).

7.8 CHEMICAL ATTACK ON BURIED CONCRETE

Based on guidance presented in BRE SD1 (2005) (14) and the water-soluble sulphate and pH testing, within both sampled soils and groundwater, a Design Sulphate Class of DS-1 and Aggressive Chemical Environment Classification (ACEC) of AC-1 are considered appropriate for below ground concrete in the Glacial Till, and of DS-2 and AC-2 for the Made Ground. On this basis, classifications of DS-2 and AC-2 may be assumed for outline design.



Based on guidance provided in BRE SD1, ammoniacal nitrogen concentrations in the groundwater (**Table 8-1**) are considered to be slightly aggressive (<30mg/l). However, as outlined in BRE SD1, specialist advice should be sought on this matter.

7.9 GEOTECHNICAL RISK REGISTER

A preliminary Geotechnical Risk Register for the scheme is presented in **Table 7.1**, which highlights the geotechnical risks post interpretation of the ground investigation data. Geo-environmental risks are assessed in the revised conceptual site model in **Section 8**.

Table 7.1 – Geotechnical Risk Register

Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
Unforeseen ground conditions	Ground conditions differ from those assumed within the design Geater depth of Made Ground/poor soils are present	Delays on site Possible re-design of foundations, retaining structures etc. Financial implications	High	Desk based study and intrusive investigation undertaken to inform the ground model and facilitate design. Note: ground investigation only samples a limited amount of the ground and conditions may exist between exploratory holes that are not identified by the ground investigation and cannot be anticipated from interpretation of the available data. As such, the risk of unforeseen ground conditions cannot be entirely mitigated. Risk to be considered when developing budget costings.	Client/Designer
Excessive settlement of foundations and ground bearing slabs	Inappropriate design Poor subgrade conditions. Poor placement of fills	Financial implications Remedial works required Financial Implications	High	Design to be based on a conservative assessment of ground conditions. Appropriate remedial works to be undertaken in advance of construction. Formation to be validated in accordance with a suitable specification. Fills to be placed in accordance with a suitable specification.	Designer/Contractor

Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
				Performance requirements for fills to be assessed at detailed design stage	
Settlement/poor performance of external paved areas	Inappropriate design Poor subgrade conditions Poor placement of fills Degradation of subgrade	Financial implications Remedial works required Financial Implications	High	Pavement design to be based on a conservative assessment of subgrade CBR. Temporary haul road to be designed by a by a specialist and taking into account the prevailing subgrade conditions. Formation to be remediated and validated in accordance with a suitable specification. Fills to be placed in accordance with a suitable specification. CBR testing to be undertaken to confirm design value is applicable. Allowance to be made for appropriate subgrade preparation, protection and validation.	Designer/Contractor
Poor performance of retaining structures	Inappropriate design Poor subgrade conditions Poor placement of fills	Financial implications Remedial works required Financial Implications	Moderate	Retaining walls to be designed by a specialist and taking into account the prevailing ground and groundwater conditions. Undertake appropriate remedial works in advance of construction	Designer/Contractor
Collapse of excavations.	Insufficient ground support, poor design of batters/ground support	Health & Safety implications	High	Temporary works to be appropriately designed, considering ground stability,	Contractor

Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
		Financial implications Delays on site		groundwater level, loading and proximity and nature of site boundaries.	
Collapse of semi-permanent cut slopes	Poor design	Health & Safety implications Financial implications Delays on site	Moderate	If parts of the mounded are to remain, then cut slopes shall be formed to a suitable angle.	Designer/Contractor
Difficult excavation	Obstructions in Made Ground	Financial implications Delays on site	Moderate	A detailed strategy for obstruction removal should be implemented to ensure that abnormal costs are appropriately managed. Allowances to be made for screening materials that are to be reused as fill.	Contractor
Excessive groundwater ingress into excavations	Excavations to remove poor soils and the culvert encountered groundwater. Groundwater levels higher than currently anticipated. Bodies of perched water in Made Ground.	Health & Safety implications Delays to programme	Moderate to High	Provision of a suitable, specialist designed dewatering strategy.	Contractor / Temporary Works Designer
Damage to services	Inappropriate buried services assessment	Delays Health and safety issues Financial / legal implications	High	Undertake appropriate services search and undertake diversion/disconnection where necessary.	Contractor
Degradation of below ground concrete	Inappropriate concrete assessment	Remedial works required Financial implications	Moderate	Assessment in accordance with BRE SD1 has been undertaken.	Designer & Contractor

Hazard	Cause	Consequence	Perceived Level of Risk Without Control	Control Adopted	Risk Ownership
	Ammoniacal nitrogen concentrations in groundwater			Specialist advice to be taken on Ammoniacal nitrogen concentrations in groundwater	

8 CONTAMINATION ASSESSMENT

8.1 UNDERSTANDING OF GROUND CONDITIONS

The site is located adjacent to a landfill site that was licenced to receive inert waste from 2012.

The northern part of the site is mounded approximately 2.5-3.0m higher than the original site level that is evident in the south, with Made Ground extending to depths of up to 4.9m (unproven at >4.0m in TP01 and TP03) below the top of the mound. To the south of the mound, Made Ground is reported to depths of 0.7-1.5m bgl.

The mounded Made Ground (encountered in TP01 to TP04, WS01 and WS04) is reported to comprise generally a sandy silt / silty gravel with variable anthropogenic inclusions of brick, coal, ash, clinker, glass, metal, plastic, ceramic and cobbles and boulders of sandstone. Evidence of an organic-rich layer is reported within the lower part of the Made Ground in TP01, TP02, WS01 and WS04 (possibly comprising the original Made Ground). The descriptions of the original Made Ground encountered in the southern area (in WS02, WS03, WS05 and TP05) are similar to the descriptions of the mounded Made Ground.

The Made Ground is consistently underlain by several metres of clay (soft to very stiff) and silt with occasional sand lenses / bands. This will likely offer some protection to the underlying bedrock aquifer from downward migration of mobile contamination. The underlying superficial and solid aquifers are considered to have a relatively low sensitivity to contamination.

Groundwater is resting at an elevation of approximately 120.5m AOD. The groundwater elevation data may suggest a slight hydraulic gradient towards the south. Migration of groundwater onto the site from the landfill to the northwest cannot be ruled out.

Geo-environmental laboratory analysis was undertaken on seven samples of the mounded Made Ground (from the northern part of the site), four samples of original Made Ground (from the southern part of the site) and two samples of natural soils from the southern part of the site. A review of the chemical results shows no appreciable difference between chemical concentrations across the sample types. Laboratory asbestos screening did not identify asbestos in any of the samples screened.

The three groundwater samples tested in the laboratory were taken from monitoring wells in the southern part of the site; the wells in the northern area did not contain sufficient water for sampling. Appreciable concentrations of ammoniacal nitrogen are noted in the groundwater sample from WS02, with concentrations in WS03 and WS05 being lower by two orders of magnitude. A second round of groundwater sampling was undertaken within WS02 and the concentrations of ammoniacal nitrogen and other contaminants was comparable.

Appreciably elevated methane and carbon dioxide concentrations have been recorded in WS02; however, flow rates in this monitoring well are negligible. Appreciable positive and negative flow rates have been recorded in WS03 and WS05 in the south-western part of the site, with no apparent correlation between the two wells.

It is understood that most of the mounded Made Ground will likely be removed from the site area to create a level site, with some material possibly being used to fill lower parts, prior to construction.

8.2 INTRODUCTION TO GQRA

In the United Kingdom, the presence of contamination within soil or groundwater is generally only of concern if there is potential for unacceptable risks to a sensitive receptor.

The Generic Quantitative Risk Assessment (GQRA) presented below follows the tiered approach described in Land Contamination Risk Management (LCRM). The risk assessment process begins with screening chemical concentrations in soil or groundwater against conservative generic screening values in a GQRA. GQRAs are performed to assess initial risks to human health and controlled waters and to identify contaminants of concern (CoC) that may require further, more detailed consideration / risk assessment.

8.3 HUMAN HEALTH GQRA

8.3.1 METHODOLOGY

WSP has derived a set of Generic Assessment Criteria (GAC) for the CLEA generic land use scenarios using the CLEA Workbook v1.071 Excel modelling tool. The CLEA workbook does not currently have the capacity to derive criteria to assess risks from the inhalation of vapours derived from contaminants dissolved in groundwater. Therefore, a set of human health groundwater GACs has also been derived using the Johnson & Ettinger (J&E) approach. Based on the nature of the proposed development, the chemical test results have been assessed against screening values derived for a commercial land use scenario. Further details in the methodologies adopted by WSP are provided in **Appendix E**.

Soil organic matter (SOM) content in the samples tested ranged from 1.5% to 12.0%w/w with an average of 5.7%w/w. This increased organic content is likely due to the ash content reported throughout the Made Ground. Notwithstanding the reported SOM content, the soil chemical data has been compared against commercial end use GACs for a more conservative 1% SOM content.

For some contaminants, direct contact will be the dominant pathway for exposure of a receptor to contamination. The nature of any proposed earthworks / soil excavation / soil re-use / areas of soft landscaping are unknown at this stage of the design; it is possible that materials from any depth could be excavated and placed at, or near the surface in the final design. Whilst it is noted that the finished scheme is likely to comprise predominantly hardstanding and building cover, thereby limiting exposure to future site users, as a conservative approach to the risk assessment, soil chemical concentrations in all tested samples have been screened, irrespective of sample depth.

VOCs in shallow groundwater may represent a potential risk to future site users via indoor vapour inhalation. WSP has generated a set of criteria applicable to selected volatile compounds in groundwater designed to be protective of human health for selected land uses, as described in **Appendix E**. The laboratory reports are contained within the LK Factual Report presented as **Appendix D** whilst the GQRA screening reports are provided in **Appendix F**.

8.3.2 RESULTS – SOILS

The screening assessment identified no exceedances of the adopted GAC for the contaminants of concern analysed. Therefore, the reported soil concentrations are considered unlikely to present significant health risk to site users based on a commercial end use.

8.3.3 RESULTS – GROUNDWATER

The concentrations of volatile compounds within the standard analysis suites (BTEX and naphthalene) have been compared to the groundwater vapour assessment criteria; none of the compounds exceed the assessment criteria.

Therefore, the potential risk to human health from vapour inhalation from a groundwater source is considered negligible.

8.3.4 ASBESTOS IN SOILS

A total of thirteen Made Ground samples were examined in the laboratory for pieces of asbestos containing materials (ACM) and asbestos fibres. No asbestos or ACM was reported in the samples that were examined. Given Made Ground is present across the site, it would be prudent to take precautions to minimise dust generation during the ground disturbance works. If suspected ACM is encountered during the ground works, professional advice should be sought.

8.4 CONTROLLED WATERS GQRA

8.4.1 METHODOLOGY

The generic controlled waters risk assessment was conducted in accordance with the principles of the Environment Agency publication 'Remedial Targets Methodology: Hydrogeological Risk Assessment for Land Contamination' 2006 (EA 2006) and the 'prevent and limit' approach of the Water Framework Directive (2000/60/EC). Generic controlled waters risk assessments compare directly measured concentrations with standard assessment criteria.

Appropriate Water Quality Standards (WQS) are selected based on both hierarchy of relevance to England and Wales and the receptor. In this case the controlled water receptors identified in the CSM are:

- Superficial Deposits (Secondary Undifferentiated Aquifers)
- Bedrock (Secondary A Aquifer)
- Unnamed onsite stream in the west
- 'U' shaped pond immediately adjacent to the south of the site

The following hierarchies of WQS were therefore considered to be appropriate:

Surface Waters

- Environmental Quality Standards (EQS) from The Water Framework Directive (Standards and Classification) Directions (England and Wales) 2015 (15). Where the hardness of the receiving water influences the EQS, the lowest (most conservative) EQS has been used in the GQRA.

Groundwater

- UK Drinking Water Standards (DWS) from the Water Supply (Water Quality) Regulation 2000 (amended 2004) (16).
- World Health Organisation Guidelines for Drinking Water Quality, Fourth Edition, Volume 1, (2011) (17).
- World Health Organisation Petroleum Products in Drinking Water (2008) (18).

Groundwater samples were taken and analysed in the laboratory from WS02, WS03 and WS05. In addition, a second round of sampling was undertaken from WS02 in February (WS02(2)). Laboratory results from these three samples have been used in the GQRA. Insufficient water was encountered within WS01 and WS04 for sampling.

8.4.2 RESULTS – RISK TO GROUNDWATER

The controlled waters GQRA screening output is provided in **Appendix F**. A summary of the groundwater samples in which chemical concentrations exceed the water quality standards protective of a groundwater resource is presented in **Table 8.1** below.

Table 8.1 - Summary of Exceedances of Water Quality Standards Protective of Groundwater

Analyte	Groundwater WQS (µg/l) (DWS)	Groundwater sample exceeding WQS	Concentration (ug/l)
Ammoniacal Nitrogen as N	389	WS02, WS05, WS02(2)	19,900, 666, 12,000

The ammoniacal nitrogen results are discussed in Section 8.4.4.

8.4.3 RESULTS – RISKS TO SURFACE WATER

A summary of surface water WQS exceedances is presented in **Table 8.2** below

Table 8.2 - Summary of Exceedances of Screening Criteria Protective of Surface Waters

Analyte	Surface Water WQS (µg/l) (EQS)	Borehole exceeding WQS	Concentration (ug/l)
Copper	1	WS02, WS03, WS05, WS02(2)	1.2, 3.9, 1.9, 2.9
Zinc	10.9	WS02, WS05, WS02(2)	74, 24, 53
Nickel	4	WS05, WS02(2)	11.3, 6.3
Ammoniacal Nitrogen as N	200	WS02, WS03, WS05, WS02(2)	19,900, 346, 666, 12,000

The ammoniacal nitrogen results are discussed in **Section 8.4.4**.

The copper, nickel and zinc EQS exceedances are considered marginal and unlikely to represent potential risks to controlled waters receptors.

In all three groundwater samples the concentrations of the following chemicals are less than the laboratory limit of detection; however, the limits of detections are greater than the WQS. As such, potential WQS exceedances are unlikely, but cannot be ruled out:

- Cadmium
- Benzo(a)pyrene
- Fluoranthene
- TPH-CWG – Aromatic C10 – C12, C12 – C16, C16 – C21, C21 – C35

8.4.4 AMMONIACAL NITROGEN DISCUSSION

Elevated ammonia / ammonium (measured by ammoniacal nitrogen) concentrations in groundwater are generally encountered where organic material is degrading / breaking down naturally. It is commonly associated with landfill leachate and outputs from wastewater treatment works and may be expected in areas of peat or organic-rich soils. Such groundwater may also contain elevated concentrations of dissolved methane.

Recorded ammoniacal nitrogen (as N) concentrations in groundwater are relatively low in WS03 and WS05; as such the groundwater and surface water WQS exceedances in these two samples (described above) are considered relatively minor and unlikely to represent an unacceptable risk to controlled waters.

Appreciably higher ammoniacal nitrogen concentrations are recorded within WS02 and the groundwater and surface water WQS exceedances in WS02 are considered more notable, potentially representing a risk to groundwater and surface water receptors. A second round of groundwater monitoring from WS02 reported concentrations of ammoniacal nitrogen of a similar magnitude, although slightly lower.

It is noted that WS02 is situated in the approximate vicinity of a former pond (on maps dated 1890) and recorded a layer of 'silt with wood' between depths of 1.5m bgl and 1.8m bgl. It is also noted that monitoring well WS02 recorded notably elevated concentrations of methane and carbon dioxide during ground gas monitoring, suggesting biodegradation of organic material is occurring at this location. A similar layer of silt with wood was recorded in WS01 (3.1-3.8m bgl) and WS04 (4.1-4.9m bgl); however, groundwater was not sampled / tested from these monitoring wells. A silt layer was not recorded in WS03 and WS05 recorded silt with rootlets between 1.3m to 2.0m bgl. Given the prevalence of the organic silty later across the northern part of the site, it is possible that groundwater beneath a proportion of the site has similar concentrations of ammoniacal nitrogen to WS02.

The elevated ammoniacal nitrogen concentrations recorded in WS02 groundwater could be attributable to onsite organic material within Made Ground / natural soils or the offsite landfill to the west. Further assessment would be needed to determine the source of the ammoniacal nitrogen and provide more information on distribution across the site.

Whilst ammoniacal nitrogen concentrations in WS02 are appreciably elevated and exceed the WQS, based on the available information it is considered that ammoniacal nitrogen in groundwater beneath the site is unlikely to present an unacceptable risk to controlled waters receptors for the following reasons:

- Ammoniacal nitrogen (as N) concentrations in WS03 and WS05 (likely to be on the down hydraulic-gradient side of the site) are two orders of magnitude lower than the concentration recorded in WS02; as such migration of ammoniacal nitrogen down-gradient from WS02 appears to be limited.
- Whilst shallow groundwater beneath the site is anticipated to be in hydraulic continuity with the surface water feature adjacent to the site in the west, given the distance to the principal surface water receptor (Brightly Brook, located approximately 1.5km west), it is considered unlikely that the observed ammoniacal nitrogen concentration recorded at WS02 represents an unacceptable risk to this receptor.

- The superficial and solid aquifers are classified as 'Secondary A Aquifers – Undifferentiated'; considered to be relatively low sensitivity.
- There are no groundwater source protection zones or abstraction wells within 1km radius of the site.

8.5 GROUND GAS RISK ASSESSMENT

8.5.1 GAS RISK ASSESSMENT

A worst-case gas screening value (GSV) for the site has been calculated in accordance with BS8485:2015+A1:2019 to determine if ground gas protection measures are required in new buildings

The GSV is the maximum volume of methane or carbon dioxide gas that could theoretically be produced each hour and is calculated using site data as follows:

- $GSV(l/hr) = \text{maximum carbon dioxide or methane concentration (\%)} / 100 \times \text{maximum steady flow rate (l/hr)}$.

The GSV is calculated in **Table 8.3**.

Table 8-3 – Ground Gas Risk Assessment

Gas	Max Steady Flow Rate (l/hr)	Max Steady Concentration (%v/v)	GSV (litres of gas per hour)	Characteristic Situation
Methane	5.0 (WS05 on visit 5)	51.2 (WS02 on visit 3)	2.56	3 (Moderate Risk: for GSV 0.7 to <3.5l/hr)

Based on the above GSV, the site is classified as Characteristic Situation 3 (Moderate Risk). This classification is typical for sites associated with old landfill / inert wastes and is therefore considered to be consistent with the recorded ground conditions and site setting. This classification requires gas protection measures to be installed in new buildings. These will need to comply with BS8485:2015+A1:2019 and will likely comprise two or more of the following measures:

- Structural barrier provided by the floor slab
- Ventilation measures
- Gas resistant membrane

The above Characteristic Situation 3 classification may be considered overly conservative, requiring overly stringent gas protection measures and could potentially be reduced based on additional gas monitoring data and assessment. However, it is considered that the requirement for 'full' radon gas protection measures for new buildings (described in **Section 8.6**) will likely provide sufficient protection for a CS3 classification and therefore attempting to reduce the classification to a CS2 would not be beneficial. The requirement for hazardous ground gas / radon protection measures should be detailed within a remediation strategy and the measures designed by a specialist in accordance with the relevant guidance.

8.6 RADON RISK ASSESSMENT

As outlined in Section 3.7, the southern portion of the site is within an area where the estimated proportion of properties affected by radon is between 10% and 30% and therefore requiring 'full' radon protection measures to be installed in new buildings.

Radon protection measures will need to be designed in accordance with BRE211 Radon: Guidance on Protective Measures for New Dwellings (2015). Full radon protection measures would comprise:

- Upgrading the damp proof membrane (DPM) to a radon barrier, which is laid across and tightly lapped and sealed around all joints and penetrations of the footprint of the building sealing the structure from the below ground.
- Subfloor extraction or ventilation, which may be either passive or active, subject to the final building design and regulatory approval.

Whilst the estimated proportion of properties affected by radon in the northern part of the site is less than 1%, given the elevated risk of radon within the southern part of the site, WSP recommend full radon protection measures are installed beneath all building footprints, regardless of their position on site. The requirement for hazardous ground gas / radon protection measures should be detailed within a remediation strategy.

8.7 REFINED CONCEPTUAL SITE MODEL

The potentially complete contaminant linkages identified in preliminary conceptual site model have been refined following the ground investigation works and presented in **Table 8.4**:

Table 8.4 : Potentially Complete Contaminant Linkages following Ground Investigation

Potentially Complete Contaminant Linkage	Updated Comment following Intrusive Investigation and Risk Assessment
1. Inhalation of asbestos fibres by construction workers during redevelopment and future site users / maintenance workers following development.	No asbestos was identified in tested soil samples. However, it should be noted that asbestos has the potential to be present within any Made Ground material so precautions to minimise dust generation during construction are advised.
2. Direct contact, ingestion and inhalation of soil-bound contamination / dust during redevelopment by construction workers and by future site users following development.	No chemical concentrations above the generic assessment criteria were recorded within soil, indicating risk to future site users is low. Residual risks to ground workers will be appropriately mitigated by the use of good site practices in relation to hygiene and use of personal protective equipment. If suspected contamination is noted during the redevelopment than additional assessment by a qualified environmental consultant is recommended. No further action required in order to mitigate identified risks.
3. Accumulation of hazardous ground gases in excavations and built structures with potential to create an explosive / asphyxiating atmosphere, potentially impacting construction workers and future site workers.	Potential risks from accumulation of hazardous gases (methane and carbon dioxide) within excavations will need to be managed during redevelopment through the use of personal gas monitoring when working within confined spaced/excavations. In addition, the ground gas risk assessment classifies the site as Characteristic Situation 3 (Moderate Risk), requiring appropriate and sufficient gas protection measures to be installed within buildings to protect future site users. It is considered that provision of full protective measures will likely provide sufficient mitigation against risks from carbon dioxide and methane, subject to the final building design and regulatory approval.

Potentially Complete Contaminant Linkage	Updated Comment following Intrusive Investigation and Risk Assessment
4. Accumulation of radon in built structures with potential for long term exposure by future site workers.	The site partly falls within an area where the estimated proportion of buildings affected by radon is between 10% and 30% and therefore requires full radon protection measures to be installed in future structures.
5. Migration of mobile contamination to the surface water (ditch) on the western boundary and the Secondary Undifferentiated Aquifer (Till), Secondary A Aquifer (Bedrock) and wider surface water environment.	Dissolved phase metals and ammoniacal nitrogen concentrations exceed water quality standards protective of groundwater and surface water. Whilst the concentrations of metals are minor, potential risks to controlled waters from ammoniacal nitrogen in groundwater at WS02 are more notable. However, risks are considered low due to: - Concentrations on down-hydraulic gradient side of site are two orders of magnitude lower than at WS02, indicating limited migration. - No source protection zones or abstraction licences are present within a 1km radius - Distance to the main surface water receptors (Brightly Brook approximately 1.5km west)
6. Inhalation of vapours associated with volatile ground contamination by construction workers, maintenance users and future site users following development (potential for volatile contamination considered to be low based on development history).	Volatile contamination not encountered and not expected. If suspected volatile contamination is noted during the redevelopment then additional assessment by a qualified environmental consultant is recommended. No further action required to mitigate risks.

9 CONCLUSIONS AND RECOMMENDATIONS

9.1 GEO-ENVIRONMENTAL

- Whilst specific remedial measures are not required in relation to soil contamination, development site staff need to be aware that contamination could be uncovered during ground works. The steps to follow if such contamination is encountered should be outlined in a remediation strategy, which will be subject to regulatory approval.
- The potential for ground gas accumulation within excavations during construction will need to be considered and addressed with appropriate monitoring / protective equipment.
- Full radon protection measures will need to be installed in new structures. The requirements will need to be outlined in the remediation strategy and the measures designed by a specialist.
- Hazardous ground gas protection measures are also required in new structures (Characteristic Situation 3). It is considered that the full radon protective measures would likely mitigate provide the required level of protection. Hazardous ground gas and radon protection measures need to be specified in the remediation strategy and designed by a specialist.
- The installation of ground gas / radon mitigation will need to be validated by an independent and suitably qualified party, in accordance with the requirements laid out in the remediation strategy.
- It would be prudent to complete a water pipeline assessment to ascertain the need for barrier pipe if new potable water pipes will be laid in existing Made Ground. Once the route of potable water pipes is known the information within this report should be reviewed and a UK WIR pipeline assessment completed if required.
- A hazardous waste assessment will be required if the mounded Made Ground is to be taken offsite to landfill. If the material is to be used elsewhere within the development, it is recommended that this is undertaken in accordance with a CL:AIRE Definition of Waste Code of Practice-compliant materials management plan.
- Re-use of site won materials should be managed through the preparation of a Materials Management Plan (MMP).

9.2 GEOTECHNICAL

- Due to the presence of mounded areas of Made Ground, significant reprofiling of the site is required to reach anticipated platform levels.
- The Made Ground is considered unsuitable for use as fill without prior screening and conditioning/modification.
- The engineering properties of the Made Ground and organic soils which will remain below platform level are considered to be poor and remedial works are likely to be required to allow the support of structures and paved areas. The exact form of such works will be dictated by the development phasing and detailed design, but may include excavation and replacement, or lime/cement modification.
- With appropriate remedial works and appropriate design, no significant problems are anticipated for the proposed substation raft foundations.
- Further consideration needs to be given to the design of the food store once loads and serviceability requirements are known.
- Groundwater control may be required to facilitate the removal of poor soils below structures and for other deep excavations (e.g. culvert removal).

- Analysis suggest that buried concrete may be designed in accordance with DS-2 and AC-2 however, further specialist consideration needs to be given to measured concentrations of ammoniacal nitrogen in the groundwater

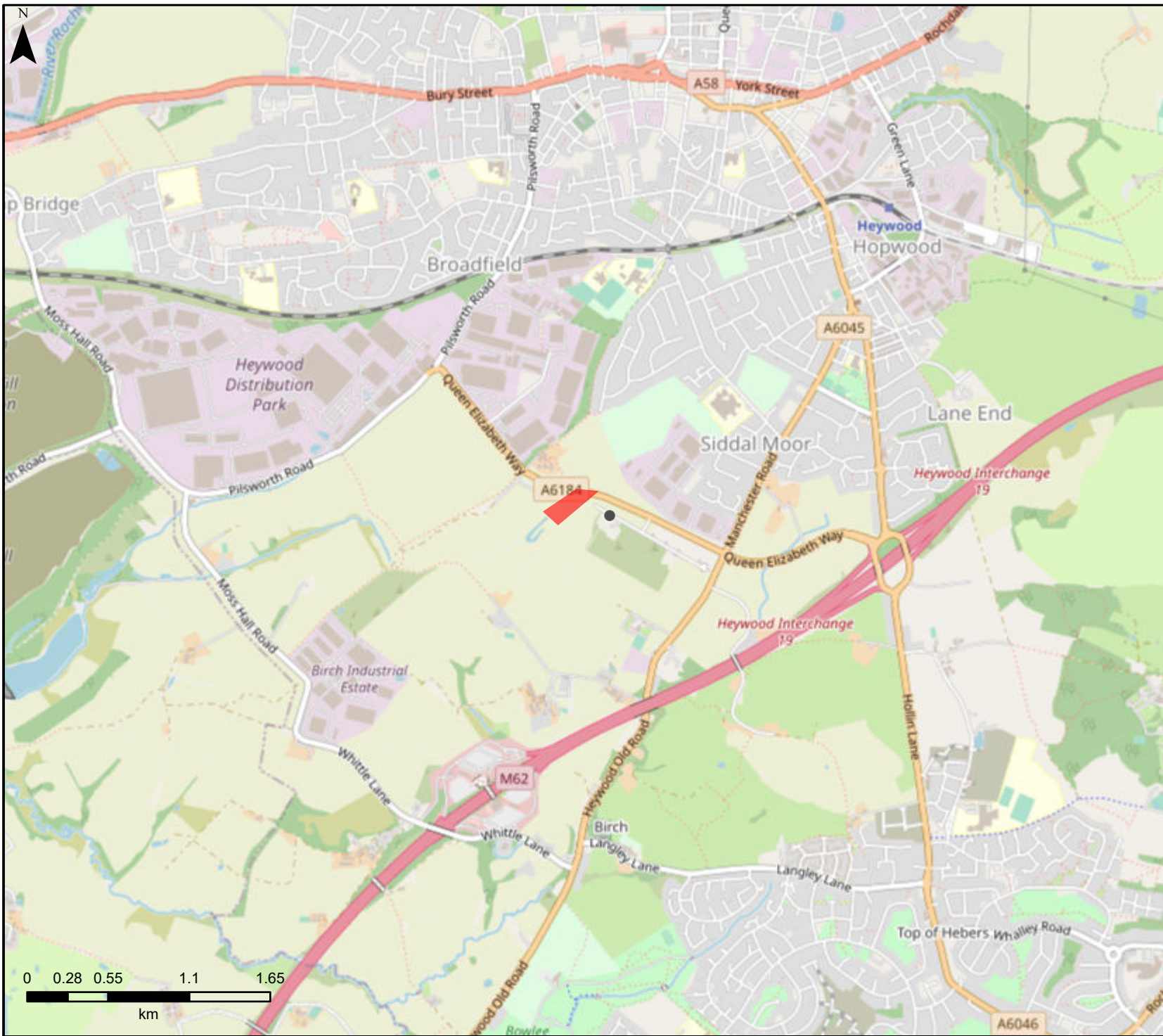
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Appendix A

FIGURES





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Legend :

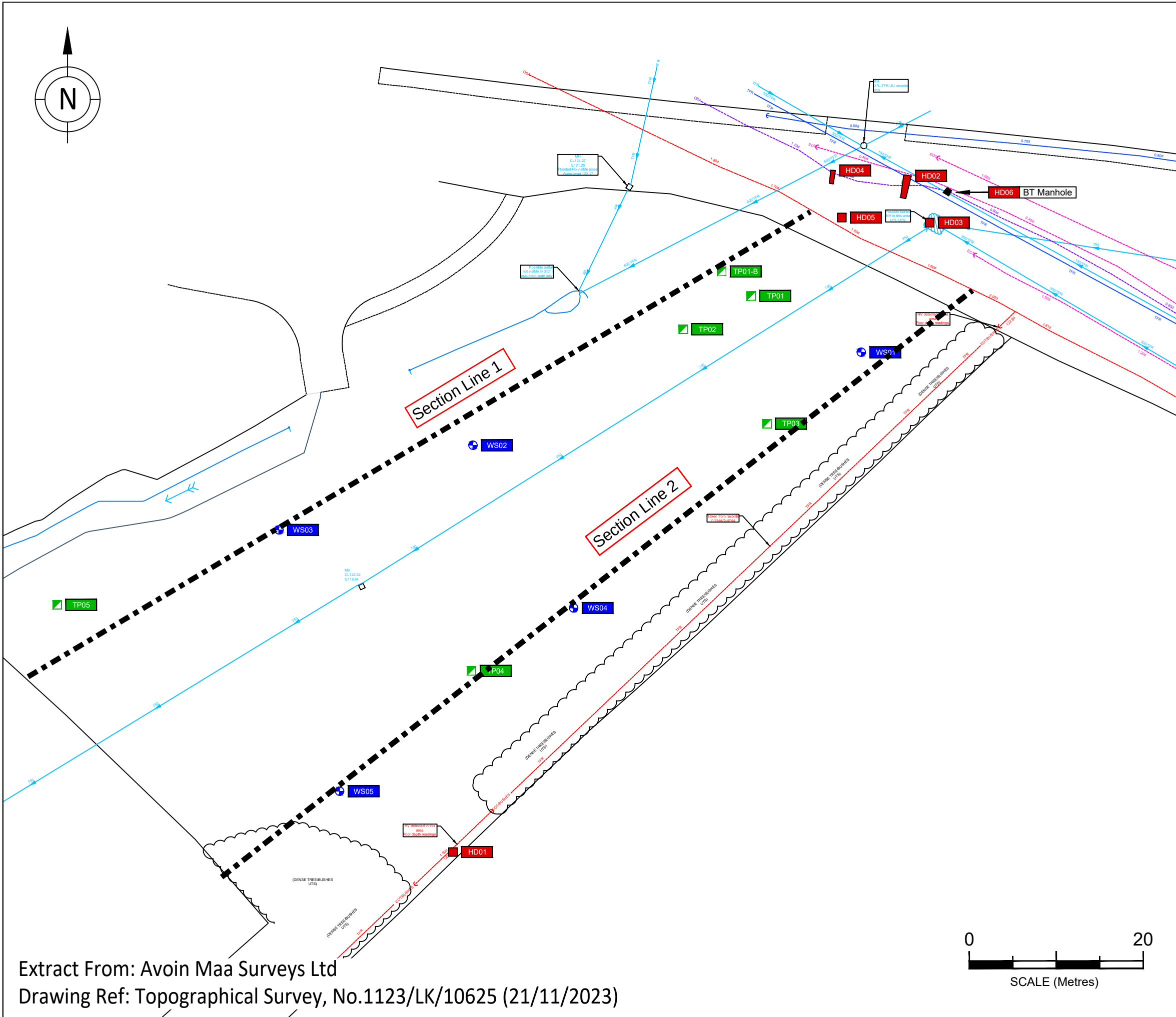
 Site Location

70114074 South Heywood
Primary Substation

Figure 1 - Site Location Plan



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KEY

- Hand Dug Trial Pit (HD)
- Trial Pit (TP)
- Window Sample Borehole (WS)
- BT Service Drain / Manhole (Discovered on Site)

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

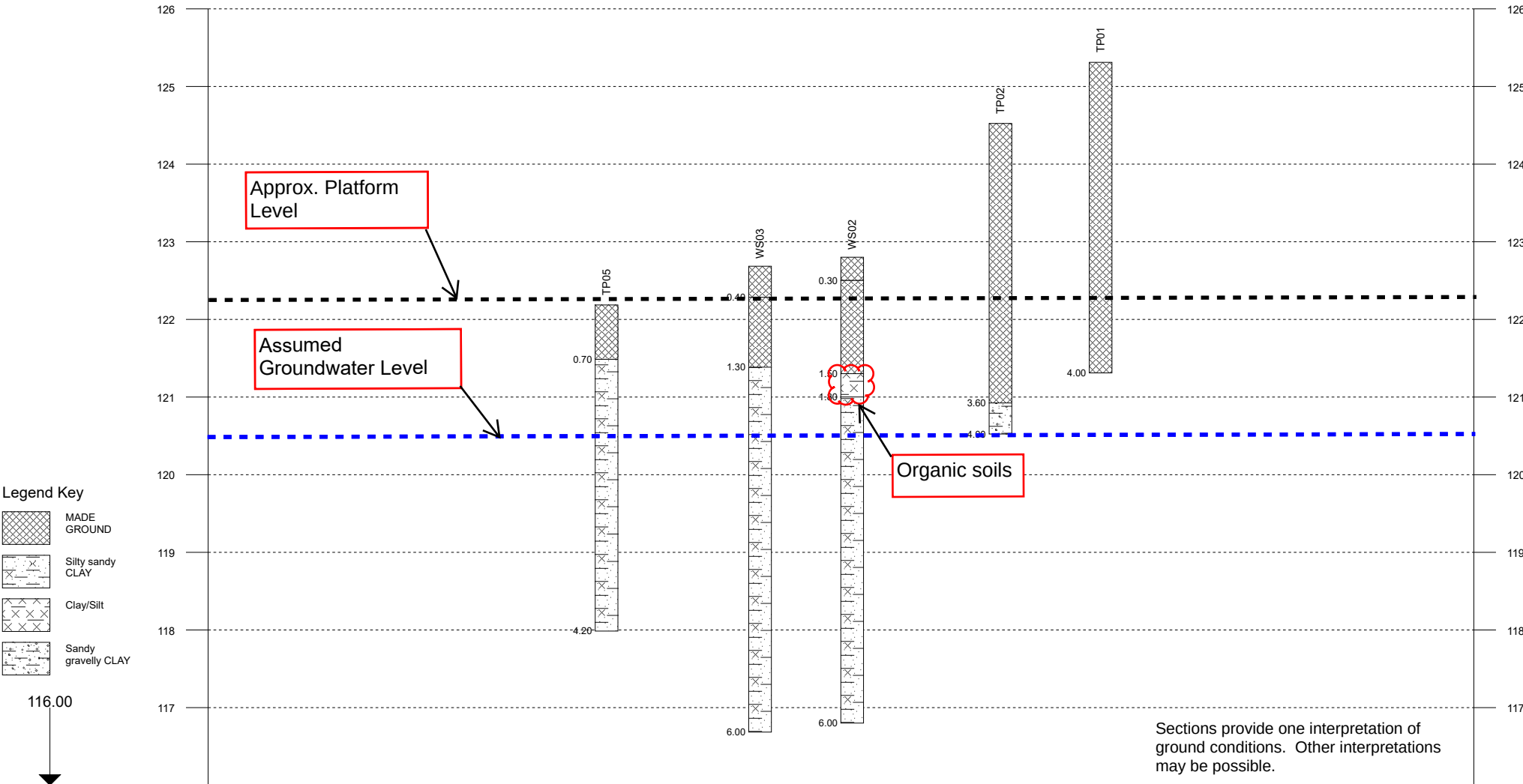


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Site:		QEII Way, Heywood	
Title:		Site Investigation Location Plan	
Job No.:	LKC 23 1637	Scale (See Scale Bar):	See Scale Bar
Drawn By:	AC	Checked By:	JW
Figure:		Revision:	
2		Nov 2023	

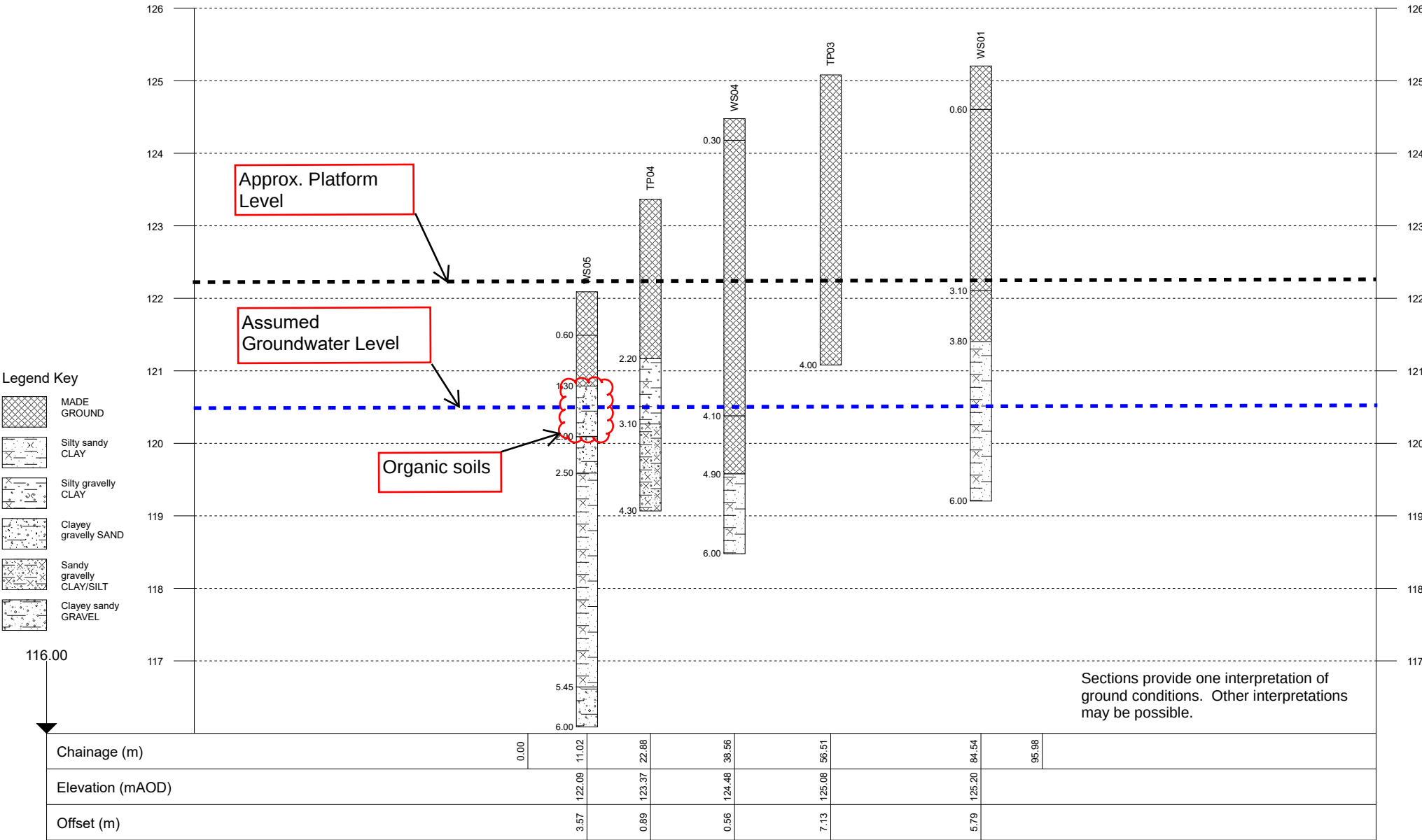
Extract From: Avoin Maa Surveys Ltd
Drawing Ref: Topographical Survey, No.1123/LK/10625 (21/11/2023)

Project Id: 70087509
Project Title: Heywood
Location: Heywood
Client: Russell LDP

Title: Section Line 1
Vertical Scale: 1:75
Horizontal Scale: 1:1000
Engineer: Jacob Paterson



Chainage (m)	0.00	7.45	35.22	51.89	78.72	96.84	99.66
Elevation (mAOD)		122.19	122.89	122.80	124.52	125.31	
Offset (m)		6.68	0.10	10.43	10.64	11.44	

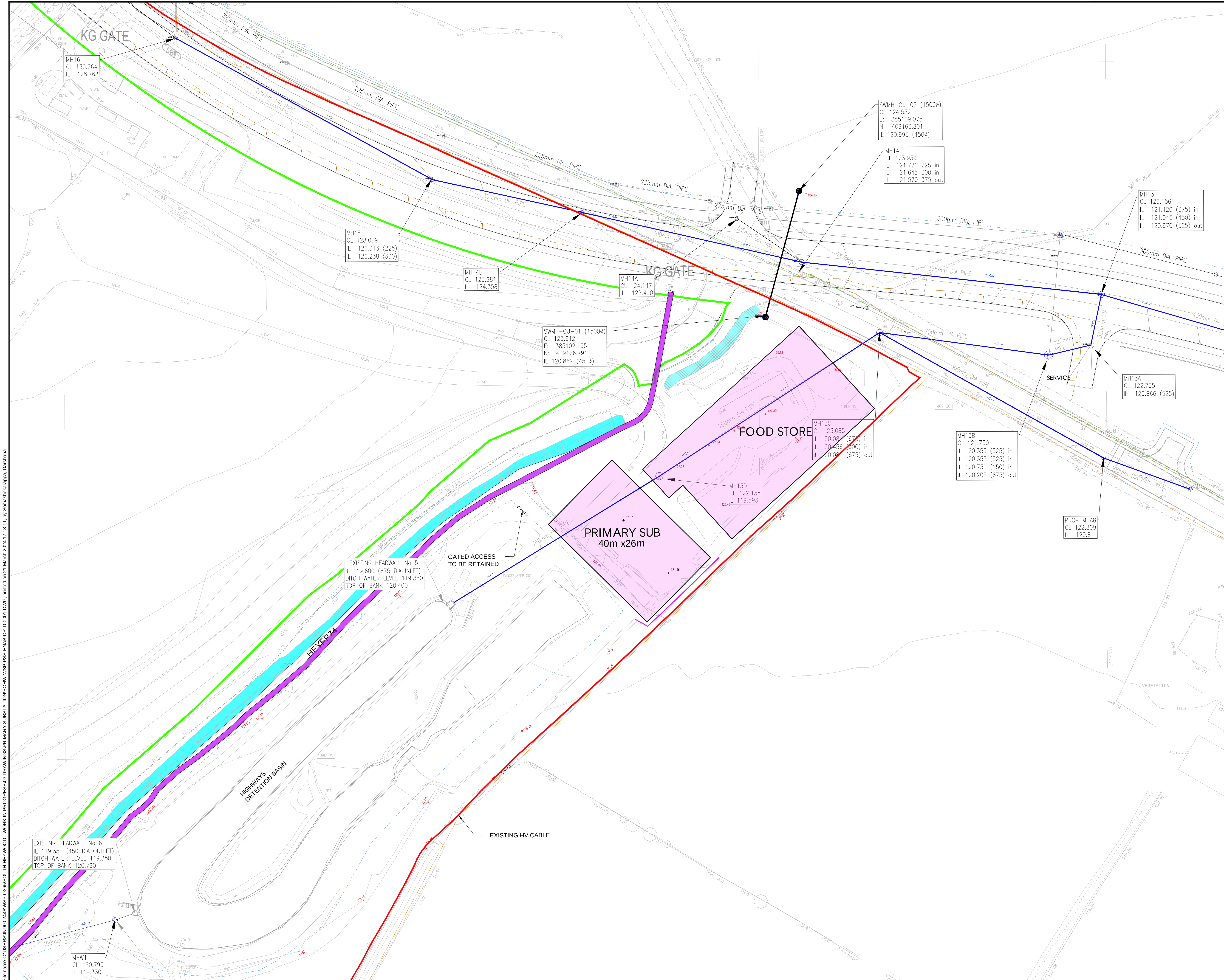


Appendix B

DEVELOPMENT PROPOSALS



File name: C:\USERS\INGO248\WSP_085\503 DRAWINGS\PRIMARY SUBSTATION\SOHW-WSP-PSS-ENAB-DR-D-0001.DWG, printed on 21 March 2024 17:18:11, by Somashakrappa, Darshana



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NOTES

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2.

DRAWING TO BE PRINTED IN COLOUR.

3.

ALL DIMENSIONS ARE IN METRES UNLESS OTHERWISE STATED.

4.

THE TOPOGRAPHICAL SURVEY UPON WHICH THIS DESIGN IS BASED HAS BEEN PROVIDED BY A THIRD PARTY AND SHOULD BE CHECKED ON SITE FOR ACCURACY.

5.

THE WORKS SHALL BE CARRIED OUT IN ACCORDANCE WITH DESIGN MANUAL FOR ROADS AND BRIDGES SPECIFICATION FOR HIGHWAY WORKS.

6.

FOR INFORMATION ON EXISTING STATUTORY UNDERTAKERS' EQUIPMENT REFER TO UTILITY DRAWINGS. CONTRACTOR TO CONFIRM LOCATION OF ALL UTILITIES PRIOR TO CONSTRUCTION.

7.

DRAWING TO BE READ IN CONJUNCTION WITH THE SCHEME 2 S278 DRAWINGS.

KEY

PERMITTED AREA BOUNDARY

SITE BOUNDARY

PUBLIC RIGHT OF WAY

EXISTING WATERCOURSE

PROPOSED BUILDING ENVELOPE

EXISTING FENCING

EXISTING HIGHWAY DRAINAGE

PRIVATE CULVERT AND MANHOLE

EXISTING HV CABLE

EXISTING RISING MAIN

EXISTING BT CABLE

EXISTING VIRGIN MEDIA CABLE

UNTIL TECHNICAL APPROVAL HAS BEEN OBTAINED FROM THE RELEVANT LOCAL AUTHORITIES OR STATUTORY BODIES, IT SHOULD BE UNDERSTOOD THAT ALL DRAWINGS ARE ISSUED AS PRELIMINARY AND NOT FOR CONSTRUCTION. SHOULD THE CONTRACTOR AND / OR EMPLOYER COMMENCE WORK PRIOR TO APPROVAL BEING GIVEN, IT IS ENTIRELY AT THEIR OWN RISK

P06	21/03/2024	DS	SUBSTATION DIMENSIONS UPDATED	DW	DW
P05	15/02/2024	DS	SUBSTATION LOCATION UPDATED	DW	DW
PD4	13/09/2023	BO	EXISTING CABLES AMENDED AS REQUESTED	DW	DW
PD3	11/09/2023	BO	HV CABLE ROUTE AMENDED AS REQUESTED.	DW	DW
PD2	04/09/2023	BO	DRAWING UPDATED AS REQUESTED	DW	DW
PD1	18/08/2023	SS	FIRST ISSUE	DW	DW
REV	DATE	BY	DESCRIPTION	CHK	APP

DRAWING STATUS:

S2 - FOR INFORMATION

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CLIENT:
RUSSELLS SOUTH HEYWOOD LIMITED

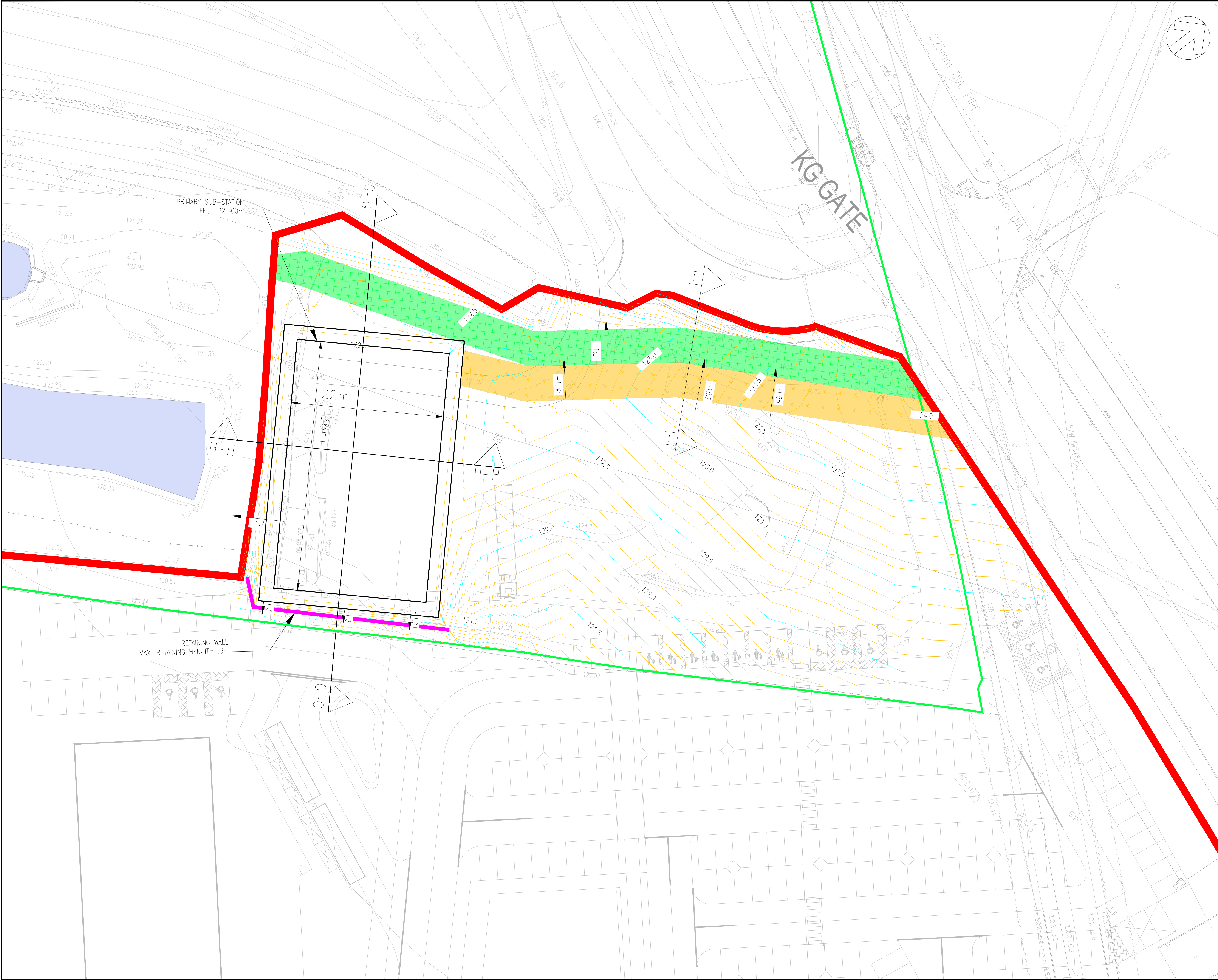
ARCHITECT:
AEW ARCHITECTS

SITE/PROJECT:
SOUTH HEYWOOD

TITLE:
PRIMARY SUBSTATION
SITE CONSTRAINTS PLAN

SCALE @ A1: 1:500	CHECKED: DW	APPROVED: DW
PROJECT NO: 70103659	DESIGNED: SS	DRAWN: SS
DATE: March 24		REV: P06

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RETAINING WALL

PLOT BOUNDARY

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DRAWING STATUS:

S2 - FOR INFORMATION

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CLIENT:

RUSSELLS SOUTH HEYWOOD LIMITED

ARCHITECT:

AEW ARCHITECTS

SITE/PROJECT:

SOUTH HEYWOOD
PRIMARY SUBSTATION

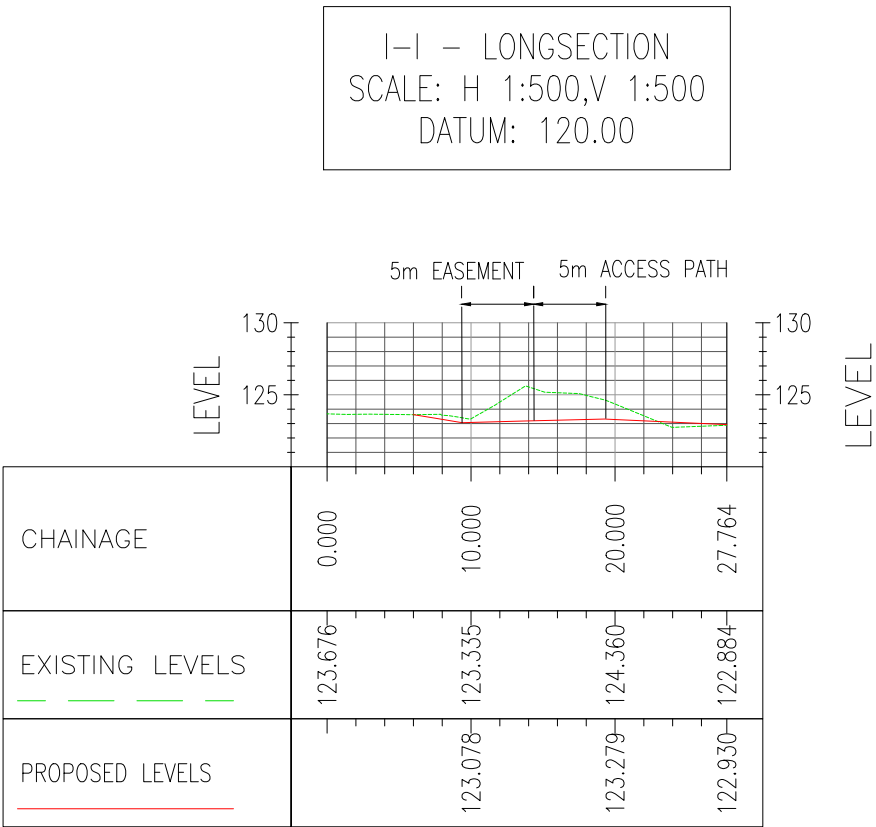
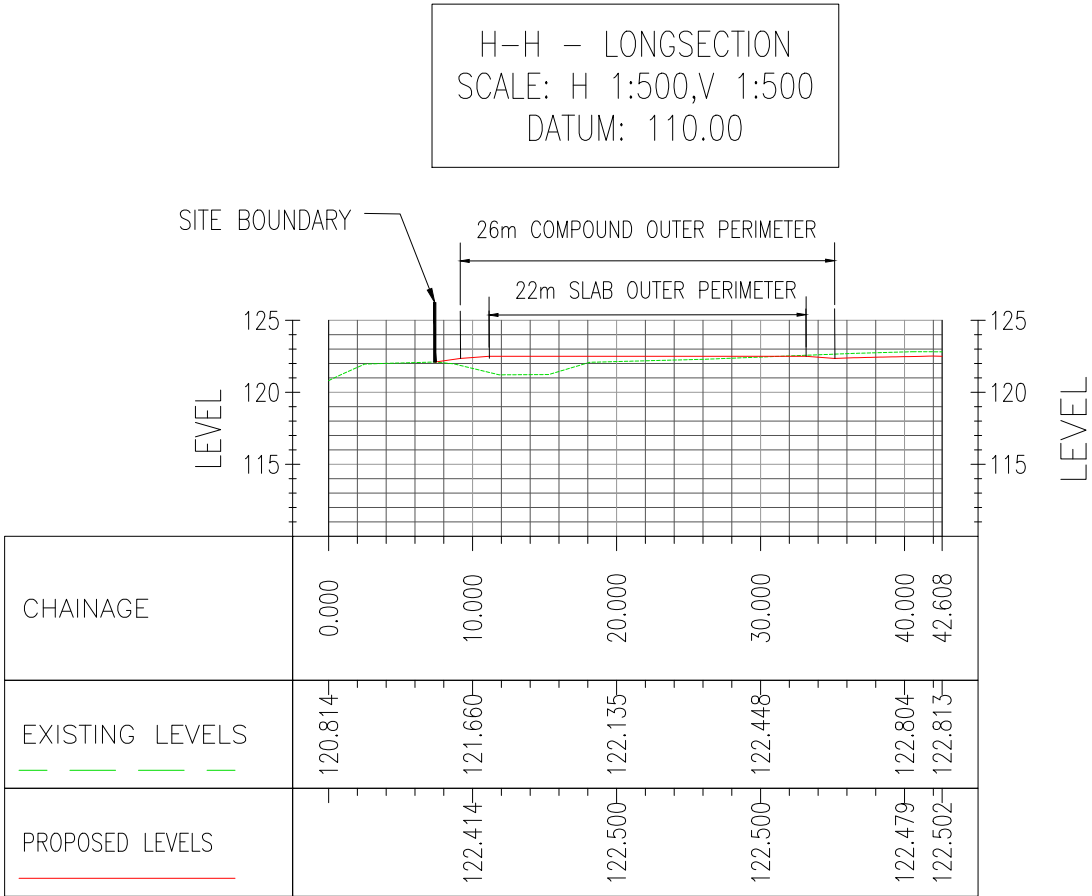
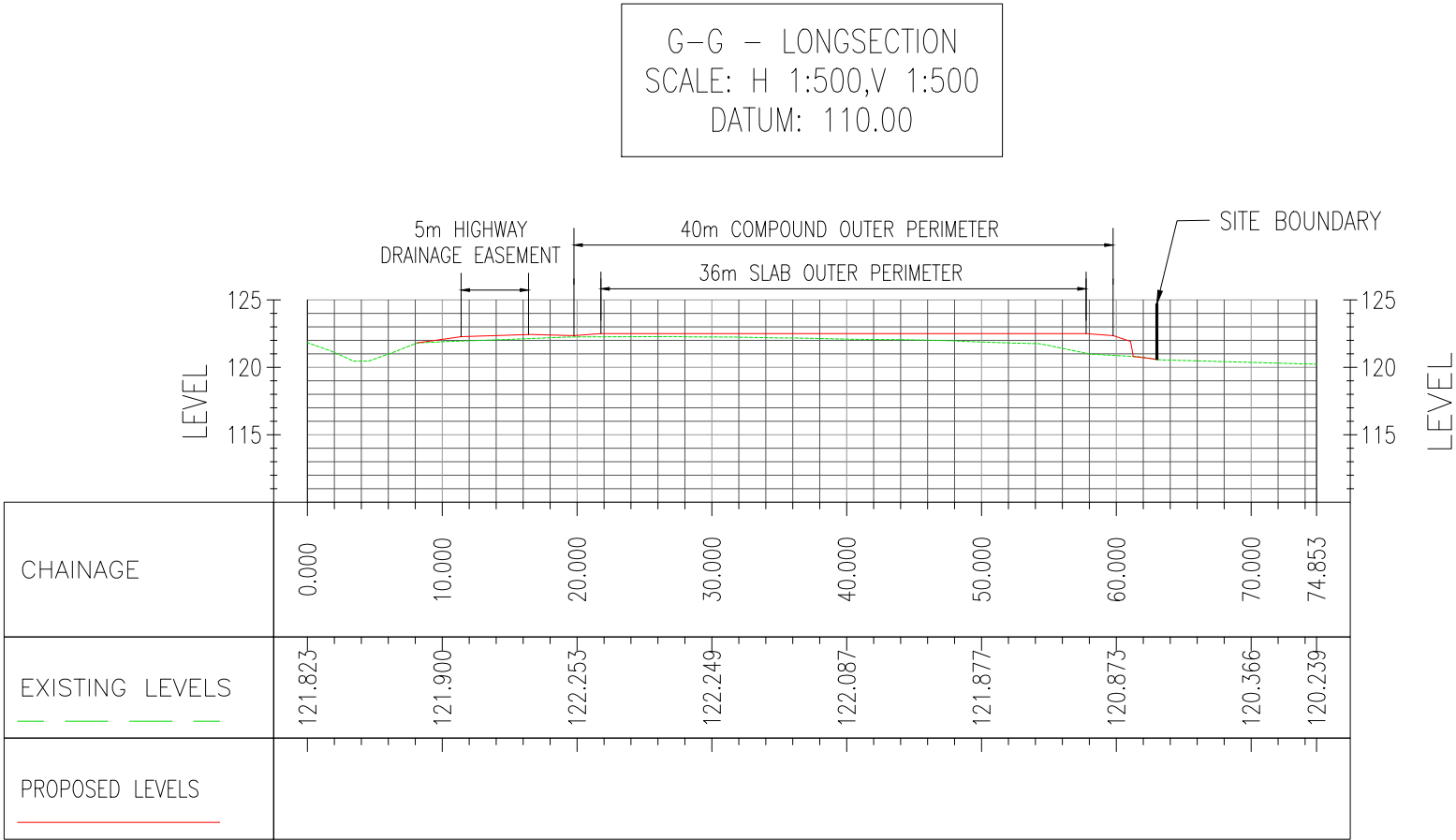
TITLE:

PRIMARY SUB-STATION EARTHWORKS
PROPOSED CONTOURS

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PROJECT NO:	70103659	DESIGNED:	SS	DRAWN:	SS
				DATE:	MARCH 24
DRAWING NO:					REV:
SOHW-WSP-PSS-ENAB-SK-D-0005					P03

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P03	21/03/2024	DS	SUBSTATION DIMENSION UPDATED	DW	DW
P02	15/03/2024	DS	SUBSTATION LOCATION UPDATED	DW	DW
P01	13/02/2024	DS	FIRST ISSUE	DW	DW
REV	DATE	BY	DESCRIPTION	CHK	APP

DRAWING STATUS:	S2 - FOR INFORMATION
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ARCHITECT:	AEW ARCHITECTS
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PROJECT:	SOUTH HEYWOOD PRIMARY SUBSTATION
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TITLE:	PRIMARY SUB-STATION EARTHWORKS SITE WIDE LONGSECTION
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SCALE @ A2: 1:500	CHECKED: DW	APPROVED: DW
PROJECT No: 70103659	DESIGNED: SS	DRAWN: SS
	DATE: March 24	

DRAWING No: SOHW-WSP-PSS-ENAB-SK-D-0006	REV: P03
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Appendix C

GENERAL LIMITATIONS



REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

GENERAL

1. WSP UK Limited has prepared this report solely for the use of the Client and those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.
2. Unless explicitly agreed otherwise, in writing, this report has been prepared under WSP UK Limited standard Terms and Conditions as included within our proposal to the Client.
3. Project specific appointment documents may be agreed at our discretion and a charge may be levied for both the time to review and finalise appointments documents and also for associated changes to the appointment terms. WSP UK Limited reserves the right to amend the fee should any changes to the appointment terms create an increase risk to WSP UK Limited.
4. The report needs to be considered in the light of the WSP UK Limited proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEO ENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

Coverage: *This section covers reports with the following titles or combination of titles: phase 1; desk top study; geo environmental assessment; development appraisal; preliminary environmental risk assessment; constraints report; due diligence report; geotechnical development review; environmental statement; environmental chapter; project scope summary report (PSSR), program environmental impact report (PEIR), geotechnical development risk register; and, baseline environmental assessment.*

5. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walk over inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. WSP UK Limited cannot be held responsible for any disclosures that are provided post production of our report and will not automatically update our report.
6. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, WSP UK Limited reserves the right to review such information and, if warranted, to modify the opinions accordingly.
7. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.
8. WSP UK Limited does not warrant work / data undertaken / provided by others.

REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

INTRUSIVE INVESTIGATION REPORTS

Coverage: *The following report titles (or combination) may cover this category of work: geo environmental site investigation; geotechnical assessment; GIR (Ground Investigation reports); preliminary environmental and geotechnical risk assessment; and, geotechnical risk register.*

9. The investigation has been undertaken to provide information concerning either:
 - i. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or
 - ii. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.
10. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.
11. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.
12. For geotechnical investigations the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.
13. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.
14. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.
15. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, WSP UK Limited has used reasonable skill and care to extrapolate conditions between these points based upon assumptions to develop our interpretation and conclusions. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation. Conditions can change between investigation points and these interpretations should be considered indicative.
16. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated

REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

with the WSP UK Limited risk assessment process have been outlined within the body or associated appendix of the report.

17. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.
18. Where soil contamination concentrations recorded as part of this investigation are used for commentary on potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed.
19. The results of the asbestos testing are factually reported and interpretation given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and / or trace loose asbestos fibres within the soil matrix at the site.
20. If costs have been included in relation to additional site works, and / or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

21. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.
22. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIAL STRATEGY REPORTS

23. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected on the basis of the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.



REPORT LIMITATIONS - GROUND RISK AND REMEDIATION

- 24. The outputs of the Detailed Quantitative Risk Assessments are based upon WSP UK Limited manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.
- 25. Prior to adoption on site they will need discussing and agreeing with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatory Authority engagement are not within the control of WSP UK Limited. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

GEOTECHNICAL DESIGN REPORT (GDR)

- 26. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS)

- 27. These reports are factual in nature and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of an earthworks or remedial works.
- 28. The data is presented and will be compared with assessment criteria.

Appendix D

FACTUAL REPORT



QEII Way, Heywood

Phase 2 Factual Geo-Environmental Investigation Report

Job Number: LKC 23 1637

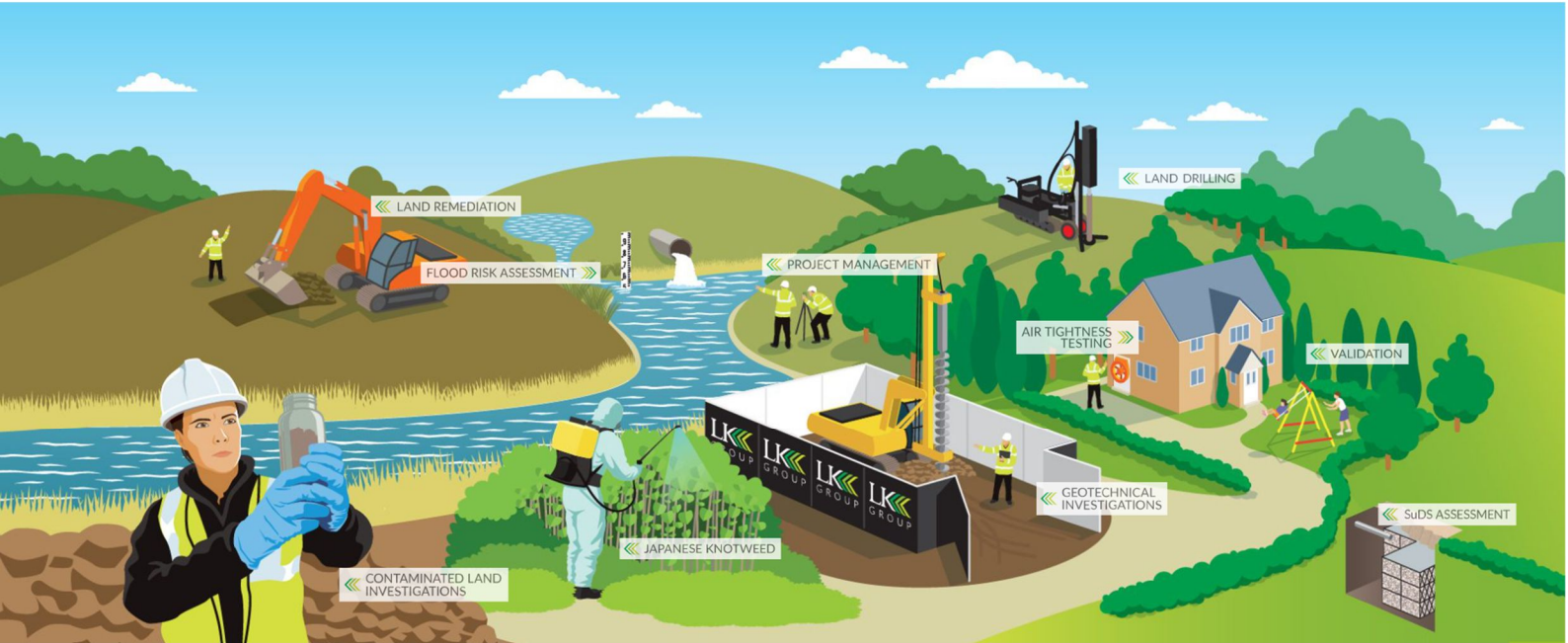
Date: March 2024

Client: Russell LDP



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DOCUMENT QUALITY ASSURANCE

Site Address	Queen Elizabeth Way, Heywood, OL10 2TB
Report Title	Phase 2 Factual Geo-Environmental Investigation Report
Job Number	LKC 23 1637
Client	Russell LDP

Revision	1	Date of Issue	12/03/24
Document Ref:	LKC 23 1637 -BX-GI-QEII Way, Heywood R0		
Status	Final		
Written By	Joe Walker		
Approved By	Kris Rodway		

Revision	2	Date of Issue	14/03/24
Document Ref:	LKC 23 1637 -BX-GI-QEII Way, Heywood R0		
Status	Final		
Written By	Kris Rodway		
Approved By	Kris Rodway		

DISCLAIMER

This report has been prepared by LK Consult Ltd (LKC) who have exercised such professional skill, care and diligence as may reasonably be expected of a properly qualified and competent consultant, experienced in preparing reports of a similar scope.

However, to the extent that the report is based or relies upon information contained in records, reports or other materials provided to LKC, which have not been independently produced or verified, LKC gives no warranty, representation, or assurance as to the accuracy or completeness of such information.

This report is issued on the condition that LKC will not be held liable for any loss arising from ground conditions between sampling points (i.e., boreholes/trial pits/hand augers/surface samples) which have not been shown by the sampling points or related testing carried out during the investigation, nor for any loss arising from conditions below the maximum depth of the investigation. Opinions on such conditions, where given, are for general guidance only.

This report is prepared solely for the benefit of the client named above. It may not be relied upon by or submitted to a third party for their reliance for the purposes of valuation, mortgage, insurance, and regulatory approval until all invoices have been settled in full.

Those using this information in subsequent assessments or evaluations do so at their own risk.

EXECUTIVE SUMMARY

Site Details

Location	The site is located off the south of the Queen Elizabeth II Way, Heywood. It is approximately 1.7km south of Heywood Town Centre. Centred at approximate National Grid Reference 385069, 409114 (nearest 5m).
Area	8000m ² .
Topography	The site has an area of raised ground/ a mound to the northeast. The mound continues for approximately 20-50m, the mound then extends into the site on SE boundary, which seems to be slightly lower than that of Queen Elizabeth Way. An approximately 1.5m deep ditch, flanked by small trees/shrubs, is present on the north-western boundary. This ditch occurs in two sections; a short length close to Queen Elizabeth Way, and a section which commences from approximately the midpoint of the boundary and continues beyond the site. The ditch carries a watercourse which flows to the southwest and is culverted below part of the site and Queen Elizabeth Way.
Current Site Use	Open vacant ground
Proposed Development	Substation and small retail unit.

Ground Investigation Work Undertaken

Date of Investigation:	27 th to 29 th November 2023.
Intrusive Investigation Work Undertaken:	5no. window sample boreholes. 5no. mechanically excavated trial pits. 6no. hand excavated trial trenches to expose services. Contamination and geotechnical testing. Gas monitoring. Groundwater monitoring.

Ground Conditions

Made Ground	Ground level to 0.70-4.90mbgl.
Superficial	Soft to very stiff clay with bands of sand. Organic strata noted in WS02 and WS05. Gravel strata present within WS05.
Groundwater	Groundwater observed at 3.00-5.50mbgl during site investigation, and at 2.00-4.00mbgl the monitoring visits.
Obstructions	Possible service encountered in TP101A; trial pit moved 3m SE.

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FIGURES

Figure 1 – Site Location and Boundary Plan

Figure 2 – Site Investigation Location Plan

APPENDICES

Appendix A – Profile Logs

Appendix B – Plate Load Testing Certificates

Appendix C – Certificates of Analysis (Soil & Water)

Appendix D – Certificates of Analysis (Geotechnical)

Appendix E – Gas Monitoring Results

Appendix F – References

1. Introduction

1.1. Background

LK Consult Ltd (LKC) has been commissioned to carry out a Phase 2 Geo-Environmental Investigation, Risk Assessment and Factual Report for QEII Way, Heywood. The investigation was undertaken in support of a proposed electrical substation.

This investigation has been undertaken to confirm the ground conditions below the site and to provide factual information relating to contamination and geotechnical.

A summary of the site details is presented in Table 1-1. Figure 1 indicates the site location and boundary plan.

Location	The site is located off the south of the Queen Elizabeth II Way, Heywood. It is approximately 250m west of Hareshill Boarding Kennels and 420m south-west of Yearsley Group Wearhouse. Centred at approximate National Grid Reference 385069, 409114 (nearest 5m).
Area	4,800m ² .
Topography	The site appears to have been levelled with an area of raised ground to the northeast. The mound continues for approximately 20m into the site then falls steeply westwards and to a level, which seems to be slightly lower than that of Queen Elizabeth Way. An approximately 1.5m deep ditch, flanked by small trees/shrubs, is present on the north-western boundary. This ditch occurs in two sections; a short length close to Queen Elizabeth Way, and a section which commences from approximately the midpoint of the boundary and continues beyond the site. The ditch carries a watercourse which flows to the southwest and is culverted below part of the site and Queen Elizabeth Way.
Current Site Use	Open vacant ground
Proposed Development	Substation and small retail unit.

Table 1-1: Summary of site details.

2. Ground Investigation

2.1. Site Investigation Scope

The scope of the investigation was agreed with the client prior to undertaking the work.

Locations had to be altered slightly due to the presence of underground services, and the presence of a historical road in the north of the site.

LKC do not consider the changes to be significant and sufficient investigation work has been undertaken to thoroughly investigate the site.

2.2. Site Investigation Design and Methodology

The investigation was carried out on 27th to 29th November 2023 and comprised the following:

- 5no. window sample boreholes drilled to 6.00 metres below ground level (mbgl) (ref. WS01 to WS05) with follow on Dynamic Probing through all window sample boreholes to a depth of 7.72-10.00mbgl.
- 5no. trial pits 13 tonne tracked machine excavated to 4.00-4.30mbgl (ref. TP01 to TP05).
- 6no. hand excavated trial pits (using spade) excavated to attempt to locate services / manholes (ref. HD101 to HD106).

All site investigation locations are shown in Figure 2.

The locations were chosen by WSP to allow adequate assessment of ground conditions across the site. Table 2-1 details the site investigation locations.

Site Investigation Locations	Rationale
TP01, TP02, TP03, TP04, W01, WS04	General site coverage. Target large mound on site.
TP05, WS02, WS03, WS05	General site coverage.
HD01	Target and locate high voltage cable on site.
HD02 & HD04	Target and locate services in north of site.
HD03	Target and locate the possible service manhole.
HD05	Provide bulk sample for CBR testing in area of proposed development entrance.

Table 2-1: Summary of Sampling Locations.

TP01 had to be repositioned due to the presence of pea gravel in trench at a depth of 0.80mbgl. Original location marked as TP01-B (see Figure 2). Pea gravel found in TP01 on second attempt. Trial pit was extended south-west to avoid potential services.

All profile logs are provided in Appendix A and are in line with BS14688-1¹ and BS5930².

2.3. Well Installations

All of the boreholes were installed with monitoring wells for gas and groundwater monitoring / sampling. Monitoring wells were installed in accordance with BS10175³ and CIRIA C665⁴ and generally comprised approximately 1m plain pipe over a length of slotted pipe surrounded by pea gravel and sealed at the top with bentonite and concrete.

WS04 was installed to specifically target an organic made ground strata at 4.10-4.90mbgl, and the install comprised an approximate length of 4m plain pipe over 1m of slotted pipe.

Well installation details are provided in Profile Logs in Appendix A.

2.4. Sampling Protocol

2.4.1. Soil Sampling (Contamination)

Standard sampling protocol and preservation of samples was undertaken as described in the EA guidance on site investigation⁵.

Soil was collected for onsite testing for total volatile organic compounds (TVOCs) using a photoionisation detector (PID) fitted with a 10.6eV lamp and moisture trap. A plastic zip bag was half filled with soil allowing a suitably sized headspace. The bag was sealed and stored for at least 20 minutes before being tested. Results of the PID readings are presented on the profile logs (Appendix A). The on-site monitoring was carried out in line CIRIA C665⁶ to aid in screening samples for volatile analysis.

Soil samples of approximately 500g were recovered in amber jars and plastic tubs. All the samples were sent to DETS laboratory for chemical testing.

Many of the contamination tests are UKAS or MCERTS accredited and further details are given in the Certificate of Analysis presented in Appendix C. Table 2-2 shows the soil testing undertaken.

Testing	No. Samples
Metals / metalloids, pH, sulphate, speciated PAHs and hardness.	3
Metals / metalloids, pH, sulphate, cyanide suite, TPHCWG, BTEX, MTBE, speciated PAHs, phenol, and hardness.	9
Metals / metalloids, pH, sulphate, cyanide suite, TPHCWG, BTEX, MTBE, speciated PAHs, phenol, VOCs, SVOCs and hardness.	1

Table 2-2: Summary of Soil Testing.

Notes:

If asbestos present during screen identification and quantification will be undertaken.

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc, and boron; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, BTEX=benzene, toluene, ethylbenzene, and xylenes; MTBE=Methyl tert-butyl ether, VOC=Volatile organic Compounds, SVOC= Semi Volatile Organic Compounds, SOM=Soil Organic Matter.

2.4.2. Soil Sampling (Geotechnical)

Soil samples taken during the investigation were collected in tubs and bulk bags and sent to Murray Rix Laboratories / DETS for geotechnical testing.

Many of the tests are UKAS accredited and further details are given in the laboratory report presented in Appendix D. Table 2-3 shows the geotechnical testing undertaken.

Testing	No. Samples
pH and water-soluble sulphate	4
Atterberg Limits (plasticity testing)	9
Particle Size Distribution (PSD)	7
Moisture Content	28
Organic Matter	4
Particle Density	6
2.5kg Compaction	6
Lab CBR At NMC. 2.5kg Compaction	4
WS Sulphate, Acid Soluble Sulphate, Total Sulphur & pH	7

Table 2-3: Summary of Geotechnical Testing Undertaken.

2.4.3. Water Sampling

Sampling was carried out in accordance with BS5930⁷ and BS5667-11⁸.

The groundwater samples were collected a minimum of 1 week after drilling had finished. Sample collection was undertaken using a disposable bailer. The sample was collected in glass and plastic bottles and a glass vial. A water meter was used to test the pH, temperature, and conductivity before sampling until equilibrium conditions were met, as per BS10175⁹ guidelines.

The samples were sent to DETS laboratory for analysis. The sampling suite is presented in Table 2-4.

Testing	No. Samples
Metals / metalloids, pH, sulphate, TPHCWG, speciated PAHs, and ammoniacal nitrogen.	6 (G)

Table 2-4: Summary of Groundwater/Leachate Tests Undertaken.

Notes:

L=Leachate Sample; G=Groundwater Sample.

Metal/metalloids=arsenic, cadmium, chromium, (total and hexavalent), copper, lead, mercury, nickel, selenium, vanadium, zinc, and boron; TPHCWG=carbon banded and aromatic/aliphatic split petroleum hydrocarbons; PAH=polycyclic aromatic hydrocarbons, BTEX=benzene, toluene, ethylbenzene, and xylenes; MTBE=Methyl tert-butyl ether, VOC=Volatile organic Compounds, SVOC= Semi Volatile Organic Compounds, PCB=polychlorinated biphenyls.

2.5. In-situ Testing

2.5.1. Geotechnical Testing

In-situ geotechnical tests were performed in the boreholes to further characterise the sub-soil conditions. The following tests were undertaken:

- Standard Penetration Tests (SPTs) were performed in the window sample boreholes and cable percussion boreholes at approximately 1m intervals.
- Shear vane tests / pocket penetrometer tests (giving undrained shear strength) were performed in the window sample boreholes and trial pits within cohesive strata.
- Plate Loads Tests were undertaken to provide CBR values for road and pavement design.

Shear vanes tests / pocket penetrometer tests were not always possible due to the granular rich nature of some of the clay deposits.

The results are provided within Appendix A.

2.6. Well Installations

All of the boreholes were installed with monitoring wells for gas and groundwater monitoring and groundwater sampling. Monitoring wells were installed in accordance with BS10175 and CIRIA C665¹⁰ and generally comprised approximately 1m plain pipe over a length of slotted pipe surrounded by pea gravel and sealed at the top with bentonite and concrete. WS04 comprised approximately 4m of plain pipe over 1m of slotted pipe.

Well installation details are provided in Profile Logs in Appendix A.

3. Ground Conditions

3.1. Geology

The ground conditions beneath the site are summarised below. Logs are provided in Appendix A.

3.1.1. Made Ground

Made ground was recorded in all boreholes and trial pits to depths of 0.70-4.90mbgl. The made ground comprised horizons of gravel, sand, silt, clay with anthropogenic material including clinker, ash, brick, plastic, concrete, metal, ceramic and glass.

3.1.2. Natural Strata

Superficial strata generally comprised horizons of soft to very stiff clay with frequent bands of sand. Organic stratas of silt were present in WS02 1.50-1.80mbgl and WS05 1.30-2.00mbgl. A gravel strata was present in WS05 5.45-6.00mbgl.

3.1.3. Contamination

Except for the anthropogenic material encountered in the made ground (as described above), no further contamination was identified.

There was no visual / olfactory evidence of hydrocarbons or volatile contaminants in any locations. The PID recorded a maximum of 0.4ppm TVOC in the samples.

3.1.4. Obstructions

The following obstructions were encountered:

- TP101: pea gravel encountered in first attempt (ref Figure 2: TP01-B) indicating possible service. Trial pit moved approximately 3.00m south-east. Pea gravel found in new location, but pit extended southwest until no gravel present.

3.2. Groundwater

3.2.1. Groundwater Levels

Groundwater strikes were recorded during the investigation in trial pits and boreholes. This data is provided in the profile logs (Appendix A). Groundwater strikes are shown below in Table 3-1. No groundwater strikes were recorded the remainder of the trial pits.

Location	TP05	WS01	WS02	WS03	WS04	WS05
SI - Groundwater Strikes (mbgl)	4.00	3.90	3.00	3.00	3.20	5.50

Table 3-1: Summary of Groundwater Depths

Groundwater monitoring within the borehole wells has been undertaken on six occasions and is now complete. An oil-water interface probe was used to detect the presence of free phase hydrocarbons within each borehole. This data is provided in Appendix E.

3.2.2. Contamination

No visual or olfactory evidence of contamination was identified in the groundwater during investigation work or monitoring. No free phase hydrocarbons were detected.

3.3. Ground Gas Monitoring

All the installed boreholes are currently being monitored for gas. All gas monitoring is now complete.

Monitoring was undertaken using a Geotechnical Instruments GA5000 in accordance with the monitoring protocol outlined in CIRIA C665¹¹ (flow rate measured first). The monitoring was undertaken over a range of weather conditions (including low and falling barometric pressure and heavy rain) to demonstrate worst-case conditions.

The gas monitoring results are presented in table 3-2 below, are reproduced in full in Appendix E.

Borehole Ref.	Visit	Peak CH ₄ (%v/v)	Peak CO ₂ (%v/v)	Min O ₂ (%v/v)	Steady Flow (l/h)	Groundwater Level (mbgl)	Pressure (mb)	Prev 24hr Pressure Trend
WS01	1	2.6	0.1	0.1	<0.1	3.78	991	F
	2	2.4	0.2	<0.1	<0.1	Dry	1001	F
	3	2.4	0.2	0.1	<0.1	Dry	1018	R
	4	1.3	0.3	0.2	<0.1	Dry	1003	F
	5	1.7	0.3	0.1	<0.1	Dry	988	R/F
	6	1.7	0.3	0.1	<0.1	Dry	986	R
WS02	1	36.8	8.8	4.8	-1.7	2.0	993	F
	2	39.2	19.1	1.3	<0.1	2.4	1001	F
	3	51.4	19.7	0.1	<0.1	2.4	1019	R
	4	48.7	19	0.1	<0.1	2.4	1004	F
	5	35.7	17.7	0.1	0.1	2.2	988	R/F
	6	41.3	17.6	0.1	<0.1	2.26	986	R
WS03	1	1.1	4.6	0.2	<0.1	2.15	993	F
	2	1.4	6.3	<0.1	1.2	2.27	1001	F
	3	3.3	4.2	1.2	-2.5	2.16	1019	R
	4	5.1	5.5	0.7	-0.2	2.12	1004	F
WS04	1	1.9	1.2	0.3	<0.1	3.82	993	F
	2	1.2	1.7	5.2	<0.1	3.92	1001	F
	3	0.6	1.7	3.9	<0.1	3.89	1019	R
	4	0.4	1.1	1.4	<0.1	4.00	1003	F
	5	0.5	1.3	0.9	<0.1	3.93	988	R/F
	6	0.6	2	1.5	<0.1	3.79	987	R

Table 3-2: Summary of Ground Gas Concentrations and Groundwater Depths

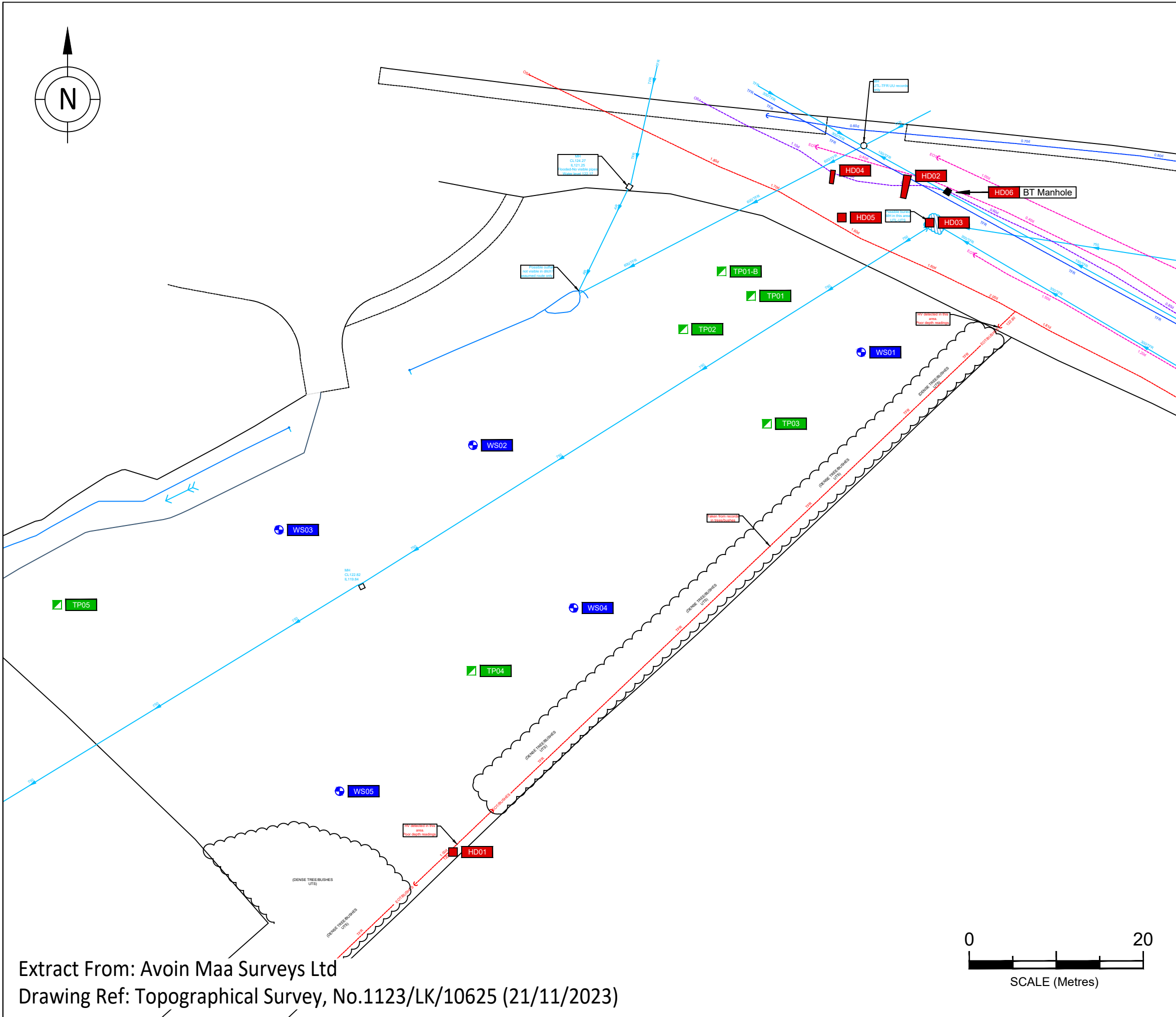
WS05	1	0.3	3.8	0.2	1.9	1.51	993	F
	2	<0.1	4.7	2.2	<0.1	1.76	1001	F
	3	<0.1	3.7	0.8	-1.3	1.91	1019	R
	4	<0.1	3.8	0.6	2.1	1.82	1005	F
	5	0.4	3.5	0.1	<0.1	1.16	989	R/F
	6	0.1	3.5	1.3	3.1	1.69	987	R

Table 3-3 (cont): Summary of Ground Gas Concentrations and Groundwater Depths

Figures



Client: Russell LDP				Title: Site Location & Boundary Plan			
Site: QEII Way, Heywood				Scale (see scale bar): 1:25,000 & 1:1,000 @ A4			
Job No.: LKC 23 1637		Drawn By: KR	Checked By: KR	Drawn: Dec 2023	Figure: 1		



KEY

- Hand Dug Trial Pit (HD)
- Trial Pit (TP)
- Window Sample Borehole (WS)
- BT Service Drain / Manhole (Discovered on Site)

Sampling Locations and features annotated by LK Consult Ltd are approximate and are based upon observed measurements unless otherwise stated. Do not scale from this drawing and work from marked dimensions only. All dimensions and features should be confirmed on site by the Contractor. Where this drawing includes information provided to LK Consult Ltd by others, LK Consult Ltd gives no warranty, representation or assurance as to the accuracy of such information.

Client:			
Russell LDP			
Site:			
QEII Way, Heywood			
Title:			
Site Investigation Location Plan			
Job No.:	Scale (See Scale Bar):	Figure:	Revision:
LKC 23 1637	See Scale Bar	2	
Drawn By:	Checked By:		
AC	JW	Nov 2023	

Extract From: Avoin Maa Surveys Ltd
Drawing Ref: Topographical Survey, No.1123/LK/10625 (21/11/2023)

Appendix A – Profile Logs

Project: QEII Way, Heywood		Client: Russel LDP		Date: 28/11/2023	
Project No. : LKC 23 1637		Contractor: D&I Drilling		Co-ords: E385082.09 N409049.97	
Equipment:		Level 120.73m AoD	Logged By JW	Scale 1:25	Page Number Sheet 1 of 1
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description	Level (m)
0.20 0.20	ES PID=0.0ppm	0.30		MADE GROUND: Dark brown slightly gravelly slightly sandy clayey SILT with frequent rootlets, occasional ash, clinker and rare brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite.	120.43
0.50 0.50	ES PID=0.0ppm	0.56		MADE GROUND: Dark brown slightly gravelly slightly sandy silty CLAY with frequent rootlets and rare brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite. End of Trial Pit at 0.56m	120.17
					0.5 1.0 1.5 2.0 2.5 3.0 3.5 4.0 4.5 5.0
		Pit Dimensions			Pit Stability
		Length (m)	Width (m)	Depth (m)	Stable
				0.56	
		Remarks: Concrete encountered at 0.56mbgl, presumed high voltage service. Directly above the concrete, only the uppermost strata was present.			

		Trial Pit Log					Location Number: HD02				
Project: QEII Way, Heywood			Client: Russel LDP			Date: 28/11/2023					
Project No. : LKC 23 1637			Contractor: D&I Drilling			Co-ords: E385134.15 N409125.09					
Equipment:			Level 123.32m AoD		Logged By JW		Scale 1:25		Page Number Sheet 1 of 1		
Depth (m)		Samples / Tests		Depth (m)	Legend	Stratum Description					Level (m)
0.10 0.10		ES PID=0.0ppm		0.24		MADE GROUND: Dark brown slightly gravelly slightly sandy clayey SILT with frequent rootlets, occasional ash, clinker and brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite. End of Trial Pit at 0.24m					123.08
										0.5	
										1.0	
										1.5	
										2.0	
										2.5	
										3.0	
										3.5	
										4.0	
										4.5	
										5.0	
					Pit Dimensions			Pit Stability			
					Length (m)		Width (m)	Depth (m)		Stable	
								0.24			
					Remarks: Refusal on concrete (presumed historic road).						

		Trial Pit Log				Location Number: HD03	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 28/11/2023	
Project No. : LKC 23 1637			Contractor: D&I Drilling			Co-ords: E385136.90 N409122.35	
Equipment:			Level 123.28m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description	Level (m)
0.10 0.10	ES PID=0.0ppm	0.32		MADE GROUND: Dark brown slightly gravelly slightly sandy clayey SILT with frequent rootlets, occasional ash, clinker and brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite. End of Trial Pit at 0.32m	122.96
					0.5
					1.0
					1.5
					2.0
					2.5
					3.0
					3.5
					4.0
					4.5
					5.0

			Pit Dimensions			Pit Stability
			Length (m)	Width (m)	Depth (m)	
					0.32	
Stable						
Remarks: Hand excavated trial pit undertaken in attempt to locate service drain. No services located. Refusal on concrete and sub-base (presumed historic road).						

		Trial Pit Log				Location Number: HD04	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 28/11/2023	
Project No. : LKC 23 1637			Contractor: D&I Drilling			Co-ords: E385126.05 N409128.34	
Equipment:			Level 123.50m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description	Level (m)
0.10 0.10	ES PID=0.0ppm	0.25		MADE GROUND: Dark brown slightly gravelly slightly sandy clayey SILT with frequent rootlets, occasional ash, clinker and brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite. End of Trial Pit at 0.25m	123.25
					0.5
					1.0
					1.5
					2.0
					2.5
					3.0
					3.5
					4.0
					4.5
					5.0

Pit Dimensions Pit Stability Length (m) Width (m) Depth (m) 0.25 Stable		
Remarks: Hand excavated trial pit undertaken to confirm presence of underlying concrete from historical road. Refusal on concrete (presumed historic road).		

		Trial Pit Log				Location Number: HD05	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 28/11/2023	
Project No. : LKC 23 1637			Contractor: D&I Drilling			Co-ords: E385126.79 N409122.92	
Equipment:			Level 123.33m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description	Level (m)
0.10 0.10 0.20	ES PID=0.0ppm B	0.28		MADE GROUND: Dark brown slightly gravelly slightly sandy clayey SILT with frequent rootlets, occasional ash, clinker and brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite. End of Trial Pit at 0.28m	123.05
					0.5
					1.0
					1.5
					2.0
					2.5
					3.0
					3.5
					4.0
					4.5
					5.0

			Pit Dimensions			Pit Stability
			Length (m)	Width (m)	Depth (m)	
					0.28	
Stable						
Remarks: Hand excavated trial pit undertaken in location of proposed development entrance. Refusal on concrete (presumed historic road).						

		Trial Pit Log				Location Number: HD06	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 28/11/2023	
Project No. : LKC 23 1637			Contractor: D&I Drilling			Co-ords: E385139.09 N409125.41	
Equipment:			Level 123.10m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description	Level (m)
		0.18		MADE GROUND: Dark brown slightly gravelly slightly sandy clayey SILT with frequent rootlets, occasional ash, clinker and brick fragments. Sand is fine to coarse. Gravel is fine to medium subangular to subrounded comprising sandstone and quartzite. End of Trial Pit at 0.18m	122.92
					0.5
					1.0
					1.5
					2.0
					2.5
					3.0
					3.5
					4.0
					4.5
					5.0

			Pit Dimensions			Pit Stability
			Length (m)	Width (m)	Depth (m)	
					0.18	
Remarks: Hand excavated trial pit undertaken to locate manhole. BT manhole located at 0.18mbgl.						

		Trial Pit Log				Location Number: TP01	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 27/11/2023	
Project No. : LKC 23 1637			Contractor: Arnold Plant Hire			Co-ords: E385122.00 N409122.34	
Equipment: 13 tonne tracked excavator			Level 125.31m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)
0.00 0.00 0.00	B ES PID=0.0ppm			MADE GROUND: Dark brownish grey very gravelly sandy SILT with moderate cobble content, frequent clay lenses, brick fragments, coal fragments, clinker, ash, occasional concrete fragments, plastic fragments, metal fragments, whole bricks and glass fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and quartz. Cobbles comprising sandstone and concrete. Strata becomes dark grey in colour with a moderate organic odour at 1.90-3.00mbgl. Band of sand present at 3.70-3.90mbgl.		
0.50 0.50 0.50	B ES PID=0.0ppm				0.5	
1.00 1.00 1.00	B ES PID=0.2ppm				1.0	
					1.5	
2.00 2.00 2.00	B ES PID=0.1ppm				2.0	
				2.5		
						3.0
						3.5
3.00 3.00 3.00	B ES PID=0.1ppm					4.0
						4.5
						5.0
4.00 4.00 4.00	B ES PID=0.2ppm	4.00		End of Trial Pit at 4.00m		121.31



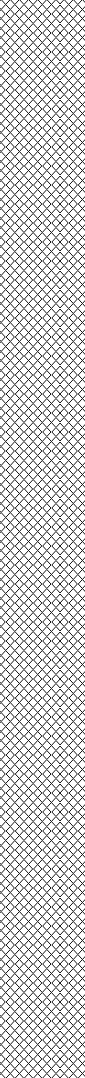
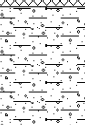
Pit Dimensions			Pit Stability
Length (m)	Width (m)	Depth (m)	Stable
5.00	0.80	4.00	

Remarks:

Service found, pea gravel. Pit extended towards back of site. Initial pit dug in correct place. Pit dug approximately 3.00m away.

Trial pit dry.

		Trial Pit Log				Location Number: TP02	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 27/11/2023	
Project No. : LKC 23 1637			Contractor: Arnold Plant Hire			Co-ords: E385106.87 N409112.34	
Equipment: 13 tonne tracked excavator			Level 124.52m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)
0.00 0.00	ES PID=0.1ppm			MADE GROUND: Dark brown very gravely slightly sandy SILT with a moderate cobble content, frequent brick fragments, clinker, occasional plastic fragments, metal fragments, ceramic fragments. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone. Cobbles comprise sandstone. Slight organic odour and brownish grey in colour at 1.20-2.50mbgl.		
0.50 0.50	ES PID=0.0ppm				0.5	
1.00 1.00 1.00	B ES PID=0.3ppm				1.0	
					1.5	
					2.0	
2.00 2.00 2.00	B ES PID=0.3ppm				2.5	
3.00 3.00 3.00	B ES PID=0.2ppm				3.0	
					3.5	
		3.60		Stiff consistency medium strength brown slightly gravely sandy silty CLAY with occasional sand lenses. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone and quartzite.		120.92
3.80	SV=44.00kPa					
4.00 4.00 4.00	B ES PID=0.1ppm	4.00		End of Trial Pit at 4.00m	4.0	120.52
					4.5	
					5.0	



Pit Dimensions			Pit Stability
Length (m)	Width (m)	Depth (m)	Stable
3.20	0.80	4.00	

Remarks:
 Trial pit dry.

Project: QEII Way, Heywood

Client: Russel LDP

Date: 27/11/2023

Project No. : LKC 23 1637

Contractor: Arnold Plant Hire

Co-ords: E385104.40 N409099.33

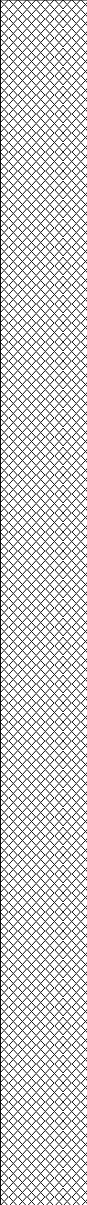
Equipment: 13 tonne tracked excavator

Level
125.08m AoD

Logged By
JW

Scale
1:25

Page Number
Sheet 1 of 1

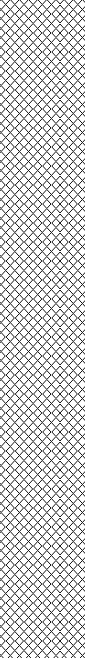
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)	
0.00 0.00	ES PID=0.1ppm			MADE GROUND: Dark brownish grey sandy slightly silty GRAVEL with moderate sandstone cobble content and occasional clay lenses, frequent brick fragments, occasional coal fragments, ash, metal and rare plastic. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone. Cobbles are subangular to subrounded.			
0.50 0.50 0.50	B ES PID=0.0ppm			Frequent rootlets present at 0.00-0.60mbgl.	0.5		
1.00 1.00 1.00	B ES PID=0.0ppm				1.0		
					1.5		
2.00 2.00 2.00 2.00 2.00	B B ES ES PID=0.0ppm				2.0		
					2.5		
3.00 3.00 3.00	B ES PID=0.0ppm				3.0		
					3.5		
4.00 4.00 4.00	B ES PID=0.0ppm	4.00			End of Trial Pit at 4.00m	4.0	121.08
						4.5	
					5.0		



Pit Dimensions			Pit Stability
Length (m)	Width (m)	Depth (m)	
3.50	0.80	4.00	

Remarks:
Trial pit dry.

		Trial Pit Log				Location Number: TP04	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 27/11/2023	
Project No. : LKC 23 1637			Contractor: Arnold Plant Hire			Co-ords: E385085.51 N409070.37	
Equipment: 13 tonne tracked excavator			Level 123.37m AoD		Logged By JW		Scale 1:25 Page Number Sheet 1 of 1

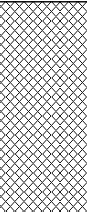
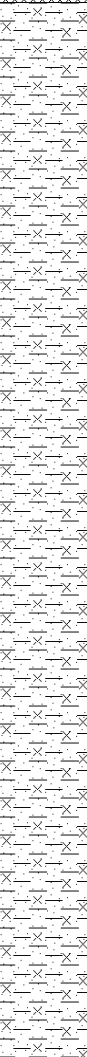
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description	Level (m)
0.00 0.00	ES PID=0.0ppm			MADE GROUND: Dark brown very gravelly slightly sandy SILT with moderate cobble content, low boulder and large boulder content, frequent brick fragments, coal fragments, ash, rare metal fragments and plastic fragments. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded comprising sandstone. Cobbles, boulder and large boulders subangular to subrounded comprising sandstone.	
0.50 0.50 0.50	B ES PID=0.4ppm				0.5
1.00 1.00 1.00	B ES PID=0.3ppm				1.0
					1.5
2.00 2.00 2.00	B ES PID=0.0ppm	2.20			2.0
					121.17
2.50	SV=34.00kPa				2.5
					3.0
3.00 3.00 3.00 3.00	B ES SV=42.00kPa PID=0.0ppm	3.10			120.27
					3.5
4.00 4.00 4.00	B ES PID=0.0ppm	4.30		4.0	
			End of Trial Pit at 4.30m	119.07	
				4.5	
				5.0	



Pit Dimensions			Pit Stability
Length (m)	Width (m)	Depth (m)	Stable
3.00	0.80	4.30	

Remarks:

Perched water present above clay strata.

		Trial Pit Log					Location Number: TP05	
Project: QEII Way, Heywood			Client: Russel LDP			Date: 27/11/2023		
Project No. : LKC 23 1637			Contractor: Arnold Plant Hire			Co-ords: E385046.88 N409073.66		
Equipment: 13 tonne tracked excavator			Level 122.19m AoD	Logged By JW	Scale 1:25	Page Number Sheet 1 of 1		
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description			Level (m)	Water Strikes
0.00 0.00 0.00	B ES PID=0.0ppm	0.70		MADE GROUND: Dark brown gravelly sandy SILT with occasional clinker, coal fragments, brick fragments and rootlets. Sand is fine to coarse. Gravel is fine to coarse, sub-angular to sub-rounded comprising sandstone.			121.49	
0.50 0.50 0.50	B ES PID=0.0ppm					0.5		
1.00 1.00 1.00 1.00	B ES SV=34.00kPa PID=0.0ppm			Soft to firm low to medium strength consistency brown sandy silty CLAY with frequent bands of silty sand. Sand is fine to coarse.		1.0		
						1.5		
1.80	SV=42.00kPa					2.0		
2.00 2.00 2.00	B ES PID=0.0ppm					2.5		
2.50	SV=46.00kPa					3.0		
3.00 3.00 3.00	B ES PID=0.0ppm					3.5		
3.80	SV=38.00kPa					4.0		
4.00 4.00 4.00	B ES PID=0.0ppm					4.5		
		5.0						
		4.20		End of Trial Pit at 4.20m			117.99	▼
			Pit Dimensions			Pit Stability		
			Length (m)	Width (m)	Depth (m)	Unstable		
			2.90	3.20	4.20			
			Remarks:					
Trial pit highly unstable at 0.80-4.20m. Several collapses of sidewall during excavation,								

Date: 29/11/2023

Co-ords: E385133.63 N409109.24

Page Number
Sheet 1 of 1

Remarks:
Water strike at 3.90mbgl.
Stable.

Date: 28/11/2023

Co-ords: E385085.04 N409096.74

Page Number
Sheet 1 of 1

Remarks:
Water strike at 3.00mbgl.
Stable.

Date: 28/11/2023

Co-ords: E385065.36 N409095.47

Page Number
Sheet 1 of 1

Remarks:
Water strike at 3.00mbgl.
Stable.

Project Name: QEII Way, Heywood			Client: Russel LDP			Date: 29/11/2023		
Project No. : LKC 23 1637			Contractor: D&I Drilling			Co-ords: E385095.89 N409082.21		
			Level 124.48m AoD		Logged By JW		Scale 1:50	
							Page Number Sheet 1 of 1	
Depth (m)	Samples / Tests	Depth (m)	Legend	Stratum Description		Level (m)	Water Strikes	Well
0.00	ES	0.30		MADE GROUND: Dark brown gravelly slightly sandy SILT with frequent rootlets and occasional coal fragments. Sand is fine to coarse. Gravel is fine to medium, subangular to subrounded comprising sandstone and quartzite. MADE GROUND: Dark brown sandy silty clayey GRAVEL with frequent brick fragments, occasional ash and clinker. Sand is fine to coarse. Gravel is fine to coarse, subangular to subrounded comprising sandstone. No 3m SPT recovery.	1	124.18		
0.00	PID=0.2ppm							
0.50	ES							
0.50	PID=0.0ppm							
1.00	D	4.10		MADE GROUND: Dark grey very gravelly slightly sandy SILT with occasional wood, plant material (moss), ash and clinker. Sand is fine to coarse. Gravel is fine to coarse subangular to subrounded comprising sandstone. Moderate organic odour.	2			
1.00	ES							
1.00	PID=0.0ppm							
1.20	D							
1.20 - 1.65	N=25 (4,7/6,7,6,6)							
2.00	D							
2.00	D							
2.00 - 2.45	N=13 (4,2/3,3,3,4)							
2.50	D							
2.50	ES							
2.50	PID=0.0ppm	4.90		Firm consistency medium strength brown with grey mottling sandy silty CLAY with frequent bands of sand and occasional coal fragments. Sand is fine to coarse. Band of sand present at 4.10-4.20mbgl and 5.40-5.60mbgl. No 6.00m SPT recovery.	3			
3.00 - 3.45	N=13 (4,4/4,3,3,3)							
4.00	D							
4.00 - 4.45	N=8 (4,3/2,2,2,2)							
4.50	D	6.00		End of Borehole at 6.00m	4	120.38		
4.50	ES							
4.50	PID=0.1ppm							
4.80	PP=49.0kPa							
5.00	ES	6.00		End of Borehole at 6.00m	5	119.58		
5.00 - 5.45	N=16 (6,4/4,4,4,4)							
5.80	PP=63.8kPa							
6.00	D							
					6	118.48		
					7			
					8			
					9			
					10			

Remarks:

Water strike at 3.20mbgl.
Stable.

Date: 28/11/2023

Co-ords: E385073.84 N409065.45

Page Number
Sheet 1 of 1

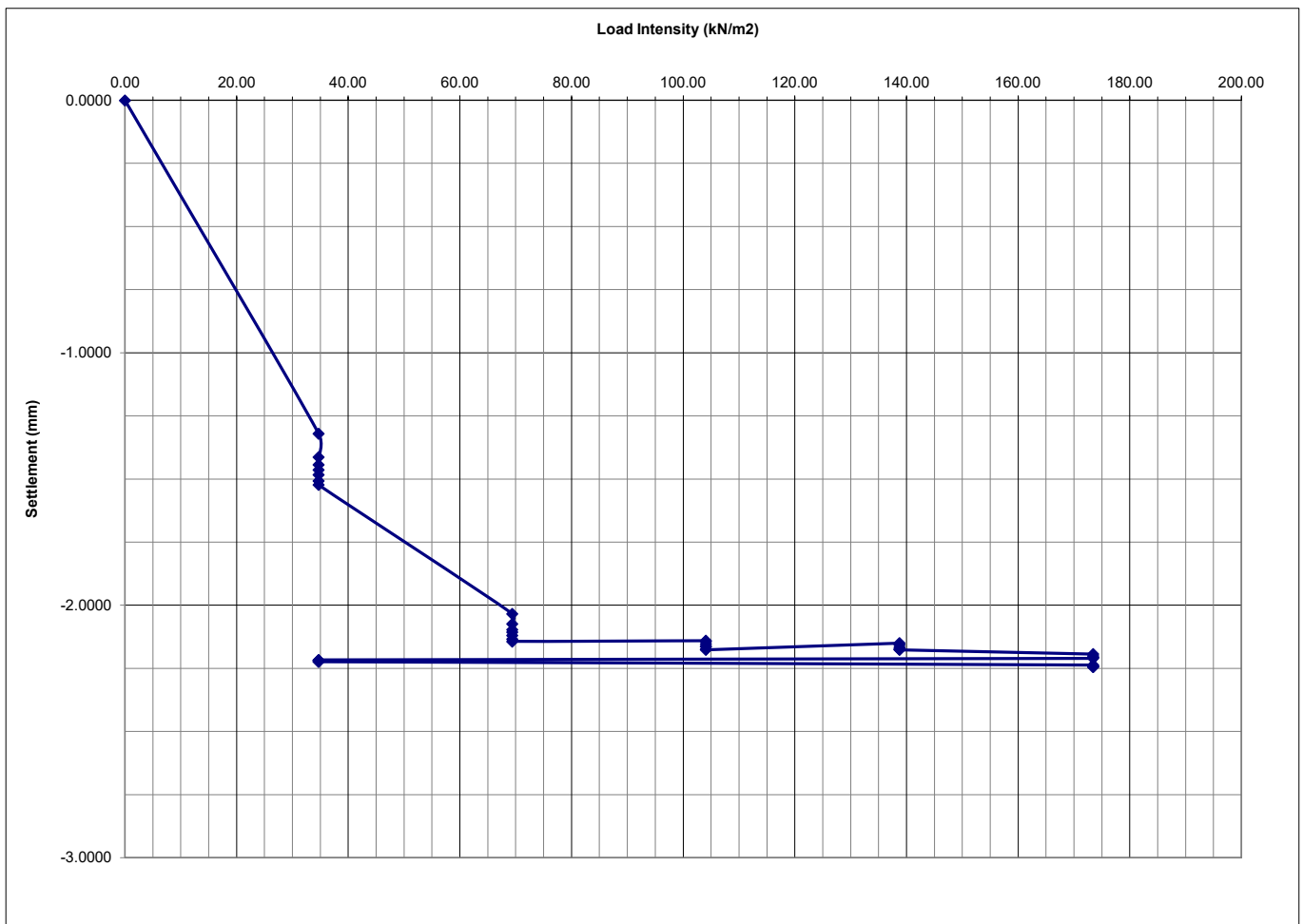
Remarks:
Water strike at 5.50mbgl.
Stable.

Appendix B – Plate Load Testing Results

TP04 - Vertical Deformation Test-Equivalent CBR Value

In Accordance with BS1377: Part 9:1990

Site Name:	QEII Way, Heywood	Test Date:	27/11/2023
Site Ref:	LKC 23 1637	Type of Kentledge:	13T Excavator
Test No.:	TP04	Test Depth (m bgl):	0.30
Plate Diameter (mm)	600	Easting:	385084.218
Maximum Applied Pressure (kN/m ²):	173.48	Northing:	409070.798
Maximum Deformation (mm):	-2.24	Weather:	Overcast
Strata Description:	Made Ground		



Equivalent CBR Value of 2%

Corrected Subgrade Reaction (k_{762}): **22304** kN/m²

Comments

Site Engineer:	Date:
JW	18/12/2023

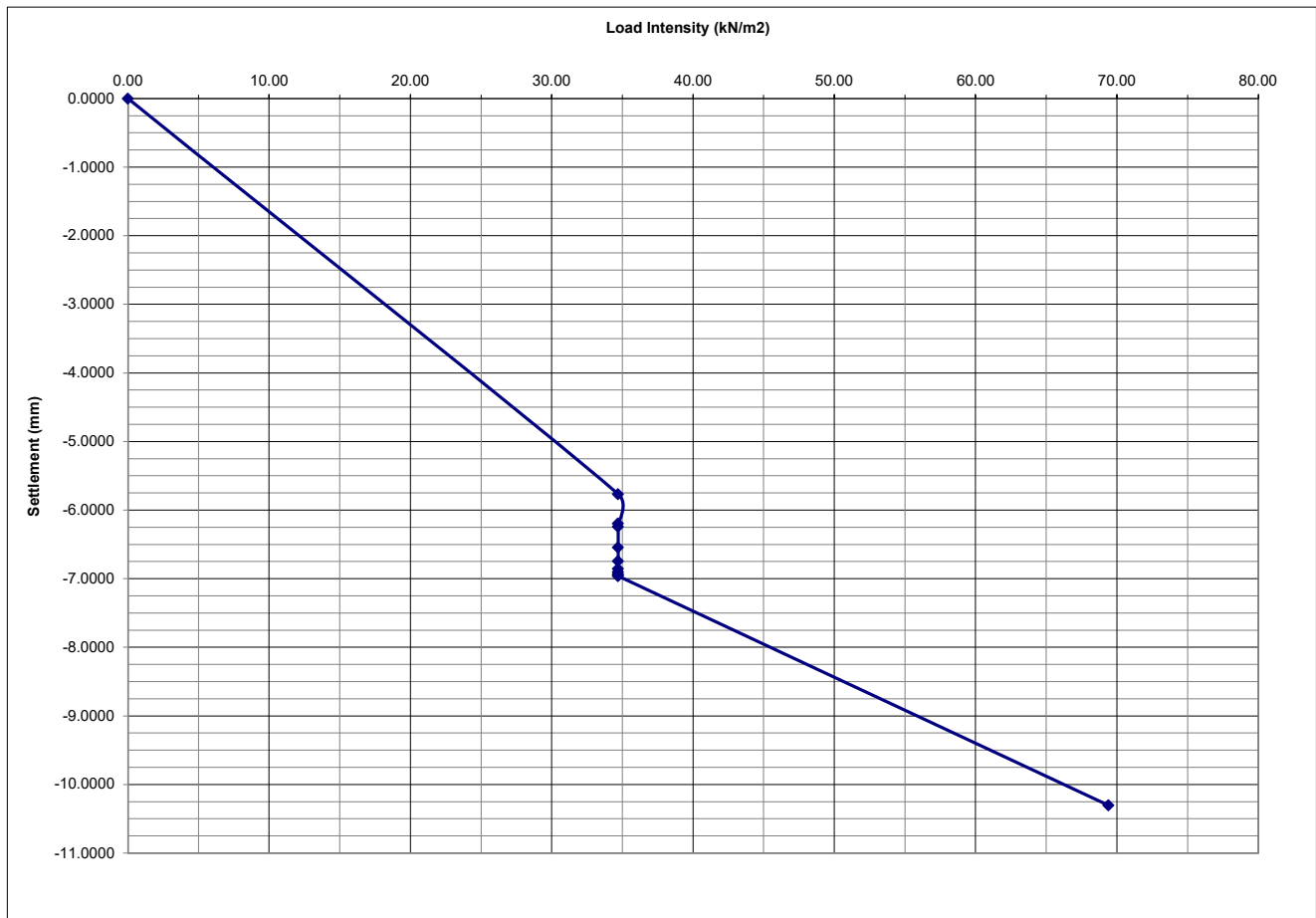
Approved By:	Date:
CW	18/12/2023



TP05 - Vertical Deformation Test-Equivalent CBR Value

In Accordance with BS1377: Part 9:1990

Site Name:	QEII Way, Heywood	Test Date:	27/11/2023
Site Ref:	LKC 23 1637	Type of Kentledge:	13T Excavator
Test No.:	TP05 Test 1	Test Depth (m bgl):	0.30
Plate Diameter (mm)	600	Easting:	385084.218
Maximum Applied Pressure (kN/m ²):	69.39	Northing:	409070.798
Maximum Deformation (mm):	-10.30	Weather:	Overcast
Strata Description:	Made Ground		



Equivalent CBR Value of 0.15%

Corrected Subgrade Reaction (k_{762}): 4920 kN/m²

Comments

Test ended due to max gauge reading exceeded at 2 tonnes.

Site Engineer:	Date:
JW	18/12/2023

Approved By:	Date:
CW	18/12/2023

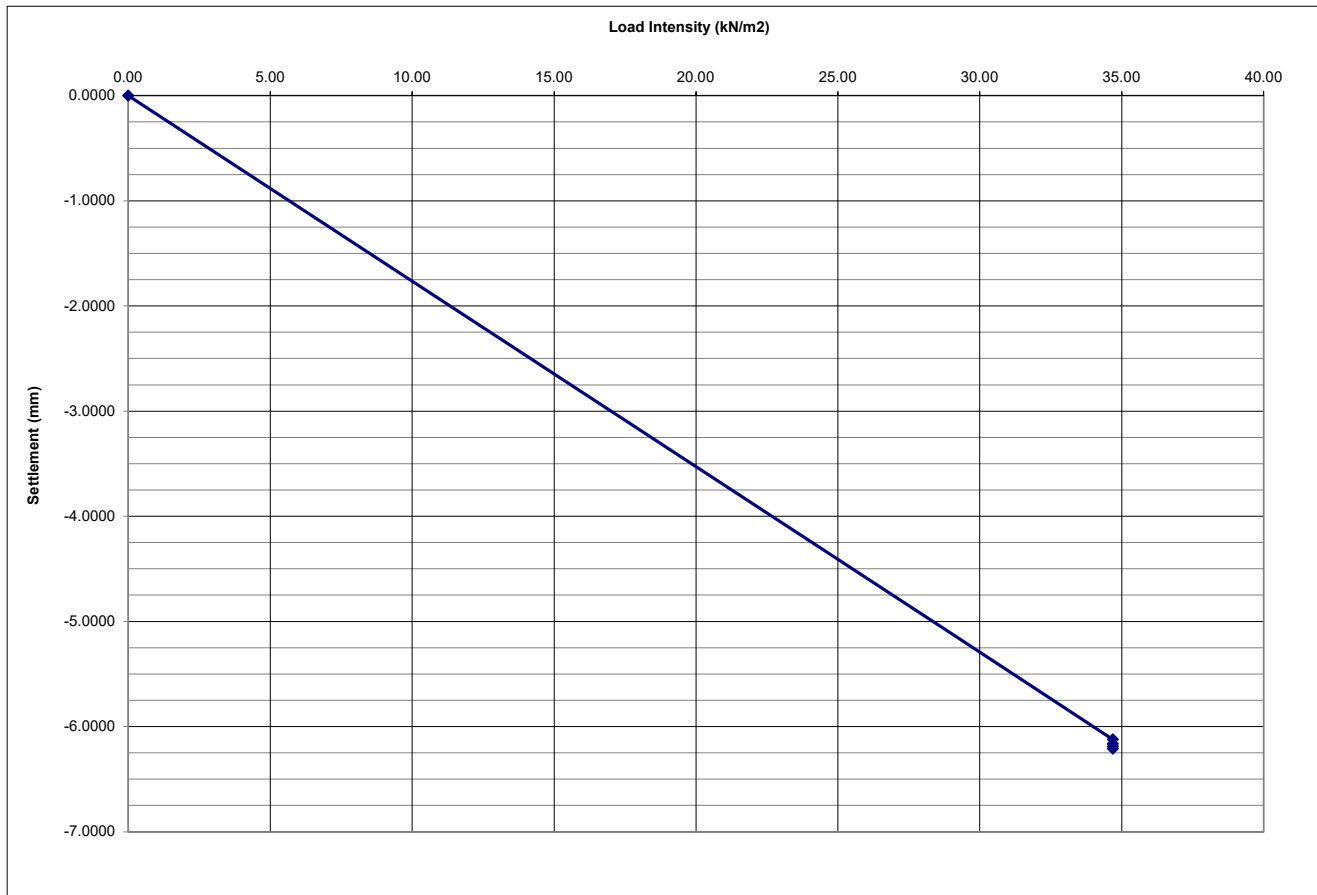


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TP05 - Vertical Deformation Test-Equivalent CBR Value

In Accordance with BS1377: Part 9:1990

Site Name:	QEII Way, Heywood	Test Date:	27/11/2023
Site Ref:	LKC 23 1637	Type of Kentledge:	13T Excavator
Test No.:	TP05 Test 2	Test Depth (m bgl):	0.30
Plate Diameter (mm)	600	Easting:	385084.218
Maximum Applied Pressure (kN/m ²):	34.70	Northing:	409070.798
Maximum Deformation (mm):	-6.21	Weather:	Overcast
Strata Description:	Made Ground		



Equivalent CBR Value of 0.14%

Corrected Subgrade Reaction (k_{762}): 4592 kN/m²

Comments

Test ended due to max gauge reading exceeded at 1 tonne.

Site Engineer:	Date:
JW	18/12/2023

Approved By:	Date:
CW	18/12/2023

Appendix C – Certificates of Analysis (Soil & Water)



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LK Consult Limited
Unit 29 Eton Business Park
Eton Hill Road
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M26 2ZS

Derwentside Environmental Testing Services Ltd
Unit 1
Rose Lane Industrial Estate
Rose Lane
Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 23-14742

Site Reference: OEII Wav, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC231637-KR

Sample Receipt Date: 01/12/2023

Sample Scheduled Date: 01/12/2023

Report Issue Number: 1

Reporting Date: 07/12/2023

Authorised by:

Steve Knight
Customer Support Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Soil Analysis Certificate						
DETS Report No: 23-14742	Date Sampled	27/11/23	27/11/23	27/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	TP01	TP02	TP03		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC231637-KR	Depth (m)	0.50	1.00	0.00		
Reporting Date: 07/12/2023	DETS Sample No	688185	688186	688187		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	7.3	7.2	7.4		
Total Cyanide	mg/kg	< 1	NONE	< 1	< 1	< 1		
Free Cyanide	mg/kg	< 1	NONE	< 1	< 1	< 1		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	73	76	31		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.07	0.08	0.03		
Organic Matter (SOM)	%	< 0.1	MCERTS	1.5	3.5	4.7		
Arsenic (As)	mg/kg	< 2	MCERTS	5	9	11		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	< 0.2	< 0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	7	12	25		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	12	120	29		
Lead (Pb)	mg/kg	< 3	MCERTS	9	120	58		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	9	13	10		
Selenium (Se)	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Vanadium (V)	mg/kg	< 1	MCERTS	10	17	19		
Zinc (Zn)	mg/kg	< 3	MCERTS	19	130	50		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2	< 2		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Maidstone
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Tel : 01622 850410



Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 23-14742	Date Sampled	27/11/23	27/11/23	27/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	TP01	TP02	TP03		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC231637-KR	Depth (m)	0.50	1.00	0.00		
Reporting Date: 07/12/2023	DETS Sample No	688185	688186	688187		

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.14		
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	0.16	0.18		
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	0.12	< 0.1		
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	0.81	1.20		
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.17	0.22		
Fluoranthene	mg/kg	< 0.1	MCERTS	0.29	1.06	1.44		
Pyrene	mg/kg	< 0.1	MCERTS	0.26	1.06	1.40		
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.15	0.48	0.59		
Chrysene	mg/kg	< 0.1	MCERTS	0.15	0.55	0.71		
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.16	0.53	0.75		
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	0.22	0.21		
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.15	0.51	0.72		
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	0.25	0.39		
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1		
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	0.23	0.37		
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	6.2	8.3		



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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 23-14742	Date Sampled	27/11/23	27/11/23	27/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	TP01	TP02	TP03		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC231637-KR	Depth (m)	0.50	1.00	0.00		
Reporting Date: 07/12/2023	DETS Sample No	688185	688186	688187		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6 : HS_1D_MS_AL	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aliphatic >C6 - C8 : HS_1D_MS_AL	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aliphatic >C8 - C10 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C10 - C12 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aliphatic >C12 - C16 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C16 - C21 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3	< 3		
Aliphatic >C21 - C34 : EH_CU_1D_AL	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aliphatic >C34 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10		
Aliphatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AL	mg/kg	< 21	NONE	< 21	< 21	< 21		
Aromatic >C5 - C7 : HS_1D_MS_AR	mg/kg	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Aromatic >C7 - C8 : HS_1D_MS_AR	mg/kg	< 0.05	NONE	< 0.05	< 0.05	< 0.05		
Aromatic >C8 - C10 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Aromatic >C10 - C12 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2	3		
Aromatic >C12 - C16 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2	3		
Aromatic >C16 - C21 : EH_CU_1D_AR	mg/kg	< 3	MCERTS	< 3	< 3	8		
Aromatic >C21 - C35 : EH_CU_1D_AR	mg/kg	< 10	MCERTS	< 10	< 10	< 10		
Aromatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10	< 10		
Aromatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AR	mg/kg	< 21	NONE	< 21	< 21	< 21		
Total >C5 - C44 : HS_1D_MS+EH_CU_1D_Tot al	mg/kg	< 42	NONE	< 42	< 42	< 42		



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 23-14742	Date Sampled	27/11/23	27/11/23	27/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	TP01	TP02	TP03		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC231637-KR	Depth (m)	0.50	1.00	0.00		
Reporting Date: 07/12/2023	DETS Sample No	688185	688186	688187		

Determinand	Unit	RL	Accreditation					
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	< 5		
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	< 2		
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	< 5		



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Rose Lane
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Maidstone
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Tel : 01622 850410



Soil Analysis Certificate - Sample Descriptions

DETS Report No: 23-14742	
LK Consult Limited	
Site Reference: QEII Way, Heywood	
Project / Job Ref: LKC 23 1637	
Order No: LKC231637-KR	
Reporting Date: 07/12/2023	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
688185	TP01	None Supplied	0.50	10.6	Brown sandy clay with stones
688186	TP02	None Supplied	1.00	13.4	Brown sandy clay with stones
688187	TP03	None Supplied	0.00	23.6	Brown sandy clay with stones

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{U/S}

Unsuitable Sample ^{U/S}



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Lenham Heath
Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 23-14742

LK Consult Limited

Site Reference: QEII Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC231637-KR

Reporting Date: 07/12/2023

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



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List of HWOL Acronyms and Operators
DETS Report No: 23-14742
LK Consult Limited
Site Reference: QEII Way, Heywood
Project / Job Ref: LKC 23 1637
Order No: LKC231637-KR
Reporting Date: 07/12/2023

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym
Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_CU_1D_AL
TPH CWG - Aliphatic >C12 - C16 - EH_CU_1D_AL
TPH CWG - Aliphatic >C16 - C21 - EH_CU_1D_AL
TPH CWG - Aliphatic >C21 - C34 - EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_CU_1D_AL
TPH CWG - Aromatic >C10 - C12 - EH_CU_1D_AR
TPH CWG - Aromatic >C12 - C16 - EH_CU_1D_AR
TPH CWG - Aromatic >C16 - C21 - EH_CU_1D_AR
TPH CWG - Aromatic >C21 - C35 - EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_CU_1D_AR
TPH CWG - Total >C5 - C44 - HS_1D_MS+EH_CU_1D_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS



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Derwentside Environmental Testing Services Ltd
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DETS Report No: 23-14743

Site Reference: OEII Wav, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC231637-KR

Sample Receipt Date: 01/12/2023

Sample Scheduled Date: 01/12/2023

Report Issue Number: 1

Reporting Date: 07/12/2023

Authorised by:

Steve Knight
Customer Support Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Soil Analysis Certificate						
DETS Report No: 23-14743	Date Sampled	29/11/23	29/11/23	29/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	WS01	WS01	WS04		
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES	ES		
Order No: LKC231637-KR	Depth (m)	0.50	1.00	0.50		
Reporting Date: 07/12/2023	DETS Sample No	688188	688189	688190		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	7.2	7.8	7.6		
Total Cyanide	mg/kg	< 1	NONE	< 1	< 1	< 1		
Free Cyanide	mg/kg	< 1	NONE	< 1	< 1	< 1		
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	35	52	46		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.03	0.05	0.05		
Organic Matter (SOM)	%	< 0.1	MCERTS	6.7	5	4.4		
Arsenic (As)	mg/kg	< 2	MCERTS	13	12	30		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1		
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.2	0.4	0.3		
Chromium (Cr)	mg/kg	< 2	MCERTS	14	14	20		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	30	40	71		
Lead (Pb)	mg/kg	< 3	MCERTS	55	95	173		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	9	13	15		
Selenium (Se)	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Vanadium (V)	mg/kg	< 1	MCERTS	22	19	21		
Zinc (Zn)	mg/kg	< 3	MCERTS	52	92	110		
Total Phenols (monohydric)	mg/kg	< 2	NONE		< 2	< 2		

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
 Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 23-14743	Date Sampled	29/11/23	29/11/23	29/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	WS01	WS01	WS04		
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES	ES		
Order No: LKC231637-KR	Depth (m)	0.50	1.00	0.50		
Reporting Date: 07/12/2023	DETS Sample No	688188	688189	688190		

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	0.21	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	0.14	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	0.42	1.30	0.25	
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	0.25	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	0.85	1.63	0.35	
Pyrene	mg/kg	< 0.1	MCERTS	0.79	1.62	0.35	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.42	0.70	0.18	
Chrysene	mg/kg	< 0.1	MCERTS	0.48	0.73	0.21	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.56	0.75	0.23	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	0.17	0.20	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.50	0.62	0.19	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	0.27	0.30	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	0.23	0.28	< 0.1	
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	4.7	8.7	1.8	



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Soil Analysis Certificate - TPH CWG Banded					
DETS Report No: 23-14743	Date Sampled	29/11/23	29/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	WS01	WS04		
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES		
Order No: LKC231637-KR	Depth (m)	1.00	0.50		
Reporting Date: 07/12/2023	DETS Sample No	688189	688190		

Determinand	Unit	RL	Accreditation				
Aliphatic >C5 - C6 : HS_1D_MS_AL	mg/kg	< 0.01	NONE	< 0.01	< 0.01		
Aliphatic >C6 - C8 : HS_1D_MS_AL	mg/kg	< 0.05	NONE	0.05	< 0.05		
Aliphatic >C8 - C10 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	< 2		
Aliphatic >C10 - C12 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	3	< 2		
Aliphatic >C12 - C16 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3		
Aliphatic >C16 - C21 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3		
Aliphatic >C21 - C34 : EH_CU_1D_AL	mg/kg	< 10	MCERTS	< 10	< 10		
Aliphatic >C34 - C44	mg/kg	< 10	NONE	< 10	< 10		
Aliphatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AL	mg/kg	< 21	NONE	< 21	< 21		
Aromatic >C5 - C7 : HS_1D_MS_AR	mg/kg	< 0.01	NONE	< 0.01	< 0.01		
Aromatic >C7 - C8 : HS_1D_MS_AR	mg/kg	< 0.05	NONE	< 0.05	< 0.05		
Aromatic >C8 - C10 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2		
Aromatic >C10 - C12 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	2	< 2		
Aromatic >C12 - C16 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	2	< 2		
Aromatic >C16 - C21 : EH_CU_1D_AR	mg/kg	< 3	MCERTS	8	< 3		
Aromatic >C21 - C35 : EH_CU_1D_AR	mg/kg	< 10	MCERTS	12	< 10		
Aromatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10		
Aromatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AR	mg/kg	< 21	NONE	24	< 21		
Total >C5 - C44 : HS_1D_MS+EH_CU_1D_Tot al	mg/kg	< 42	NONE	< 42	< 42		



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 23-14743	Date Sampled	29/11/23	29/11/23			
LK Consult Limited	Time Sampled	None Supplied	None Supplied			
Site Reference: QEII Way, Heywood	TP / BH No	WS01	WS04			
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES			
Order No: LKC231637-KR	Depth (m)	1.00	0.50			
Reporting Date: 07/12/2023	DETS Sample No	688189	688190			

Determinand	Unit	RL	Accreditation			
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	



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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 23-14743	
LK Consult Limited	
Site Reference: QEII Way, Heywood	
Project / Job Ref: LKC 23 1637	
Order No: LKC231637-KR	
Reporting Date: 07/12/2023	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
688188	WS01	ES	0.50	21.3	Brown sandy clay
688189	WS01	ES	1.00	9.7	Brown sandy clay with stones and concrete
688190	WS04	ES	0.50	14.8	Brown sandy clay with stones and concrete

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{U/S}

Unsuitable Sample ^{U/S}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 23-14743

LK Consult Limited

Site Reference: QEII Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC231637-KR

Reporting Date: 07/12/2023

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



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List of HWOL Acronyms and Operators
DETS Report No: 23-14743
LK Consult Limited
Site Reference: QEII Way, Heywood
Project / Job Ref: LKC 23 1637
Order No: LKC231637-KR
Reporting Date: 07/12/2023

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym
Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_CU_1D_AL
TPH CWG - Aliphatic >C12 - C16 - EH_CU_1D_AL
TPH CWG - Aliphatic >C16 - C21 - EH_CU_1D_AL
TPH CWG - Aliphatic >C21 - C34 - EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_CU_1D_AL
TPH CWG - Aromatic >C10 - C12 - EH_CU_1D_AR
TPH CWG - Aromatic >C12 - C16 - EH_CU_1D_AR
TPH CWG - Aromatic >C16 - C21 - EH_CU_1D_AR
TPH CWG - Aromatic >C21 - C35 - EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_CU_1D_AR
TPH CWG - Total >C5 - C44 - HS_1D_MS+EH_CU_1D_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS



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DETS Report No: 23-14744

Site Reference: OEII Wav, Heywood

Project / Job Ref: LKC 23 1637

Order No: None Supplied

Sample Receipt Date: 01/12/2023

Sample Scheduled Date: 01/12/2023

Report Issue Number: 1

Reporting Date: 07/12/2023

Authorised by:

Steve Knight
Customer Support Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Soil Analysis Certificate						
DETS Report No: 23-14744	Date Sampled	27/11/23	27/11/23	27/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	TP04	TP05	TP05		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.00	0.50	1.00		
Reporting Date: 07/12/2023	DETS Sample No	688191	688192	688193		

Determinand	Unit	RL	Accreditation					
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected		
pH	pH Units	N/a	MCERTS	7.4	7.0	5.1		
Total Cyanide	mg/kg	< 1	NONE	< 1	< 1			
Free Cyanide	mg/kg	< 1	NONE	< 1	< 1			
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	15	11	28		
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.02	0.01	0.03		
Organic Matter (SOM)	%	< 0.1	MCERTS	12	9.3	2.4		
Arsenic (As)	mg/kg	< 2	MCERTS	14	13	7		
W/S Boron	mg/kg	< 1	NONE	< 1	< 1			
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	0.2	< 0.2		
Chromium (Cr)	mg/kg	< 2	MCERTS	14	13	18		
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2		
Copper (Cu)	mg/kg	< 4	MCERTS	44	41	21		
Lead (Pb)	mg/kg	< 3	MCERTS	73	62	14		
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1		
Nickel (Ni)	mg/kg	< 3	MCERTS	12	11	17		
Selenium (Se)	mg/kg	< 2	MCERTS	< 2	< 2	< 2		
Vanadium (V)	mg/kg	< 1	MCERTS	24	25	24		
Zinc (Zn)	mg/kg	< 3	MCERTS	89	68	41		
Total Phenols (monohydric)	mg/kg	< 2	NONE	< 2	< 2			

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 23-14744	Date Sampled	27/11/23	27/11/23	27/11/23		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QEII Way, Heywood	TP / BH No	TP04	TP05	TP05		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: None Supplied	Depth (m)	0.00	0.50	1.00		
Reporting Date: 07/12/2023	DETS Sample No	688191	688192	688193		

Determinand	Unit	RL	Accreditation				
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Chrysene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	< 1.6	



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Maidstone
Kent ME17 2JN
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Soil Analysis Certificate - TPH CWG Banded

DETS Report No: 23-14744	Date Sampled	27/11/23	27/11/23			
LK Consult Limited	Time Sampled	None Supplied	None Supplied			
Site Reference: QEII Way, Heywood	TP / BH No	TP04	TP05			
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	0.00	0.50			
Reporting Date: 07/12/2023	DETS Sample No	688191	688192			

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6 : HS_1D_MS_AL	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aliphatic >C6 - C8 : HS_1D_MS_AL	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aliphatic >C8 - C10 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C10 - C12 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	4			
Aliphatic >C12 - C16 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	4			
Aliphatic >C16 - C21 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C21 - C34 : EH_CU_1D_AL	mg/kg	< 10	MCERTS	< 10	< 10			
Aliphatic >C34 - C44	mg/kg	< 10	NONE	< 10	< 10			
Aliphatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AL	mg/kg	< 21	NONE	< 21	< 21			
Aromatic >C5 - C7 : HS_1D_MS_AR	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aromatic >C7 - C8 : HS_1D_MS_AR	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aromatic >C8 - C10 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C10 - C12 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	5			
Aromatic >C12 - C16 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C16 - C21 : EH_CU_1D_AR	mg/kg	< 3	MCERTS	< 3	< 3			
Aromatic >C21 - C35 : EH_CU_1D_AR	mg/kg	< 10	MCERTS	< 10	< 10			
Aromatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10			
Aromatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AR	mg/kg	< 21	NONE	< 21	< 21			
Total >C5 - C44 : HS_1D_MS+EH_CU_1D_Tot al	mg/kg	< 42	NONE	< 42	< 42			



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 23-14744	Date Sampled	27/11/23	27/11/23			
LK Consult Limited	Time Sampled	None Supplied	None Supplied			
Site Reference: QEII Way, Heywood	TP / BH No	TP04	TP05			
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied			
Order No: None Supplied	Depth (m)	0.00	0.50			
Reporting Date: 07/12/2023	DETS Sample No	688191	688192			

Determinand	Unit	RL	Accreditation			
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	



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Soil Analysis Certificate - Sample Descriptions

DETS Report No: 23-14744	
LK Consult Limited	
Site Reference: QEII Way, Heywood	
Project / Job Ref: LKC 23 1637	
Order No: None Supplied	
Reporting Date: 07/12/2023	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
688191	TP04	None Supplied	0.00	31.4	Brown sandy clay with stones and vegetation
688192	TP05	None Supplied	0.50	28.9	Brown sandy clay with stones and vegetation
688193	TP05	None Supplied	1.00	15.4	Light brown clay

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{U/S}

Unsuitable Sample ^{U/S}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 23-14744

LK Consult Limited

Site Reference: QEII Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: None Supplied

Reporting Date: 07/12/2023

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



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List of HWOL Acronyms and Operators
DETS Report No: 23-14744
LK Consult Limited
Site Reference: QEII Way, Heywood
Project / Job Ref: LKC 23 1637
Order No: None Supplied
Reporting Date: 07/12/2023

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym
Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_CU_1D_AL
TPH CWG - Aliphatic >C12 - C16 - EH_CU_1D_AL
TPH CWG - Aliphatic >C16 - C21 - EH_CU_1D_AL
TPH CWG - Aliphatic >C21 - C34 - EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_CU_1D_AL
TPH CWG - Aromatic >C10 - C12 - EH_CU_1D_AR
TPH CWG - Aromatic >C12 - C16 - EH_CU_1D_AR
TPH CWG - Aromatic >C16 - C21 - EH_CU_1D_AR
TPH CWG - Aromatic >C21 - C35 - EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_CU_1D_AR
TPH CWG - Total >C5 - C44 - HS_1D_MS+EH_CU_1D_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS



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t: 01622 850410

DETS Report No: 23-14745

Site Reference: OEII Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC 23 1637

Sample Receipt Date: 01/12/2023

Sample Scheduled Date: 01/12/2023

Report Issue Number: 1

Reporting Date: 07/12/2023

Authorised by:

Steve Knight
Customer Support Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Soil Analysis Certificate						
DETS Report No: 23-14745	Date Sampled	28/11/23	28/11/23	28/11/23	28/11/23	
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: QEII Way, Heywood	TP / BH No	WS02	WS03	WS05	WS05	
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES	ES	ES	
Order No: LKC 23 1637	Depth (m)	0.50	0.50	1.00	2.00	
Reporting Date: 07/12/2023	DETS Sample No	688194	688195	688196	688197	

Determinand	Unit	RL	Accreditation				
Asbestos Screen ^(S)	N/a	N/a	ISO17025	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS	7.3	7.3	7.1	6.9
Total Cyanide	mg/kg	< 1	NONE	< 1	< 1	< 1	
Free Cyanide	mg/kg	< 1	NONE	< 1	< 1	< 1	
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS	122	105	94	53
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS	0.12	0.11	0.09	0.05
Organic Matter (SOM)	%	< 0.1	MCERTS	6	9.1	5	4.8
Arsenic (As)	mg/kg	< 2	MCERTS	12	14	15	6
W/S Boron	mg/kg	< 1	NONE	< 1	< 1	< 1	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	0.3	0.3	0.5	0.4
Chromium (Cr)	mg/kg	< 2	MCERTS	13	16	18	10
Chromium (hexavalent)	mg/kg	< 2	NONE	< 2	< 2	< 2	< 2
Copper (Cu)	mg/kg	< 4	MCERTS	84	49	47	31
Lead (Pb)	mg/kg	< 3	MCERTS	82	78	80	48
Mercury (Hg)	mg/kg	< 1	MCERTS	< 1	< 1	< 1	< 1
Nickel (Ni)	mg/kg	< 3	MCERTS	11	13	15	12
Selenium (Se)	mg/kg	< 2	MCERTS	< 2	< 2	< 2	< 2
Vanadium (V)	mg/kg	< 1	MCERTS	19	27	32	13
Zinc (Zn)	mg/kg	< 3	MCERTS	105	94	134	129
Total Phenols (monohydric)	mg/kg	< 2	NONE		< 2	< 2	

Analytical results are expressed on a dry weight basis where samples are assisted-dried at less than 30°C. The Method Description page describes if the test is performed on the dried or as-received portion
 Subcontracted analysis (S)



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Soil Analysis Certificate - Speciated PAHs						
DETS Report No: 23-14745	Date Sampled	28/11/23	28/11/23	28/11/23	28/11/23	
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied	None Supplied	
Site Reference: QEII Way, Heywood	TP / BH No	WS02	WS03	WS05	WS05	
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES	ES	ES	
Order No: LKC 23 1637	Depth (m)	0.50	0.50	1.00	2.00	
Reporting Date: 07/12/2023	DETS Sample No	688194	688195	688196	688197	

Determinand	Unit	RL	Accreditation					
Naphthalene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Acenaphthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Fluorene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Phenanthrene	mg/kg	< 0.1	MCERTS	0.18	< 0.1	0.39	< 0.1	
Anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Fluoranthene	mg/kg	< 0.1	MCERTS	0.31	< 0.1	1.09	< 0.1	
Pyrene	mg/kg	< 0.1	MCERTS	0.33	< 0.1	0.99	< 0.1	
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS	0.15	< 0.1	0.47	< 0.1	
Chrysene	mg/kg	< 0.1	MCERTS	0.18	< 0.1	0.52	< 0.1	
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS	0.17	< 0.1	0.61	< 0.1	
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.19	< 0.1	
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	0.15	< 0.1	0.56	< 0.1	
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.32	< 0.1	
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	< 0.1	< 0.1	
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS	< 0.1	< 0.1	0.27	< 0.1	
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS	< 1.6	< 1.6	5.4	< 1.6	



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Soil Analysis Certificate - TPH CWG Banded						
DETS Report No: 23-14745	Date Sampled	28/11/23	28/11/23			
LK Consult Limited	Time Sampled	None Supplied	None Supplied			
Site Reference: QEII Way, Heywood	TP / BH No	WS03	WS05			
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES			
Order No: LKC 23 1637	Depth (m)	0.50	1.00			
Reporting Date: 07/12/2023	DETS Sample No	688195	688196			

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6 : HS_1D_MS_AL	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aliphatic >C6 - C8 : HS_1D_MS_AL	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aliphatic >C8 - C10 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C10 - C12 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	< 2	< 2			
Aliphatic >C12 - C16 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C16 - C21 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	< 3	< 3			
Aliphatic >C21 - C34 : EH_CU_1D_AL	mg/kg	< 10	MCERTS	< 10	20			
Aliphatic >C34 - C44	mg/kg	< 10	NONE	< 10	< 10			
Aliphatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AL	mg/kg	< 21	NONE	< 21	< 21			
Aromatic >C5 - C7 : HS_1D_MS_AR	mg/kg	< 0.01	NONE	< 0.01	< 0.01			
Aromatic >C7 - C8 : HS_1D_MS_AR	mg/kg	< 0.05	NONE	< 0.05	< 0.05			
Aromatic >C8 - C10 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C10 - C12 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	< 2			
Aromatic >C12 - C16 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	< 2	2			
Aromatic >C16 - C21 : EH_CU_1D_AR	mg/kg	< 3	MCERTS	< 3	8			
Aromatic >C21 - C35 : EH_CU_1D_AR	mg/kg	< 10	MCERTS	< 10	30			
Aromatic >C35 - C44	mg/kg	< 10	NONE	< 10	< 10			
Aromatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AR	mg/kg	< 21	NONE	< 21	40			
Total >C5 - C44 : HS_1D_MS+EH_CU_1D_Tot al	mg/kg	< 42	NONE	< 42	60			



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Soil Analysis Certificate - BTEX / MTBE						
DETS Report No: 23-14745	Date Sampled	28/11/23	28/11/23			
LK Consult Limited	Time Sampled	None Supplied	None Supplied			
Site Reference: QEII Way, Heywood	TP / BH No	WS03	WS05			
Project / Job Ref: LKC 23 1637	Additional Refs	ES	ES			
Order No: LKC 23 1637	Depth (m)	0.50	1.00			
Reporting Date: 07/12/2023	DETS Sample No	688195	688196			

Determinand	Unit	RL	Accreditation			
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	< 2	< 2	
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	< 5	< 5	



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Soil Analysis Certificate - Sample Descriptions	
DETS Report No: 23-14745	
LK Consult Limited	
Site Reference: QEII Way, Heywood	
Project / Job Ref: LKC 23 1637	
Order No: LKC 23 1637	
Reporting Date: 07/12/2023	

DETS Sample No	TP / BH No	Additional Refs	Depth (m)	Moisture Content (%)	Sample Matrix Description
688194	WS02	ES	0.50	15.8	Brown sandy clay with stones
688195	WS03	ES	0.50	22.5	Brown sandy clay with stones and brick
688196	WS05	ES	1.00	14.9	Brown sandy clay with stones and brick
688197	WS05	ES	2.00	12.9	Brown sandy clay with stones

Moisture content is part of procedure E003 & is not an accredited test

Insufficient Sample ^{1/s}

Unsuitable Sample ^{u/s}



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Soil Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 23-14745

LK Consult Limited

Site Reference: QEII Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC 23 1637

Reporting Date: 07/12/2023

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Soil	D	Boron - Water Soluble	Determination of water soluble boron in soil by 2:1 hot water extract followed by ICP-OES	E012
Soil	AR	BTEX	Determination of BTEX by headspace GC-MS	E001
Soil	D	Cations	Determination of cations in soil by aqua-regia digestion followed by ICP-OES	E002
Soil	D	Chloride - Water Soluble (2:1)	Determination of chloride by extraction with water & analysed by ion chromatography	E009
Soil	AR	Chromium - Hexavalent	Determination of hexavalent chromium in soil by extraction in water then by acidification, addition of 1,5 diphenylcarbazide followed by colorimetry	E016
Soil	AR	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E015
Soil	AR	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E015
Soil	D	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through extraction with cyclohexane	E011
Soil	AR	Diesel Range Organics (C10 - C24)	Determination of hexane/acetone extractable hydrocarbons by GC-FID	E004
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of saturated calcium sulphate followed by electrometric measurement	E022
Soil	AR	Electrical Conductivity	Determination of electrical conductivity by addition of water followed by electrometric measurement	E023
Soil	D	Elemental Sulphur	Determination of elemental sulphur by solvent extraction followed by GC-MS	E020
Soil	AR	EPH (C10 - C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH Product ID	Determination of acetone/hexane extractable hydrocarbons by GC-FID	E004
Soil	AR	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of acetone/hexane extractable hydrocarbons by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E004
Soil	D	Fluoride - Water Soluble	Determination of Fluoride by extraction with water & analysed by ion chromatography	E009
Soil	D	Fraction Organic Carbon (FOC)	Determination of TOC by combustion analyser.	E027
Soil	D	Organic Matter (SOM)	Determination of TOC by combustion analyser.	E027
Soil	D	TOC (Total Organic Carbon)	Determination of TOC by combustion analyser.	E027
Soil	AR	Exchangeable Ammonium	Determination of ammonium by discrete analyser.	E029
Soil	D	FOC (Fraction Organic Carbon)	Determination of fraction of organic carbon by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	D	Loss on Ignition @ 450oC	Determination of loss on ignition in soil by gravimetrically with the sample being ignited in a muffle furnace	E019
Soil	D	Magnesium - Water Soluble	Determination of water soluble magnesium by extraction with water followed by ICP-OES	E025
Soil	D	Metals	Determination of metals by aqua-regia digestion followed by ICP-OES	E002
Soil	AR	Mineral Oil (C10 - C40)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge	E004
Soil	AR	Moisture Content	Moisture content; determined gravimetrically	E003
Soil	D	Nitrate - Water Soluble (2:1)	Determination of nitrate by extraction with water & analysed by ion chromatography	E009
Soil	D	Organic Matter	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	PAH - Speciated (EPA 16)	Determination of PAH compounds by extraction in acetone and hexane followed by GC-MS with the use of surrogate and internal standards	E005
Soil	AR	PCB - 7 Congeners	Determination of PCB by extraction with acetone and hexane followed by GC-MS	E008
Soil	D	Petroleum Ether Extract (PEE)	Gravimetrically determined through extraction with petroleum ether	E011
Soil	AR	pH	Determination of pH by addition of water followed by electrometric measurement	E007
Soil	AR	Phenols - Total (monohydric)	Determination of phenols by distillation followed by colorimetry	E021
Soil	D	Phosphate - Water Soluble (2:1)	Determination of phosphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Total	Determination of total sulphate by extraction with 10% HCl followed by ICP-OES	E013
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of sulphate by extraction with water & analysed by ion chromatography	E009
Soil	D	Sulphate (as SO4) - Water Soluble (2:1)	Determination of water soluble sulphate by extraction with water followed by ICP-OES	E014
Soil	AR	Sulphide	Determination of sulphide by distillation followed by colorimetry	E018
Soil	D	Sulphur - Total	Determination of total sulphur by extraction with aqua-regia followed by ICP-OES	E024
Soil	AR	SVOC	Determination of semi-volatile organic compounds by extraction in acetone and hexane followed by GC-MS	E006
Soil	AR	Thiocyanate (as SCN)	Determination of thiocyanate by extraction in caustic soda followed by acidification followed by addition of ferric nitrate followed by colorimetry	E017
Soil	D	Toluene Extractable Matter (TEM)	Gravimetrically determined through extraction with toluene	E011
Soil	D	Total Organic Carbon (TOC)	Determination of organic matter by oxidising with potassium dichromate followed by titration with iron (II) sulphate	E010
Soil	AR	TPH CWG (ali: C5- C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C35. C5 to C8 by headspace GC-MS	E004
Soil	AR	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of hexane/acetone extractable hydrocarbons by GC-FID fractionating with SPE cartridge for C8 to C44. C5 to C8 by headspace GC-MS	E004
Soil	AR	VOCs	Determination of volatile organic compounds by headspace GC-MS	E001
Soil	AR	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E001

D Dried
AR As Received



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List of HWOL Acronyms and Operators
DETS Report No: 23-14745
LK Consult Limited
Site Reference: QEII Way, Heywood
Project / Job Ref: LKC 23 1637
Order No: LKC 23 1637
Reporting Date: 07/12/2023

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym
Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_CU_1D_AL
TPH CWG - Aliphatic >C12 - C16 - EH_CU_1D_AL
TPH CWG - Aliphatic >C16 - C21 - EH_CU_1D_AL
TPH CWG - Aliphatic >C21 - C34 - EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_CU_1D_AL
TPH CWG - Aromatic >C10 - C12 - EH_CU_1D_AR
TPH CWG - Aromatic >C12 - C16 - EH_CU_1D_AR
TPH CWG - Aromatic >C16 - C21 - EH_CU_1D_AR
TPH CWG - Aromatic >C21 - C35 - EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C44 - HS_1D_MS+EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_CU_1D_AR
TPH CWG - Total >C5 - C44 - HS_1D_MS+EH_CU_1D_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS



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DETS Report No: 24-00749

Site Reference: OE11 Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC 23 1637-KR

Sample Receipt Date: 26/01/2024

Sample Scheduled Date: 26/01/2024

Report Issue Number: 1

Reporting Date: 31/01/2024

Authorised by:

Steve Knight
Customer Support Manager

Dates of laboratory activities for each tested analyte are available upon request.

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Water Analysis Certificate						
DETS Report No: 24-00749	Date Sampled	25/01/24	25/01/24	25/01/24		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QE11 Way, Heywood	TP / BH No	WS05	WS03	WS02		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC 23 1637-KR	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 31/01/2024	DETS Sample No	695835	695836	695837		

Determinand	Unit	RL	Accreditation					
pH	pH Units	N/a	ISO17025	8.4	8.3	7.0		
Sulphate as SO ₄	mg/l	< 1	ISO17025	40	41	6		
Ammoniacal Nitrogen as N	ug/l	< 50	ISO17025	666	346	19900		
Arsenic (dissolved)	ug/l	< 0.2	ISO17025	1.8	0.4	3.4		
Barium (dissolved)	ug/l	< 0.2	ISO17025	329.0	180.0	696.0		
Beryllium (dissolved)	ug/l	< 0.2	ISO17025	< 0.2	< 0.2	< 0.2		
Boron (dissolved)	ug/l	< 1	ISO17025	97	63	104		
Cadmium (dissolved)	ug/l	< 0.2	ISO17025	< 0.2	< 0.2	< 0.2		
Chromium (dissolved)	ug/l	< 0.2	ISO17025	< 0.2	< 0.2	< 0.2		
Copper (dissolved)	ug/l	< 0.2	ISO17025	1.9	3.9	1.2		
Lead (dissolved)	ug/l	< 0.2	ISO17025	< 0.2	< 0.2	< 0.2		
Mercury (dissolved)	ug/l	< 0.04	ISO17025	< 0.04	< 0.04	< 0.04		
Nickel (dissolved)	ug/l	< 0.2	ISO17025	11.3	3.9	3.5		
Selenium (dissolved)	ug/l	< 0.2	ISO17025	0.4	< 0.2	0.2		
Vanadium (dissolved)	ug/l	< 0.2	ISO17025	< 0.2	< 0.2	< 0.2		
Zinc (dissolved)	ug/l	< 1	ISO17025	24	4	74		

Subcontracted analysis ^(S)
Insufficient sample ^{I/S}
Unsuitable Sample ^{U/S}



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Water Analysis Certificate - Speciated PAH						
DETS Report No: 24-00749	Date Sampled	25/01/24	25/01/24	25/01/24		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QE11 Way, Heywood	TP / BH No	WS05	WS03	WS02		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC 23 1637-KR	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 31/01/2024	DETS Sample No	695835	695836	695837		

Determinand	Unit	RL	Accreditation					
Naphthalene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Acenaphthylene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Acenaphthene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Fluorene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Phenanthrene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Benzo(a)anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Chrysene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Benzo(b)fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Benzo(k)fluoranthene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Benzo(a)pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Dibenz(a,h)anthracene	ug/l	< 0.01	NONE	< 0.01	< 0.01	< 0.01		
Benzo(ghi)perylene	ug/l	0.008	NONE	< 0.008	< 0.008	< 0.008		
Total EPA-16 PAHs	ug/l	< 0.16	NONE	< 0.16	< 0.16	< 0.16		



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Water Analysis Certificate - TPH CWG Banded						
DETS Report No: 24-00749	Date Sampled	25/01/24	25/01/24	25/01/24		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QE11 Way, Heywood	TP / BH No	WS05	WS03	WS02		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC 23 1637-KR	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 31/01/2024	DETS Sample No	695835	695836	695837		

Determinand	Unit	RL	Accreditation					
Aliphatic >C5 - C6 : HS 1D MS AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic >C6 - C8 : HS 1D MS AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic >C8 - C10 : EH CU 1D AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic >C10 - C12 : EH CU 1D AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic >C12 - C16 : EH CU 1D AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic >C16 - C21 : EH CU 1D AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic >C21 - C34 : EH CU 1D AL	ug/l	< 10	NONE	< 10	< 10	< 10		
Aliphatic (C5 - C34) : HS 1D MS+EH CU 1D AL	ug/l	< 70	NONE	< 70	< 70	< 70		
Aromatic >C5 - C7 : HS 1D MS AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic >C7 - C8 : HS 1D MS AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic >C8 - C10 : EH CU 1D AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic >C10 - C12 : EH CU 1D AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic >C12 - C16 : EH CU 1D AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic >C16 - C21 : EH CU 1D AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic >C21 - C35 : EH CU 1D AR	ug/l	< 10	NONE	< 10	< 10	< 10		
Aromatic (C5 - C35) : HS 1D MS+EH CU 1D AR	ug/l	< 70	NONE	< 70	< 70	< 70		
Total >C5 - C35 : HS 1D MS+EH CU 1D Total	ug/l	< 140	NONE	< 140	< 140	< 140		



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Water Analysis Certificate - BTEX / MTBE						
DETS Report No: 24-00749	Date Sampled	25/01/24	25/01/24	25/01/24		
LK Consult Limited	Time Sampled	None Supplied	None Supplied	None Supplied		
Site Reference: QE11 Way, Heywood	TP / BH No	WS05	WS03	WS02		
Project / Job Ref: LKC 23 1637	Additional Refs	None Supplied	None Supplied	None Supplied		
Order No: LKC 23 1637-KR	Depth (m)	None Supplied	None Supplied	None Supplied		
Reporting Date: 31/01/2024	DETS Sample No	695835	695836	695837		

Determinand	Unit	RL	Accreditation					
Benzene : HS 1D MS	ug/l	< 1	ISO17025	< 1	< 1	< 1		
Toluene : HS 1D MS	ug/l	< 5	ISO17025	< 5	< 5	< 5		
Ethylbenzene : HS 1D MS	ug/l	< 5	ISO17025	< 5	< 5	< 5		
p & m-xylene : HS 1D MS	ug/l	< 10	ISO17025	< 10	< 10	< 10		
o-xylene : HS 1D MS	ug/l	< 5	ISO17025	< 5	< 5	< 5		
MTBE : HS 1D MS	ug/l	< 10	ISO17025	< 10	< 10	< 10		



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Water Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 24-00749

LK Consult Limited

Site Reference: QE11 Way, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC 23 1637-KR

Reporting Date: 31/01/2024

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	F	Ammoniacal Nitrogen	Determination of ammoniacal nitrogen by discrete analyser.	E126
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	UF	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazide followed by	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR detection	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	TPH CWG (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered
UF Unfiltered



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List of HWOL Acronyms and Operators

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total

Det - Acronym
Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_CU_1D_AL
TPH CWG - Aliphatic >C12 - C16 - EH_CU_1D_AL
TPH CWG - Aliphatic >C16 - C21 - EH_CU_1D_AL
TPH CWG - Aliphatic >C21 - C34 - EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C34 - HS_1D_MS+EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_CU_1D_AL
TPH CWG - Aromatic >C10 - C12 - EH_CU_1D_AR
TPH CWG - Aromatic >C12 - C16 - EH_CU_1D_AR
TPH CWG - Aromatic >C16 - C21 - EH_CU_1D_AR
TPH CWG - Aromatic >C21 - C35 - EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_CU_1D_AR
TPH CWG - Aromatic C5 - C35 - HS_1D_MS+EH_CU_1D_AR
TPH CWG - Total >C5 - C35 - HS_1D_MS+EH_CU_1D_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS



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Lenham Heath
Kent
ME17 2JN
t: 01622 850410

DETS Report No: 24-01633

Site Reference: OE11 Wav, Heywood

Project / Job Ref: LKC 23 1637

Order No: LKC 23 1637-KR

Sample Receipt Date: 16/02/2024

Sample Scheduled Date: 16/02/2024

Report Issue Number: 2

Reporting Date: 25/03/2024

Authorised by:

Steve Knight
Customer Support Manager

Dates of laboratory activities for each tested analyte are available upon request.
This report supersedes 24-01633, issue no.1.

Reason for reissue:
Re exported due to reporting error

Opinions and interpretations are outside the laboratory's scope of ISO 17025 accreditation. This certificate is issued in accordance with the accreditation requirements of the United Kingdom Accreditation Service. The results reported herein relate only to the material supplied to the laboratory. This certificate shall not be reproduced except in full, without the prior written approval of the laboratory.



Normec DETS Limited
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Maidstone
Kent ME17 2JN
Tel : 01622 850410



Water Analysis Certificate						
DETS Report No: 24-01633	~Date Sampled	15/02/24				
LK Consult Limited	~Time Sampled	None Supplied				
~Site Reference: QE11 Way, Heywood	~TP / BH No	WS02				
~Project / Job Ref: LKC 23 1637	~Additional Refs	None Supplied				
~Order No: LKC 23 1637-KR	~Depth (m)	None Supplied				
Reporting Date: 25/03/2024	DETS Sample No	699693				

Determinand	Unit	RL	Accreditation				
pH	pH Units	N/a	ISO17025	6.7			
Sulphate as SO ₄	mg/l	< 1	ISO17025	6			
Ammoniacal Nitrogen as N	ug/l	< 50	ISO17025	12000			
Arsenic (dissolved)	ug/l	< 0.2	ISO17025	5.0			
Barium (dissolved)	ug/l	< 0.2	ISO17025	827.0			
Beryllium (dissolved)	ug/l	< 0.2	ISO17025	< 0.2			
Boron (dissolved)	ug/l	< 1	ISO17025	525			
Cadmium (dissolved)	ug/l	< 0.2	ISO17025	< 0.2			
Chromium (dissolved)	ug/l	< 0.2	ISO17025	0.8			
Copper (dissolved)	ug/l	< 0.2	ISO17025	2.9			
Lead (dissolved)	ug/l	< 0.2	ISO17025	< 0.2			
Mercury (dissolved)	ug/l	< 0.04	ISO17025	< 0.04			
Nickel (dissolved)	ug/l	< 0.2	ISO17025	6.3			
Selenium (dissolved)	ug/l	< 0.2	ISO17025	0.2			
Vanadium (dissolved)	ug/l	< 0.2	ISO17025	0.9			
Zinc (dissolved)	ug/l	< 1	ISO17025	53			

Subcontracted analysis ^(S)

Insufficient sample ^{I/S}

Unsuitable Sample ^{U/S}

~ Sample details provided by the customer



Normec DETS Limited
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Rose Lane
Lenham Heath
Maidstone
Kent ME17 2JN
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Water Analysis Certificate - Speciated PAH						
DETS Report No: 24-01633	~Date Sampled	15/02/24				
LK Consult Limited	~Time Sampled	None Supplied				
~Site Reference: QE11 Way, Heywood	~TP / BH No	WS02				
~Project / Job Ref: LKC 23 1637	~Additional Refs	None Supplied				
~Order No: LKC 23 1637-KR	~Depth (m)	None Supplied				
Reporting Date: 25/03/2024	DETS Sample No	699693				

Determinand	Unit	RL	Accreditation				
Naphthalene	ug/l	< 0.01	NONE	< 0.01			
Acenaphthylene	ug/l	< 0.01	NONE	< 0.01			
Acenaphthene	ug/l	< 0.01	NONE	< 0.01			
Fluorene	ug/l	< 0.01	NONE	< 0.01			
Phenanthrene	ug/l	< 0.01	NONE	< 0.01			
Anthracene	ug/l	< 0.01	NONE	< 0.01			
Fluoranthene	ug/l	< 0.01	NONE	< 0.01			
Pyrene	ug/l	< 0.01	NONE	< 0.01			
Benzo(a)anthracene	ug/l	< 0.01	NONE	< 0.01			
Chrysene	ug/l	< 0.01	NONE	< 0.01			
Benzo(b)fluoranthene	ug/l	< 0.01	NONE	< 0.01			
Benzo(k)fluoranthene	ug/l	< 0.01	NONE	< 0.01			
Benzo(a)pyrene	ug/l	< 0.01	NONE	< 0.01			
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	NONE	< 0.01			
Dibenz(a,h)anthracene	ug/l	< 0.01	NONE	< 0.01			
Benzo(ghi)perylene	ug/l	0.008	NONE	< 0.008			
Total EPA-16 PAHs	ug/l	< 0.16	NONE	< 0.16			

~ Sample details provided by the customer



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Water Analysis Certificate - TPH CWG Banded						
DETS Report No: 24-01633	~Date Sampled	15/02/24				
LK Consult Limited	~Time Sampled	None Supplied				
~Site Reference: QE11 Way, Heywood	~TP / BH No	WS02				
~Project / Job Ref: LKC 23 1637	~Additional Refs	None Supplied				
~Order No: LKC 23 1637-KR	~Depth (m)	None Supplied				
Reporting Date: 25/03/2024	DETS Sample No	699693				

Determinand	Unit	RL	Accreditation				
Aliphatic >C5 - C6 : HS_1D_MS_AL	ug/l	< 10	NONE	< 10			
Aliphatic >C6 - C8 : HS_1D_MS_AL	ug/l	< 10	NONE	< 10			
Aliphatic >C8 - C10 : EH_CU_1D_AL	ug/l	< 10	NONE	< 10			
Aliphatic >C10 - C12 : EH_CU_1D_AL	ug/l	< 10	NONE	< 10			
Aliphatic >C12 - C16 : EH_CU_1D_AL	ug/l	< 10	NONE	< 10			
Aliphatic >C16 - C21 : EH_CU_1D_AL	ug/l	< 10	NONE	< 10			
Aliphatic >C21 - C34 : EH_CU_1D_AL	ug/l	< 10	NONE	< 10			
Aliphatic (C5 - C34) : HS_1D_MS+EH_CU_1D_AL	ug/l	< 70	NONE	< 70			
Aromatic >C5 - C7 : HS_1D_MS_AR	ug/l	< 10	NONE	< 10			
Aromatic >C7 - C8 : HS_1D_MS_AR	ug/l	< 10	NONE	< 10			
Aromatic >C8 - C10 : EH_CU_1D_AR	ug/l	< 10	NONE	< 10			
Aromatic >C10 - C12 : EH_CU_1D_AR	ug/l	< 10	NONE	< 10			
Aromatic >C12 - C16 : EH_CU_1D_AR	ug/l	< 10	NONE	< 10			
Aromatic >C16 - C21 : EH_CU_1D_AR	ug/l	< 10	NONE	< 10			
Aromatic >C21 - C35 : EH_CU_1D_AR	ug/l	< 10	NONE	< 10			
Aromatic (C5 - C35) : HS_1D_MS+EH_CU_1D_AR	ug/l	< 70	NONE	< 70			
Total >C5 - C35 : HS_1D_MS+EH_CU_1D_Tot al	ug/l	< 140	NONE	< 140			

~ Sample details provided by the customer



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Water Analysis Certificate - BTEX / MTBE						
DETS Report No: 24-01633	~Date Sampled	15/02/24				
LK Consult Limited	~Time Sampled	None Supplied				
~Site Reference: QE11 Way, Heywood	~TP / BH No	WS02				
~Project / Job Ref: LKC 23 1637	~Additional Refs	None Supplied				
~Order No: LKC 23 1637-KR	~Depth (m)	None Supplied				
Reporting Date: 25/03/2024	DETS Sample No	699693				

Determinand	Unit	RL	Accreditation				
Benzene : HS_1D_MS	ug/l	< 1	ISO17025	< 1			
Toluene : HS_1D_MS	ug/l	< 5	ISO17025	< 5			
Ethylbenzene : HS_1D_MS	ug/l	< 5	ISO17025	< 5			
p & m-xylene : HS_1D_MS	ug/l	< 10	ISO17025	< 10			
o-xylene : HS_1D_MS	ug/l	< 5	ISO17025	< 5			
MTBE : HS_1D_MS	ug/l	< 10	ISO17025	< 10			

~ Sample details provided by the customer



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Water Analysis Certificate - Methodology & Miscellaneous Information

DETS Report No: 24-01633

LK Consult Limited

~Site Reference: QE11 Way, Heywood

~Project / Job Ref: LKC 23 1637

~Order No: LKC 23 1637-KR

Reporting Date: 25/03/2024

Matrix	Analysed On	Determinand	Brief Method Description	Method No
Water	UF	Alkalinity	Determination of alkalinity by titration against hydrochloric acid using bromocresol green as the end point	E103
Water	F	Ammoniacal Nitrogen	Determination of ammoniacal nitrogen by discrete analyser.	E126
Water	UF	BTEX	Determination of BTEX by headspace GC-MS	E101
Water	F	Cations	Determination of cations by filtration followed by ICP-MS	E102
Water	U	Chemical Oxygen Demand (COD)	Determination using a COD reactor followed by colorimetry	E112
Water	UF	Biological Oxygen Demand (BOD)	Determination using BOD sensors measuring the change of pressure	E133
Water	F	Chloride	Determination of chloride by filtration & analysed by ion chromatography	E109
Water	F	Chromium - Hexavalent	Determination of hexavalent chromium by acidification, addition of 1,5 diphenylcarbazide followed by	E116
Water	UF	Cyanide - Complex	Determination of complex cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Free	Determination of free cyanide by distillation followed by colorimetry	E115
Water	UF	Cyanide - Total	Determination of total cyanide by distillation followed by colorimetry	E115
Water	UF	Cyclohexane Extractable Matter (CEM)	Gravimetrically determined through liquid:liquid extraction with cyclohexane	E111
Water	F	Diesel Range Organics (C10 - C24)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	Dissolved Organic Content (DOC)	Determination of DOC by filtration followed by low heat with persulphate addition followed by IR detection	E110
Water	UF	Electrical Conductivity	Determination of electrical conductivity by electrometric measurement	E123
Water	F	EPH (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID	E104
Water	F	EPH TEXAS (C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C40)	Determination of liquid:liquid extraction with hexane followed by GC-FID for C8 to C40. C6 to C8 by headspace GC-MS	E104
Water	F	Fluoride	Determination of Fluoride by filtration & analysed by ion chromatography	E109
Water	F	Hardness	Determination of Ca and Mg by ICP-MS followed by calculation	E102
Leachate	F	Leachate Preparation - NRA	Based on National Rivers Authority leaching test 1994	E301
Leachate	F	Leachate Preparation - WAC	Based on BS EN 12457 Pt1, 2, 3	E302
Water	F	Metals	Determination of metals by filtration followed by ICP-MS	E102
Water	F	Mineral Oil (C10 - C40)	Determination of liquid:liquid extraction with hexane followed by GI-FID	E104
Water	F	Nitrate	Determination of nitrate by filtration & analysed by ion chromatography	E109
Water	UF	Monohydric Phenol	Determination of phenols by distillation followed by colorimetry	E121
Water	F	PAH - Speciated (EPA 16)	Determination of PAH compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E105
Water	F	PCB - 7 Congeners	Determination of PCB compounds by concentration through SPE cartridge, collection in dichloromethane	E108
Water	UF	Petroleum Ether Extract (PEE)	Gravimetrically determined through liquid:liquid extraction with petroleum ether	E111
Water	UF	pH	Determination of pH by electrometric measurement	E107
Water	F	Phosphate	Determination of phosphate by filtration & analysed by ion chromatography	E109
Water	UF	Redox Potential	Determination of redox potential by electrometric measurement	E113
Water	F	Sulphate (as SO4)	Determination of sulphate by filtration & analysed by ion chromatography	E109
Water	UF	Sulphide	Determination of sulphide by distillation followed by colorimetry	E118
Water	F	SVOC	Determination of semi-volatile organic compounds by concentration through SPE cartridge, collection in dichloromethane followed by GC-MS	E106
Water	UF	Toluene Extractable Matter (TEM)	Gravimetrically determined through liquid:liquid extraction with toluene	E111
Water	UF	Total Organic Carbon (TOC)	Low heat with persulphate addition followed by IR detection	E110
Water	F	TPH CWG (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C34, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C35. C5 to C8 by headspace GC-MS	E104
Water	F	TPH LQM (ali: C5-C6, C6-C8, C8-C10, C10-C12, C12-C16, C16-C35, C35-C44, aro: C5-C7, C7-C8, C8-C10, C10-C12, C12-C16, C16-C21, C21-C35, C35-C44)	Determination of liquid:liquid extraction with hexane, fractionating with SPE followed by GC-FID for C8 to C44. C5 to C8 by headspace GC-MS	E104
Water	UF	VOCs	Determination of volatile organic compounds by headspace GC-MS	E101
Water	UF	VPH (C6-C8 & C8-C10)	Determination of hydrocarbons C6-C8 by headspace GC-MS & C8-C10 by GC-FID	E101

Key

F Filtered

UF Unfiltered

~ Sample details provided by the customer



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4480

List of HWOL Acronyms and Operators

Acronym	Description
HS	Headspace analysis
EH	Extractable Hydrocarbons - i.e. everything extracted by the solvent
CU	Clean-up - e.g. by florisil, silica gel
1D	GC - Single coil gas chromatography
2D	GC-GC - Double coil gas chromatography
Total	Aliphatics & Aromatics
AL	Aliphatics only
AR	Aromatics only
#1	EH_2D_Total but with humics mathematically subtracted
#2	EH_2D_Total but with fatty acids mathematically subtracted
_	Operator - underscore to separate acronyms (exception for +)
+	Operator to indicate cumulative eg. EH+HS_Total or EH_CU+HS_Total
~	Sample details provided by the customer

Benzene - HS_1D_MS
Ethylbenzene - HS_1D_MS
MTBE - HS_1D_MS
TPH CWG - Aliphatic >C10 - C12 - EH_CU_1D_AL
TPH CWG - Aliphatic >C12 - C16 - EH_CU_1D_AL
TPH CWG - Aliphatic >C16 - C21 - EH_CU_1D_AL
TPH CWG - Aliphatic >C21 - C34 - EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C34 - HS_1D_MS+EH_CU_1D_AL
TPH CWG - Aliphatic >C5 - C6 - HS_1D_MS_AL
TPH CWG - Aliphatic >C6 - C8 - HS_1D_MS_AL
TPH CWG - Aliphatic >C8 - C10 - EH_CU_1D_AL
TPH CWG - Aromatic >C10 - C12 - EH_CU_1D_AR
TPH CWG - Aromatic >C12 - C16 - EH_CU_1D_AR
TPH CWG - Aromatic >C16 - C21 - EH_CU_1D_AR
TPH CWG - Aromatic >C21 - C35 - EH_CU_1D_AR
TPH CWG - Aromatic >C5 - C7 - HS_1D_MS_AR
TPH CWG - Aromatic >C7 - C8 - HS_1D_MS_AR
TPH CWG - Aromatic >C8 - C10 - EH_CU_1D_AR
TPH CWG - Aromatic C5 - C35 - HS_1D_MS+EH_CU_1D_AR
TPH CWG - Total >C5 - C35 - HS_1D_MS+EH_CU_1D_Total
Toluene - HS_1D_MS
m & p-xylene - HS_1D_MS
o-Xylene - HS_1D_MS

Appendix D – Certificates of Analysis (Geotechnical)

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e: reception@i2analytical.com

e: MURRAYRIX Group

Analytical Report Number : 23-73182

Project / Site name:	LKC 23 1637 QEII Way Haywood	Samples received on:	05/12/2023
Your job number:		Samples instructed on/ Analysis started on:	05/12/2023
Your order number:	23 495	Analysis completed by:	12/12/2023
Report Issue Number:	1	Report issued on:	12/12/2023
Samples Analysed:	8 soil samples		

Signed:



Dominika Liana
Junior Reporting Specialist
For & on behalf of i2 Analytical Ltd.

Standard Geotechnical, Asbestos and Chemical Testing Laboratory located at: ul. Pionierów 39, 41-711 Ruda Śląska, Poland.

Accredited tests are defined within the report, opinions and interpretations expressed herein are outside the scope of accreditation.

Standard sample disposal times, unless otherwise agreed with the laboratory, are :

soils - 4 weeks from reporting
leachates - 2 weeks from reporting
waters - 2 weeks from reporting
asbestos - 6 months from reporting

Excel copies of reports are only valid when accompanied by this PDF certificate.

Any assessments of compliance with specifications are based on actual analytical results with no contribution from uncertainty of measurement.
Application of uncertainty of measurement would provide a range within which the true result lies.
An estimate of measurement uncertainty can be provided on request.

Analytical Report Number: 23-73182
 Project / Site name: LKC 23 1637 QEII Way Haywood
 Your Order No: 23 495

Lab Sample Number				2901168	2901169	2901170	2901171	2901172
Sample Reference				134696	133668	134629	134633	134634
Sample Number				WS2 ES4	WS03 D	TP01	TP01	TP02
Depth (m)				None Supplied	2.00	0.50	4.00	1.00
Date Sampled				28/11/2023	28/11/2023	Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status					
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	25	17	20	15	17
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.4	0.4	0.4

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	7.3	7.1	8.1	-	8.2
Total Sulphate as SO ₄	%	0.005	MCERTS	0.034	0.015	0.013	-	0.069
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.165	0.0175	0.0312	-	0.389
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	165	17.5	31.2	-	389
Total Sulphur	%	0.005	MCERTS	0.083	0.017	0.052	-	0.096
Organic Matter (automated)	%	0.1	MCERTS	6	-	2.1	2.4	3

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number: 23-73182
 Project / Site name: LKC 23 1637 QEII Way Haywood
 Your Order No: 23 495

Lab Sample Number				2901173	2901174	2901175
Sample Reference				134636	134639	134649
Sample Number				TP02	TP03	TP05
Depth (m)				3.00	1.00	1.00
Date Sampled				Deviating	Deviating	Deviating
Time Taken				None Supplied	None Supplied	None Supplied
Analytical Parameter (Soil Analysis)	Units	Limit of detection	Accreditation Status			
Stone Content	%	0.1	NONE	< 0.1	< 0.1	< 0.1
Moisture Content	%	0.01	NONE	17	14	28
Total mass of sample received	kg	0.001	NONE	0.4	0.4	0.4

General Inorganics

pH - Automated	pH Units	N/A	MCERTS	8.4	8.1	8.2
Total Sulphate as SO ₄	%	0.005	MCERTS	0.07	0.089	0.078
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	g/l	0.00125	MCERTS	0.153	0.273	0.0246
Water Soluble SO ₄ 16hr extraction (2:1 Leachate Equivalent)	mg/l	1.25	MCERTS	153	273	24.6
Total Sulphur	%	0.005	MCERTS	0.06	0.058	0.057
Organic Matter (automated)	%	0.1	MCERTS	-	-	-

U/S = Unsuitable Sample I/S = Insufficient Sample ND = Not detected

Analytical Report Number : 23-73182

Project / Site name: LKC 23 1637 QEII Way Haywood

* These descriptions are only intended to act as a cross check if sample identities are questioned. The major constituent of the sample is intended to act with respect to MCERTS validation. The laboratory is accredited for sand, clay and loam (MCERTS) soil types. Data for unaccredited types of solid should be interpreted with care.

Stone content of a sample is calculated as the % weight of the stones not passing a 10 mm sieve. Results are not corrected for stone content.

Lab Sample Number	Sample Reference	Sample Number	Depth (m)	Sample Description *
2901168	134696	WS2 ES4	None Supplied	Grey clay and sand with gravel and vegetation.
2901169	133668	WS03 D	2	Brown clay and sand.
2901170	134629	TP01	0.5	Brown clay and sand with gravel and vegetation.
2901171	134633	TP01	4	Brown clay and sand with gravel and brick.
2901172	134634	TP02	1	Brown clay and sand with gravel and brick.
2901173	134636	TP02	3	Brown clay and sand with gravel.
2901174	134639	TP03	1	Brown loam and clay with gravel and vegetation.
2901175	134649	TP05	1	Brown clay and loam with gravel and vegetation.

Analytical Report Number : 23-73182
Project / Site name: LKC 23 1637 QEII Way Haywood

Water matrix abbreviations:

Surface Water (SW) Potable Water (PW) Ground Water (GW) Process Waters (PrW) Final Sewage Effluent (FSE) Landfill Leachate (LL)

Analytical Test Name	Analytical Method Description	Analytical Method Reference	Method number	Wet / Dry Analysis	Accreditation Status
Moisture Content	Moisture content, determined gravimetrically. (30 oC)	In house method.	L019-UK/PL	W	NONE
pH in soil (automated)	Determination of pH in soil by addition of water followed by automated electrometric measurement.	In house method.	L099-PL	D	MCERTS
Stones content of soil	Standard preparation for all samples unless otherwise detailed. Gravimetric determination of stone > 10 mm as % dry weight.	In-house method based on British Standard Methods and MCERTS requirements.	L019-UK/PL	D	NONE
Organic matter (Automated) in soil	Determination of organic matter in soil by oxidising with potassium dichromate followed by titration with iron (II) sulphate.	In house method.	L009-PL	D	MCERTS
Total Sulphate in soil as %	Determination of total sulphate in soil by extraction with 10% HCl followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Total Sulphur in soil as %	Determination of total sulphur in soil by extraction with aqua-regia, potassium bromide/bromate followed by ICP-OES.	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil (16hr extraction)	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS
Sulphate, water soluble, in soil	Determination of water soluble sulphate by ICP-OES. Results reported directly (leachate equivalent) and corrected for extraction ratio (soil equivalent).	In house method.	L038-PL	D	MCERTS

For method numbers ending in 'UK or A' analysis have been carried out in our laboratory in the United Kingdom (WATFORD).

For method numbers ending in 'F' analysis have been carried out in our laboratory in the United Kingdom (East Kilbride).

For method numbers ending in 'PL or B' analysis have been carried out in our laboratory in Poland.

Soil analytical results are expressed on a dry weight basis. Where analysis is carried out on as-received the results obtained are multiplied by a moisture correction factor that is determined gravimetrically using the moisture content which is carried out at a maximum of 30oC.

Unless otherwise indicated, site information, order number, project number, sampling date, time, sample reference and depth are provided by the client. The instructed on date indicates the date on which this information was provided to the laboratory.

Sample Deviation Report



Analytical Report Number : 23-73182

Project / Site name: LKC 23 1637 QEII Way Haywood

This deviation report indicates the sample and test deviations that apply to the samples submitted for analysis. Please note that the associated result(s) may be unreliable and should be interpreted with care.

Key: a - No sampling date b - Incorrect container c - Holding time d - Headspace e - Temperature

Sample ID	Other ID	Sample Type	Lab Sample Number	Sample Deviation	Test Name	Test Ref	Test Deviation
134629	TP01	S	2901170	a	None Supplied	None Supplied	None Supplied
134633	TP01	S	2901171	a	None Supplied	None Supplied	None Supplied
134634	TP02	S	2901172	a	None Supplied	None Supplied	None Supplied
134636	TP02	S	2901173	a	None Supplied	None Supplied	None Supplied
134639	TP03	S	2901174	a	None Supplied	None Supplied	None Supplied
134649	TP05	S	2901175	a	None Supplied	None Supplied	None Supplied

TEST REPORT

Client LK Consult Ltd

Address Unit 29 Eton Business Park
Eton Hill Road
Radcliffe
Greater Manchester
M26 2ZS

Contract LKC 23 1637 -
QEII Way, Heywood

Job Number MRN 4606/123
Date of Issue 19 December 2023
Page 1 of 29

Approved Signatories

S J Hutchings, O P Davies

Notes

- 1 All remaining samples and remnants from this contract will be disposed 28 days from the date of this report unless you notify us to the contrary.
- 2 Result certificates, in this report, not bearing a UKAS mark, are not included in our UKAS accreditation schedule.
- 3 Opinions and interpretations expressed herein are outside the scope of our UKAS accreditation.
- 4 Certified that the samples have been examined and tested in accordance with the terms of the contract/order and unless otherwise stated conform to the standards/specifications quoted.
- 5 The results included within the report are representative of the samples submitted for analysis.
- 6 This certificate should not be reproduced, except in full, without the express permission of the laboratory.



Andrew House, Hadfield Street, Dukinfield, Cheshire SK16 4QX Tel: 0161 475 0870
Email: enquiries@murrayrix.com Website: www.murrayrix.com

Also at: London: 020 8523 1999

Murray Rix is the trading name of Murray Rix (Northern) Limited. Registered in England 2878361

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DETERMINATION OF THE WATER CONTENT

(OVEN DRY)

BS EN 17892-1:2014+A1:2022

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

DATE SAMPLED	28, 29-Nov-23	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

Laboratory Sample Number	Site Reference	Material	Sample Location	Water Content (%)
134658	WS02 1 D	Brown silty slightly sandy slightly gravelly CLAY	WS02 1 D	24.7
134664	WS02 4 D	Brown silty slightly sandy slightly gravelly CLAY	WS02 4 D	16.6
134668	WS03 2 D	Brown silty slightly sandy slightly gravelly CLAY	WS03 2 D	16.5
134669	WS03 3 D	Brown silty slightly sandy slightly gravelly CLAY	WS03 3 D	17.4
134673	WS03 5 D	Brown silty slightly sandy slightly gravelly CLAY	WS03 5 D	11
134676	WS04 2 SPT	Brown silty slightly sandy slightly gravelly CLAY	WS04 2 SPT	16.1
134677	WS04 2.5 D	Brown silty slightly sandy slightly gravelly CLAY	WS04 2.5 D	18.7
134679	WS04 4.5 D	Brown silty slightly sandy slightly gravelly CLAY	WS04 4.5 D	15.9
134684	WS05 3 D	Brown silty slightly sandy slightly gravelly CLAY	WS05 3 D	17.3
134686	WS05 4 SPT	Brown silty slightly sandy slightly gravelly CLAY	WS05 4 SPT	14.4

COMMENT / ANOMALIES

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DETERMINATION OF THE WATER CONTENT

(OVEN DRY)

BS EN 17892-1:2014+A1:2022

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

DATE SAMPLED	28, 29-Nov-23	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

Laboratory Sample Number	Site Reference	Material	Sample Location	Water Content (%)
134630	TP01- 1.00	Brown silty slightly sandy slightly gravelly CLAY	TP01- 1.00	29.6
134631	TP01 - 2.00	Brown silty slightly sandy slightly gravelly CLAY	TP01 - 2.00	21
134632	TP01 - 3.00	Brown silty slightly sandy slightly gravelly CLAY	TP01 - 3.00	23.6
134635	TP02 - 2.00	Brown silty slightly sandy slightly gravelly CLAY	TP02 - 2.00	19.7
134638	TP03 - 0.50	Brown clay bound silty SAND & GRAVEL	TP03 - 0.50	22.4
134649	TP05 - 1.00	Brown silty slightly sandy slightly gravelly CLAY	TP05 - 1.00	21.9
134650	TP05 - 2.00	Brown silty slightly sandy slightly gravelly CLAY	TP05 - 2.00	22.1

COMMENT / ANOMALIES

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

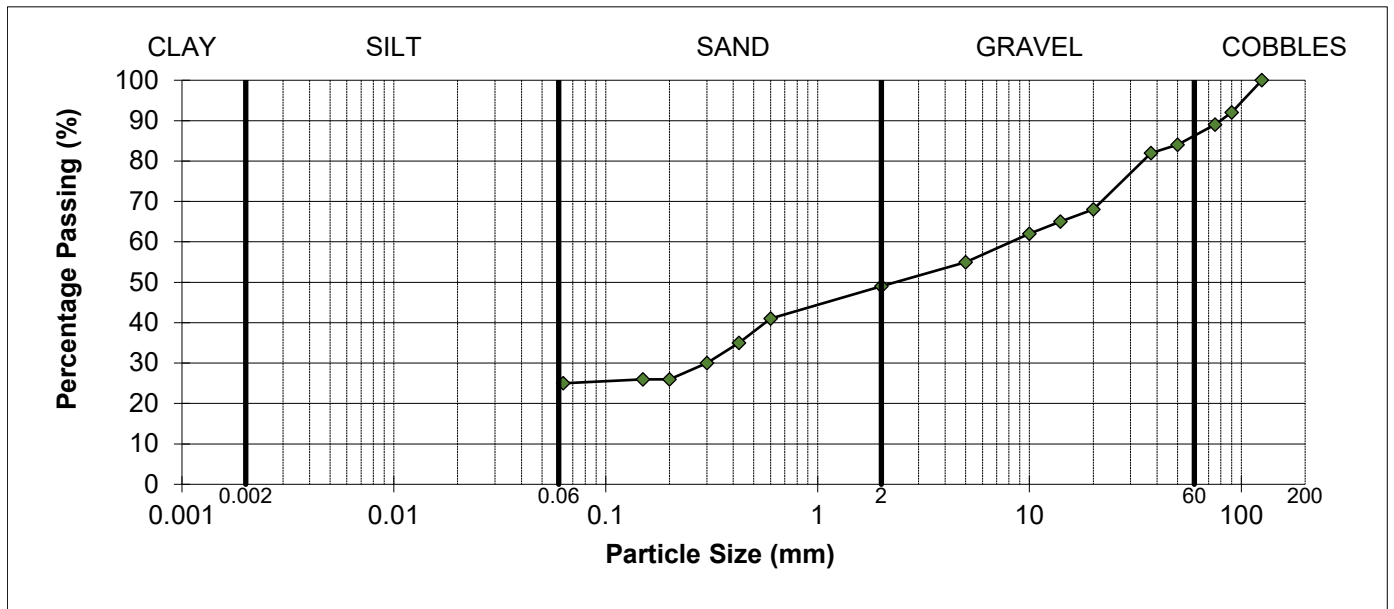
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 0.50	DATE SAMPLED	Not advised
LAB SAMPLE No	134629	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	55	
90	92		2	49	
75	89		0.6	41	
50	84		0.425	35	
37.5	82		0.3	30	
20	68		0.2	26	
14	65		0.15	26	
10	62		0.063	25	



REMARKS

As received water content = 16.2%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

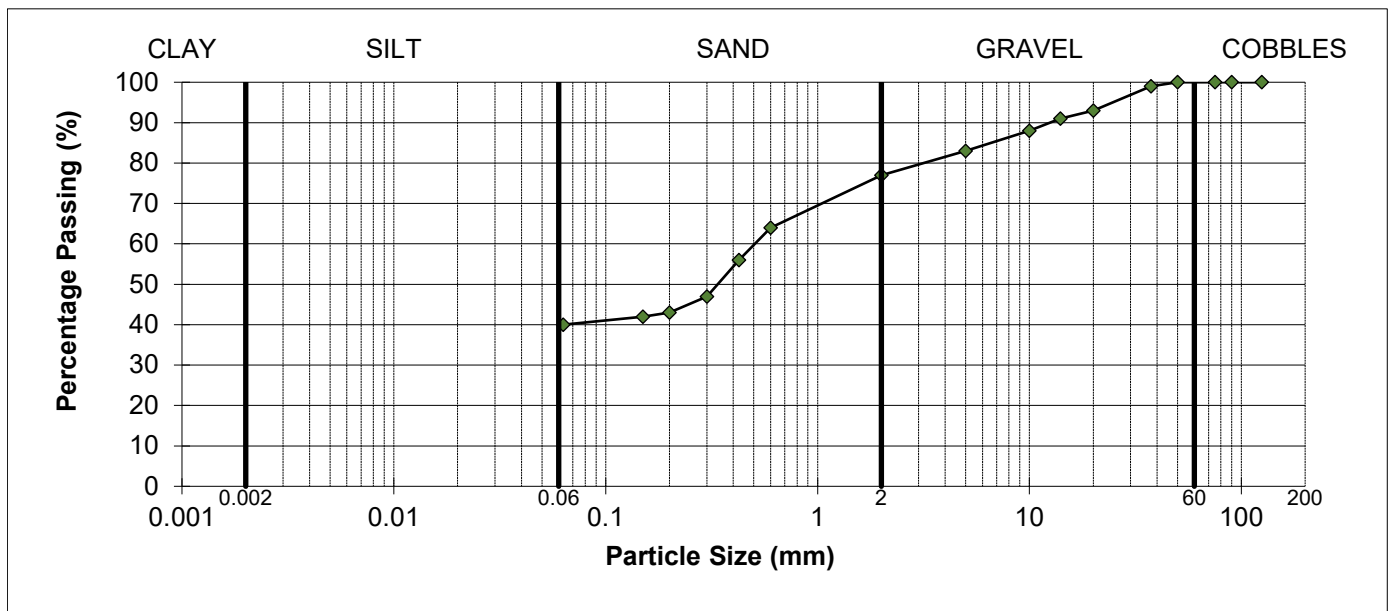
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 4.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134633	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty sandy slightly gravelly CLAY
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	83	
90	100		2	77	
75	100		0.6	64	
50	100		0.425	56	
37.5	99		0.3	47	
20	93		0.2	43	
14	91		0.15	42	
10	88		0.063	40	



REMARKS

As received water content = 23.3%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

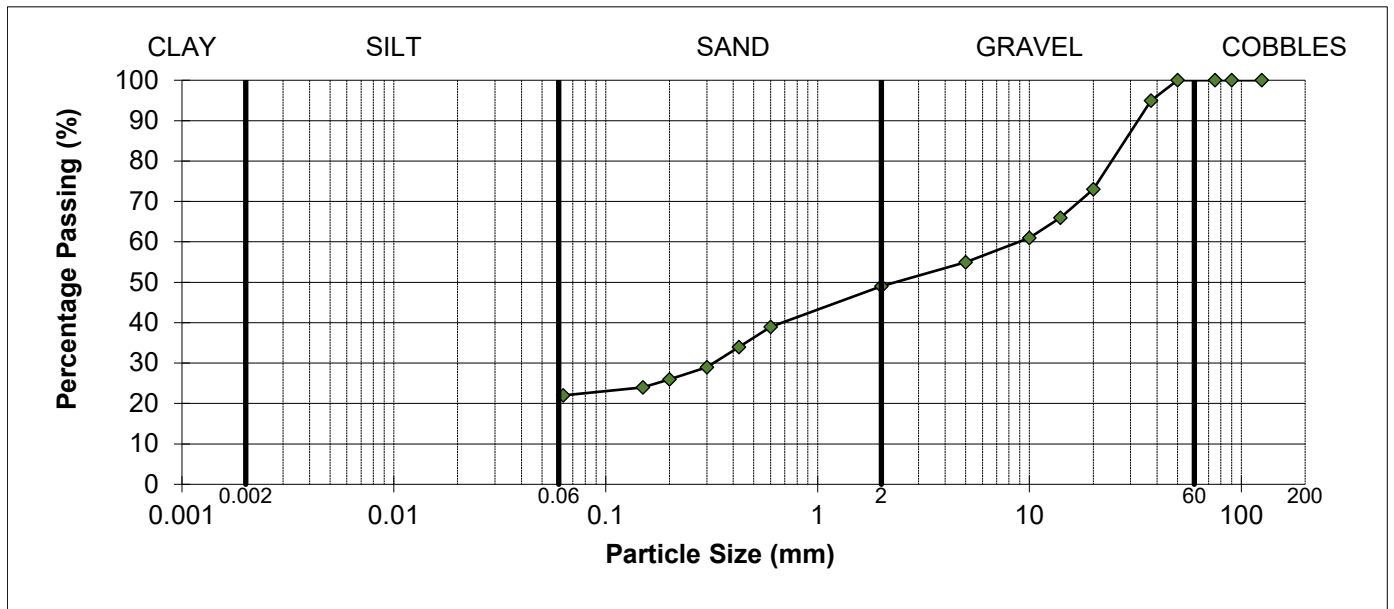
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP02 - 1.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134634	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	55	
90	100		2	49	
75	100		0.6	39	
50	100		0.425	34	
37.5	95		0.3	29	
20	73		0.2	26	
14	66		0.15	24	
10	61		0.063	22	



REMARKS

As received water content = 17.8%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

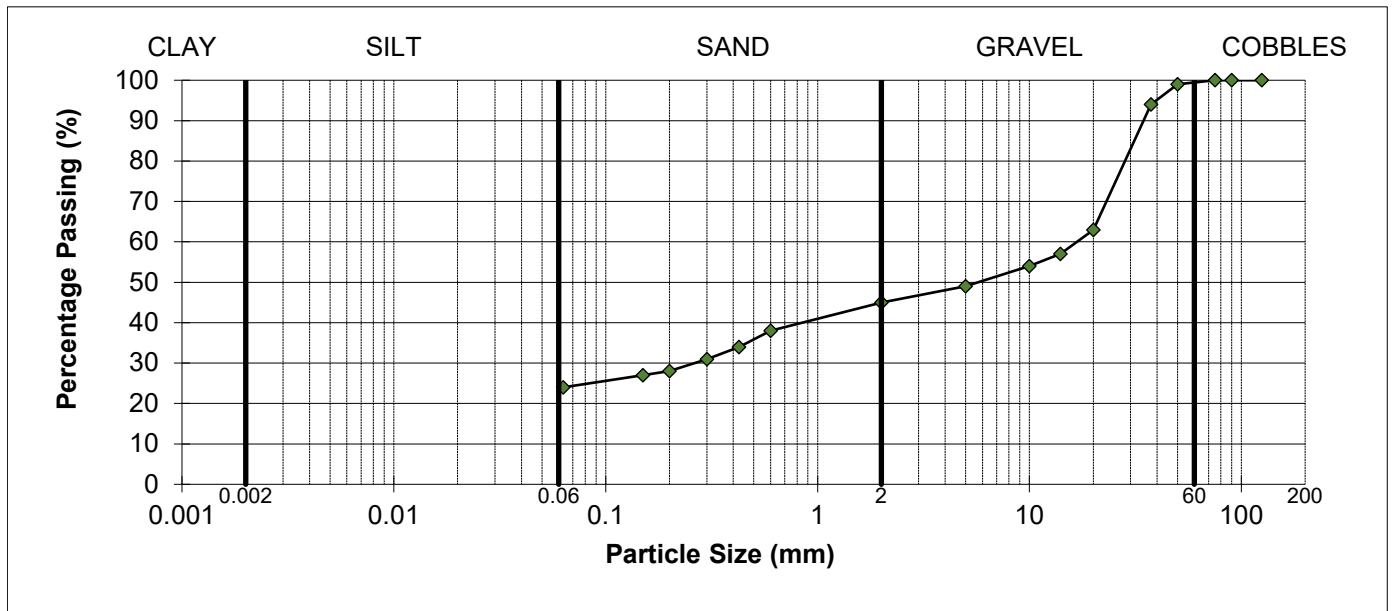
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP02 - 3.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134636	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	49	
90	100		2	45	
75	100		0.6	38	
50	99		0.425	34	
37.5	94		0.3	31	
20	63		0.2	28	
14	57		0.15	27	
10	54		0.063	24	



REMARKS

As received water content = 19.3%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

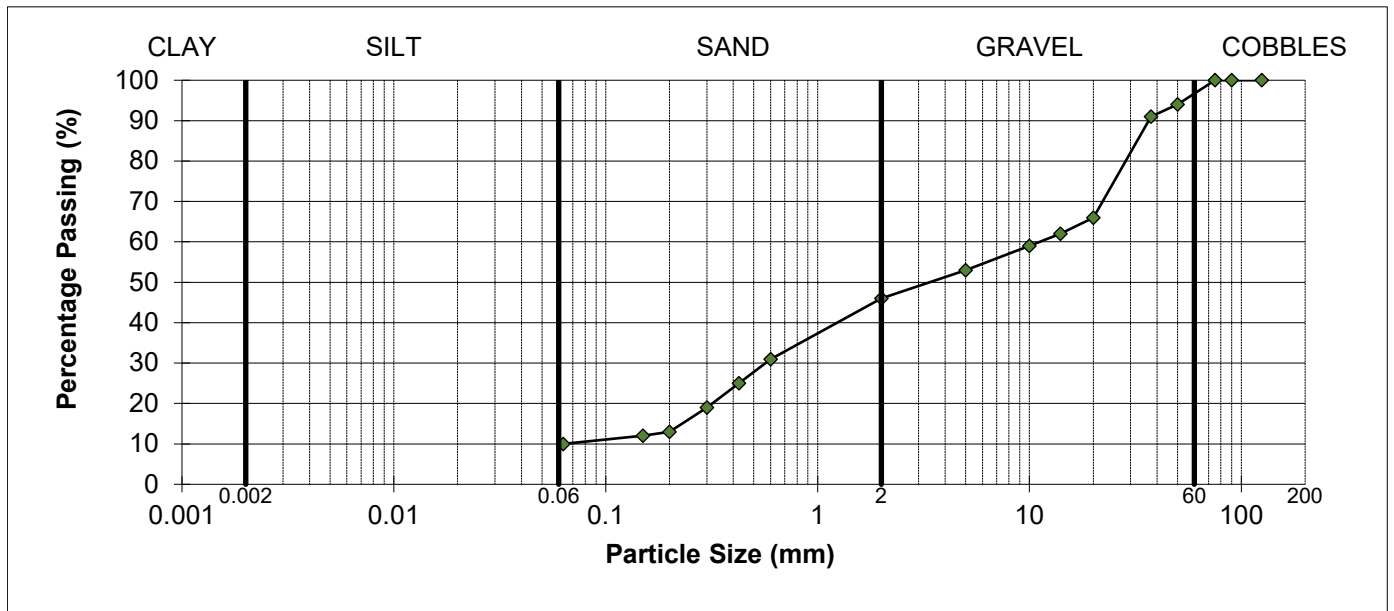
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP03 - 1.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134639	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	53	
90	100		2	46	
75	100		0.6	31	
50	94		0.425	25	
37.5	91		0.3	19	
20	66		0.2	13	
14	62		0.15	12	
10	59		0.063	10	



REMARKS

As received water content = 19.3%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

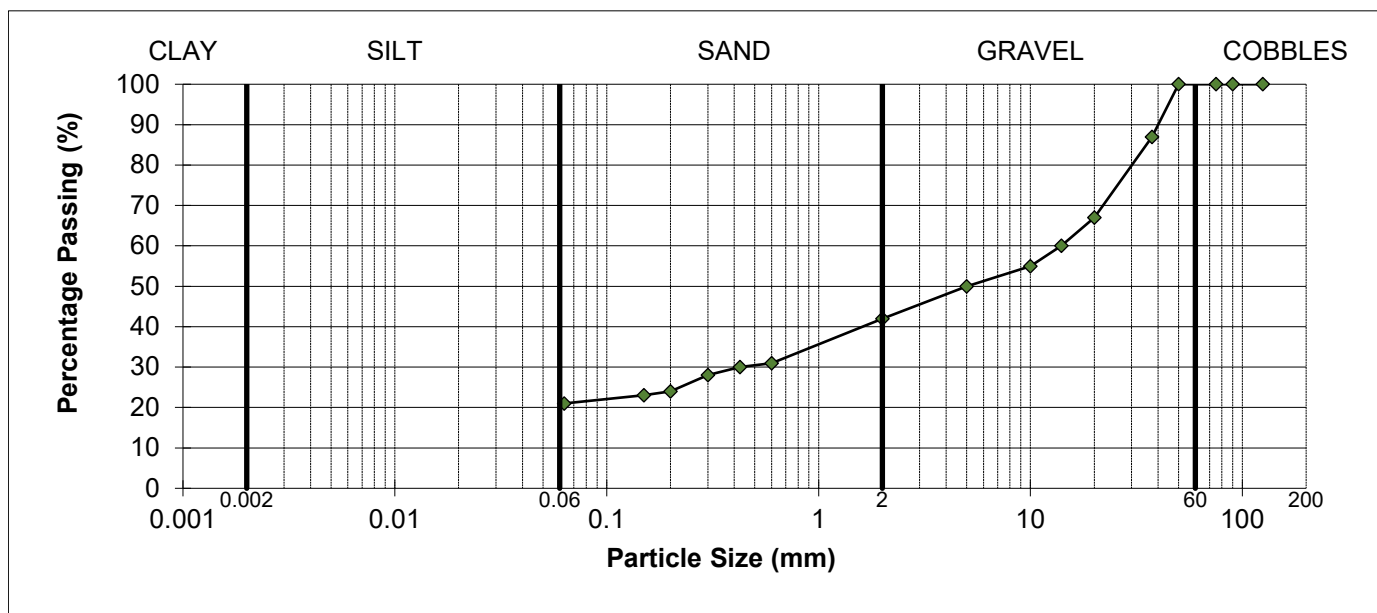
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP03 - 1.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134641	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	50	
90	100		2	42	
75	100		0.6	31	
50	100		0.425	30	
37.5	87		0.3	28	
20	67		0.2	24	
14	60		0.15	23	
10	55		0.063	21	



REMARKS

As received water content = 21.1%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

TEST CERTIFICATE
PARTICLE SIZE DISTRIBUTION

BS EN ISO 17892-4:2016

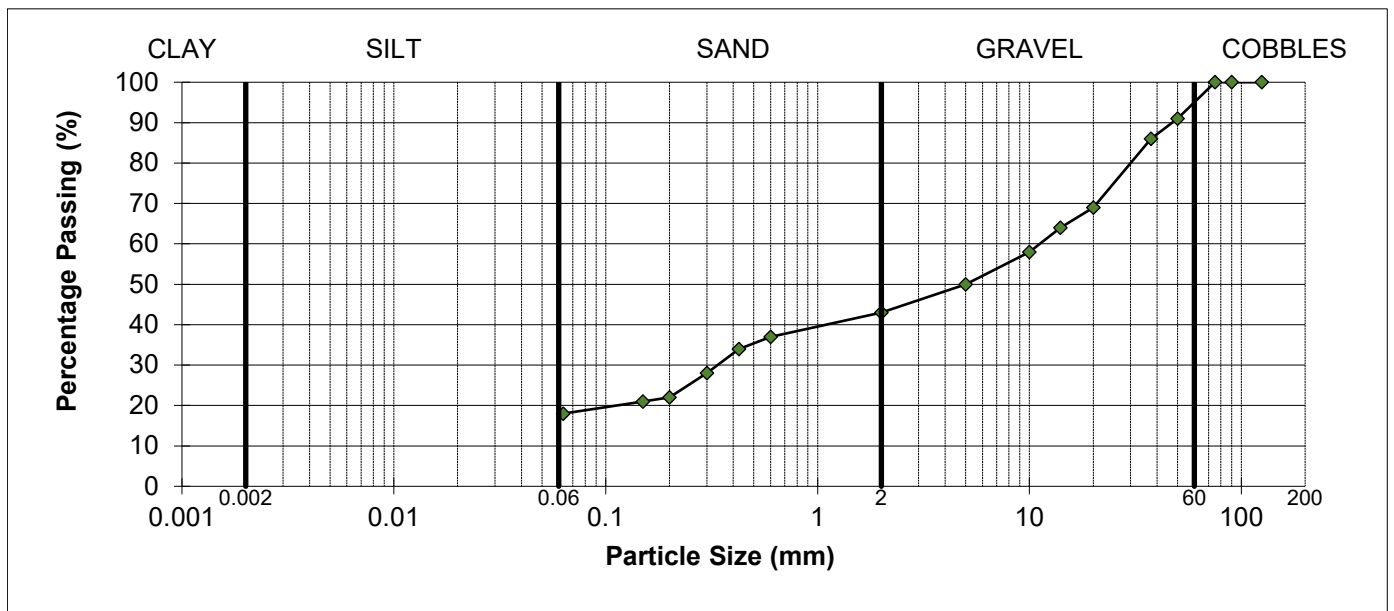
Determination of Water Content in accordance with BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP05 - 0.50	DATE SAMPLED	Not advised
LAB SAMPLE No	134643	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

Sieve Size (mm)	% Passing (%)	Specification (%)	Sieve Size (mm)	% Passing (%)	Specification (%)
125	100		5	50	
90	100		2	43	
75	100		0.6	37	
50	91		0.425	34	
37.5	86		0.3	28	
20	69		0.2	22	
14	64		0.15	21	
10	58		0.063	18	



REMARKS

As received water content = 11.6%

SIGNED



NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

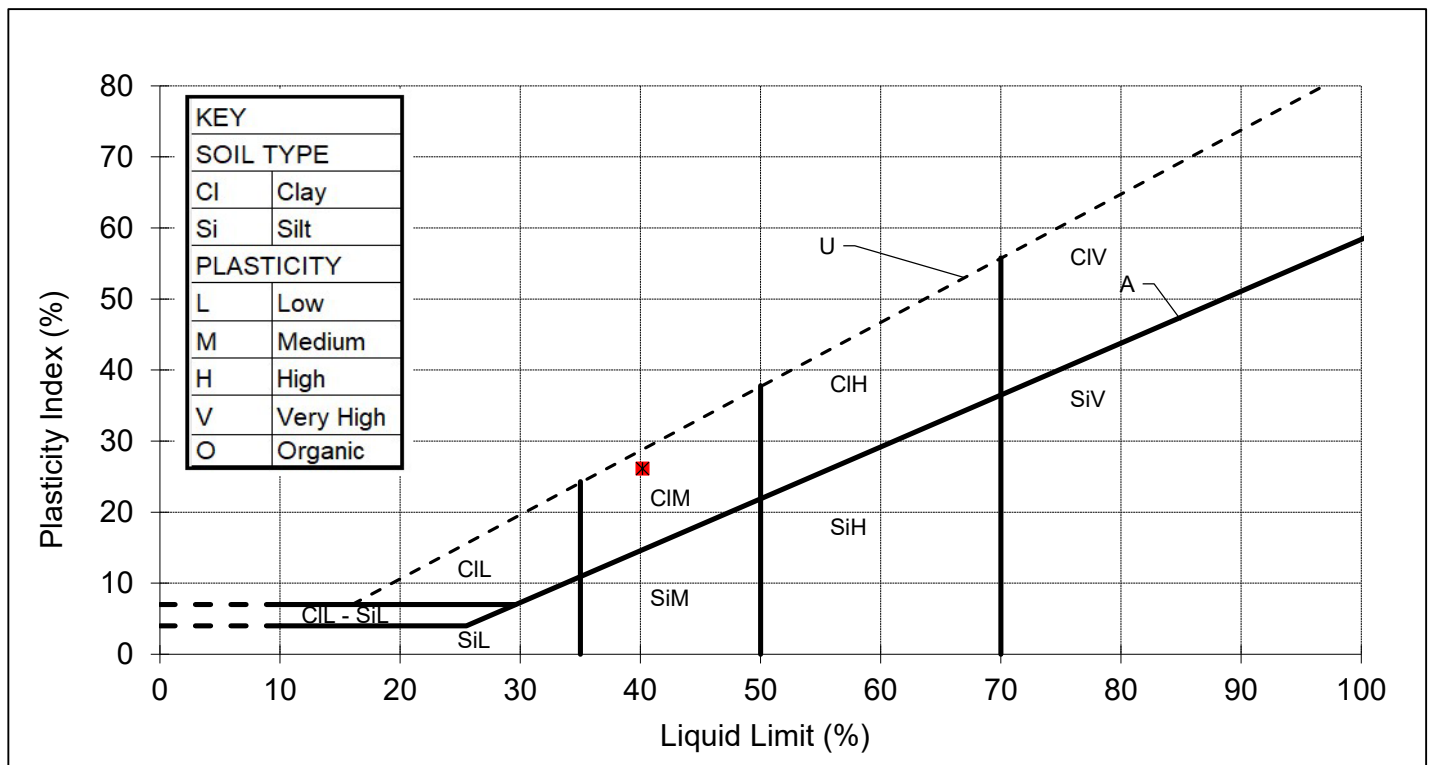
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	WS01 5 - SPT	DATE SAMPLED	29-Nov-23
SAMPLE No.	134657	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	19.5	39.8	1.013	
Determination 2 (avg)	19.2	39.5		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
22.2	40	14	26	92



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

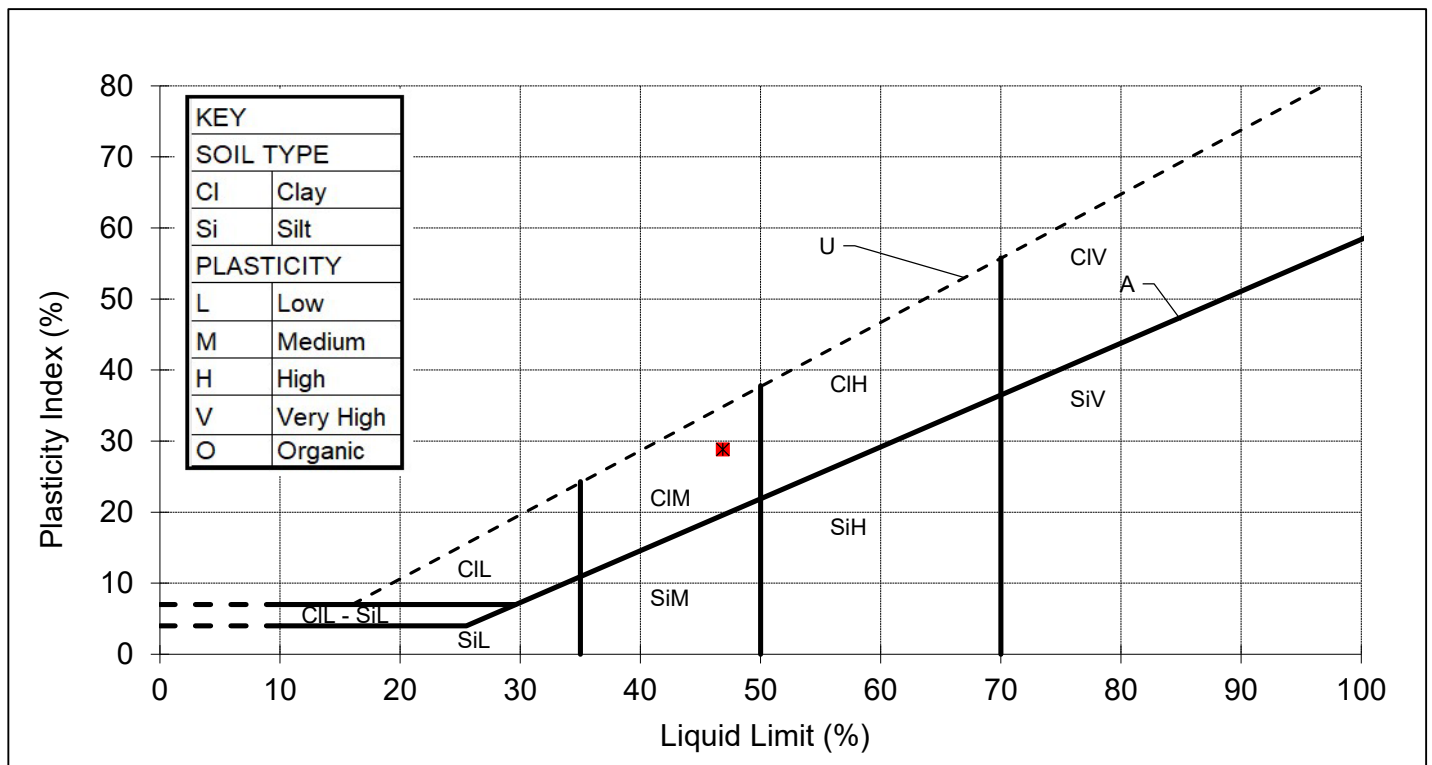
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	WS02 ES4	DATE SAMPLED	28-Nov-23
SAMPLE No.	134696	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly organic CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.2	45.4	1.034	
Determination 2 (avg)	18.2	45.2		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
25.2	47	18	29	99



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

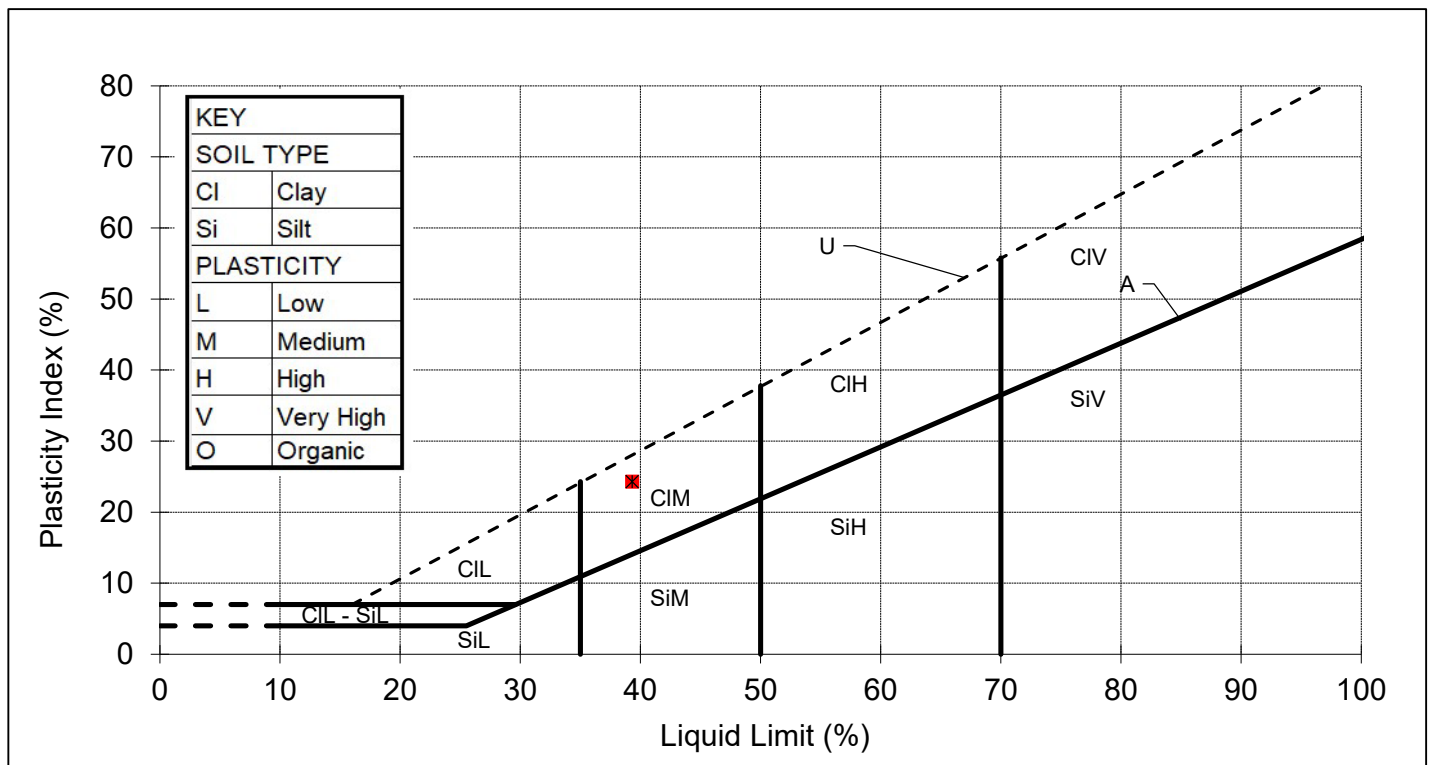
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	WS02 3 - D	DATE SAMPLED	28-Nov-23
SAMPLE No.	134661	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly organic CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	16.5	37.2	1.054	
Determination 2 (avg)	16.8	37.4		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
17.1	39	15	24	88



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

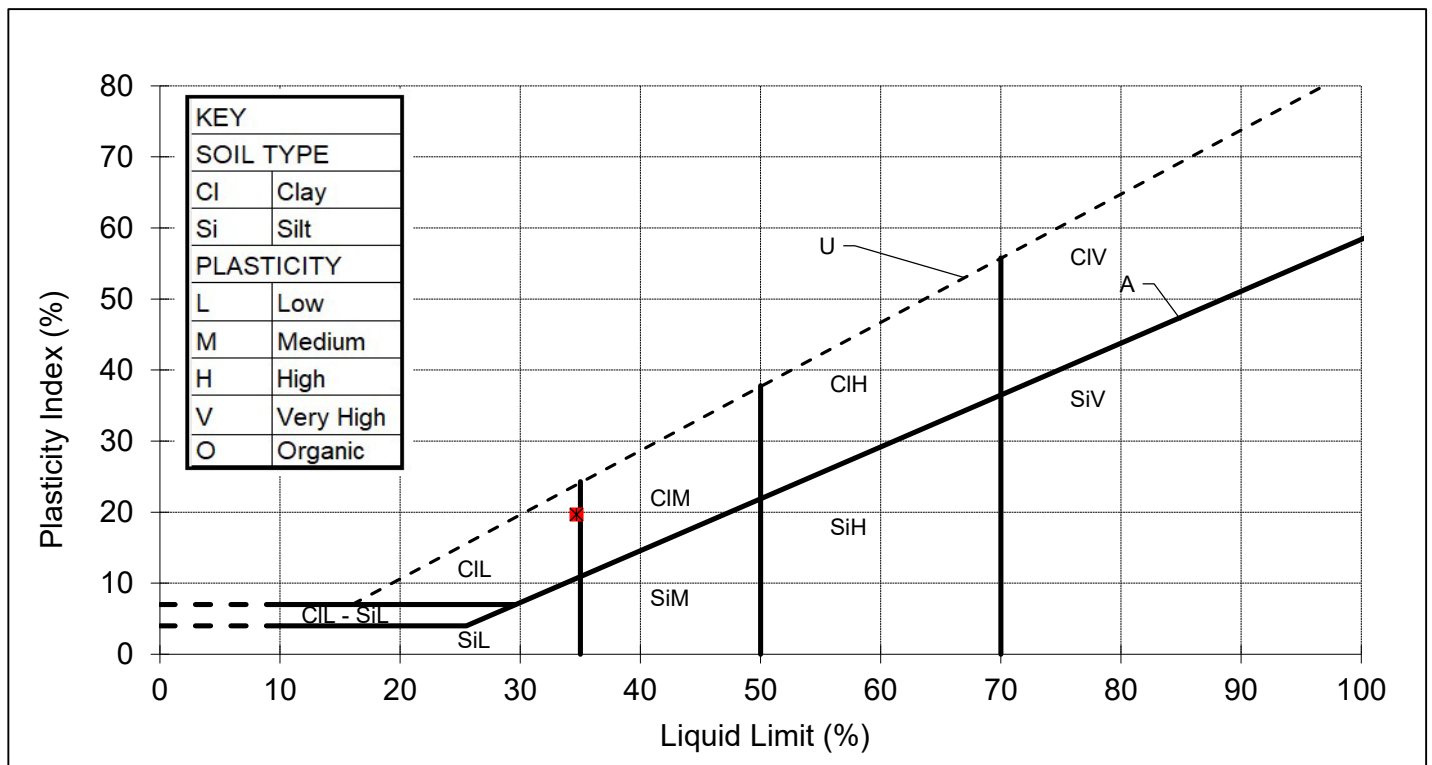
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 0.50	DATE SAMPLED	Not advised
SAMPLE No.	134629	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.2	33.8	1.028	
Determination 2 (avg)	18.1	33.7		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
16.2	35	15	20	35



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

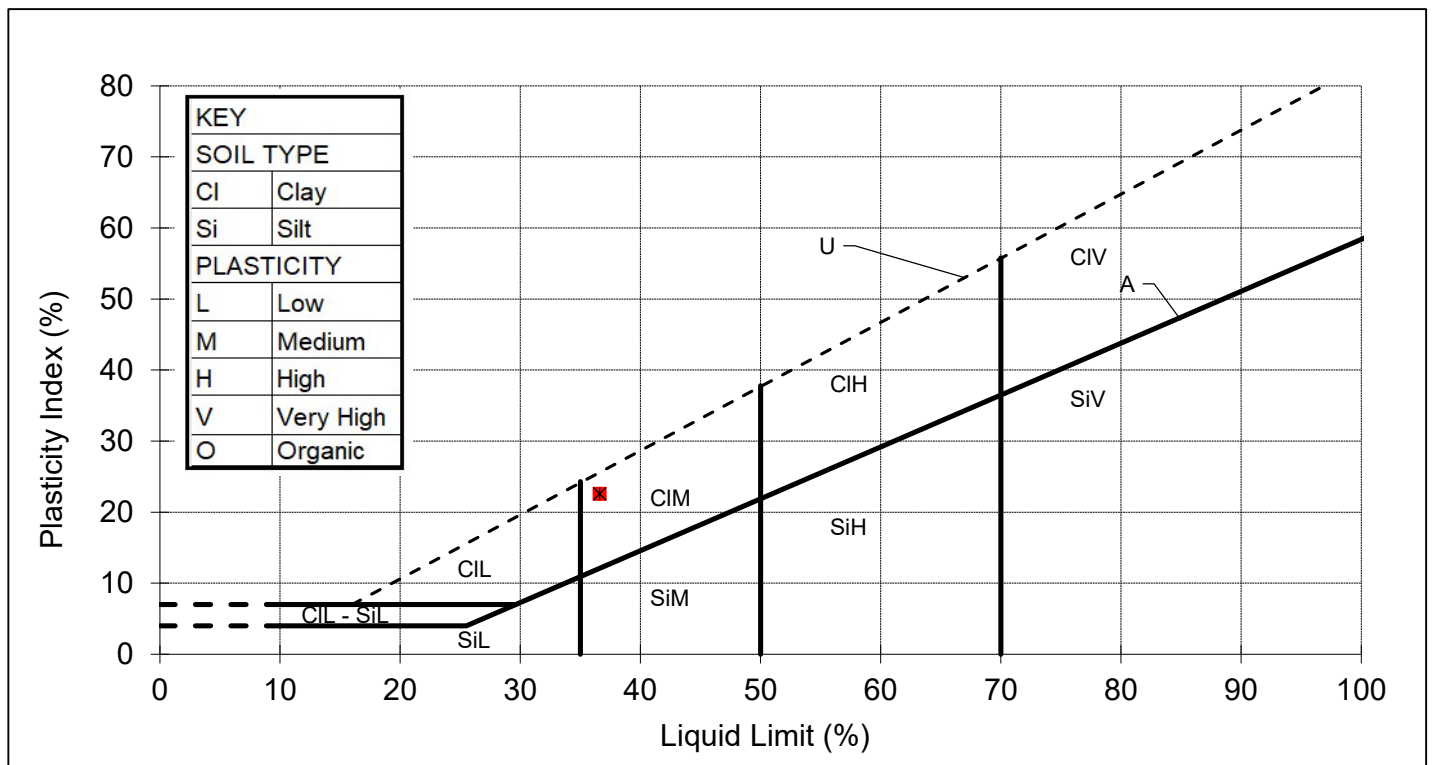
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 4.00	DATE SAMPLED	Not advised
SAMPLE No.	134633	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	17.9	35.1	1.044	
Determination 2 (avg)	17.1	35.0		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
23.3	37	14	23	56



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

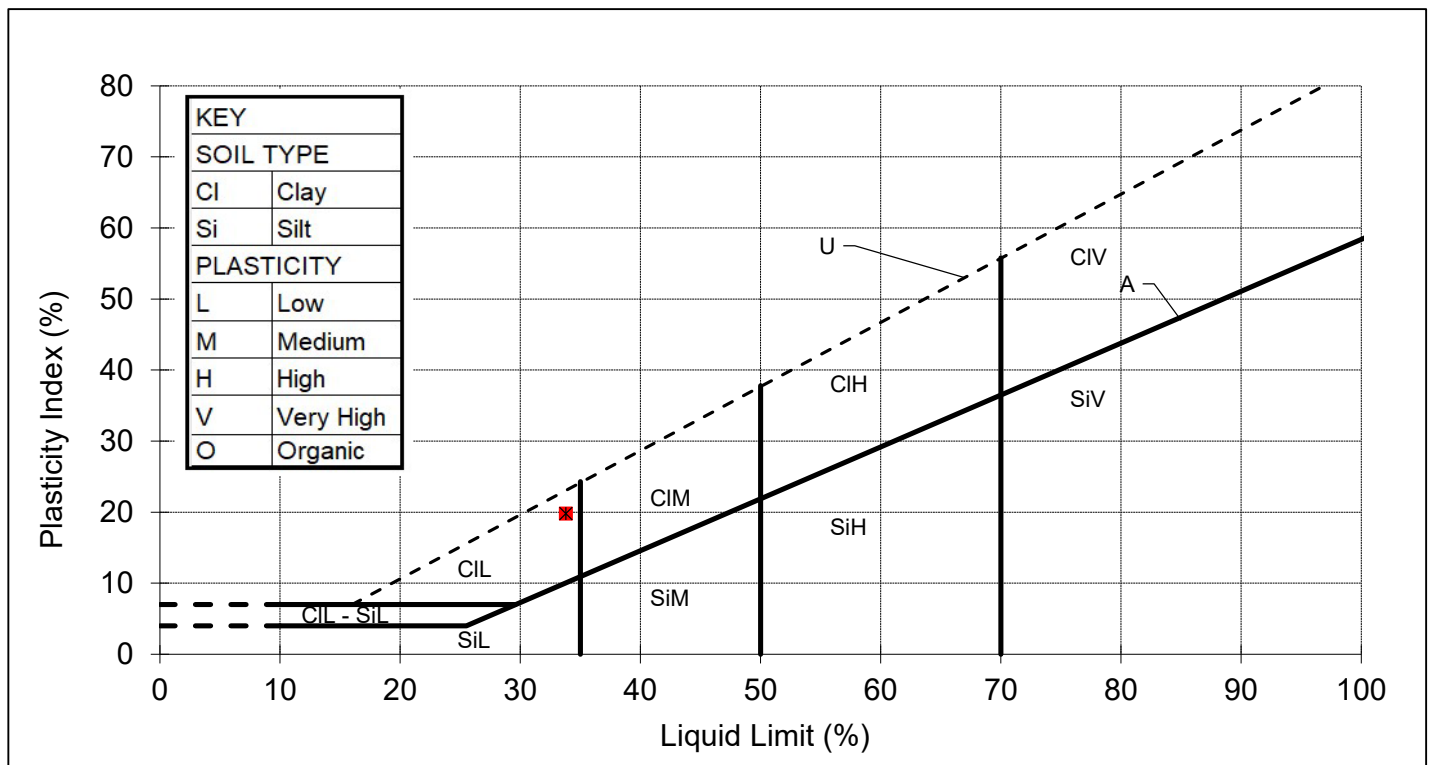
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP02 - 1.00	DATE SAMPLED	Not advised
SAMPLE No.	134634	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	20.1	33.8	1.002	
Determination 2 (avg)	19.7	33.7		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
17.8	34	14	20	34



REMARKS

SIGNED

NAME

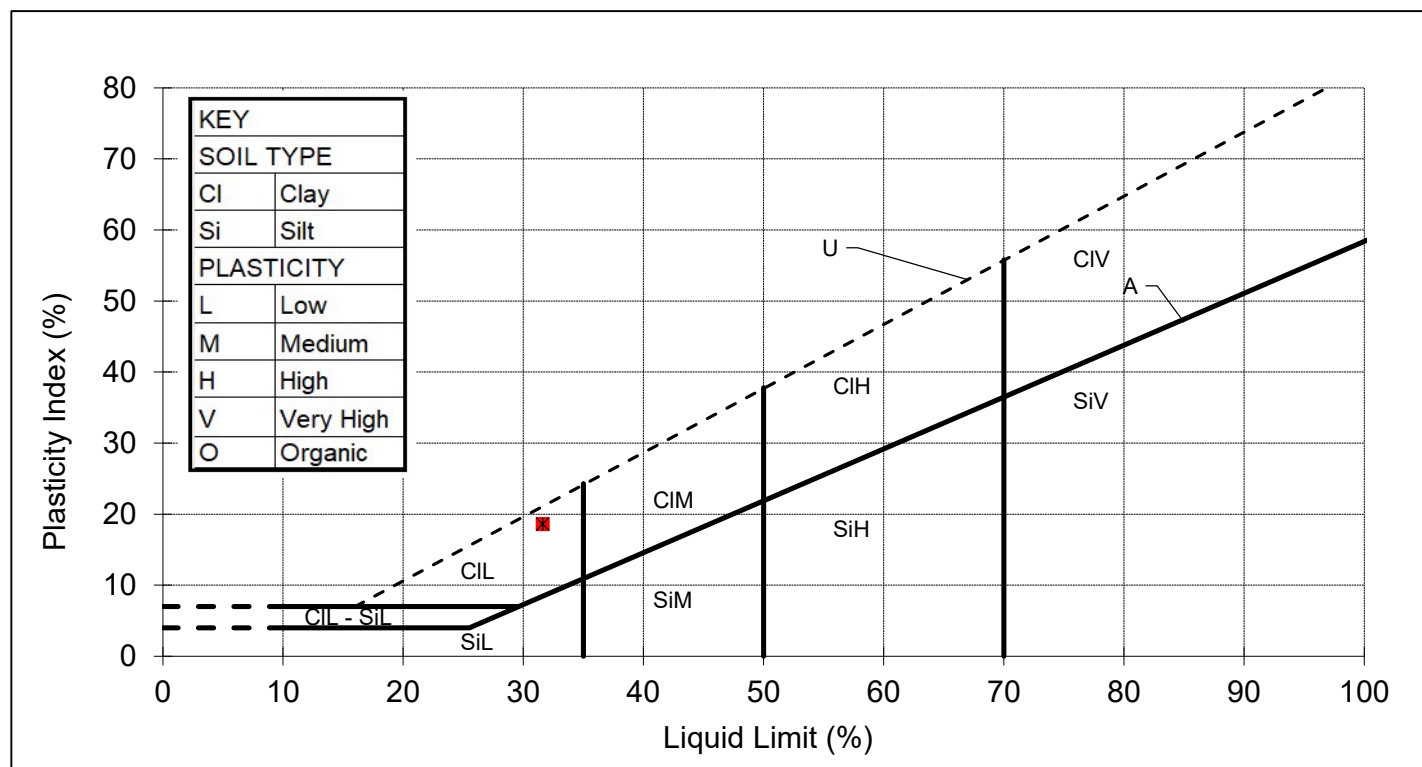
O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

1580

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022



Page 17 of 29

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

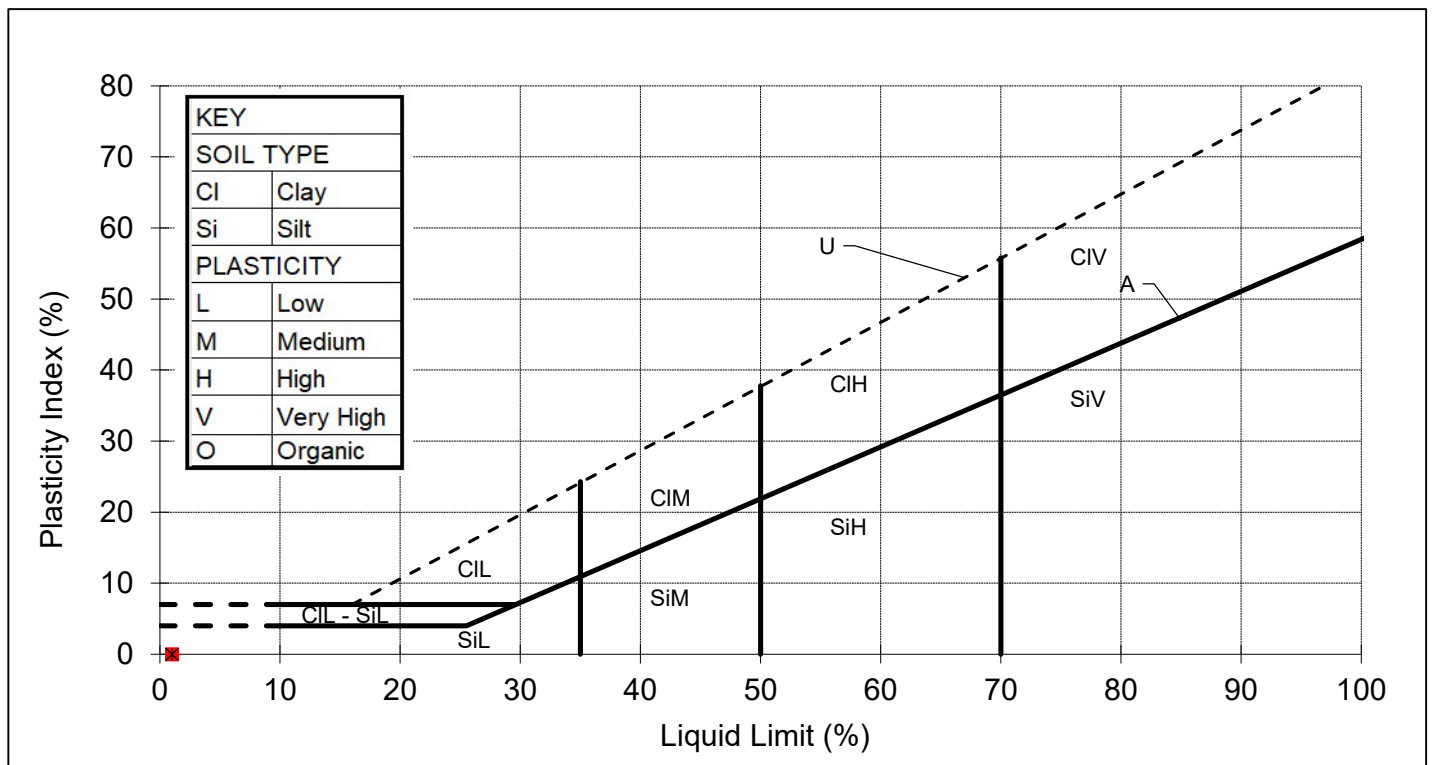
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP04 - 0.50	DATE SAMPLED	Not advised
SAMPLE No.	134643	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty SAND & GRAVEL		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	N/A	N/A	N/A	
Determination 2 (avg)	N/A	N/A		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
11.6	N/A	Non Plastic	N/A	34



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

LIQUID LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.3 (30° FALL CONE) 1 POINT METHOD

PLASTIC LIMIT BS EN ISO 17892-12:2018+A2:2022 Clause 5.5

WATER CONTENT METHOD BS EN ISO 17892-1:2014+A1:2022

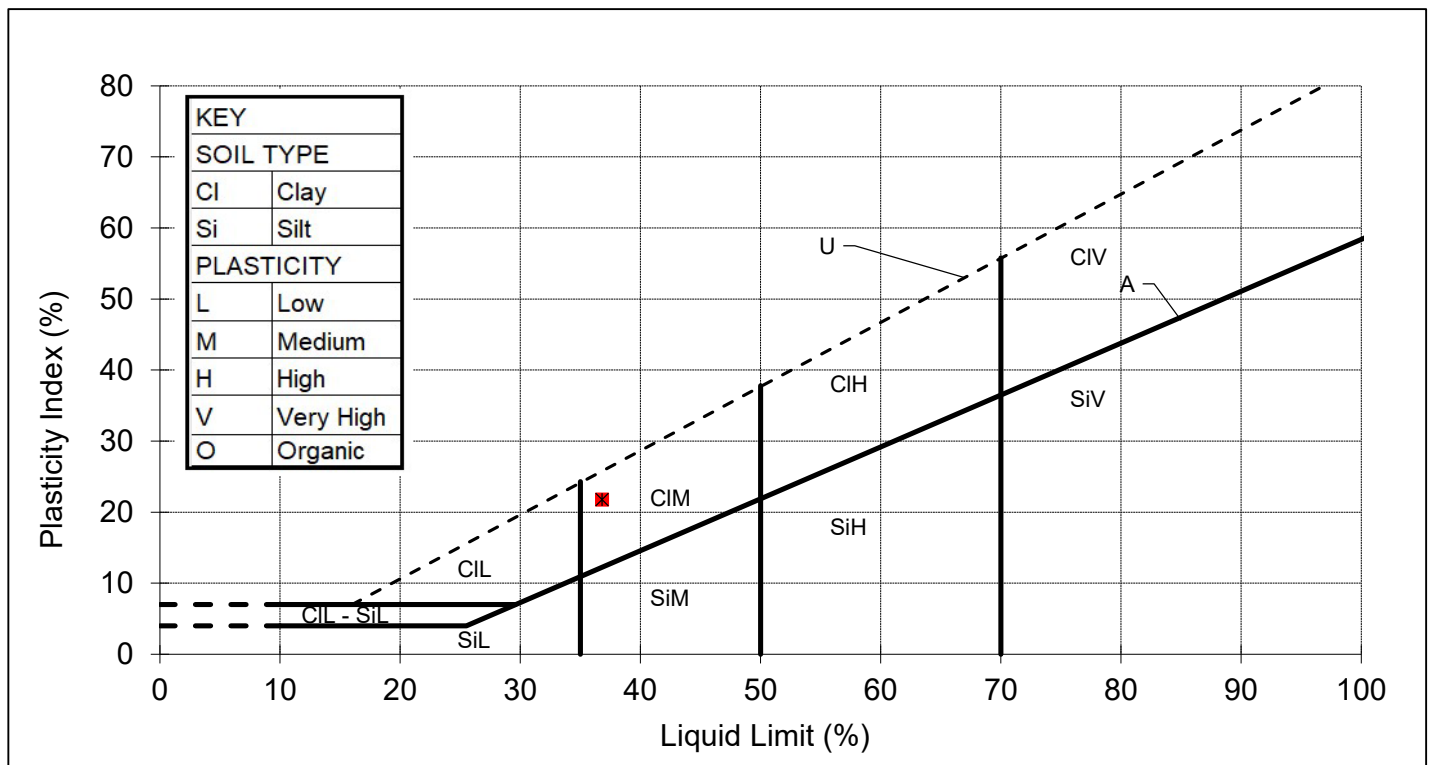
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP05 - 0.50	DATE SAMPLED	Not advised
SAMPLE No.	134648	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY		
ADVISED SOURCE	Site Investigation Sample	WATER CONTENT	Increasing
SAMPLE HISTORY	Natural State	% RET. 425um BY	Wet Sieved

Test Readings mm (average)		Moisture Content %	Correction Factor	Correction factor from Clayton and Jukes 1978
Determination 1 (avg)	18.1	35.7	1.038	
Determination 2 (avg)	18.0	35.2		

Natural Moisture Content (%)	Liquid Limit (%)	Plastic Limit (%)	Plasticity Index (%)	Passing 425 micron (%)
19.3	37	15	22	55



REMARKS

SIGNED

NAME

O.P. Davies BA (Hons)
(Laboratory Manager)

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER

BS 1377-2:2022 Cl.11

PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

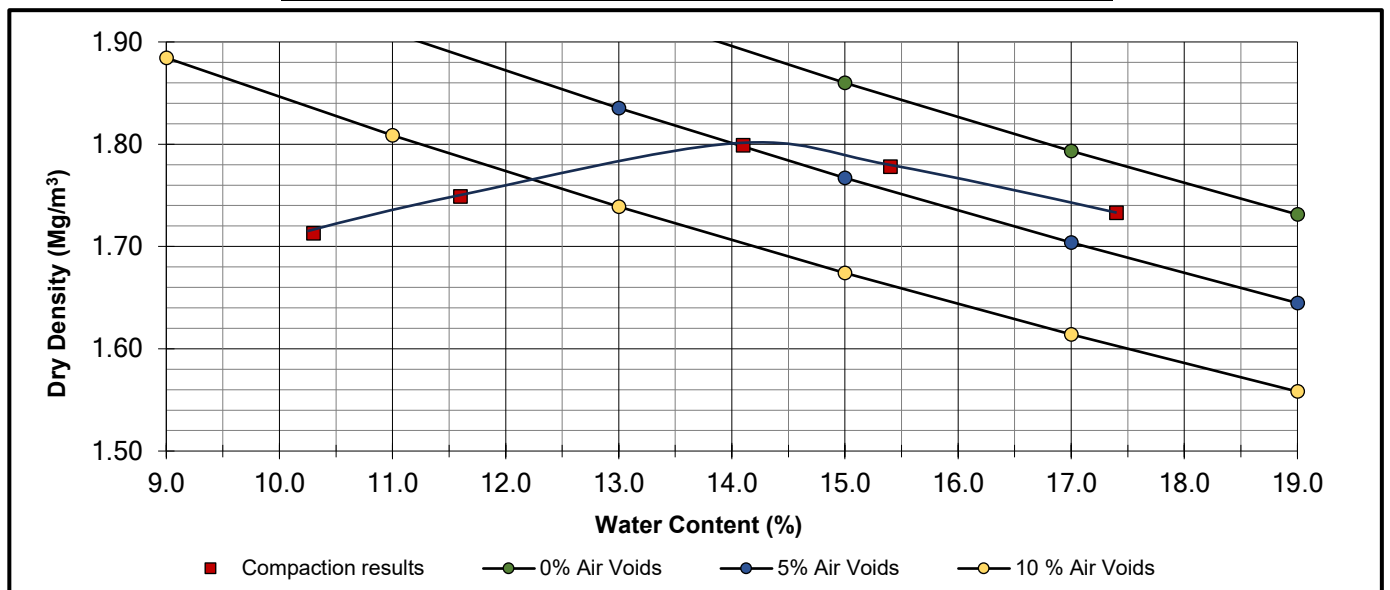
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 0.50	DATE SAMPLED	Not advised
SAMPLE NUMBER	134629	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	18 %	GRADING ZONE	Zone X
RETAINED 20mm	32 %	PARTICLE DENSITY	2.58 Mg/m ³ (Measured)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m ³)
1	10.3	1.713
2	11.6	1.749
3	14.1	1.799
4	15.4	1.778
5	17.4	1.733



OPTIMUM WATER CONTENT	14	(%)
MAXIMUM DRY DENSITY	1.80	(Mg/m ³)

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER

BS 1377-2:2022 Cl.11

PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

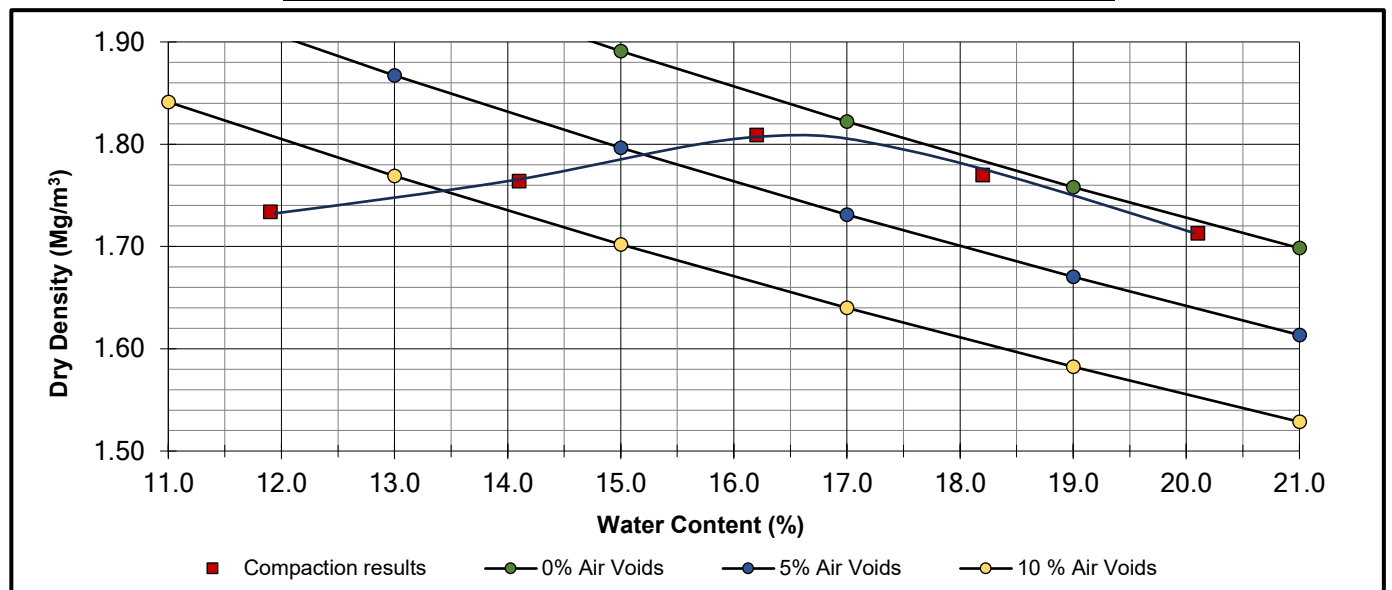
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 4.00	DATE SAMPLED	Not advised
SAMPLE NUMBER	134633	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty sandy slightly gravelly CLAY
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	1 %	GRADING ZONE	Zone 4
RETAINED 20mm	7 %	PARTICLE DENSITY	2.64 Mg/m3 (Measured)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m ³)
1	11.9	1.734
2	14.1	1.764
3	16.2	1.809
4	18.2	1.770
5	20.1	1.713



OPTIMUM WATER CONTENT	17 (%)
MAXIMUM DRY DENSITY	1.81 (Mg/m ³)

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER

BS 1377-2:2022 Cl.11

PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

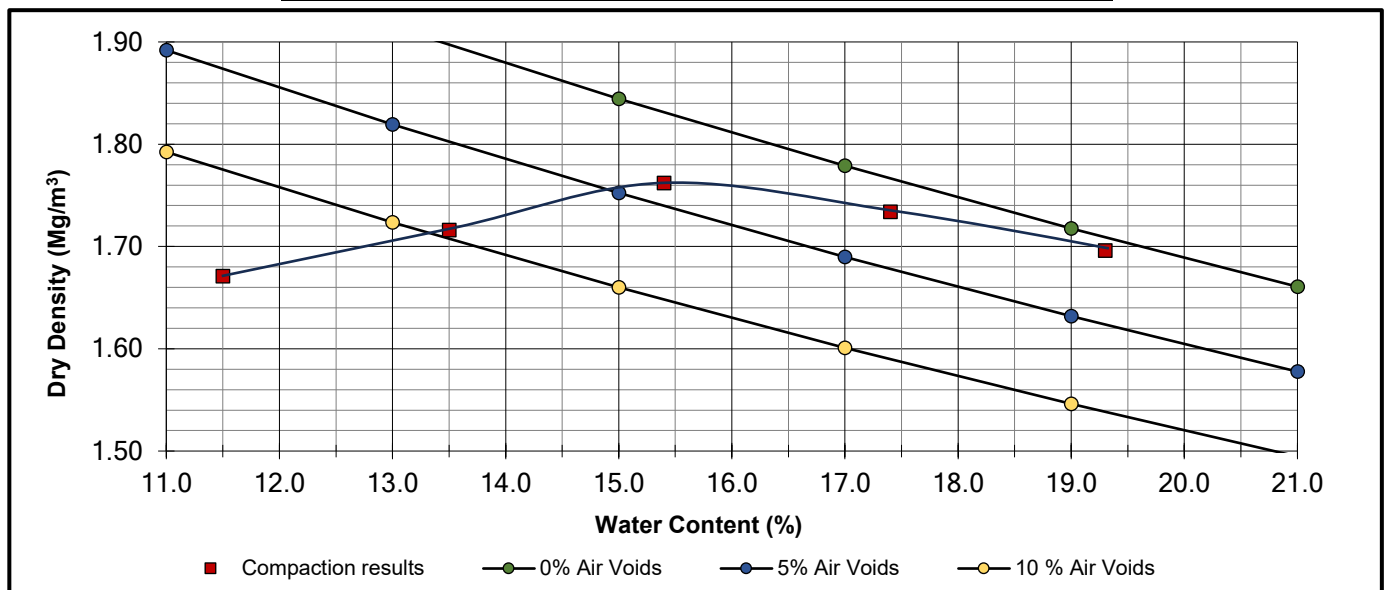
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP02 - 1.00	DATE SAMPLED	Not advised
SAMPLE NUMBER	134634	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	5 %	GRADING ZONE	Zone 4
RETAINED 20mm	27 %	PARTICLE DENSITY	2.55 Mg/m3 (Measured)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m ³)
1	11.5	1.671
2	13.5	1.716
3	15.4	1.762
4	17.4	1.734
5	19.3	1.696



OPTIMUM WATER CONTENT	15 (%)
MAXIMUM DRY DENSITY	1.76 (Mg/m ³)

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER

BS 1377-2:2022 Cl.11

PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

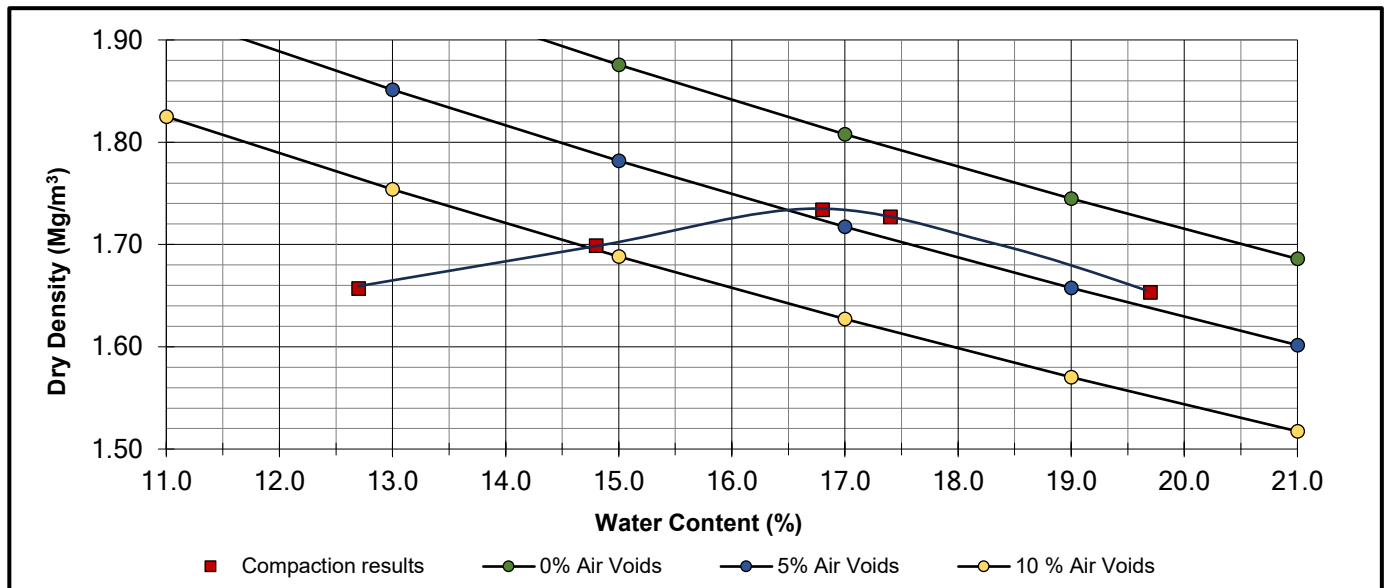
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP02 - 3.00	DATE SAMPLED	Not advised
SAMPLE NUMBER	134636	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	6 %	GRADING ZONE	Zone X
RETAINED 20mm	37 %	PARTICLE DENSITY	2.61 Mg/m ³ (Measured)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m ³)
1	12.7	1.657
2	14.8	1.699
3	16.8	1.734
4	17.4	1.727
5	19.7	1.653



OPTIMUM WATER CONTENT	17 (%)
MAXIMUM DRY DENSITY	1.73 (Mg/m ³)

REMARKS

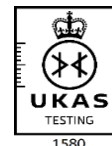
NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER

BS 1377-2:2022 Cl.11

PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

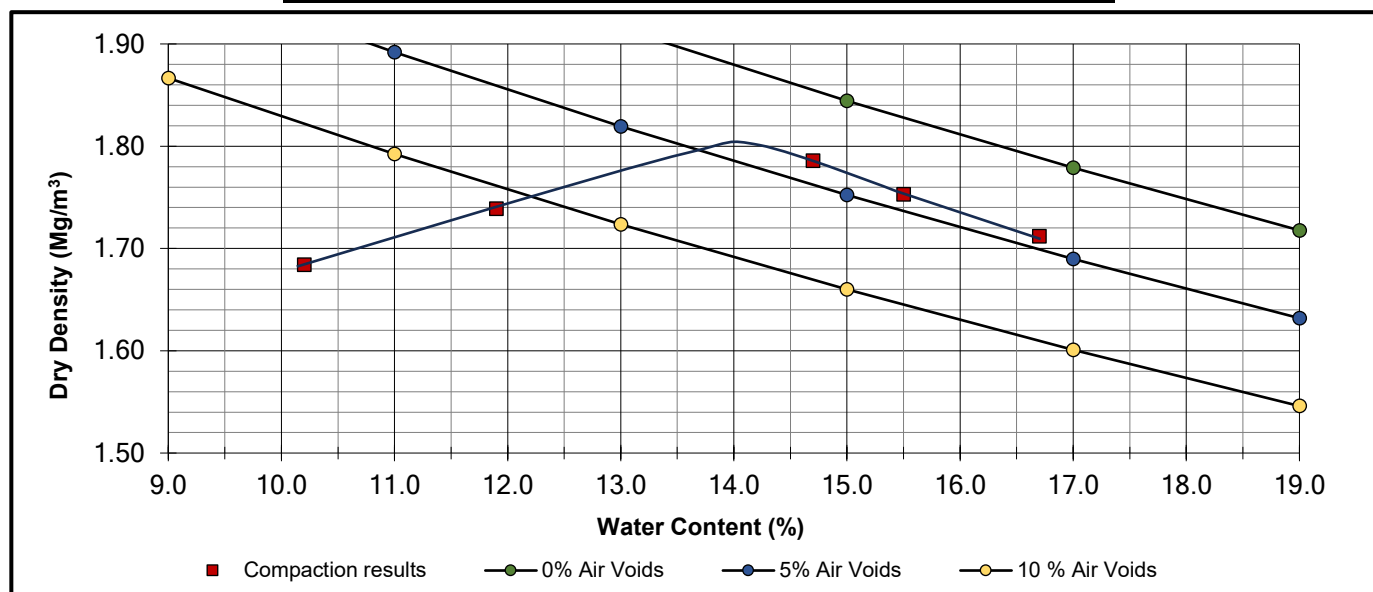
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP03 - 1.00	DATE SAMPLED	Not advised
SAMPLE NUMBER	134639	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	9 %	GRADING ZONE	Zone X
RETAINED 20mm	34 %	PARTICLE DENSITY	2.55 Mg/m ³ (Measured)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m ³)
1	10.2	1.684
2	11.9	1.739
3	14.7	1.786
4	15.5	1.753
5	16.7	1.712



OPTIMUM WATER CONTENT	14 (%)
MAXIMUM DRY DENSITY	1.80 (Mg/m ³)

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

DRY DENSITY/WATER CONTENT RELATIONSHIP 2.5kg RAMMER

BS 1377-2:2022 Cl.11

PARTICLE DENSITY METHOD BS 1377-2:2022 Cl.9.2

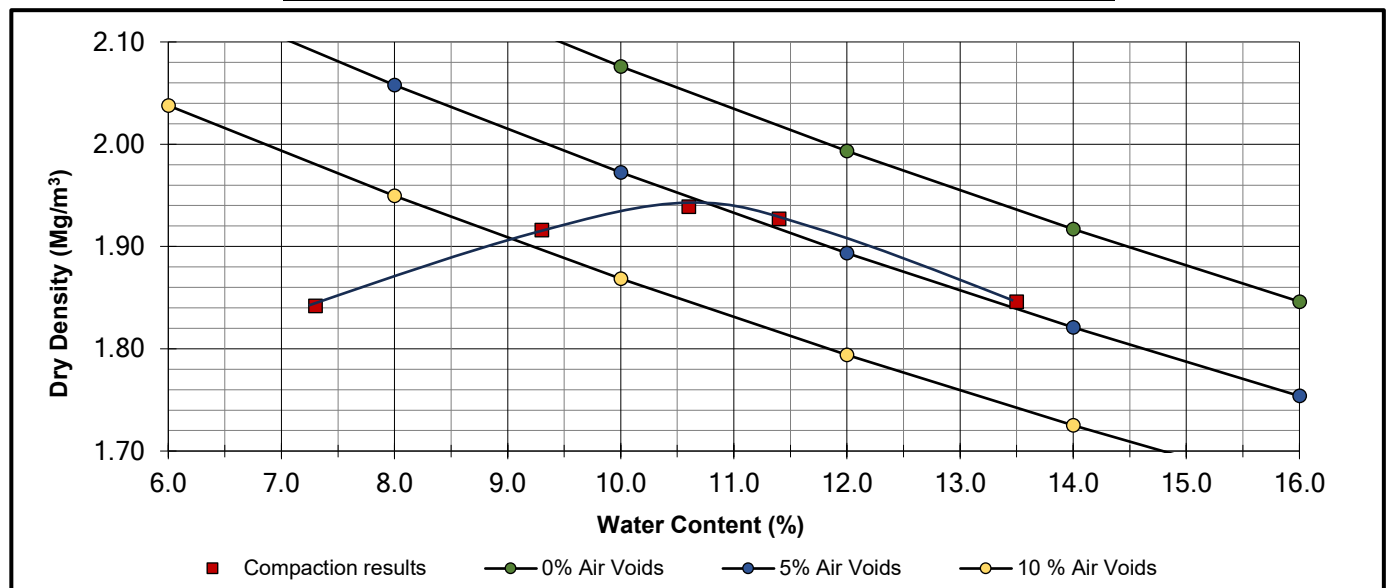
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP05 - 0.50	DATE SAMPLED	Not advised
SAMPLE NUMBER	134643	DATE RECEIVED	01-Dec-23
DATE TESTED	05-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample
PRE TREATMENT	Air Dried / Separate Batches

RETAINED 37.5mm	14 %	GRADING ZONE	Zone X
RETAINED 20mm	31 %	PARTICLE DENSITY	2.62 Mg/m3 (Measured)

POINT NUMBER	WATER CONTENT (%)	DRY DENSITY (Mg/m ³)
1	7.3	1.842
2	9.3	1.916
3	10.6	1.939
4	11.4	1.927
5	13.5	1.846



OPTIMUM WATER CONTENT	11 (%)
MAXIMUM DRY DENSITY	1.94 (Mg/m ³)

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE 19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

CALIFORNIA BEARING RATIO (CBR)

BS 1377-2:2022 Cl. 15

DETERMINATION OF WATER CONTENT - BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

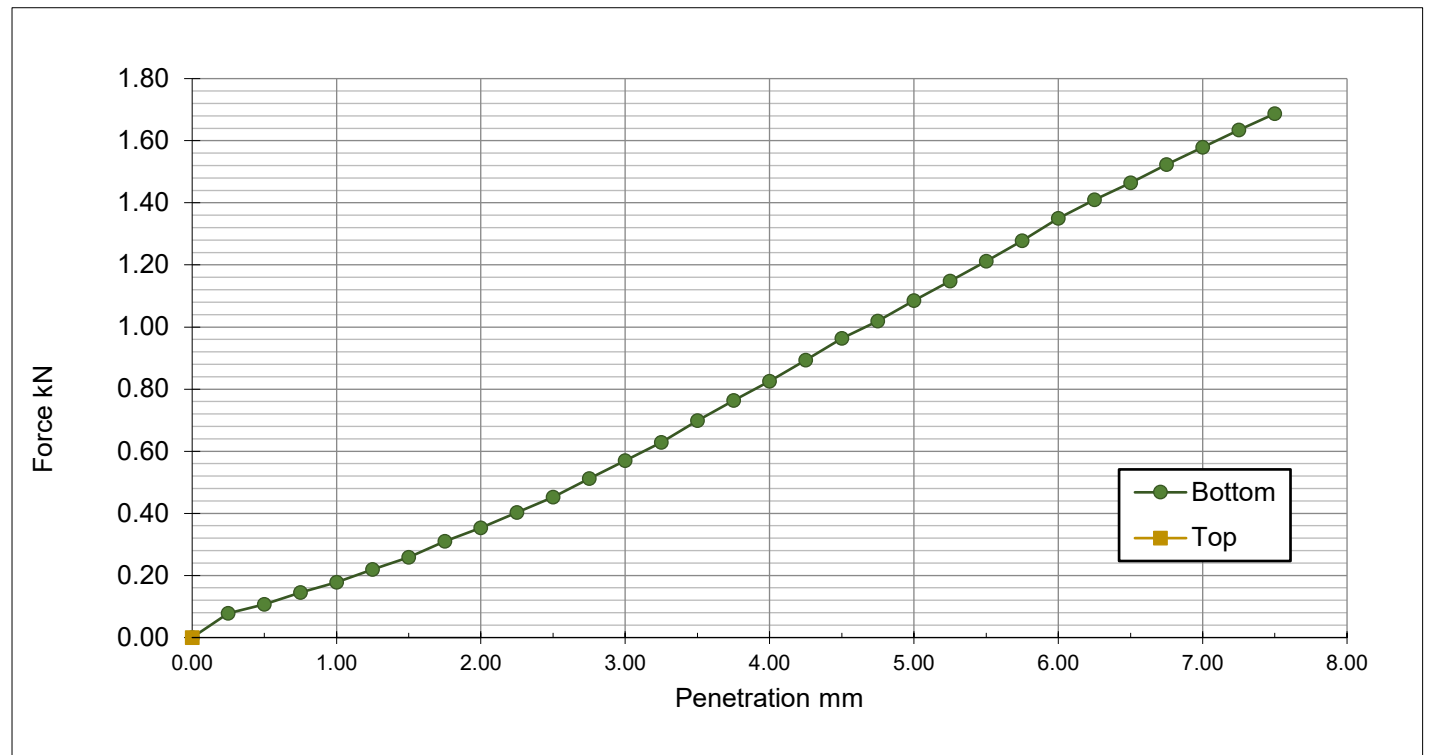
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	HD105 0.2 B	DATE SAMPLED	28-Nov-23
LAB SAMPLE No	134653	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown clay bound silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

INITIAL CONDITIONS

SAMPLE PREPARATION	Dynamic Compaction, Specified Effort, 2.5 kg Rammer				
GREATER THAN 20 mm REMOVED	6 %				
BULK DENSITY	2.08 Mg/m3	MOISTURE CONTENT	30.5 %	DRY DENSITY	1.59 Mg/m3
TEST CONDITION	Unsoaked	MEASURED SWELL	N/A mm	SURCHARGE	2 kg



CBR VALUE

Top N/A %
Bottom 5.4 %

ORIGIN CORRECTION

Top N/A mm
Bottom N/A mm

FINAL MOISTURE CONTENT

Top N/A %
Bottom 30.5 %

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE

19-Dec-23

MURRAY RIX

ANDREW HOUSE, HADFIELD STREET,
DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

CALIFORNIA BEARING RATIO (CBR)

BS 1377-2:2022 Cl. 15

DETERMINATION OF WATER CONTENT - BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

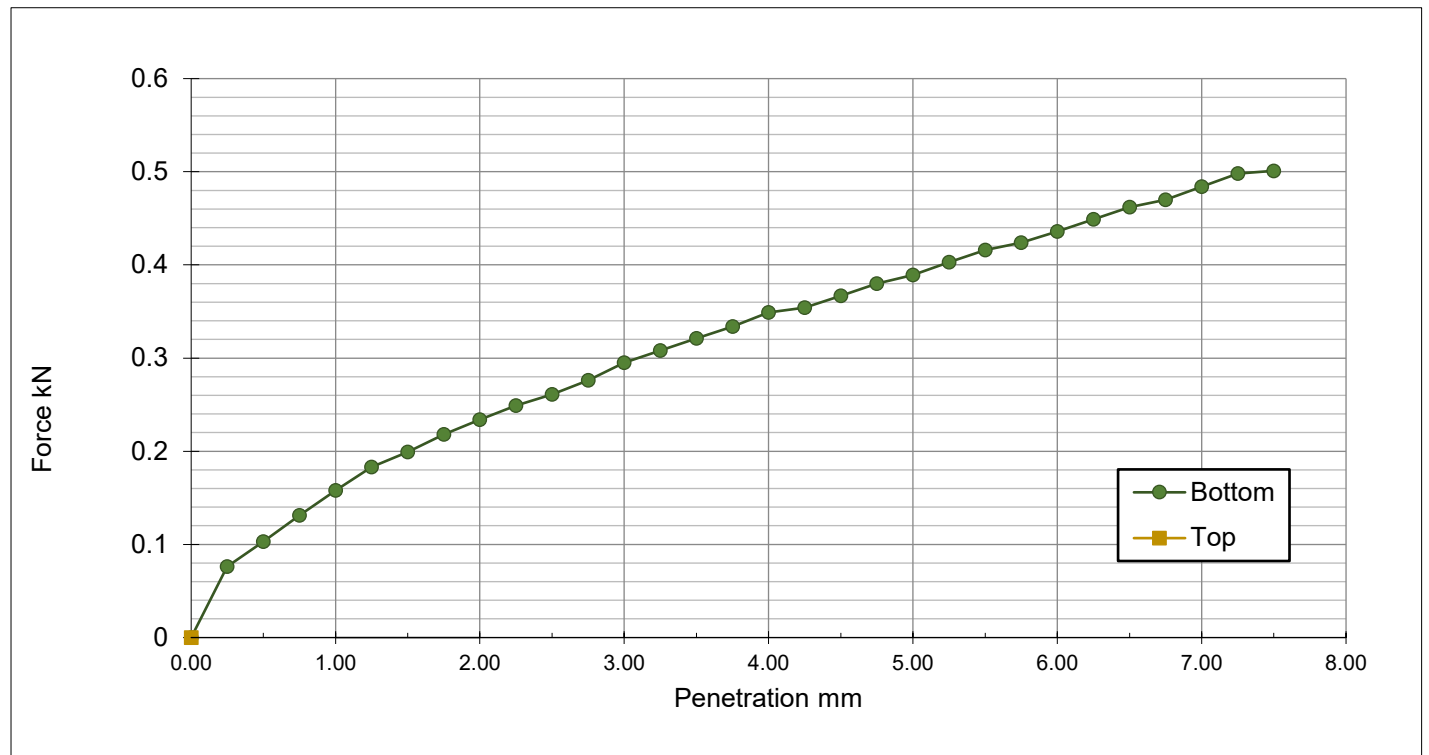
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP01 - 4.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134633	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty sandy slightly gravelly CLAY
ADVISED SOURCE	Site Investigation Sample

INITIAL CONDITIONS

SAMPLE PREPARATION	Dynamic Compaction, Specified Effort, 2.5 kg Rammer				
GREATER THAN 20 mm REMOVED	7 %				
BULK DENSITY	1.92 Mg/m3	MOISTURE CONTENT	24.9 %	DRY DENSITY	1.54 Mg/m3
TEST CONDITION	Unsoaked	MEASURED SWELL	N/A mm	SURCHARGE	2 kg



CBR VALUE

Top N/A %
Bottom 2.0 %

ORIGIN CORRECTION

Top N/A mm
Bottom N/A mm

FINAL MOISTURE CONTENT

Top N/A %
Bottom 24.9 %

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE

19-Dec-23

MURRAY RIX

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DUKINFIELD, CHESHIRE SK16 4QX
TEL 0161 475 0870



TEST CERTIFICATE

CALIFORNIA BEARING RATIO (CBR)

BS 1377-2:2022 Cl. 15

DETERMINATION OF WATER CONTENT - BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

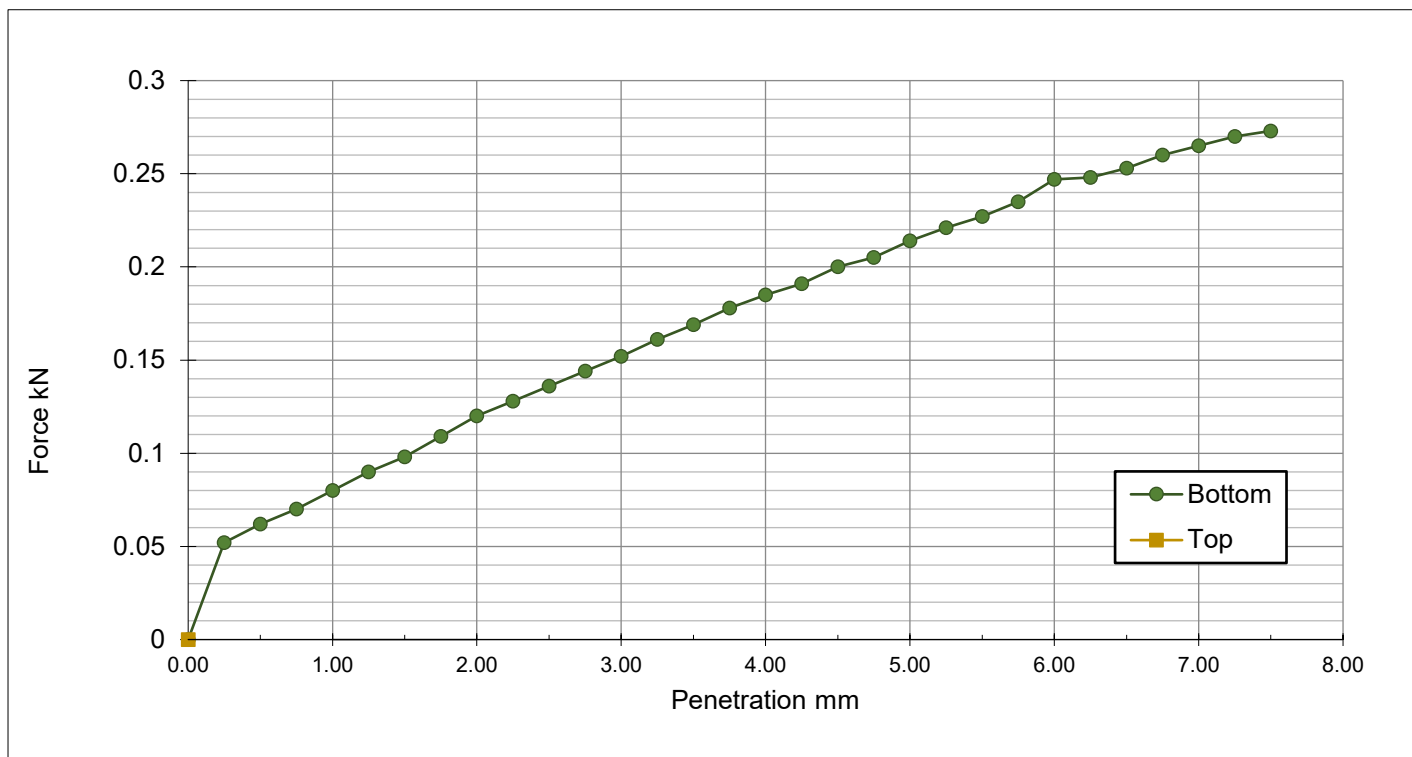
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP04 - 0.50	DATE SAMPLED	Not advised
LAB SAMPLE No	134643	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty SAND & GRAVEL
ADVISED SOURCE	Site Investigation Sample

INITIAL CONDITIONS

SAMPLE PREPARATION	Dynamic Compaction, Specified Effort, 2.5 kg Rammer				
GREATER THAN 20 mm REMOVED	31 %				
BULK DENSITY	2.06 Mg/m ³	MOISTURE CONTENT	14.4 %	DRY DENSITY	1.80 Mg/m ³
TEST CONDITION	Unsoaked	MEASURED SWELL	N/A mm	SURCHARGE	2 kg



CBR VALUE

Top N/A %
Bottom 1.1 %

ORIGIN CORRECTION

Top N/A mm
Bottom N/A mm

FINAL MOISTURE CONTENT

Top N/A %
Bottom 14.4 %

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED

DATE

19-Dec-23

TEST CERTIFICATE
CALIFORNIA BEARING RATIO (CBR)
BS 1377-2:2022 Cl. 15

DETERMINATION OF WATER CONTENT - BS EN ISO 17892-1:2014+A1:2022 (Oven Dry)

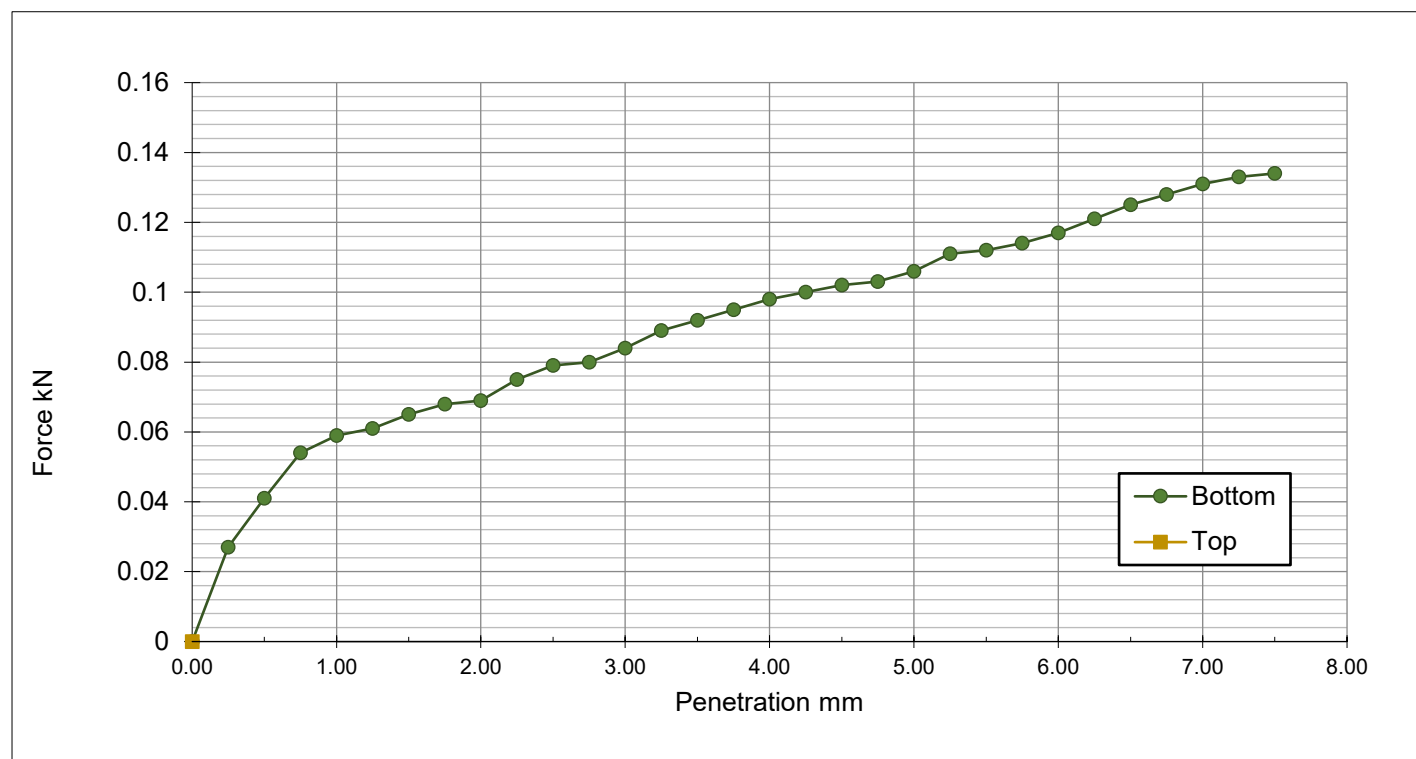
CLIENT	LK Consult Ltd
SITE	LKC 23 1637 - QEII Way, Heywood
JOB NUMBER	MRN 4606/123

SAMPLE LABEL	TP05 - 1.00	DATE SAMPLED	Not advised
LAB SAMPLE No	134649	DATE RECEIVED	01-Dec-23
DATE TESTED	12-Dec-23	SAMPLED BY	Client

MATERIAL	Brown silty slightly sandy slightly gravelly CLAY
ADVISED SOURCE	Site Investigation Sample

INITIAL CONDITIONS

SAMPLE PREPARATION	Dynamic Compaction, Specified Effort, 2.5 kg Rammer				
GREATER THAN 20 mm REMOVED	3 %				
BULK DENSITY	1.74 Mg/m ³	MOISTURE CONTENT	26.9 %	DRY DENSITY	1.37 Mg/m ³
TEST CONDITION	Unsoaked	MEASURED SWELL	N/A mm	SURCHARGE	2 kg



CBR VALUE

Top	N/A	%
Bottom	0.6	%

ORIGIN CORRECTION

Top	N/A	mm
Bottom	N/A	mm

FINAL MOISTURE CONTENT

Top	N/A	%
Bottom	26.9	%

REMARKS

NAME O.P. Davies BA (Hons)
(Laboratory Manager)

SIGNED



DATE

19-Dec-23

Appendix E – Gas Monitoring Results

	LK CONSULT LTD GAS MONITORING RECORD	Site Details		Monitoring Visit Conditions		Visit No. 1 of 6
		Site Name	QEII Way, Heywood	Recent Weather	Dry, Overcast	
		Job Number	LKC 23 1637	Ground Conditions	Boggy	
		Engineer	EH / JW	Approx. Air temperature (°C)	7	
		Date	13/12/2023	Atmospheric Pressure (Prev. 24 hrs)	Falling	

Site Monitoring	BH Ref.	WS01	WS02	WS03	WS04	WS05										
	Time	09:34:01	11:18:37	10:23:15	09:47:28	10:06:40										
	Barometric Pressure (mb)	991	993	993	993	993										
	Relative Pressure (mb)	0.3	0.14	-6.05	0.69	7.23										
Gas and Groundwater Monitoring Data	Internal Flow ³ (l/hr)	0	0	-1.7	0	1.9										
	Peak Flow (l/hr)	0	0	-3.2	0	3.6										
	Steady CH ₄ (%v/v)	2.6	36.8	1.1	1.9	0										
	Peak CH ₄ (%v/v)	2.6	36.8	1.1	1.9	0.3										
	% LEL ²	52	>>>>	22	38	0										
	Steady CO ₂ (%v/v)	0.1	8.8	4.6	1.2	3.8										
	Peak CO ₂ (%v/v)	0.1	8.8	4.6	1.2	3.8										
	Steady O ₂ (%v/v)	0.1	4.8	0.2	0.3	0.2										
	Min O ₂ (%v/v)	0.1	4.8	0.2	0.3	0.2										
	Balance (%)	97.3	49.6	94.1	96.6	95.9										
	Steady CO (ppm)	0	7	2	1	0										
	Peak CO (ppm)	4	16	3	4	2										
	Steady H ₂ S (ppm)	0	0	0	0	0										
	Peak H ₂ S (ppm)	0	0	0	0	0										
	Steady PID (ppm)	0	0	0	0.4	0.2										
	Max PID (ppm)	0	0.4	0.1	0.4	0.3										
	Standing Water Level (mbgl)	3.78	2.00	2.15	3.82	1.51										
	Installation Base Depth (mbgl)	3.92	3.89	4.30	4.84	3.88										
	Response Zone/Strata	1.00-4.00	1.00-4.00	1.00-4.50	4.00-5.00	1.00-4.00										
	Comments	Water is black in colour with strong organic odour. Well developed, 1 litre of groundwater removed.	Water has a slight organic odour. Well developed, 6 litres of groundwater removed.	Well developed, 6 litres of groundwater removed.	Well developed, 3 litres of groundwater removed.	Flow taken for 1.5 minutes. Silty water. Well developed, 15 litres of groundwater removed.										
Equipment							ABBREVIATIONS					NOTES				
Gas Machine	Gas Analyser GA5000						ND	Not detected		ppm	Parts per million	All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.				
	G507783						NR	Not recorded		mb	Millibars					
Dipmeter	HydroTechnik						UR	Unable to record		l/hr	Litres per hour	¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates.				
	HT-02						OS	Off recordable scale		mbgl	Metres below ground level					
PID	Mini Rae Lite+ PGM7300						N/A	Not applicable		LEL	Lower explosive limit in air	² CH ₄ is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH ₄ .				
	590-913892															

 LK CONSULT	LK CONSULT LTD GAS MONITORING RECORD	Site Details		Monitoring Visit Conditions		Visit No. 2 of 6
		Site Name	QEII Way, Heywood	Recent Weather	Windy, rainy, cold	
		Job Number	LKC 23 1637	Ground Conditions	Boggy	
		Engineer	EH	Approx. Air temperature (°C)	9	
		Date	20/12/2023	Atmospheric Pressure (Prev. 24 hrs)	Falling	

Site Monitoring	BH Ref.	WS01	WS02	WS03	WS04	WS05	0	0	0	0	0	0	0	0	0	0	0
	Time	08:55:03	11:19:19	10:26:07	09:07:35	09:43:46	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
Gas and Groundwater Monitoring Data	Barometric Pressure (mb)	1001	1000	1001	1001	1001	0	0	0	0	0	0	0	0	0	0	0
	Relative Pressure (mb)	-0.09	0.09	2.48	-0.07	-0.02	0	0	0	0	0	0	0	0	0	0	0
	Internal Flow ³ (l/hr)	0	0	1.2	0	-0.1	0	0	0	0	0	0	0	0	0	0	0
	Peak Flow (l/hr)	0	0	1.8	0	-0.1	0	0	0	0	0	0	0	0	0	0	0
	Steady CH ₄ (%v/v)	2.4	39.2	1.4	1.2	0	0	0	0	0	0	0	0	0	0	0	0
	Peak CH ₄ (%v/v)	2.4	39.2	1.4	1.2	0	0	0	0	0	0	0	0	0	0	0	0
	% LEL ²	48	>>>>	28	24	0	0	0	0	0	0	0	0	0	0	0	0
	Steady CO ₂ (%v/v)	0.1	18.3	6.3	1.7	4.7	0	0	0	0	0	0	0	0	0	0	0
	Peak CO ₂ (%v/v)	0.2	19.1	6.3	1.8	4.7	0	0	0	0	0	0	0	0	0	0	0
	Steady O ₂ (%v/v)	0	1.3	0	5.2	2.2	0	0	0	0	0	0	0	0	0	0	0
	Min O ₂ (%v/v)	0	1.3	0	5.2	2.2	0	0	0	0	0	0	0	0	0	0	0
	Balance (%)	97.5	41.2	92.2	92	93.2	0	0	0	0	0	0	0	0	0	0	0
	Steady CO (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Peak CO (ppm)	1	4	29	1	0	0	0	0	0	0	0	0	0	0	0	0
	Steady H ₂ S (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Peak H ₂ S (ppm)	0	0	0	1	0	0	0	0	0	0	0	0	0	0	0	0
	Steady PID (ppm)	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	Max PID (ppm)	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	Standing Water Level (mbgl)	Dry	2.4	2.27	3.92	1.76	0	0	0	0	0	0	0	0	0	0	0
	Installation Base Depth (mbgl)	3.41	3.88	4.31	4.84	3.88	0	0	0	0	0	0	0	0	0	0	0
	Response Zone/Strata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Comments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0

Equipment			ABBREVIATIONS				NOTES
Gas Machine	Gas Analyser GA5000		ND	Not detected	ppm	Parts per million	All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665. ¹Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates. ²CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4. ³Flow readings are based on steady 1 minute value where flow is detected (equipment range of +/- 12 ltr/hr).
	G507783		NR	Not recorded	mb	Millibars	
Dipmeter	HydroTechnik		UR	Unable to record	l/hr	Litres per hour	
	HT-02		OS	Off recordable scale	mbgl	Metres below ground level	
PID	-		N/A	Not applicable	LEL	Lower explosive limit in air	
	-						

 LK CONSULT	LK CONSULT LTD	Site Details		Monitoring Visit Conditions		Visit No.
	GAS MONITORING RECORD	Site Name	QEII Way, Heywood	Recent Weather	Sunny, dry, windy, cold	3
		Job Number	LKC 23 1637	Ground Conditions	Boggy	of
		Engineer	EH	Approx. Air temperature (°C)	4	6
		Date	09/01/2024	Atmospheric Pressure (Prev. 24 hrs)	Falling	

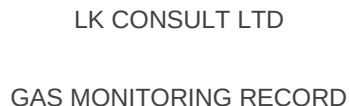
Site Monitoring Visit Details	BH Ref.	WS01	WS04	WS05	WS03	WS02	0	0	0	0	0	0	0	0	0	0	0
	Time	11:34:31	11:44:37	11:55:46	12:06:55	12:18:31	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
	Barometric Pressure (mb)	1018	1019	1019	1019	1019	0	0	0	0	0	0	0	0	0	0	0
	Relative Pressure (mb)	0.11	0.27	-5.34	-19.72	0.04	0	0	0	0	0	0	0	0	0	0	0
Gas and Groundwater Monitoring Data	Internal Flow ³ (l/hr)	0	0	-1.3	-2.5	0	0	0	0	0	0	0	0	0	0	0	0
	Peak Flow (l/hr)	0	0	-3.9	-10.1	0.1	0	0	0	0	0	0	0	0	0	0	0
	Steady CH ₄ (%v/v)	2.4	0.6	0	3.3	51.2	0	0	0	0	0	0	0	0	0	0	0
	Peak CH ₄ (%v/v)	2.4	0.6	0	3.3	51.4	0	0	0	0	0	0	0	0	0	0	0
	% LEL ²	48	12	0	66	>>>>	0	0	0	0	0	0	0	0	0	0	0
	Steady CO ₂ (%v/v)	0.2	1.5	3.7	4.2	18.6	0	0	0	0	0	0	0	0	0	0	0
	Peak CO ₂ (%v/v)	0.2	1.7	3.7	4.2	19.7	0	0	0	0	0	0	0	0	0	0	0
	Steady O ₂ (%v/v)	0.1	3.9	0.8	1.2	0.1	0	0	0	0	0	0	0	0	0	0	0
	Min O ₂ (%v/v)	0.1	3.9	0.8	1.2	0.1	0	0	0	0	0	0	0	0	0	0	0
	Balance (%)	97.3	94	95.5	91.3	30.1	0	0	0	0	0	0	0	0	0	0	0
	Steady CO (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Peak CO (ppm)	1	1	0	1	2	0	0	0	0	0	0	0	0	0	0	0
	Steady H ₂ S (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Peak H ₂ S (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Steady PID (ppm)	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	Max PID (ppm)	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	Standing Water Level (mbgl)	Dry	3.89	1.91	2.16	2.4	0	0	0	0	0	0	0	0	0	0	0
	Installation Base Depth (mbgl)	3.43	4.83	3.88	4.31	3.9	0	0	0	0	0	0	0	0	0	0	0
	Response Zone/Strata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Comments	0	0	ken for 1.5	maken for 2 m	0	0	0	0	0	0	0	0	0	0	0	0

Equipment			ABBREVIATIONS				NOTES
Gas Machine	Gas Analyser GA5000		ND	Not detected	ppm	Parts per million	All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665.
	G502417		NR	Not recorded	mb	Millibars	
Dipmeter	HydroTechnik		UR	Unable to record	l/hr	Litres per hour	¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates. ² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4.
	HT-03		OS	Off recordable scale	mbgl	Metres below ground level	
PID	-		N/A	Not applicable	LEL	Lower explosive limit in air	³ Flow readings are based on steady 1 minute value where flow is detected (equipment range of +/- 12 ltr/hr).
	-						

 LK CONSULT	LK CONSULT LTD	Site Details		Monitoring Visit Conditions		Visit No.
	GAS MONITORING RECORD	Site Name	QEII Way, Heywood	Recent Weather	Overcast, dry, windy	4
		Job Number	LKC 23 1637	Ground Conditions	Boggy	of
		Engineer	EH	Approx. Air temperature (°C)	8	6
		Date	25/01/2024	Atmospheric Pressure (Prev. 24 hrs)	Rising	

Site Monitoring Visit Details	BH Ref.	WS05	WS03	WS02	WS04	WS01										
	Time	09:45:40	10:49:59	11:32:05	12:29:31	12:43:10										
	Barometric Pressure (mb)	1005	1004	1004	1003	1003										
	Relative Pressure (mb)	9.28	-8.39	0.23	0.23	0.53										
Gas and Groundwater Monitoring Data	Internal Flow ³ (l/hr)	2.1	-0.2	0	0	0										
	Peak Flow (l/hr)	6	-5.6	0	0.1	0										
	Steady CH ₄ (%v/v)	0	5.1	48.5	0.4	1.3										
	Peak CH ₄ (%v/v)	0	5.1	48.7	0.4	1.3										
	% LEL ²	0	>>>>	>>>>	8	26										
	Steady CO ₂ (%v/v)	3.8	5.5	17.8	1	0.3										
	Peak CO ₂ (%v/v)	3.8	5.5	19	1.1	0.3										
	Steady O2 (%v/v)	0.6	0.7	0.1	1.4	0.2										
	Min O ₂ (%v/v)	0.6	0.7	0.1	1.4	0.2										
	Balance (%)	95.6	88.7	33.6	97.2	98.2										
	Steady CO (ppm)	0	0	1	1	1										
	Peak CO (ppm)	1	1	2	1	1										
	Steady H ₂ S (ppm)	0	0	0	0	0										
	Peak H ₂ S (ppm)	0	0	0	0	0										
	Steady PID (ppm)	-	-	-	-	-										
	Max PID (ppm)	-	-	-	-	-										
	Standing Water Level (mbgl)	1.82	2.12	2.4	4	Dry										
	Installation Base Depth (mbgl)	3.87	4.3	3.09	4.82	3.42										
	Response Zone/Strata															
	Comments	Flow taken for 2 minutes 50 seconds.	Flow taken fro 3 minutes 10 seconds.													
Equipment						ABBREVIATIONS						NOTES				
Gas Machine	Gas Analyser GA5000					ND	Not detected			ppm	Parts per million		All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665. ¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates. ² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4. ³ Flow readings are based on steady 1 minute value where flow is detected (equipment range of +/- 12 ltr/hr).			
	G502417					NR	Not recorded			mb	Millibars					
Dipmeter	HydroTechnik					UR	Unable to record			l/hr	Litres per hour					
	HT-02					OS	Off recordable scale			mbgl	Metres below ground level					
PID	-					N/A	Not applicable			LEL	Lower explosive limit in air					
	-															

LKCONSULT LK CONSULT LTD GAS MONITORING RECORD		Site Details						Monitoring Visit Conditions						Visit No.			
		Site Name			QEII Way, Heywood			Recent Weather			Dry, overcast, mild			5 of 6			
		Job Number			LKC 23 1637			Ground Conditions			Boggy						
		Engineer			EH			Approx. Air temperature (°C)			14°C						
		Date			15/02/2024			Atmospheric Pressure (Prev. 24 hrs)			Rising						
Site Monitoring Visit Details	BH Ref.	WS02	WS03	WS05	WS04	WS01	0	0	0	0	0	0	0	0	0	0	0
	Time	11:09:31	11:54:26	12:09:39	12:33:40	12:46:17	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00	00:00:00
Gas and Groundwater Monitoring Data	Barometric Pressure (mb)	988	988	989	988	988	0	0	0	0	0	0	0	0	0	0	0
	Relative Pressure (mb)	0.04	7.78	14.01	-0.11	0.04	0	0	0	0	0	0	0	0	0	0	0
	Internal Flow ³ (l/hr)	0	2.4	5	0	0	0	0	0	0	0	0	0	0	0	0	0
	Peak Flow (l/hr)	0.1	5.9	8	0	0	0	0	0	0	0	0	0	0	0	0	0
	Steady CH ₄ (%v/v)	35.7	3.3	0.1	0.5	1.7	0	0	0	0	0	0	0	0	0	0	0
	Peak CH ₄ (%v/v)	35.7	3.4	0.4	0.5	1.7	0	0	0	0	0	0	0	0	0	0	0
	% LEL ²	>>>>	66	2	10	34	0	0	0	0	0	0	0	0	0	0	0
	Steady CO ₂ (%v/v)	16.9	6.9	3.5	1.2	0.1	0	0	0	0	0	0	0	0	0	0	0
	Peak CO ₂ (%v/v)	17.7	6.9	3.5	1.3	0.3	0	0	0	0	0	0	0	0	0	0	0
	Steady O ₂ (%v/v)	0.1	0.1	0.1	0.9	0.1	0	0	0	0	0	0	0	0	0	0	0
	Min O ₂ (%v/v)	0.1	0.1	0.1	0.9	0.1	0	0	0	0	0	0	0	0	0	0	0
	Balance (%)	47.2	89.7	96.4	97.4	98.1	0	0	0	0	0	0	0	0	0	0	0
	Steady CO (ppm)	2	1	1	2	1	0	0	0	0	0	0	0	0	0	0	0
	Peak CO (ppm)	4	2	1	3	2	0	0	0	0	0	0	0	0	0	0	0
	Steady H ₂ S (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Peak H ₂ S (ppm)	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0
	Steady PID (ppm)	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	Max PID (ppm)	-	-	-	-	-	0	0	0	0	0	0	0	0	0	0	0
	Standing Water Level (mbgl)	2.22	2.28	1.16	3.93	Dry	0	0	0	0	0	0	0	0	0	0	0
	Installation Base Depth (mbgl)	3.9	4.31	3.89	4.83	3.43	0	0	0	0	0	0	0	0	0	0	0
Response Zone/Strata	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Comments	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	0	
Equipment						ABBREVIATIONS						NOTES					
Gas Machine		Gas Analyser GA5000				ND	Not detected			ppm	Parts per million		All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665. ¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates. ² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4. ³ Flow readings are based on steady 1 minute value where flow is detected (equipment range of +/- 12 ltr/hr).				
		G502417				NR	Not recorded			mb	Millibars						
Dipmeter		HydroTechnik				UR	Unable to record			l/hr	Litres per hour						
		HT-04				OS	Off recordable scale			mbgl	Metres below ground level						
PID		-				N/A	Not applicable			LEL	Lower explosive limit in air						
		-															



Site Monitoring Visit Details	BH Ref.	WS01	WS04	WS05	WS03	WS02											
	Time	10:31:09	10:40:53	10:52:11	11:04:55	11:17:03											
	Barometric Pressure (mb)	986	987	987	987	987											
	Relative Pressure (mb)	0.18	1.86	12	0.32	-0.02											
Gas and Groundwater Monitoring Data	Internal Flow ³ (l/hr)	0	0	3.1	0	0											
	Peak Flow (l/hr)	0	0	7.5	0	0											
	Steady CH ₄ (%v/v)	1.6	0.6	0	2	41.3											
	Peak CH ₄ (%v/v)	1.7	0.6	0.1	2	41.3											
	% LEL ²	32	12	0	40	>>>>											
	Steady CO ₂ (%v/v)	0.2	2	3.5	3.8	16.2											
	Peak CO ₂ (%v/v)	0.3	2	3.5	3.8	17.6											
	Steady O2 (%v/v)	0.1	1.5	1.3	0.1	0.1											
	Min O ₂ (%v/v)	0.1	1.5	1.3	0.1	0.1											
	Balance (%)	98.1	95.9	95.3	94.1	42.4											
	Steady CO (ppm)	1	1	0	0	1											
	Peak CO (ppm)	1	1	0	4	2											
	Steady H ₂ S (ppm)	0	0	0	0	0											
	Peak H ₂ S (ppm)	0	0	0	0	0											
	Steady PID (ppm)	-	-	-	-	-											
	Max PID (ppm)	-	-	-	-	-											
	Standing Water Level (mbgl)	Dry	3.79	1.69	2.15	2.26											
	Installation Base Depth (mbgl)	3.43	4.83	3.89	4.32	3.89											
	Response Zone/Strata	0	0	0	0	0											
	Comments																
Equipment						ABBREVIATIONS						NOTES					
Gas Machine	Gas Analyser GA5000					ND	Not detected		ppm	Parts per million		All monitoring is carried out in line with LK Consult Ltd procedures, with reference to CIRIA C665. ¹ Equipment is serviced and checked as recommended by the manufacturer. Refer to calibration records and service certificates. ² CH4 is explosive between the range of 5-15%v/v. 100% lower explosive limit is equal to 5%v/v CH4. ³ Flow readings are based on steady 1 minute value where flow is detected (equipment range of +/- 12 ltr/hr).					
	G502417					NR	Not recorded		mb	Millibars							
Dipmeter	HydroTechnik					UR	Unable to record		l/hr	Litres per hour							
	HT-04					OS	Off recordable scale		mbgl	Metres below ground level							
PID	-					N/A	Not applicable		LEL	Lower explosive limit in air							
	-																

Appendix F – References

¹ The British Standards Institution (BSI Standards), March 2018, "Geotechnical investigation and testing. Identification and classification of soil - Part 1: Identification and description", BS EN ISO 14688-1:2018.

² The British Standards Institution (BSI Standards), May 2020, "Code of practice for ground investigations", BS 5930:2015+A1:2020.

³ The British Standards Institution (BSI Standards), December 2017, "Investigation of potentially contaminated sites - Code of practice", BS 10175:2011+A2:2017.

⁴ CIRIA, December 2007, "Assessing risks posed by hazardous ground gases to buildings", C665.

⁵ Environment Agency, 2000, "Technical Aspects of Site Investigation", Technical Report P5-065/TR, Volumes I and II, Text Supplements.

⁶ CIRIA, December 2007, "Assessing risks posed by hazardous ground gases to buildings", C665.

⁷ The British Standards Institution (BSI Standards), May 2020, "Code of practice for ground investigations", BS 5930:2015+A1:2020.

⁸ The British Standards Institution (BSI Standards), May 2009, "Water quality. Sampling - Guidance on sampling of groundwaters", BS ISO 5667-11:2009.

⁹ The British Standards Institution (BSI Standards), December 2017, "Investigation of potentially contaminated sites - Code of practice", BS 10175:2011+A2:2017.

¹⁰ CIRIA, December 2007, "Assessing risks posed by hazardous ground gases to buildings", C665.

¹¹ CIRIA, December 2007, "Assessing risks posed by hazardous ground gases to buildings", C665.

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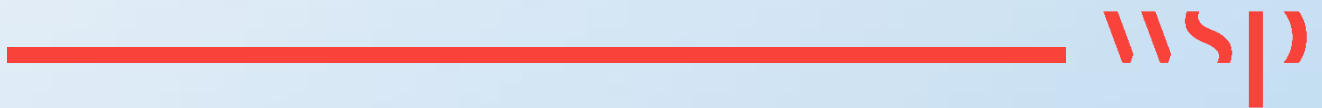
t: 0161 763 7200
e: info@thelkgroup.com



- » Geotechnical
- » Contaminated
- » SuDS & Flood Risk
- » Project Management
- » Land Remediation
- » Land Drilling
- » Japanese Knotweed
- » Air Tightness Testing

Appendix E

WSP APPROACH TO RISK ASSESSMENT & GAC



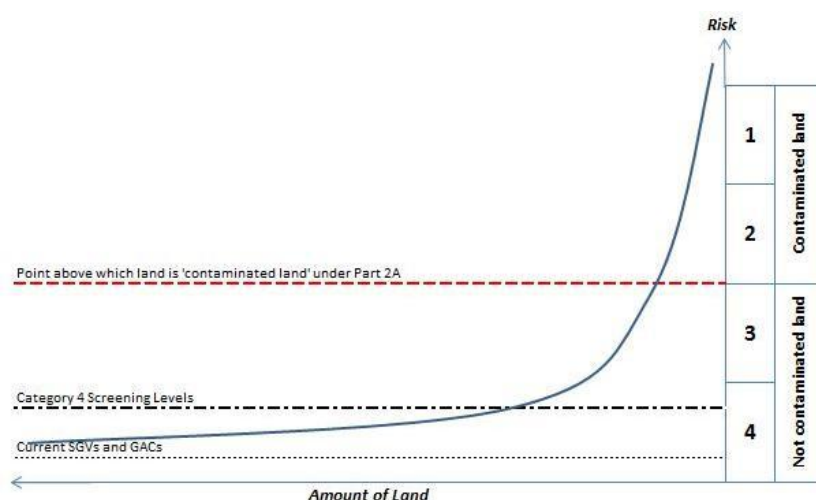
METHODOLOGY FOR THE DERIVATION OF GENERIC QUANTITATIVE ASSESSMENT CRITERIA TO EVALUATE RISKS TO HUMAN HEALTH FROM SOIL & GROUNDWATER CONTAMINATION

UK APPROACH

In the UK, the potential risks to human health from contamination in the ground are usually evaluated through a generic quantitative risk assessment (GQRA) approach. This allows generic and conservative exposure assumptions to be readily applied to risk assessments, and can be a useful tool for rapidly screening data and to identify those contaminants or scenarios that could benefit from further investigation and/or site-specific detailed quantitative risk assessment (DQRA). Current industry good practice is to use the approach presented in the Environment Agency (EA) publications SR2¹ and SR3². This approach allows the derivation of Generic Assessment Criteria (GACs), primarily for chronic exposure.

In April 2012, the Department of Environment, Food and Rural Affairs (Defra) published updated statutory guidance³ which introduced a four category approach to determining whether land in England and Wales is contaminated or not on the grounds of significant possibility of significant harm (SPOSH). **Figure 1** presents a graphical representation of the categories.

Figure 1: Four Categories for Determining if Land Represent a SPOSH



Cases classified as Category 1 are considered to be SPOSH based on actual evidence or an unacceptably high probability of harm existing. Category 4 cases are those where there is no risk, or a low risk of SPOSH.

¹ Environment Agency 'Human Health Toxicological Assessment of Contaminants in Soil', Report SC050021/SR2. January 2009.

² Environment Agency 'Updated Technical Background to the CLEA Model,' Report SC050021/SR3. January 2009.

³ Defra 'Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance'. April 2012.

GACs represent a minimal risk level, well within Category 4. A 2014 publication by Contaminated Land: Applications in Real Environments (CL:AIRE), SP1010⁴ and endorsed by Defra⁵ provided an approach to determine Category 4 Screening Levels (C4SLs) which are higher than the GACs whilst being “more pragmatic but still strongly precautionary”. It also provided C4SLs for six contaminants of concern. Although the C4SLs were designed to support Part 2A assessments to determine ‘contaminated land’ they are specifically mentioned, along with reference to the Part 2A statutory guidance, by the Department for Communities and Local Government (DCLG) for use in a planning context⁶.

An updated version the Contaminated Land Exposure Assessment (CLEA) Workbook (v1.071) was released by the EA in September 2015 to take into account the publication of SP1010. The updates comprised: additional toxicity data for the six chemicals for which C4SLs were derived; two new public open space land use scenarios; updated exposure parameters; options to run the model using C4SL exposure assumptions; and increased functionality. There were no changes to algorithms, so it is still possible to replicate the withdrawn SGVs using the input parameters held within v1.071.

It should be noted that the four category approach has not been adopted in Scotland under Part 2A or the planning regime. The Part 2A statutory guidance applicable in Scotland (Paper SE/2006/44 dated May 2006) does not reflect the changes introduced by Defra in April 2012 which allow for the use of C4SLs within Part 2A risk assessments. Additionally, it is considered that the principal of ‘minimal risk’ should still apply under planning in Scotland, based on current guidance.

WSP APPROACH

Following the withdrawal of the SGVs, and in the absence of an industry-wide, accepted set of GACs it is down to individual practitioners to derive their own soil assessment criteria. WSP has used the approach provided within SR2, SR3, SP1010, CLEA Workbook v1.071 and SR4⁷ to produce a set of minimal risk GACs. The chemical-specific data within two key publications were considered during their production: CL:AIRE 2010⁸ and LQM 2015⁹. Both documents provide comprehensive sets of GACs for different contaminants of concern.

The LQM Suitable For Use Levels (S4ULs) have selected exposure parameters consistent with the C4SL exposure scenarios. This approach was rejected by WSP as not representing minimal risk. However, the LQM S4UL document was critically reviewed and the approach and chemical input parameters were utilised where considered to be appropriate.

An industry-led C4SL Working Group is in the process of deriving a larger set of C4SLs in the near future, for approximately 20 contaminants. This will include a critical review of the chemical input data for all selected substances, and may therefore lead to further amendments to the chemical input data used in the WSP in-house screening values. It is considered likely that the contaminant list will

⁴ CL:AIRE ‘Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination’ SP1010, Final Project Report (Revision 2). September 2014.

⁵ Defra ‘SP1010: Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination – Policy Companion Document’. December 2014.

⁶ DCLG Planning Practice Guidance ‘Land Affected by Contamination’, particularly Paragraphs 001 and 007. Ref IDs: 33-001-20140306 & 33-007-20140612.

⁷ Environment Agency ‘CLEA Software (Version 1.05) Handbook (and Software)’, Report SC050021/SR4. September 2009.

⁸ CL:AIRE ‘The EIC/AGS/CL:AIRE Soil Generic Assessment Criteria for Human Health Risk Assessment’. ISBN 978-1-05046-20-1. January 2010.

⁹ Nathanail et al ‘The LQM/CIEH S4ULs for Human Health Risk Assessment’, Land Quality Press, ISBN 978-0-9931084-0-2. 2015.

crossover with the 2009 EIC/AGS/CL:AIRE GACs. As such, this document was not critically reviewed by WSP.

WSP's current approach to the assessment of risks to human health is to continue to evaluate minimal risk through the use of in-house derived GACs, and to use the published C4SLs as a secondary tier of assessment until such time as additional C4SLs are published and/or in-house values are derived.

EXPOSURE MODELS

LAND USES

WSP has largely adopted the exposure assumptions of the generic land use scenarios included within SR3, with two additional public open space scenarios included from within SP1010 and two bespoke exposure scenarios (highways):

- à Residential with homegrown produce consumption;
- à Residential without homegrown produce consumption;
- à Allotments;
- à Commercial;
- à Public open space near residential housing (POS_{resi});
- à Public park (POS_{park});
- à Highways (surface soils); and
- à Highways (subsurface soils).

Exceptions are described in the following Sections.

SOIL PROPERTIES

SR3 assumes a sandy loam soil with a pH of 7 and a Soil Organic Matter (SOM) content of 6% for its generic land uses, based on the geographical spread of topsoils in the UK. WSP has adopted these default values. In addition, GACs based on an SOM of 1% and 2.5% have been derived, based on common experience of the nature of Made Ground and lack of topsoil on many brownfield sites.

RECEPTOR CHARACTERISTICS AND BEHAVIOURS

SP1010 provides some updated exposure parameters for long-term inhalation rates¹⁰ and the consumption rates for homegrown produce¹¹ compared to those provided in SR3. This data was used to derived WSP's GACs.

The changes in inhalation rates do not apply to the allotment generic land use scenario, as these are based on the breathing rates for short-term exposure of light to moderate intensity activity which were derived from a study that was not updated in USEPA 2011, so the SR3 rates were retained.

¹⁰ USEPA, National Centre for Environmental Assessment 'Exposure Factors Handbook: 2011 Edition' EPA/600/R-09/052F. September 2011.

¹¹ National Diet and Nutrition Survey 2008/2009 to 2010/2011.

HIGHWAYS EXPOSURE SCENARIOS

Human health GAC for a Highways exposure scenario have been derived. The site area is defined by publicly accessible land adjacent to highways, comprising both hard and soft landscaped areas. Exposure is considered to be largely transitory.

There are no publicly available GAC for this exposure scenario. Consequently, WSP have derived GAC for the following exposure scenarios:

- à Highways (surface soils); and
- à Highways (sub-surface soils).

Surface soils GAC are for soil at ground level and within 300mm of the surface. Conversely, subsurface GAC are for soils at a depth exceeding 0.3m bgl. These GAC are not to be used as import criteria.

The critical receptor is a young female child, CLEA age classes 4-9. This is consistent with the critical receptor for the POS(resi) exposure scenario, and considered to be appropriate for a child potentially playing outside without direct adult supervision.

For all GAC, a sandy loam soil and a soil organic matter content of 1% is assumed. There is no building on site.

Exposure scenarios for surface and subsurface soils are detailed below. These are considered to be conservative estimates, due to the mostly transitory use of publically accessible lands adjacent to highways.

HIGHWAYS GAC (SURFACE SOILS)

The relevant exposure pathways include direct soil and dust ingestion, dermal contact (outdoors) and the inhalation of outdoor dust and vapour.

The exposure frequency is 170 days per annum, and the occupancy period outdoors is 1 hour per day (as per the POS (resi) exposure scenario). The soil and dust ingestion rate has been set at 50 mg/day, consistent with a POS(park) exposure scenario.

HIGHWAYS GAC (SUBSURFACE SOILS)

The single relevant exposure pathway is the inhalation of outdoor vapour. Direct exposure pathways are not viable due to the depth of the soils below ground level.

The exposure frequency is 170 days per annum, and the occupancy period outdoors is 1 hour per day (as per the POS (resi) exposure scenario). The soil and dust ingestion rate has been set to zero, as direct exposure pathways to soils at this depth are not viable.

CHEMICAL DATA

PHYSICO-CHEMICAL PARAMETERS

Physico-chemical properties for the contaminants for which GACs have been derived have been obtained following critical review of the following hierarchy of data sources:

1. Environment Agency/Defra SGV reports where available;
2. Environment Agency '*Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values*', Report SC050021/SR7, November 2008; and
3. Published fate and transport reviews within Nathanail et. al 2015 and CL:AIRE 2010.

Where appropriate, and where sufficient data is available, values were adjusted to reflect a UK soil temperature of 10°C (e.g. K_{aw}).

TOXICOLOGICAL DATA

Toxicological data for the derivation of minimal risk Health Criteria Values (HCV) for each contaminant was selected with due regard to the approach presented in SR2. Where appropriate, the following hierarchy of data sources was used:

1. UK toxicity reviews published by authoritative bodies including:
 - < EA;
 - < Public Health England (PHE);
 - < Committee on Toxicity of Chemicals in Food, Consumer Products and the Environment (COT); and
 - < Committee on Carcinogenicity of Chemicals in Food, Consumer Products and the Environment (COC).
2. Authoritative European sources such as European Food Standards Agency (EFSA)
3. International organisations including:
 - < World Health Organisation (WHO); and
 - < Joint FAO/WHO Expert Committee on Food Additives (JECFA).
4. Authoritative country-specific sources including:
 - < United States Environmental Protection Agency (USEPA);
 - < US Agency for Toxic Substances and Disease Registry (ATSDR);
 - < US Integrated Risk Information System (IRIS); and
 - < Netherlands National Institute for Public Health and the Environment (RIVM).

Factors such as the applicability of the data to human health (e.g. epidemiological vs. animal studies), the quality of the data, the level of uncertainty in the results and the age of the data were also taken into account in the final selection. Details for specific substances are available on request.

MEAN DAILY INTAKES

Estimations of background exposure for each threshold substance have been updated. In line with the SR2 approach, the exposure from non-threshold substances in the soil does not take into account exposure from other sources, and as such GACs were derived without consideration of the Mean Daily Intake (MDI) for those substances.

The data published by the EA in its series of TOX reports between 2002 and 2009 was evaluated to determine whether the values were considered to remain valid today. Values from these current UK published sources were not amended unless they were considered to be significantly different so that the GACs remained as comparable as possible with the revoked SGVs.

ORAL MEAN DAILY INTAKES

Oral MDI were generally estimated as the sum of exposure via the ingestion of food and drinking water using the default adult physiological parameters presented in Table 3.3 of SR2.

Data on the exposure of substances from food ingestion was generally obtained from UK Total Diet Studies (TDS) published by the Food Standards Agency (FSA) and its predecessor the Ministry of Agriculture, Fisheries and Food (MAFF) and from studies commissioned by COT. Where no UK-specific data was available, MDI were derived from the European Food Safety Authority (EFSA), Health Canada and US sources. This was a rare occurrence, and in these instances, the data was evaluated to determine its applicability to the UK.

Data on the concentrations of substances in tap water was obtained from a variety of sources. UK data was used where available, with preference given to Drinking Water Inspectorate (DWI) 2014 data from water company tap water testing (LOD, 1st and 99th percentile data is available). Where the substance was not included in tap water testing, other UK sources of information were considered including:

- à DWI data from water company tap water testing from previous years;
- à COT; and
- à FSA.

Where UK data was not available, a number of other data sources were considered, largely WHO International Programme on Chemical Safety (IPCS) Concise International Chemical Assessment Documents (CICADs) and background documents for the development of Guidelines for Drinking Water Quality, using professional judgement on the relevance of the data to the UK. The final decision on the MDI from drinking water was made using professional judgement on the balance of relevance and probability, taking into account the detection limit where not detected, Koc and solubility, reduction in use of the substance, banned substances, tight controls (e.g. on explosives) and with due consideration to the SR2 instruction that “if no data or information in background exposure are available, background exposure should be assumed to be negligible and the MDI set to zero....”.

Data from other countries was generally not used because it was considered that the hydrogeology of these countries along with industrial practices were unlikely to be reflective of the UK.

INHALATION MEAN DAILY INTAKES

Inhalation MDIs were based on estimates of average daily exposure by the inhalation pathway and calculated using the default adult physiological parameters presented in Table 3.3 of SR2.

The inhalation MDIs were generally estimated using background exposure data from the UK, derived from Defra's UK-AIR: Air Information Resource¹², which provides ambient air quality data from a number of sites forming a UK-wide monitoring network. The MDIs for heavy metals were based on rolling annual average metal mass concentration data from Defra's UK Heavy Metals Monitoring Network from the period October 2009 to September 2010¹³.

Information for some substances was obtained from UK sources including Environment Agency TOX reports and data from the UK Expert Panel on Air Quality Standards (EPAQS). Where recent UK data was not available, data was sourced from the International Programme on Chemical Safety (IPCS), the World Health Organisation (WHO), the Agency for Toxic Substances and Diseases Registry (ATSDR), Health Canada, and various other peer-reviewed sources summarised by LQM/CIEH¹⁴.

For other substances, where no data or information on background exposure was available, background exposure was assumed to be negligible and the MDI set at 0.5*TDI in accordance with guidance in SR2.

PLANT UPTAKE

Soil to plant concentration factors are available in CLEA v1.071 for arsenic, cadmium, hexavalent chromium, lead, mercury, nickel and selenium. For all remaining inorganic chemicals, concentration factors were obtained using the PRISM model. Substance-specific correction factors have been selected in accordance with the guidance established within SR3. This is consistent to the approach utilised in the derivation of the LQM S4UL and the EIC/AGS/CL:AIRE GAC.

Where there is a lack of appropriate data to enable the derivation of specific soil to plant concentrations factors for organic chemicals, plant uptake was modelled within CLEA v1.071 using the generic equations recommended within SR3, as follows:

- à Green Vegetables – Ryan et al. (1988);
- à Root Vegetables – Trapp (2002);
- à Tuber Vegetables – Trapp et al. (2007); and
- à Tree Fruit – Trapp et al. (2003).

There are no suitable models available for modelling uptake for herbaceous fruit or shrub fruit. Exposure is considered negligible.

¹² Crown 2016 copyright Defra via uk-air.defra.gov.uk, licenced under the Open Government Licence (OGL).

¹³ Defra, 2013 Spreadsheet of historic data for multiple years for the Metals network. Available online at: <http://uk-air.defra.gov.uk/data/metals-data>. [Accessed 13/03/2016].

¹⁴ LQM/CIEH, 2015. The LQM/CIEH S4ULs for Human Health Risk Assessment.

SOIL SATURATION LIMITS

GACs are not limited to their theoretical soil saturation within CLEA, although where either the aqueous or the vapour-based saturation is exceeded, this is highlighted within the Workbook (compared with the lower of the two values). This affects pathways which depend on partitioning calculations so in reality this only affects the vapour pathways and is relevant to organic substances and other substances, such as elemental mercury, that have a significant volatile component. However, the Workbook highlights saturation for direct contact pathways to indicate to the user where further qualitative consideration of free phase contamination at the surface may be required.

Where the lower of the two saturation limits is exceeded and the vapour pathway is the only exposure route being considered, the chronic risks to human health are likely to be negligible. Further evaluation could be undertaken using an alternative model suitable for evaluating non-aqueous phase liquids (NAPLs), such as the Johnson & Ettinger (J&E) approach described in USEPA 2003. However, WSP considers that if NAPLs are suspected, given the known limitations and over-simplifications of J&E, soil vapour monitoring is a more accurate way of assessing potential risks.

Where the lower saturation limit is exceeded for the vapour pathway and a number of exposure routes are being considered, then the contribution from the NAPL via vapour inhalation to the overall exposure can be evaluated using the procedure provided in SR4. WSP would evaluate this as part of a DQRA process or through soil vapour monitoring on-site to determine site-specific soil vapour concentrations.

CHEMICAL SPECIFIC ASSUMPTIONS

CYANIDES

Cyanide has high acute toxicity, and short term exposure is an important consideration when assessing the risks from soils contaminated with cyanide. The primary risk to human receptors from free cyanide in soils is an acute risk.

There is no current UK guidance available for calculating acute risks from free cyanide. Consequently, GAC for acute exposure were derived using the algorithms presented in MADEP 1992¹⁵ and assuming a one-off ingestion of 10g of soil (this conservative value has been taken as an upper bound estimate for a one-off soil ingestion rate amongst children). Receptor body weights have been selected according to the critical receptor for each exposure scenario. The lowest of the chronic and acute GAC for each land use scenario were adopted by WSP.

LEAD

The SGV for lead was withdrawn by the EA in 2009, and in 2011 the EA withdrew their published TOX report in light of new scientific evidence. The C4SL for lead was derived using the latest scientific evidence from a large human dataset. As such, no chemical-specific margin was applied in the derivation of the C4SL for lead. It may be possible for WSP to derive a GAC for lead using the same dataset and applying a chemical-specific margin, but the value is likely to be lower than UK natural background concentrations. Therefore, WSP has adopted the toxicological data used to derive the C4SLs in deriving the GAC for lead until such time as alternative GACs are published by an authoritative body. The relative bioavailability was set at 100% in line with the approach taken for other GACs, whereas the C4SL assumes 60% for soil and 64% for airborne dust. Thus, the WSP GAC are lower than the C4SLs.

¹⁵ MADEP 'Background Documentation for the Development of an "Available Cyanide" Benchmark Concentration' 1992. http://www.mass.gov/dep/toxics/cn_soil.htm

POLYCYCLIC AROMATIC HYDROCARBONS

WSP's approach to the assessment of polycyclic aromatic hydrocarbons (PAHs) uses the surrogate marker approach. BaP was used as a surrogate marker for all genotoxic PAHs in line with the Health Protection Agency 2010¹⁶ recommendations and SP1010. This assumes that the PAH profile of the data is similar to that of the coal tars used in the Culp *et al* oral carcinogenicity study from which the toxicity data for BaP was produced. In reality, this profile has been shown by HPA to be applicable on the majority of contaminated sites based on assessment of sites across the country.

The alternative is the Toxic Equivalency Factor (TEF) approach which uses a reference compound and assigns TEFs for other compounds based on estimates of potency. Key uncertainties with this approach include the assumption that all compounds have the same toxic mechanism of action within the body and that no compounds with a greater potency than the reference compound are present. It is considered by the HPA that the TEF approach is likely to under predict the true carcinogenicity of PAHs and therefore favours the surrogate marker approach.

For these reasons, WSP considers that the adoption of BaP as a surrogate marker for genotoxic PAHs, as opposed to the TEF approach, is reasonable. In rare cases where the PAH profile may differ from the wide definitions of the Culp *et al* study the user should discuss their project with an experienced risk assessor. In addition, WSP has derived a GAC for naphthalene, which is commonly a risk driver due to its high volatility, relative to other PAH compounds.

TRIMETHYLBENZENES

The GAC for trimethylbenzenes can be used for the assessment of any individual isomer (1,2,3-trimethylbenzene, 1,2,4-trimethylbenzene or 1,3,5-trimethylbenzene), or a mixture of the three isomers.

CHEMICAL GROUPS

For a number of chemical groups, the available toxicity data is for combinations of chemicals. Given that the physico-chemical parameters may differ between the chemicals, the GACs for the chemicals within the groups have been calculated and then the lowest GAC selected to represent the entire group. This was the approach taken by the EA for m-, o- and p-xylenes, and has also been adopted by WSP for:

- à 2-chlorophenol, 2,4-dichlorophenol, 2,4,6-trichlorophenol and 2,3,4,6-tetrachlorophenol;
- à 2-, 3- and 4-methylphenol (total cresols);
- à aldrin and dieldrin; and
- à α - and β -endosulphan.

¹⁶ HPA Contaminated Land Information Sheet 'Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs) 2010

EXPOSURE TO VAPOURS

INHALATION OF MEASURED VAPOURS

WSP has derived a set of soil vapour GACs (GAC_{sv}) that allow for the assessment of measured site soil vapour concentrations, using J&E, in order to establish potential risks via indoor inhalation of vapours. This methodology enables a more robust assessment of exposure via the inhalation of soil vapours indoors than using CLEA-derived soil GAC, as it is based upon measured soil vapour concentrations beneath the site. It also allows for the assessment of vapours from all source terms (i.e. groundwater, soil or NAPL). Outdoor inhalation was not included. WSP considers that the indoor inhalation pathway is the significantly dominant risk-driver.

The generic land use scenarios within CLEA (residential and commercial) that were used to derive the soil GAC were used to define the receptor and building characteristics for the soil vapour GAC. Only residential and commercial generic land use scenarios include the indoor inhalation of vapours pathway.

The GAC_{sv} were derived for three different soil types; sand, sandy loam and clay, reflecting the importance of this parameter within the J&E model. A depth to contamination of 0.85 m below the base of the building foundation was assumed (i.e. 1 m below ground level). This differs from the depth assumed for the soil GAC (0.5 m bgl), but was selected by WSP as a reasonable worst case scenario.

It is acknowledged that the J&E commonly over-predicts indoor vapour concentrations. In particular, it will significantly over-predict vapour concentrations for suspended floor slabs, which many new builds are constructed with, it does not take into account lateral migration and assumes an infinite source of contamination at steady state conditions. In addition, it is common for soil gas/vapour wells to be installed with at least 1 m of plain riser at the surface and this equates to a total depth of 0.85 m below the building foundation plus a 0.15 m thick foundation, and so is more representative of the depth that samples will be taken from.

The TDSIs and IDs for each substance were converted from $\mu g kg^{-1} bw day^{-1}$ to $\mu g m^{-3}$ using the standard conversions quoted in Table 3.3 of SR2, thereby replacing the need to model C_{air} in the equation:

$$C_{air} = \alpha \cdot C_{vap} \cdot 1,000,000 cm^3 m^{-3}$$

Where:

C_{air} is the concentration of vapours within the building, $mg m^{-3}$

α is the steady state attenuation coefficient between soil and indoor air, dimensionless

C_{vap} is the soil vapour concentration, $mg cm^{-3}$

The target concentrations within indoor air for each substance (C_{air}) are a function of receptor inhalation rates and occupancy periods, as defined by the site conceptual exposure model (assuming standard CLEA occupancy periods and receptors).

The attenuation factor was calculated using J&E (Equation 10.4 in SR3) and the resulting C_{vap} is equivalent to the GAC_{sv} for the modelled exposure scenario.

Where reported soil vapour concentrations exceed the relevant saturated vapour concentration, free product may occur, and the user should discuss their project with an experienced risk assessor.

INHALATION OF GROUNDWATER-DERIVED VAPOURS

WSP has derived a set of groundwater GACs (GAC_{gw}) to evaluate the potential risks through the indoor inhalation of groundwater-derived vapours by first applying the approach described above for the derivation of the WSP GAC_{sv} to determine the acceptable concentration in soil vapour directly above the water table.

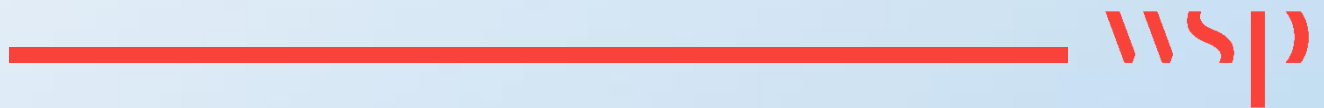
The depth to groundwater was assumed to be 1 m bgl (i.e. 0.85 m below the base of the building foundation). This depth was considered to be more representative of commonly encountered groundwater conditions than the 0.5 m below the base of the building foundation (i.e. 0.65 m bgl) that is used by CLEA for an unsaturated source present in the overlying soil.

The GAC_{gw} was then back-calculated from the GAC_{sv} using the air-water partition coefficient (K_{aw}) for each substance.

The WSP Groundwater Vapour GAC are protective against a dissolved phase contaminant source only. If the presence of NAPL is suspected, the risks from this source will need to be assessed. Where reported groundwater concentrations exceed the relevant solubility limit, free product may occur, and the user should discuss their project with an experienced risk assessor.

Appendix F

SOIL AND GROUNDWATER SCREENING RESULTS



70114074 Heywood Substation

Mar-24

Soil Results and Generic Quantitative Risk Assessment

Key

0.00	Concentrations exceed Human Health GAC
<0.00	Concentrations are below the laboratory LOD

Soil Analysis Certificate

DETS Report No: 23-14742	Date Sampled	WSP Human Health Commercial GAC 2.5%	27/11/23	27/11/23	27/11/23	29/11/23	29/11/23	29/11/23	27/11/23	27/11/23	27/11/23	28/11/23	28/11/23	28/11/23	28/11/23
LK Consult Limited			TP01	TP02	TP03	WS01	WS01	WS04	TP04	TP05	TP05	WS02	WS03	WS05	WS05
Site Reference: QEII Way, Heywood	TP / BH No		0.50	1.00	0.00	0.50	1.00	0.50	0.00	0.50	1.00	0.50	0.50	1.00	2.00
Order No: LKC231637-KR	Depth (m)		Mounded MG	Mounded MG	Mounded MG	Mounded MG	Mounded MG	Mounded MG	Mounded MG	Original MG	Natural	Original MG	Original MG	Original MG	Natural
	Soil Type														

Determinand	Unit	LOD	Accreditation													
Asbestos Screen ^(S)	N/a	N/a	ISO17025		Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected	Not Detected
pH	pH Units	N/a	MCERTS		7.3	7.2	7.4	7.2	7.8	7.6	7.4	7	5.1	7.3	7.3	6.9
Total Cyanide	mg/kg	< 1	NONE		1	1	1		1	1	1	1		1	1	
Free Cyanide	mg/kg	< 1	NONE		1	1	1		1	1	1	1		1	1	
W/S Sulphate as SO ₄ (2:1)	mg/l	< 10	MCERTS		73	76	31	35	52	46	15	11	28	122	105	53
W/S Sulphate as SO ₄ (2:1)	g/l	< 0.01	MCERTS		0.07	0.08	0.03	0.03	0.05	0.05	0.02	0.01	0.03	0.12	0.11	0.05
Organic Matter (SOM)	%	< 0.1	MCERTS		1.5	3.5	4.7	6.7	5	4.4	12	9.3	2.4	6	9.1	4.8
Arsenic (As)	mg/kg	< 2	MCERTS	635	5	9	11	13	12	30	14	13	7	12	14	6
W/S Boron	mg/kg	< 1	NONE	207000	1	1	1		1	1	1	1		1	1	
Cadmium (Cd)	mg/kg	< 0.2	MCERTS	223	0.2	0.2	0.2	0.2	0.4	0.3	0.3	0.2	0.2	0.3	0.3	0.4
Chromium (Cr)	mg/kg	< 2	MCERTS	9550	7	12	25	14	14	20	14	13	18	13	16	10
Chromium (hexavalent)	mg/kg	< 2	NONE	24	2	2	2	2	2	2	2	2	2	2	2	2
Copper (Cu)	mg/kg	< 4	MCERTS	69800	12	120	29	30	40	71	44	41	21	84	49	31
Lead (Pb)	mg/kg	< 3	MCERTS	1390	9	120	58	55	95	173	73	62	14	82	78	48
Mercury (Hg)	mg/kg	< 1	MCERTS	1110	1	1	1	1	1	1	1	1	1	1	1	1
Nickel (Ni)	mg/kg	< 3	MCERTS	1710	9	13	10	9	13	15	12	11	17	11	13	12
Selenium (Se)	mg/kg	< 2	MCERTS	12300	2	2	2	2	2	2	2	2	2	2	2	2
Vanadium (V)	mg/kg	< 1	MCERTS		10	17	19	22	19	21	24	25	24	19	27	13
Zinc (Zn)	mg/kg	< 3	MCERTS	1050000	19	130	50	52	92	110	89	68	41	105	94	129
Total Phenols (monohydric)	mg/kg	< 2	NONE		2	2	2		2	2	2	2		2	2	
Naphthalene	mg/kg	< 0.1	MCERTS	193	0.1	0.1	0.14	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Acenaphthylene	mg/kg	< 0.1	MCERTS		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Acenaphthene	mg/kg	< 0.1	MCERTS		0.1	0.16	0.18	0.1	0.21	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Fluorene	mg/kg	< 0.1	MCERTS		0.1	0.12	0.1	0.1	0.14	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Phenanthrene	mg/kg	< 0.1	MCERTS		0.1	0.81	1.2	0.42	1.3	0.25	0.1	0.1	0.1	0.18	0.1	0.39
Anthracene	mg/kg	< 0.1	MCERTS		0.1	0.17	0.22	0.1	0.25	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Fluoranthene	mg/kg	< 0.1	MCERTS		0.29	1.06	1.44	0.85	1.63	0.35	0.1	0.1	0.1	0.31	0.1	1.09
Pyrene	mg/kg	< 0.1	MCERTS		0.26	1.06	1.4	0.79	1.62	0.35	0.1	0.1	0.1	0.33	0.1	0.99
Benzo(a)anthracene	mg/kg	< 0.1	MCERTS		0.15	0.48	0.59	0.42	0.7	0.18	0.1	0.1	0.1	0.15	0.1	0.47
Chrysene	mg/kg	< 0.1	MCERTS		0.15	0.55	0.71	0.48	0.73	0.21	0.1	0.1	0.1	0.18	0.1	0.52
Benzo(b)fluoranthene	mg/kg	< 0.1	MCERTS		0.16	0.53	0.75	0.56	0.75	0.23	0.1	0.1	0.1	0.17	0.1	0.61
Benzo(k)fluoranthene	mg/kg	< 0.1	MCERTS		0.1	0.22	0.21	0.17	0.2	0.1	0.1	0.1	0.1	0.1	0.1	0.19
Benzo(a)pyrene	mg/kg	< 0.1	MCERTS	38	0.15	0.51	0.72	0.5	0.62	0.19	0.1	0.1	0.1	0.15	0.1	0.56
Indeno(1,2,3-cd)pyrene	mg/kg	< 0.1	MCERTS		0.1	0.25	0.39	0.27	0.3	0.1	0.1	0.1	0.1	0.1	0.1	0.32
Dibenz(a,h)anthracene	mg/kg	< 0.1	MCERTS		0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1	0.1
Benzo(ghi)perylene	mg/kg	< 0.1	MCERTS		0.1	0.23	0.37	0.23	0.28	0.1	0.1	0.1	0.1	0.1	0.1	0.27
Total EPA-16 PAHs	mg/kg	< 1.6	MCERTS		1.60	6.2	8.3	4.7	8.7	1.8	1.60	1.60	1.60	1.60	1.60	5.4
Aliphatic >C5 - C6 : HS -1D MS AL	mg/kg	< 0.01	NONE	3190	0.01	0.01	0.01	-	0.01	0.01	0.01	0.01	-	-	0.01	-

Aliphatic >C6 - C8 : HS_1D_MS_AL	mg/kg	< 0.05	NONE	7780	0.05	0.05	0.05	-	0.05	0.05	0.05	0.05	-	-	0.05	0.05	-
Aliphatic >C8 - C10 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	2000	2	2	2	-	2	2	2	2	-	-	2	2	-
Aliphatic >C10 - C12 : EH_CU_1D_AL	mg/kg	< 2	MCERTS	9690	2	2	2	-	3	2	2	4	-	-	2	2	-
Aliphatic >C12 - C16 : EH_CU_1D_AL	mg/kg	< 3	MCERTS	58800	3	3	3	-	3	3	3	4	-	-	3	3	-
Aliphatic >C16 - C21 : EH_CU_1D_AL	mg/kg	< 3	MCERTS		3	3	3	-	3	3	3	3	-	-	3	3	-
Aliphatic >C21 - C34 : EH_CU_1D_AL	mg/kg	< 10	MCERTS		10	10	10	-	10	10	10	10	-	-	10	20	-
Aliphatic >C34 - C44	mg/kg	< 10	NONE		10	10	10	-	10	10	10	10	-	-	10	10	-
Aliphatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AL	mg/kg	< 21	NONE		21	21	21	-	21	21	21	21	-	-	21	21	-
Aromatic >C5 - C7 : HS_1D_MS_AR	mg/kg	< 0.01	NONE		0.01	0.01	0.01	-	0.01	0.01	0.01	0.01	-	-	0.01	0.01	-
Aromatic >C7 - C8 : HS_1D_MS_AR	mg/kg	< 0.05	NONE	56,100	0.05	0.05	0.05	-	0.05	0.05	0.05	0.05	-	-	0.05	0.05	-
Aromatic >C8 - C10 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	3,460	2	2	2	-	2	2	2	2	-	-	2	2	-
Aromatic >C10 - C12 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	16,200	2	2	3	-	2	2	2	5	-	-	2	2	-
Aromatic >C12 - C16 : EH_CU_1D_AR	mg/kg	< 2	MCERTS	36,200	2	2	3	-	2	2	2	2	-	-	2	2	-
Aromatic >C16 - C21 : EH_CU_1D_AR	mg/kg	< 3	MCERTS	28,200	3	3	8	-	8	3	3	3	-	-	3	8	-
Aromatic >C21 - C35 : EH_CU_1D_AR	mg/kg	< 10	MCERTS		10	10	10	-	12	10	10	10	-	-	10	30	-
Aromatic >C35 - C44	mg/kg	< 10	NONE		10	10	10	-	10	10	10	10	-	-	10	10	-
Aromatic (C5 - C44) : HS_1D_MS+EH_CU_1D_AR	mg/kg	< 21	NONE		21	21	21	-	24	21	21	21	-	-	21	40	-
Total >C5 - C44 : HS_1D_MS+EH_CU_1D_Total	mg/kg	< 42	NONE		42	42	42	-	42	42	42	42	-	-	42	60	-
Benzene : HS_1D_MS	ug/kg	< 2	MCERTS	27	2	2	2	-	2	2	2	2	-	-	2	2	-
Toluene : HS_1D_MS	ug/kg	< 5	MCERTS	56300	5	5	5	-	5	5	5	5	-	-	5	5	-
Ethylbenzene : HS_1D_MS	ug/kg	< 2	MCERTS	7480	2	2	2	-	2	2	2	2	-	-	2	2	-
p & m-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	5920	2	2	2	-	2	2	2	2	-	-	2	2	-
o-xylene : HS_1D_MS	ug/kg	< 2	MCERTS	5920	2	2	2	-	2	2	2	2	-	-	2	2	-
MTBE : HS_1D_MS	ug/kg	< 5	MCERTS	7480	5	5	5	-	5	5	5	5	-	-	5	5	-

70114074 South Heywood Substation
Groundwater Data - January and February 2024

Key

0.00	Concentrations exceed Drinking Water Standards (protective of groundwater quality)
0.00	Concentrations exceed Environmental Quality Standards (protective of surface water quality)
0.00	Concentrations exceed both DWS and EQS
<0.00	Concentrations are below the laboratory LOD

Water Analysis Certificate											
DETS Report No: 24-00749			Date Sampled								
Site Reference: QE11 Way, Heywood			TP / BH No								
Reporting Date: 31/01/2024			DETS Sample No								
Determinand	Unit	RL	Accreditat	Water Quality Standards		26/01/2024	26/01/2024	26/01/2024	15/02/2024		
				DWS	EQS	WS05	WS03	WS02	WS02(2)		
						695835	695836	695837	699693		
pH	pH Units	N/a	ISO17025	5.5 - 10	6 - 9	8.4	8.3	7	6.7		
Sulphate as SO ₄	mg/l	< 1	ISO17025	250		40	41	6	6		
Ammoniacal Nitrogen as N	ug/l	< 50	ISO17025	389	200	666	346	19900	12000		
Arsenic (dissolved)	ug/l	< 0.2	ISO17025	10	50	1.8	0.4	3.4	5		
Barium (dissolved)	ug/l	< 0.2	ISO17025			329	180	696	827		
Beryllium (dissolved)	ug/l	< 0.2	ISO17025			0.2	0.2	0.2	0.2		
Boron (dissolved)	ug/l	< 1	ISO17025			97	63	104	525		
Cadmium (dissolved)	ug/l	< 0.2	ISO17025	5	0.08	0.2	0.2	0.2	0.2		
Chromium (dissolved)	ug/l	< 0.2	ISO17025	50	4.7	0.2	0.2	0.2	0.8		
Copper (dissolved)	ug/l	< 0.2	ISO17025	2000	1	1.9	3.9	1.2	2.9		
Lead (dissolved)	ug/l	< 0.2	ISO17025	10	1.2	0.2	0.2	0.2	0.2		
Mercury (dissolved)	ug/l	< 0.04	ISO17025	1	0.07	0.04	0.04	0.04	0.04		
Nickel (dissolved)	ug/l	< 0.2	ISO17025	20	4	11.3	3.9	3.5	6.3		
Selenium (dissolved)	ug/l	< 0.2	ISO17025	10		0.4	0.2	0.2	0.2		
Vanadium (dissolved)	ug/l	< 0.2	ISO17025			0.2	0.2	0.2	0.9		
Zinc (dissolved)	ug/l	< 1	ISO17025		10.9	24	4	74	53		
Naphthalene	ug/l	< 0.01	NONE		2	0.01	0.01	0.01	0.01		
Acenaphthylene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Acenaphthene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Fluorene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Phenanthrene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Anthracene	ug/l	< 0.01	NONE		0.1	0.01	0.01	0.01	0.01		
Fluoranthene	ug/l	< 0.01	NONE		0.006	0.01	0.01	0.01	0.01		
Pyrene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Benzo(a)anthracene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Chrysene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Benzo(b)fluoranthene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Benzo(k)fluoranthene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Benzo(a)pyrene	ug/l	< 0.01	NONE	0.01	0.0002	0.01	0.01	0.01	0.01		
Indeno(1,2,3-cd)pyrene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Dibenz(a,h)anthracene	ug/l	< 0.01	NONE			0.01	0.01	0.01	0.01		
Benzo(ghi)perylene	ug/l	< 0.008	NONE			0.008	0.008	0.008	0.008		
Total EPA-16 PAHs	ug/l	< 0.16	NONE			0.16	0.16	0.16	0.16		
Aliphatic >C5 - C6 : HS_1D_MS_AL	ug/l	< 10	NONE	15,000		10	10	10	10		
Aliphatic >C6 - C8 : HS_1D_MS_AL	ug/l	< 10	NONE	15,000		10	10	10	10		
Aliphatic >C8 - C10 : EH_CU_1D_AL	ug/l	< 10	NONE	300		10	10	10	10		
Aliphatic >C10 - C12 : EH_CU_1D_AL	ug/l	< 10	NONE	300		10	10	10	10		
Aliphatic >C12 - C16 : EH_CU_1D_AL	ug/l	< 10	NONE	300		10	10	10	10		
Aliphatic >C16 - C21 : EH_CU_1D_AL	ug/l	< 10	NONE			10	10	10	10		
Aliphatic >C21 - C34 : EH_CU_1D_AL	ug/l	< 10	NONE			10	10	10	10		
Aliphatic (C5 - C34) : HS_1D_MS+EH_CU_1D_AL	ug/l	< 70	NONE			70	70	70	70		
Aromatic >C5 - C7 : HS_1D_MS_AR	ug/l	< 10	NONE		10	10	10	10	10		
Aromatic >C7 - C8 : HS_1D_MS_AR	ug/l	< 10	NONE		74	10	10	10	10		
Aromatic >C8 - C10 : EH_CU_1D_AR	ug/l	< 10	NONE	300	20	10	10	10	10		
Aromatic >C10 - C12 : EH_CU_1D_AR	ug/l	< 10	NONE	90	2	10	10	10	10		
Aromatic >C12 - C16 : EH_CU_1D_AR	ug/l	< 10	NONE	90	2	10	10	10	10		
Aromatic >C16 - C21 : EH_CU_1D_AR	ug/l	< 10	NONE	90	0.1	10	10	10	10		
Aromatic >C21 - C35 : EH_CU_1D_AR	ug/l	< 10	NONE	90	0.0002	10	10	10	10		
Aromatic (C5 - C35) : HS_1D_MS+EH_CU_1D_AR	ug/l	< 70	NONE			70	70	70	70		
Total >C5 - C35 : HS_1D_MS+EH_CU_1D_Total	ug/l	< 140	NONE			140	140	140	140		
Benzene : HS_1D_MS	ug/l	< 1	ISO17025	1	10	1	1	1	1		
Toluene : HS_1D_MS	ug/l	< 5	ISO17025	700	74	5	5	5	5		
Ethylbenzene : HS_1D_MS	ug/l	< 5	ISO17025	300	20	5	5	5	5		
p & m-xylene : HS_1D_MS	ug/l	< 10	ISO17025			10	10	10	10		
o-xylene : HS_1D_MS	ug/l	< 5	ISO17025	500	30	5	5	5	5		
MTBE : HS_1D_MS	ug/l	< 10	ISO17025	15		10	10	10	10		



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