SOIL RESOURCE SURVEY

FOR

LAND AT EASTERN AVENUE

PENTWYN

CARDIFF

ON BEHALF OF

CURTIS HALL LTD

ARP GEOTECHNICAL LTD

CHARTERED CONSULTING ENGINEERS

Northwest House 5/6 Northwest Business Park Servia Hill Leeds LS6 2QH

0113 245 8498 leeds@arpgeotechnical.co.uk www.arpgeotechnical.co.uk

CLIENT: CURTIS HALL LTD

JOB NUMBER: CTS/01

PROJECT: LAND AT EASTERN AVENUE, CARDIFF

REPORT TYPE: SOIL RESOURCE SURVEY

REPORT REFERENCE: CTS/01r1a V6

	Name	**Signature**
Prepared By:	J Davey BSc PhD RPGeo	
Authorised By:	J Race BSc CGeol FGS EurGeol	

ISSUE	**DATE**	**STATUS**
1	28TH July 2022	FINAL
1a	02nd November 2022	FINAL (minor red line boundary plan revision only)
2	13th February 2023	FINAL
3	18th May 2023	FINAL (minor layout revisions – plan P14)
4	01st August 2023	FINAL (minor layout revisions – plan P15)
5	14th December 2023	FINAL (minor layout revisions – plan P19)
6	2nd December 2025	FINAL (minor layout revisions)

1.0 INTRODUCTION

1.1 This document has been prepared to provide information for the Client and other interested parties, such as the Regulatory Authorities, outlining the soil quality on the site, and the protection measures to be applied to the soils for the proposed development at, Eastern Avenue, Pentywn, Cardiff. The document should be agreed, prior to implementation, with the relevant Regulatory Authorities, typically the local Planning Authority and Natural Resources Wales.

1.2 The proposed development will comprise a mix of retail and light industrial type units, with associated service yards, parking, and road infrastructure. It is noted that the proposed development has minimal extension on the footprint of the current development.

1.3 This report has been compiled in accordance with the Cardiff Green Infrastructure SPG: Soils and Development Technical Guidance Note (2017) and the DEFRA Construction Code of Practice for the Sustainable Use of Soils on Construction Sites (2009).

1.4 This report has been compiled by a PhD qualified geologist and reviewed by a Geological Society of London Chartered Geologist. Both of these scientists have extensive experience in UK soil science.

1.5 Considered in this assessment are the details from the following reports and documents:

- Geo-environmental Investigation and Assessment Pentwyn, Cardiff; Bradbrook Consulting, June 2021 (REF: 21-009)
- Curtis Hall, Cardiff Park & Ride East, Indicative Landscape Strategy Plan; Barry Chinn Associates, April 2022 (REF: 2190-21-01)
- Topsoil ground investigation 2022.

2.0 THE SITE

2.1 The site, which is centred on Ordnance Survey National Grid Reference ST 213809, is located to the east of the A48 (Eastern Avenue), approximately 7km to the northeast of Cardiff city centre.

2.2 The site is approximately 14Ha, a rough oblate shape. At the time of the 2021 investigation the site comprised of the following:

- A Park and Ride facility in the south, comprising asphalt surfacing. A waste management system is located in the north of this area.
- Parkland in the north, including open grass area with footways and mature trees.
- Mature trees along the western boundary.
- Overhead power cables run parallel to the boundary over the west of the site.

2.3 The site is located within a residential area, with residential dwellings in the distant surrounds. Immediately to the northeast and southeast of the site is parkland comprising mature trees, grassland and shrubs. A petrol station and some retail units are located approximately 70m west of the site. The Rhymney River runs close to the eastern site boundary and the A48 (Eastern Avenue) runs along the western site boundary.

2.4 Ordnance Survey maps show the site to comprise agricultural fields with associated farm buildings until 1984, when the farm buildings are no longer shown. In 2009, construction started on the Park and Ride facility that currently occupies the site. There is no evidence of further site development since 2011.

2.5 The 1:50,000 BGS geological map shows the site to be underlain by superficial deposits of alluvium, listed as clay, silt, sand, and gravel, glaciofluvial sheet deposits, listed as sands and gravels, and artificial ground in the southeastern and southwestern corners of the site. The underlying bedrock comprises mudstones, siltstones and sandstones of the Raglan Mudstone Formation.

Hydrology & Hydrogeology

2.6 The Natural Resources Wales groundwater vulnerability map and aquifer database classifies the superficial deposits beneath the site as a Secondary Aquifer-Undifferentiated. This is defined as: *"In most cases, this means that the layer in question has previously been designated as both minor and non-aquifer in different locations due to the variable characteristics of the rock type."*

2.7 The Natural Resources Wales groundwater vulnerability map and aquifer database classifies the bedrock beneath the site as a 'Secondary B' Aquifer. 'Secondary B' Aquifers are defined as: *"Predominantly lower permeability layers which may store and yield limited amounts of groundwater due to localised features such as fissures, thin permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers."*

2.8 The Groundwater Vulnerability map of the area indicates the combined aquifer to have a medium vulnerability. The pollutant speed is intermediate, with well-connected fractures.

2.9 The site is not located within a groundwater source protection zone (SPZ) and there are no known groundwater abstractions within 1 km of site boundaries.

2.10 The nearest surface watercourse is the Rhymney River, which is located approximately 100m south and between about 5m and 50m east of the site. The river geomorphology around the site is classed as being in the lower reaches, typically being a lowland and meandering body.

Environmental Data

2.11 Two historical landfills are located within 500m of the site boundary. The closest landfill is 67m to the northeast. Disposed waste has included inert commercial and household waste with input records up to closure in 1966. The second historical landfill is located 478m to the southeast of the site. Disposed waste is listed as inert commercial and household waste, with input records up to closure in 1986.

2.12 Two licenced waste transfer sites are registered within 250m of the site boundary, at 203m and 280m north of the site, both at Caxton Place. Both are licenced for clinical waste transfer.

Ground Conditions

2.13 Exploratory holes were situated in various parts of the site based off access and distribution. It is noted a full investigation on a typical commercial standard grid has not been undertaken. BH01, BH02, BH03, BH07 were located in vegetated areas. BH04, BH05 were located within the asphalt-surfaced car park (BH04, BH05), and, BH06 was located within a gravel-surfaced yard.

2.14 Made ground was confined to the boreholes in the car park and gravelled surfaces and comprised black sandy GRAVEL, with gravel of asphalt and limestone or brown sandy GRAVEL with mixed lithology. The made ground was typically immediately below the surface covering, with depths ranging from 0.9m to 1.5m.

2.15 Alluvium was encountered in all exploratory holes, either directly beneath the surface or beneath the made ground. Alluvium was encountered to depths of between 0.9m and 4.5m. The Alluvium was highly variable, comprising clays, sands and gravels in varying proportions.

2.16 Underlying the alluvium was a glaciofluvial deposit to depths between 4.5m and 8.0m. The Glaciofluvial deposits were typically brown or reddish brown sandy or cobbly gravel. The gravel was of mixed lithology.

2.17 Bedrock was encountered as stiff sandy slightly gravelly CLAY was observed at BH01, BH05, and BH07, and as a highly weathered red mudstone in other locations. The bedrock proved to be of variable lithology, often recovered as gravels of sandstone, mudstone and possible siltstone.

2.18 A summary of the strata thickness and depth ranges was present in the Barry Chinn report. It has been copied here for reference:

Stratum	Thickness range (m)	Depth range to top of lithology (m bgl)	Depth range to base of lithology (m bgl)
Asphalt or gravel	0.17-0.2 (Average 0.19)	From Surface	0.17-0.2
Made Ground	0.7 – 1.33 (Average 0.94)	0.17 - 0.2	0.9 – 1.5
Alluvium	0.4 – 4.5 Average 1.56	Surface to 4.5	0.9 – 4.5
Glaciofluvial deposits	0.4 – 6.0 Average 3.94	1.2 – 4.5	4.5 – 8.0
Raglan Mudstone Formation	Greater than 13.5 (BH07)	4.5 – 8.0	>20.0 (BH07)

Contamination

2.19 Potential contamination was assessed using a Tier 1 screening value suitable for commercial end use and considered with respect to environmental suitability for human health. The 2021 Ground Investigation Report contamination findings are summarised here:

- Eight soil samples were screened for the presence of asbestos containing materials. No asbestos was detected.
- Ten soil samples and seven groundwater samples were tested for a full suite of metals, PAH, TPH. All but one sample recorded below the selected generic assessment criteria (commercial criteria). BH5, at 0.5m depth, had two exceedances of PAH, specifically Benzo[a]pyrene (110mg/kg compared to a tolerance of 76mg/kg), and Dibenz[ah]anthracene (23mg/kg compared to a tolerance of 14mg/kg), were encountered.
- There were no elevations of phytotoxic contaminants.

It was determined the likely source of the contamination was an asphalt cluster in the sample.

2.20 Organic matter was tested as TOC by ignition. There were no reports of any fragments in the strata, such as coal, that could have caused skewing of this, as such it is all assumed to be vegetation and biota matter. The highest recorded value in the alluvium is 3.2%. Topsoil was not logged on site, therefore no assessment of TOC in topsoil can be made. There are no values recorded in the alluvium for TOC that would indicate that a topsoil unit has been tested.

2.21 The 2021 Ground Investigation monitored for potentially hazardous ground gas concentrations over a period of two months in four visits. Monitoring was conducted in BH1-BH7 over a period of variable atmospheric pressures. Test results show a maximum methane concentration of <0.1% and a maximum carbon dioxide concentration of 3.9%. A maximum gas flow rate of <0.1l/hr was recorded. In accordance with CIRIA Report C665 the GSV corresponds to Characteristic Situation 1.

Ground Mechanics

2.22 There were no water strikes during borehole drilling. However, groundwater was monitored over four visits; the shallowest recorded depth was 1.37mbgl in BH2.

2.23 Geotechnical testing was undertaken in some samples; however, due to the variable lithologies on site, the test results are not applicable site wide but do provide some indication of soil behaviours. Moisture contents ranged from 19%-37% in the Alluvium and 14%-22% in the glaciofluvial strata. PSDs were only carried out in the glaciofluivial sediments and the residual mudstone. The fines fraction was shown to be between 1%-28% in the glaciofluvial sediments and up to 78% in the residual sediments. There was no fines fraction separating in the PSDs. Casagrande plots show that BH1, BH2 and BH3 plot below the A line indicating that they are principally behaving like a silt.

2.24 Plasticity index testing varies, likely due to the silt content of the soils.

3.0 SOIL RESOURCE

3.1 In accordance with the DEFRA Code of Practice (2009), soils suitable for reuse on site are considered herein. Factors that are considered include but are not limited to:

- Mechanical suitability: Soils structurally competent and capable of use on site geotechnically.
- Agricultural suitability: Soils capable of sustaining flora and fauna, habitats and microbial habitats.
- Chemical suitability: Geochemical testing showing that the soil is environmentally suitable with respect to human health and with respect to agricultural health.
- Hydrological suitability: Soils capable of allowing percolation and capable of maintaining a balance of water suitable to the environmental conditions. Soils that will not react adversely to precipitation.

3.2 Topsoil was not logged in the initial site investigation due to the methods of drilling used. Photographs from this drilling show vegetation, as such it is assumed that topsoil was present. However, since the initial investigation, a topsoil mini investigation was undertaken.

3.2.1 The area investigated for topsoil was in the most vulnerable area on site near the river. The approximate locations of the topsoil assessment trial pits is shown on the drawing adjacent.

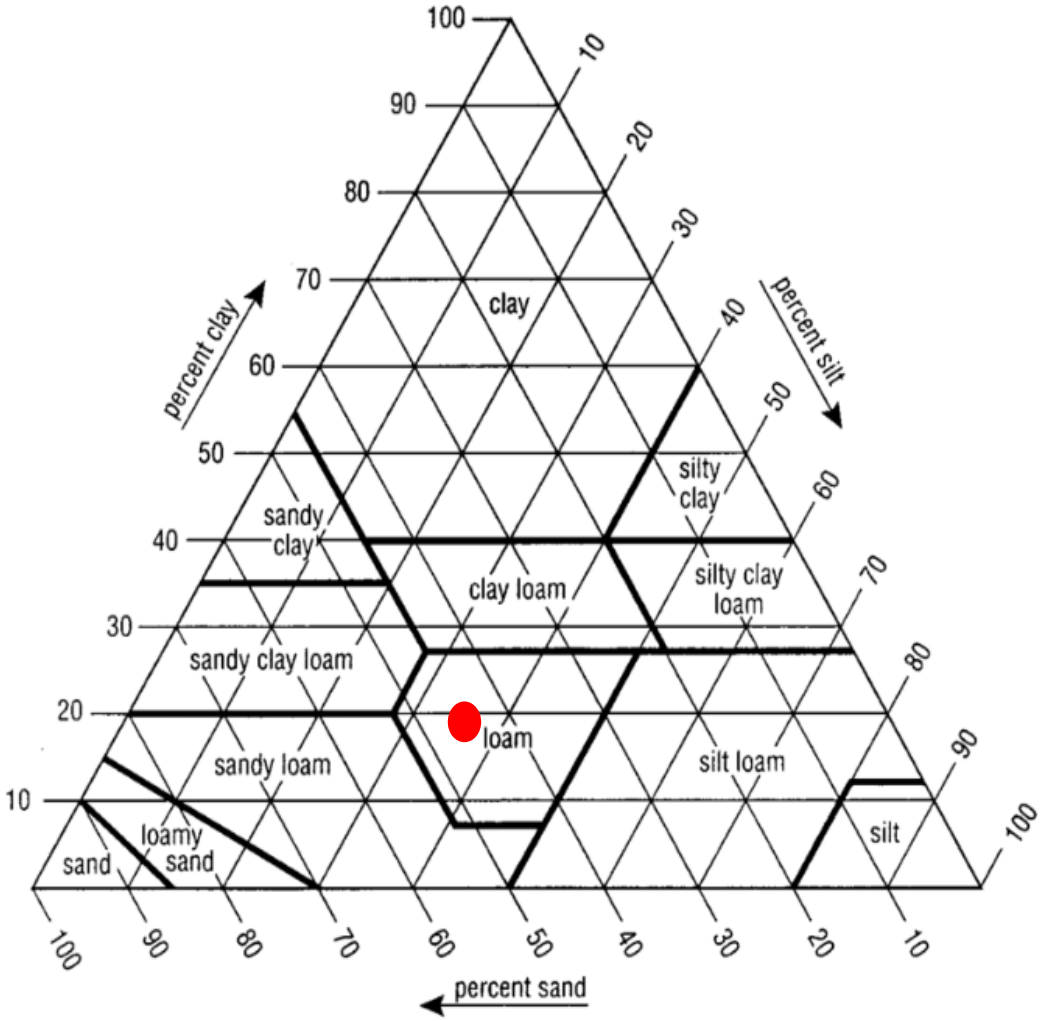
3.2.2 Topsoil was typically between 300mm and 400mm thick in trial pits. It was logged as

Dark brown to black clayey sandy silty slightly gravelly TOPSOIL. Minor rootlets. Gravel is of mixed lithology.

3.2.3 The topsoil has visible pedogens that range in size from 10mm closer to surface down to 100mm towards the transition to the subsoil. The transition between the topsoil and the subsoil is gradational. There is a decrease in moisture content deeper in the profile indicating there is not a large contribution from groundwater in hydration of topsoil.

3.2.4 There were no signs of compression within the topsoil, it was not sinking underfoot and there were no signs of bogs or marshes that had pedogenic instability across the site.

3.2.5 The topsoil is plotted on a texture chart below (as a red point). Plot is from a visual inspection and not a PSD assessment. This indicates that the topsoil is loam. It is noted that topsoil texture can vary across a site, particularly when there is a river with varying morphology.

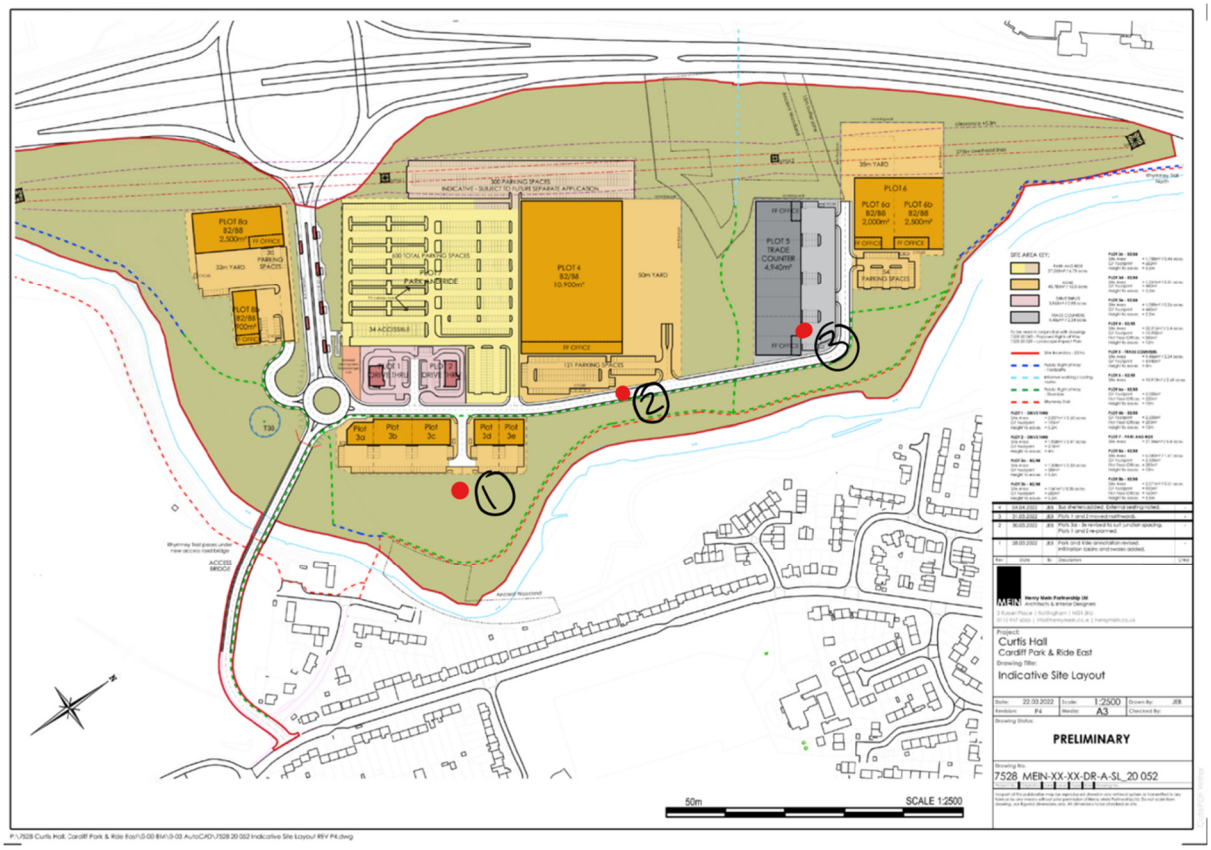


Topsoil texture classification chart

3.2.6 Loam soils are considered to be fertile, due to the mix of soil constituents and the presence of humus. This is evident by the variety of vegetation growing in the soil, as shown in the adjacent photos.

Location 1

Location 3



3.3 The topsoil is considered to be horticulturally suitable for growth of general vegetation. There have been no chemical tests of this material for consideration of the material for use as a developable soil.

3.4 When considering horticultural properties of a subsoil, it is important to consider moisture content, TOC, PSD, soil structure (pedogenic structure) and anthropogenic influence.

3.5 There is minimal distinction between the alluvium and the glaciofluvial sediments from a resource perspective. Both strata have similar subsoil potential and both are proving to be relatively free draining. The depth and thickness variations across site, coupled with the mature trees, indicate that both will be acting as a horticultural resource and, as such, will both be considered herein, in terms of site use and protection.

3.6 The lowest moisture content was 37% in the Alluvium and 22% in the glaciofluvial sediments. These are relatively high values for clay dominant subsoil, however, the proximity to the river will be affecting this. The higher water table will also be a product of the proximity to the river. The density of the vegetation and the variations in the vegetation indicate that the subsoils are not inundated to the point that they are inhibiting rhizomorphic biota development and colonies. This is likely due to the presence of the silt, sand and gravels helping the soils to drain and not become completely waterlogged.

3.7 The high variability in the grain sizes in the strata, particularly in the alluvial sediments, will be helping to drain the soils as multiple grain sizes enhance pedogenic stability. Pedogenic stability allows for a secondary porosity within the soil that enhances migration of water.

3.8 Made ground was present across the site, but this was limited to areas of development such as the asphalted parking area and the unsealed hardstanding. The one contamination exceedance found was in made ground, and interpreted in the Geo-environmental Report to be from a fragment of asphalt. It was noted in the gravel descriptions that there was abundant asphalt in the made ground logs. It is likely that this may cause further exceedance. The exceedances were two PAH compounds that are typically not harmful to the environment in the quantities found. However, as the condition of the asphalt gravels was not described in the logs, it is considered appropriate that this material is to be treated as a remedial focus for the site and as such will be discussed later in the resource assessment, but will not be treated as a resource in itself.

4.0 PROPOSED DEVELOPMENT

4.1 The proposed development comprises several buildings with associated car parking and soft landscaped areas.

4.2 It is noted that from the proposed development, that there will be minimal stripping of topsoil across site. There will be minimal increase to the current developed footprint and the landscaping plan is not proposing a strip and revegetate system. As such, the important aspects for soil preservation are construction management.

4.3 A sustainable landscaping design has been compiled for the proposed development, this has been enclosed for reference. In this document it shows the recommended horticultural position of the site. The primary focus is on preservation of wooded areas and scrublands, with strategic thinning/stripping of vegetation, selective replanting (particularly using native species), canopy development and removal of invasive species.

Drainage Support

4.4 Specific drainage design has not been considered in this review, due to the feasibility stage of this project. However, several elements of drainage design can be considered in the final development to help protect the soils and river on site.

4.5 Permeable pavement can be used within car parking bays.

- All bays are designated for short-term parking, reducing the likelihood of contamination from spills, leaks or maintenance.
- The pavement concept comprises block paving onto clean aggregate and geotextile designs as stipulated in BS 12620.
- Outlets typically comprise a 50mm perforated collection pipe wrapped in geotextile coupled to a 100mm outlet pipe to further minimise siltation.

4.6 Rain gardens can be installed around storm water runoff zones to provide a filtration system to waters that may flow into landscaped areas. This comprises filter beds atop of granular material encased in a geotextile, to prevent migration of contaminants into the soft landscaping areas.

4.7 Soft landscaping designs around the car parks may include SuDS planter boxes and garden beds. Site won topsoil or enhanced site won subsoil is recommended for these beds. This will reduce the volume of surface water to be accounted for across site, and reduce the increased volume of surface water running into the soft landscaped areas across the site.

4.8 Infiltration drainage such as soakaways can be installed closer to the river, to prevent waterlogging the whole of the site.

5.0 SOIL CONSTRUCTION PLAN

5.1 It is noted that from the proposed development, that there will be minimal stripping of topsoil across site. There will be minimal increase to the current developed footprint and the landscaping plan is not proposing a strip and revegetate system. As such, the important aspects for soil preservation are construction management.

5.2 The following strategy is to ensure that construction on site considers both the resources of the soil and the river to preserve the horticultural, ecological and structural conditions of the site.

- A Pollution Prevention Plan should be in place for the site to prevent silting and pollution of the river prior to any works commencing on site. This could include soil bunds to prevent runoff, silt traps and fencing, hay bales down slope or in places of enhanced surface water runoff.
- Fly tipped waste and any other anthropogenic materials are to be cleared and appropriately removed off-site.
- Vegetation stripping in areas of thinning or development to happen independent of, and prior to, topsoil stripping. Waste vegetation is to be removed off-site to an appropriate waste management source.
- Remediation of contaminated strata on site.
- Stripped hardcore or pavements to be stockpiled or stored away from any other soils. A minimum of 15m stand-off should be maintained between stockpiles of hardcore and natural soils.
- Stripped hardcore is not to be stored immediately on top of natural soils. If hardcore is require to be stockpiled in areas where natural ground is present, matting is required.

5.3 In areas where any soft landscaping is to be stripped, permanently or temporarily, topsoil is to be identified and stockpiled in an area safe to do so, where contamination will be minimal. Stockpiling of the soil when wet should be avoided. Suggested locations for the stockpiles include:

- Areas of car parking not being used or undergoing development at the time of topsoil stockpiling in the west of the site.
- Areas of grass in the north of the site.
- Areas of soft landscaping, where a renewed landscaping plan is proposed.

5.4 Topsoil is to only have two movement phases once it has been stripped and separated. This is to ensure over compaction of the soil does not occur.

5.5 To prevent contamination of the topsoil during construction, the stockpile is to be quarantined by fencing or by matting. If topsoil is being stored on car parking surfaces, cleaning or matting is required.

5.6 Topsoil is not to be stored in the east of the site, adjacent to the river. This is to prevent washing of the topsoil into the river. As topsoil cannot be compacted, to preserve

horticultural benefit, the topsoil must have a buffer to allow recoverable runoff from any stockpiles.

5.7 If any imported soils are required, the source will need to be confirmed, and the material tested for the attached suite of contaminants, to comply with the maximum screening values listed. The frequency is to be congruent with the site remedial strategy.

Soil Structure Protection

5.8 The pedogenic structure of subsoils is crucially important when water tables are high. This allows for enhanced free drainage of the soil, preventing water logging. Construction activities that can damage this include, but are not limited to:

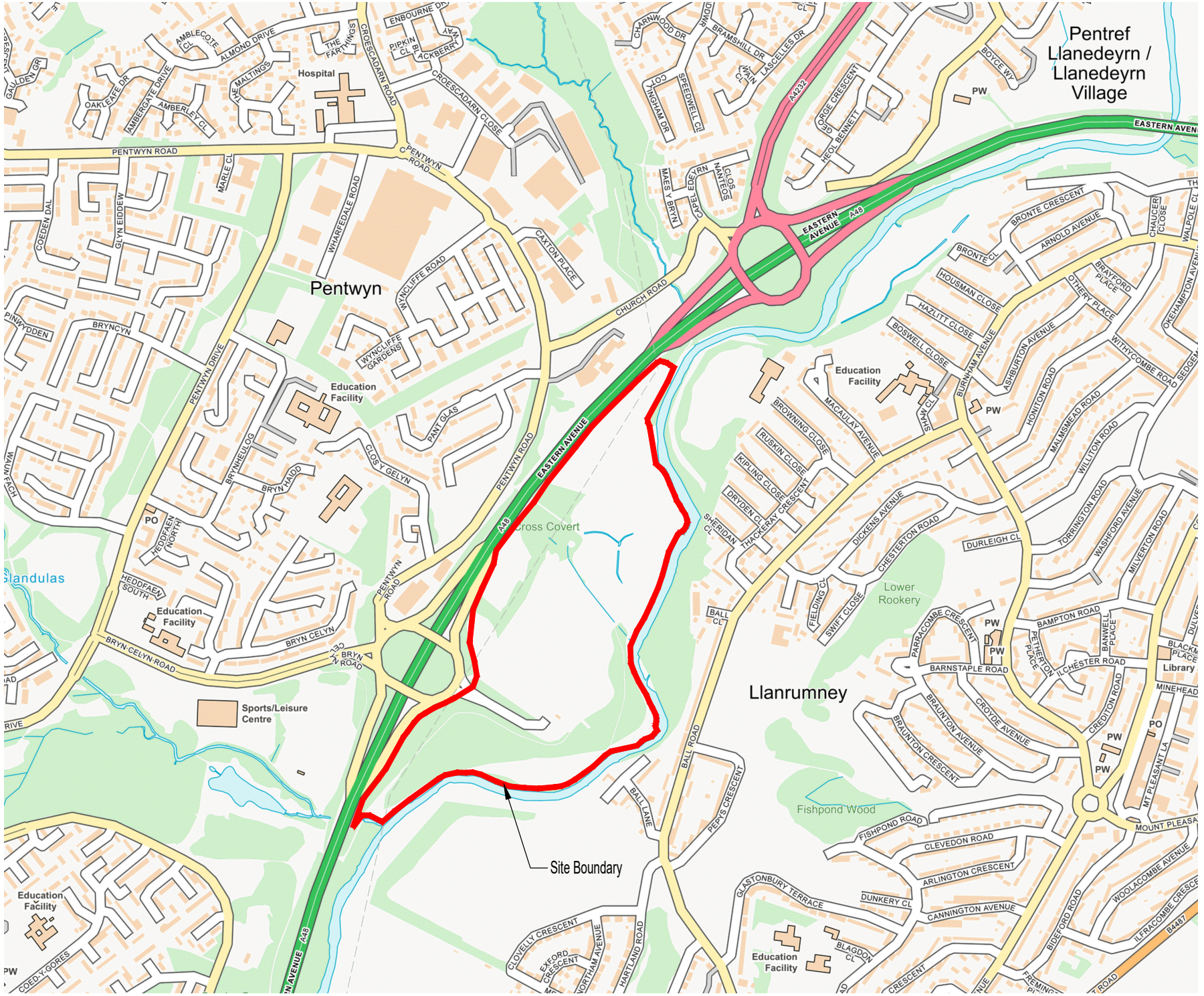
- High vibrationary equipment, typically machines that have a vibrational frequency greater than 20mm/sec at the source.
- Long placement of heavy machines such as cranes, piling rigs or cement trucks in the one place.
- Over digging and unnecessary turning over of soil profiles.

These activities should be avoided on site to help keep the soil free draining. If elements like piling or cement systems are needed, appropriate foundation mats or pads will help prevent over-pressure in the soil structures.

Landscaping

5.9 The landscaping plan includes for removal of vegetation to improve the woodlands and parklands planned to be preserved on site. However, removal of vegetation can destabilise topsoil and to a lesser extent subsoils. This will be particularly relevant in areas where the soils are wet or in the banks of the river, where removal will take away the root systems that help bind together the pedogenic systems of the soils.

5.10 Where vegetation is to be removed, an assessment of the topsoil stability is to be made to determine if temporary seeding, mesh or erosion protection is needed. Against the river bank, where the invasive species are planned to be removed, erosion matting is recommended or immediate replanting with a biodegradable vegetation enhancement mat.



ARP GEOTECHNICAL LTD
Chartered Consulting Engineers

Northwest House ● 5 & 6 Northwest Business Park ● Servia Hill, Leeds ● LS6 2QH
☎ 0113 245 8498 ✉ 0113 244 3864 ✉ leeds@arpgeotechnical.co.uk ⊕ www.arpgeotechnical.co.uk

Project
CURTIS HALL
CARDIFF PARK & RIDE EAST

Client
CURTIS HALL LTD

Title
SITE LOCATION PLAN

Date
JULY 2022

Drawn	Scale
JC	N.T.S.

Job No.
CTS/01/SK02

ARP GEOTECHNICAL LTD
Chartered Consulting Engineers
Northwest House ● 5 & 6 Northwest Business Park ● Servia Hill, Leeds ● LS6 2QH
☎ 0113 245 8498 🖷 0113 244 3864 ✉ leeds@arpgeotechnical.co.uk ⊕ www.arpgeotechnical.co.uk

Project

CURTIS HALL
CARDIFF PARK & RIDE EAST

Client

CURTIS HALL LTD

Title

AERIAL IMAGE

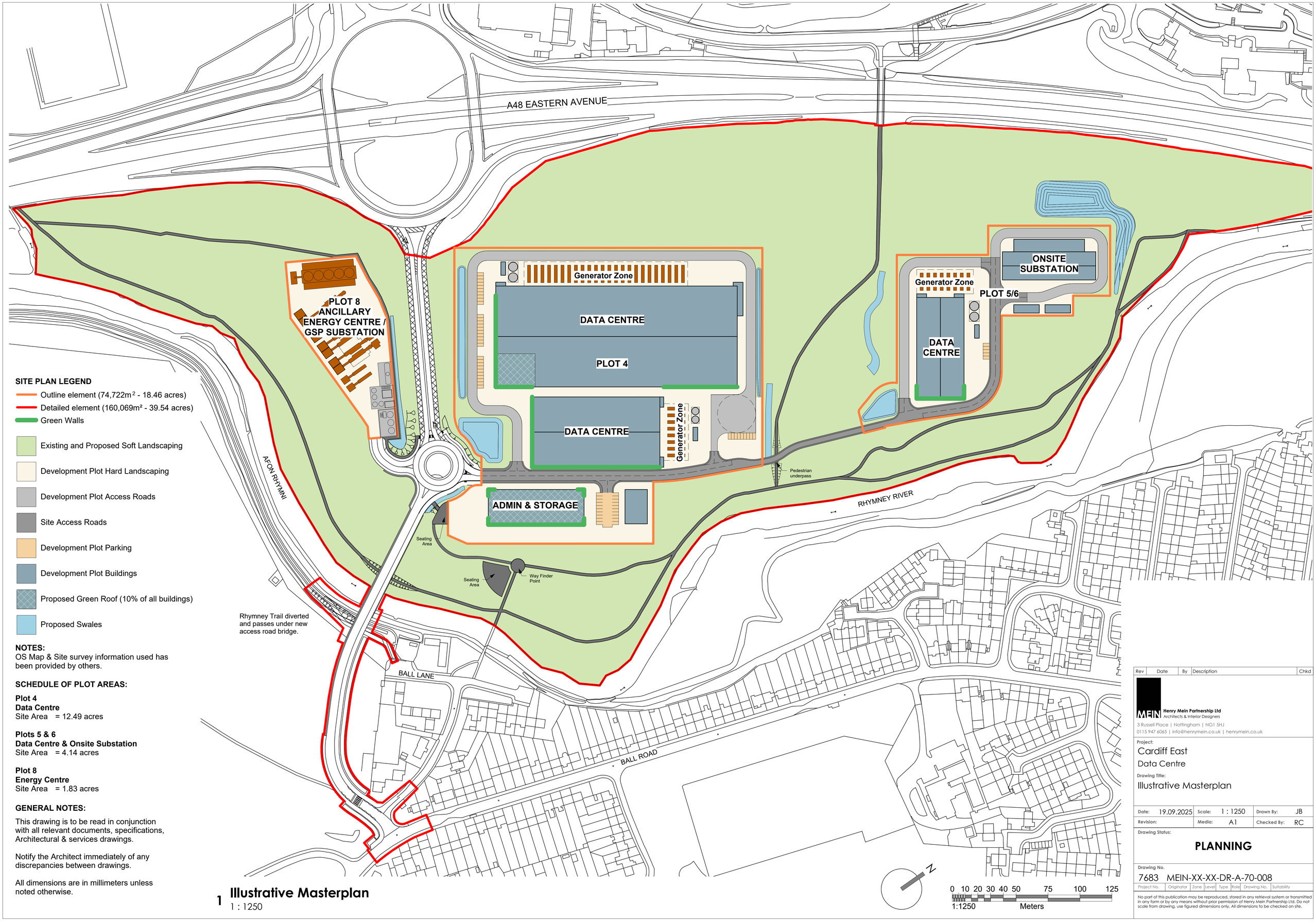
Date

JULY 2022

Drawn	Scale
JC	N.T.S.

Job No.

CTS/01/SK01



SITE PLAN LEGEND

- Outline element (74,722m² - 18.46 acres)
- Detailed element (160,069m² - 39.54 acres)
- Green Walls
- Existing and Proposed Soft Landscaping
- Development Plot Hard Landscaping
- Development Plot Access Roads
- Site Access Roads
- Development Plot Parking
- Development Plot Buildings
- Proposed Green Roof (10% of all buildings)
- Proposed Swales

NOTES:
OS Map & Site survey information used has been provided by others.

SCHEDULE OF PLOT AREAS:

Plot 4
Data Centre
Site Area = 12.49 acres

Plots 5 & 6
Data Centre & Onsite Substation
Site Area = 4.14 acres

Plot 8
Energy Centre
Site Area = 1.83 acres

GENERAL NOTES:

This drawing is to be read in conjunction with all relevant documents, specifications, Architectural & services drawings.

Notify the Architect immediately of any discrepancies between drawings.

All dimensions are in millimeters unless noted otherwise.

1 Illustrative Masterplan
1 : 1250

Rev	Date	By	Description	Chkd

Henry Mein Partnership Ltd
Architects & Interior Designers
3 Russell Place | Nottingham | NG1 5HJ
0115 947 6065 | info@henrymein.co.uk | henrymein.co.uk

Project:
Cardiff East
Data Centre

Drawing Title:
Illustrative Masterplan

Date:	19.09.2025	Scale:	1 : 1250	Drawn By:	JB
Revision:		Media:	A1	Checked By:	RC

Drawing Status:
PLANNING

Drawing No.
7683 MEIN-XX-XX-DR-A-70-008

Project No.	Originator	Zone	Level	Type	Role	Drawing No.	Suitability