Preliminary Geotechnical Interpretative Report

Middlesex Hospital Annexe

University College London Hospitals Charity (UCLHC)

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Executive Summary

AECOM has been commissioned by Client Name to provide civil and structural engineering advice in relation to the proposed development of The Middlesex Hospital Annexe. A Basement Impact Assessment and series of supporting documents has been prepared as part of this appointment. Site investigations in the location for the new development have been reviewed to provide preliminary design information and the geotechnical nature of the ground conditions.

A summary of key findings is given as follows; reference should be made to the full text for further details.

Site Description	The site is located on Cleveland Street within the London Borough of Camden. The site boundary encloses an area of approximately 0.32ha. The site consists of North House located in the northwest corner of the site; South House located in the southwest corner of the site; and the Grade II listed Middlesex Hospital Annexe (the former Union Workhouse) located in the centre of the site with two wing buildings at the rear.
Site Environs	The site is bounded to the north by the Sainsbury Wellcome Centre with Howland Street beyond; to the south by Middlesex House, Tottenham Mews and Day Hospital; to the east by Astor College; and to the west by Cleveland Street. Adjacent buildings
Site History	The historical Ordnance Survey (OS) maps obtained with the Landmark Envirocheck report date between 1851 and 2016. The site is initially identified as the 'Strand Union Workhouse' in the mapping dated 1872-1874. The site was subsequently identified as a 'sick asylum' in 1895 and the 'Middlesex Hospital Annexe' in 1953. Developments can be seen to have taken place in the earliest mapping available, predominantly residential and industrial in nature. The area around the site gradually became less industrialised with the construction of offices, university/college buildings and hospital buildings.
Ground Conditions	The geology of the site comprises the Lynch Hill Gravel overlying the London Clay Formation overlying the Lambeth Group overlying the Thanet Formation. There is Made Ground present from surface. The Lynch Hill Gravel is classified as a Secondary A Aquifer. Groundwater is present in the Lynch Hill Gravel.
Foundations	Foundations to the new building will be piled. Either CFA or bored piles are recommended. The perimeter of the basement excavation will be supported by a secant bored piled wall, and this may comprise hard-firm, CFA or bored piles. Basement excavations are likely to be braced with a single level propping system, with both horizontal and raking props. Further ground investigation is recommended for the development and this will provide further information to validate the conceptual ground model and preliminary geotechnical parameters. The investigation will include groundwater monitoring to establish groundwater levels prior to basement construction.

Introduction

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1. Introduction

1.1 Reason for the Report

AECOM has been commissioned by Client Name to provide civil and structural engineering advice in relation to the proposed development of The Middlesex Hospital Annexe. As part of this appointment, previous ground investigations have been assessed to obtain information on the geotechnical ground conditions to assist with the preliminary design of foundations, retaining walls and basement structures. These Ground Investigations are not site specific and the presented results are projections of the available data for the adjacent sites to which the previous Ground Investigations correspond. A site specific Ground Investigation needs to be conducted to verify these projections (cf. Cap. 5).

1.2 Report Objectives

Geotechnical

- Interpretation of the geological and hydrogeological ground conditions aspects of previous investigations
- Assessment of geotechnical design parameters
- Review of geotechnical hazards
- Advise on foundation solutions
- Advise on basement wall solution
- Review further investigation requirements

1.3 Previous Reports

This report supplements a Phase 1 Desk Study investigation of the site:

- AECOM (2016) *Phase 1 Geotechnical and Geo-environmental Desk Study*. Middlesex Hospital Annexe, Issue 2 8th December 2016, 60516144/DS/002;
- AECOM (2017) Site Investigation Report. Middlesex Hospital Annexe, 8th April 2017, 60516144/SIR/001.

1.4 Limitations

The information, views and conclusions drawn in this geotechnical report concerning the site are based, in part, on information supplied to AECOM by other parties. AECOM has proceeded in good faith on the assumption that this information is accurate. AECOM accepts no liability for any inaccurate conclusions, assumptions or actions taken resulting from any inaccurate information supplied to AECOM from others.

The exploratory holes were carried out during previous fieldworks by other parties in the vicinity of the site, and investigate only a small volume of the ground in relation to the size of the site; hence can only provide a general indication of site conditions. The comments made and recommendations given in this report are based on the ground conditions apparent using these exploratory holes. Further investigations will be carried out during the developed design stages. There may be exceptional ground conditions elsewhere on the site which have not been disclosed by the investigations to date and which have therefore not been taken into account in this report.

The comments made on groundwater conditions are based on observations of previous ground investigations and limited monitoring. It should be noted that further investigations are planned for gas and groundwater and groundwater levels may vary due to seasonal or other effects.

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Site Location, Description and Development History

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2. Site Location, Description and Development History

2.1 Introduction

This section is based on the information presented in the Phase 1 Geotechnical and Geo-environmental Desk Study. Further detailed information on the site is reported in the Phase 1 Geotechnical and Geo-environmental Desk Study Report (AECOM, 08/12/2016). The Envirocheck Report is contained within the Phase 1 report.

2.2 Location

The site is located within the London Borough of Camden. It is centred on National Grid Reference 529262, 181811. A site location plan is provided as Figure 1. The site covers approximately 0.32 hectares and is defined by the red line boundary shown in Figure 2.

2.3 Development Proposal

The proposed development is for the former Middlesex Hospital, including the listed Union Work House building that fronts Cleveland Street. The Work House is retained and the development behind this comprises a two to seven storey building with a single storey basement and roof plant. The new basement will be approximately 2m deeper than the existing Work House basement, with a proposed structural slab level at 22.80m AOD. Secant pile walls will be constructed around the perimeter of the new basement to form perimeter support to the basement excavation. A layout plan of the proposed basement and surrounding buildings is included as Figure 3.

2.4 Geographic Setting

Relevant features immediately surrounding the site are summarised in Table 2.1.

Table 2.1: Features Surrounding the Site

Direction	Summary
North	The Sainsbury Welcome Centre with Howland Street and the BT Tower beyond.
South	Middlesex House, Tottenham Mews, Day Hospital.
East	Astor College with Charlotte Street beyond.
West	Cleveland Street with commercial units beyond.

2.5 Listed Buildings

The former Union Workhouse and a building opposite the site at 45-49 Cleveland Street are Grade II listed buildings.

2.6 Unexploded Ordnance

According to regional unexploded bomb (UXB) mapping published by Zetica, the site lies within a zone that experiences a high risk of UXB. It is understood that the former Union Workhouse was constructed between 1775 and 1778. Following the Second World War, buildings in the vicinity of the site can be identified as ‘ruins’ on historical maps.

According to the Bomb Damage Maps (Map 61), the former Union Workhouse experienced general (non-structural) blast damage while the two wing buildings at the rear experienced general blast damage to serious damage that was considered as repairable at cost.

It is recommended that the Client commissions a specialist UXO report in advance of any future intrusive site works or development. The report should be prepared with cognisance of CIRIA publication C681 (Stone and others, 2009).

2.7 Development History

2.7.1 Sources of Information

The historical Ordnance Survey (OS) maps obtained with the Landmark Envirocheck report date between 1851 and 2016. Further details are available in the Desk Study Report.

The maps show that the site was initially identified as the ‘Strand Union Workhouse’ in the mapping dated 1872-1874. The site was subsequently identified as a ‘sick asylum’ in 1895 and the ‘Middlesex Hospital Annexe’ in 1953. Developments can be seen to have taken place in the earliest mapping available, predominantly residential and industrial in nature. Sites of local ruins can be identified after the Second World War, although the site itself shows the same pre-war layout. The area around the site gradually became less industrialised with the construction of offices, university/college buildings and hospital buildings.

2.7.2 Historical building plans

The historical building plans obtained with the Landmark Envirocheck report date between 1900 and 1966. Some of the observations related to the site have been summarised below:

- The usage of the site between 1900 and 1966 was largely related to hospital functions, including wards, nurses’ homes, a dispensary and other welfare facilities.
- A single storey building in the southeast corner of the site can be identified as a mortuary from mapping dated 1927 and 1930. The building was later used as offices.
- It appears that the basement of North House was constructed between 1900 and 1927.
- The basement below part of South House can be identified from the earliest mapping, and appears to have been extended between 1927 and 1930.
- The basement of the former Union Workhouse appears to have been constructed between 1927 and 1930. The underground service tunnel can also be seen associated with the basement construction. The tunnel appears to run in a roughly north-south direction between the former Union Workhouse and South House before running in a roughly east-west direction beneath Cleveland Street.
- Buildings on site have been shown to contain asbestos.
- Petrol tanks have been identified along the southern site boundary from mapping dated 1948.

2.8 Archaeology

Information from Historic England and the Heritage Consultants on the project notes that the hospital was ‘built as a workhouse in 1775-78 by the Parish of St Paul’s Covent Garden, on the site of their old burial ground’ and ‘a burial ground on site was consecrated in 1788 and burials had appeared to have ceased by the late 1850s’.

The Museum of London Archaeology (MoLA) has carried out a desk study with the following findings:

> “The scheme comprises the redevelopment and refurbishment of the site to create a mixed use office and residential scheme. The late 18th century Grade II listed former Strand Union Workhouse building, along with the late 19th century north/south buildings are to be retained and refurbished with an eastwards extension of the existing basement (which covers c 40% of the site). In the east of the site, the existing late 19th century ward extensions are to be demolished and a new multi-storey office building constructed, with a new single basement across an additional c 40% of the site, and piled foundations. The site lies within the Charlotte Street Conservation Area; it is not within an archaeological priority area. There has been one past archaeological investigation within the site; a watching brief in 2014. This monitored the excavation of five test pits and identified a number of buried structural remains relating to former phases of the workhouse. Only one test pit revealed human remains, in a brick feature containing disarticulated bone. No intact burials were found.”

The Archaeological Watching Brief was carried out by Pre-Construct Archaeology Ltd between 27th and 31st May 2014.

2.9 Geology

2.9.1 Geological Information from Published Information and Maps

The published 1:50,000 scale geological map of the area produced by the British Geological Survey (BGS Sheet 256, “North London”, 2006) indicates the site is underlain by the following geological succession:

Table 2.2: Geological succession from Published Mapping

Age	Geological Stratum
Quaternary	Lynch Hill Gravel
Paleogene	London Clay Formation
	Lambeth Group
	Thanet Formation

2.9.1.1 Made Ground

The existing topography and history of development of the site and the archaeological trial pits indicate that Made Ground is present on the site.

2.9.1.2 Lynch Hill

The Lynch Hill Gravel typically comprises sand and gravel, locally with lenses of silt, clay or peat. Its thickness typically ranges from 1 to 12m, commonly with an average of 7m, according to the BGS Lexicon.

2.9.1.3 London Clay

The London Clay Formation is typically a firm to stiff to very stiff to hard, fissured grey to blue-grey over-consolidated clay, which, at outcrop, becomes firm, brown weathered clay typically within the upper 5m of the stratum. The Formation often becomes sandy to very sandy towards its base with associated high content of glauconite mineral and occasionally bands of laterally extensive imbricated cobbles and boulders of claystone (argillaceous limestone concretions). Occasional bands of sand and gravel dispersed with crystals of selenite (gypsum) and pyrite, which are sulphate sources, are also present. The thickness of the London Clay in the area is expected to be in the region of 20m according to historical ground investigations. The Harwich Formation refers to all sediments between the Lambeth Group and the London Clay Formation, typically comprising sand, clayey fine-grained sand and pebble beds. According to the BGS Memoir Geology of London, the thickness of the Harwich Formation can potentially be up to 2m at the site though existing ground investigation findings have not recorded its presence.

2.9.1.4 Lambeth Group

The Lambeth Group comprises strata from the Upnor, Woolwich and Reading Formations. The group comprises laguno-marine sediments that have been deposited in an embayment of a deep marine water basin with brackish water lagoons, barrier beaches and alluvial plains. It is described as mottled clay with sand and pebble beds. The top of the Lambeth Group is marked by the eroded or interburrowed surface at the base of the Thames Group (London Clay Formation and Harwich Formation). The thickness of the Lambeth Group in the area is expected to be 15 to 20m, according to the BGS Memoir Geology of London.

2.9.1.5 Thanet Formation

The Thanet Formation is described by the BGS as “Glauconite-coated, nodular flint at base, overlain by pale yellow-brown, fine-grained sand that can be clayey and glauconitic.” It can contain rare calcareous or siliceous sandstones. The basal bed of flint nodules, which can be up to 0.3m in diameter, is referred to as the Bullhead Bed. Flints derived from the underlying Chalk can occur in places. The anticipated thickness of the Thanet Formation is 5 to 10m, according to the BGS Memoir Geology of London.

2.9.2 Geological Information from BGS Records

The British Geological Survey holds an archive of historical borehole logs throughout the UK. The database of borehole logs was searched for any records which would provide useful information on the ground profile at the site. Seven borehole logs were obtained from the BGS are described below in Table 2.3

Table 2.3: Exploratory Hole Log Data from BGS

Borehole reference NGR Distance from the site Date	Stratum[1]	Description	Depth to Top of Stratum (m bgl)	Level of Top of Stratum (m AOD)	Thickness (m)
TQ28SE225 529300,181910 60m N 30/05/1956	Made Ground	Made ground.	G.L.	-	5.79
	Lynch Hill Gravel	Sand and gravel.	5.79	-	0.92
	Weathered London Clay	Brown clay.	6.71	-	0.45
	London Clay	Blue clay.	7.16	-	BNP
TQ28SE226A 529230, 181860 45m N 14/02/1957	Made Ground	Made ground.	G.L.	-	1.22
	Lynch Hill Gravel	Sand and gravel.	1.22	-	3.50
	Weathered London Clay	Brown clay.	4.72	-	0.16
	London Clay	Stiff blue clay.	4.88	-	BNP
TQ28SE226B 529230, 181860 45m N 06/02/1957	Made Ground	Bricks, topsoil, ash.	G.L.	-	3.89
	Lynch Hill Gravel	Sand and gravel.	3.89	-	3.58
	Weathered London Clay	Brown clay.	7.47	-	0.15
	London Clay	Stiff blue clay.	7.62	-	BNP
TQ28SE226C 529230, 181860 45m N 28/01/1957	Made Ground	Bricks, soil etc.	G.L.	-	3.51
	Lynch Hill Gravel	Gravel and sand.	3.51	-	4.26
	Weathered London Clay	Brown clay.	7.77	-	0.15
	London Clay	Stiff blue clay.	7.92	-	BNP
TQ28SE226D 529230, 181860 45m N 31/01/1957	Made Ground	Bricks, topsoil, ash.	G.L.	-	3.96
	Lynch Hill Gravel	Gravel and sand.	3.96	-	2.75
	Weathered London Clay	Brown clay.	6.71	-	0.3
	London Clay	Stiff blue clay.	7.01	-	BNP
TQ28SE226E 529230, 181860 45m N 25/01/1957	Made Ground	Bricks, topsoil, ash.	G.L.	-	3.96
	Lynch Hill Gravel	Gravel and sand.	3.96	-	2.97
	Weathered London Clay	Brown clay.	6.93	-	0.31
	London Clay	Stiff blue clay.	7.24	-	BNP
TQ28SE981 529230, 181730 75m SW 08/01/1963	Made Ground	Tarmacadam and cinders.	G.L.	26.4	0.3
		Fill (brick rubble, gravel and pockets of clay).	0.3	26.1	1.8
	Lynch Hill Gravel	Soft brown sandy CLAY with gravel.	2.1	24.3	1.0
		Brown fine to medium SAND	3.1	23.3	9.2

Borehole reference NGR Distance from the site Date	Stratum[1]	Description	Depth to Top of Stratum (m bgl)	Level of Top of Stratum (m AOD)	Thickness (m)
		and fine to coarse GRAVEL with occasional cobbles.			
	Weathered London Clay	Firm brown silty CLAY with occasional fine gravel.	12.3	14.1	0.7
	London Clay	Stiff grey silty CLAY.	13.0	13.4	15.2
	Lambeth Group	Stiff to very stiff mottled red, brown, grey-blue and yellow silty CLAY with traces of grey silty sand below approx. 46m.	28.2	-1.8	BNP

Notes:
[1] The geological classification is based on information available on the logs and is therefore indicative only.

2.10 Hydrogeology

2.10.1 Aquifer Classification

The EA's Groundwater Protection Policy adopts aquifer designations that are consistent with the Water Framework Directive. According to this system:

- The Lynch Hill Gravel is classified as a Secondary A Aquifer. These are permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers.
- The London Clay Formation is classified as a Non Productive Stratum. These are rock layers or drift deposits with low permeability that has negligible significance for water supply or river base flow.
- The site is underlain by the water-bearing Chalk-Basal Sands aquifer of the London Basin. There is hydraulic continuity between the Chalk and Thanet Formation and some continuity with the Lambeth Group depending on the clay and sand content.

2.10.2 Vulnerability of Groundwater Resources

The EA's Groundwater Vulnerability Map of the area shows that the soils overlying the Secondary A Aquifer have a High Leaching Potential (U). These are soils that readily transmit liquid discharges because they are either shallow, or susceptible to rapid by-pass flow directly to rock, gravel or groundwater. Soil information for urban areas is less reliable and based on fewer observations than in rural areas and therefore a worst case vulnerability classification is assumed until proved otherwise.

In terms of identifying the risk of contamination from potential polluting activities in a given area to groundwater sources (wells, boreholes and springs) used for supplying public drinking water, the EA identifies Source Protection Zones. These show the extent of a groundwater source catchment and are divided into three zones, as follows:

- SPZ1 (Inner protection zone) is located immediately adjacent to the groundwater source. It is based on a 50-day travel time from any point below the water table and is designed to protect against the effects of human activity and biological/chemical contaminants that may have an immediate effect on the source. The zone has a minimum radius of 50m.
- SPZ2 (Outer protection zone) is larger than SPZ1 and is defined by a 400-day travel time from a point below the water table to the source. The travel time is designed to provide delay and attenuation of slowly degrading pollutants. This zone has a minimum radius of 250m or 500m, depending on the size of the abstraction.
- SPZ3 (Source catchment protection zone) covers the complete catchment area of a groundwater source.

Mapping produced by the EA and supplied with the Envirocheck report shows that the site does not lie within a Source Protection Zone.

2.10.3 Site Characteristics

The anticipated depth to the water table in the Lynch Hill Gravel (Secondary A Aquifer), i.e. the thickness of the unsaturated zone, is anticipated to be in the order of a few metres. The regional direction of groundwater flow is expected to be to the south and southeast.

However, it is possible that localised perched water may also be present in the Made Ground.

2.10.4 Risk from Rising Groundwater Levels in the Deep Aquifer

The site lies within the critical areas in the London basin defined in CIRIA Special Publication SP 69 (Simpson and others, 1989) in which exceptional structures are potentially at risk from the rising groundwater levels in the deep aquifer.

With reference to the latest Environment Agency (EA) data, the estimated level of the potentiometric surface of the Basal Sands and Chalk aquifer in January 2016 was between -35 and -36mAOD, and the latest reported rate of rise is between 1 and 2m per year.

2.10.5 Licensed Groundwater Abstractions

According to the Envirocheck Report (2016), there are fifteen recorded groundwater abstractions located within a 1km radius of the site. The nearest licence is registered to Ridgeford Properties Ltd approximately 400m west of the site and used for industrial/commercial/public services.

Table 2.4 summarises the records for groundwater abstractions within 1km of the site.

Table 2.4: EA Licensed Groundwater Abstractions (<1km of the Site)

National Grid Reference	Distance and direction	Name	Source	Use
528830, 181900	414m W	Ridgeford Properties Ltd	Groundwater	Other industrial/commercial/public services: heat pump.
529100, 181400	417m SW	Capital and Counties Property Company Ltd	Groundwater	Commercial/industrial/public services: drinking, cooking, sanitary, washing, small garden.
529010, 181350	503m SW	Pontsarn Investments Ltd	Groundwater	Commercial/industrial/public services: drinking, cooking, sanitary, washing, small garden.
529010, 181350	503m SW	Great Capital Partnership Ltd	Groundwater	Commercial/industrial/public services: drinking, cooking, sanitary, washing, small garden.
529010, 181330	520m SW	Pontsarn Investments Ltd	Groundwater	Commercial/industrial/public services: drinking, cooking, sanitary, washing, small garden.
529010, 181330	520m SW	Great Capital Partnership Ltd	Groundwater	Commercial/industrial/public services: drinking, cooking, sanitary, washing, small garden.
529000, 181300	551m SW	Capital and Counties Property Company Ltd	Groundwater	Commercial/industrial/public services: drinking, cooking, sanitary, washing, small garden.
529858, 181865	546m E	London School of Hygiene and Tropical Medicine	Groundwater	Other industrial/commercial/public services: heat pump.
529860, 181863	548m E	London School of Hygiene and Tropical Medicine	Groundwater	Other industrial/commercial/public services: heat pump.
528480, 181920	763m W	Trustees of the London Clinic Ltd	Groundwater	Other industrial/commercial/public services: non-evaporative cooling.

National Grid Reference	Distance and direction	Name	Source	Use
528480, 181930	764m W	Trustees of the London Clinic Ltd	Groundwater	Other industrial/commercial/public services: non-evaporative cooling.
528470, 181910	772m W	Trustees of the London Clinic Ltd	Groundwater	Other industrial/commercial/public services: non-evaporative cooling.
528460, 181930	784m W	Trustees of the London Clinic Ltd	Groundwater	Other industrial/commercial/public services: non-evaporative cooling.
528407, 182223	922m NW	Sir Ritblat	Groundwater	Production of energy – electricity: heat pump.
529200, 180800	984m S	Crown Estate Commissioners	Groundwater	Crown and government: drinking, cooking, sanitary, washing, small garden.

There are twenty abstractions for potable water supply within a 2km radius of the site.

2.10.6 Discharge Consents

The Envirocheck Report (2016) indicates that eight discharge consents are registered within a 1km radius of the site. The closest two entries located 418m west of the site relate to trade discharges of cooling water by Ridgeford Properties Ltd. The consents were issued in 2009 and 2013.

2.11 Hydrology

2.11.1 Surface Water Courses and Drainage

The nearest surface watercourse/feature to the site appears to be a fountain within Hanover Square located 780m southwest of the site.

The Lost Rivers of London (1992) suggests that the River Tyburn (now covered/culverted) is located approximately 1.1km west of the site.

The River Thames is located approximately 2km southeast of the site flowing in a north-easterly direction.

2.11.2 Surface Water Abstractions

According to the Envirocheck report (2016), there are four records of licensed surface water abstractions within a 2km radius of the site. The nearest licence is registered to the British Waterways Board located approximately 1,800m north of the site associated with non-remedial river/wetland support.

2.11.3 Flooding

The indicative floodplain map for the area, published by the EA, shows that the site does not lie within an area susceptible to risk of flooding from rivers and sea.

Environmental Simulations International (ESI) groundwater flood data indicate that the site is located within an area with a negligible risk of groundwater flooding. Any groundwater flooding incidence has a chance of less than 1 in 100 (<1%) probability of occurrence.

However, BGS flood data suggest that the site is located within an area with a potential for groundwater flooding of property situated below ground level.

2.11.4 Planning Policy for Flood Risk

The National Planning Policy Framework (NPPF) for England requires local planning authorities to take account of flood risk and the implications of climate change. It requires that inappropriate development in areas at risk of flooding should be avoided by directing development away from areas at highest risk, but where development is necessary, making it safe without increasing flood risk elsewhere.

Technical guidance on flood risk accompanies the NPPF and sets out how this policy should be implemented. It stipulates that development proposals in flood risk Zone 2 (medium probability), Zone 3a (high probability) and Zone 3b (the functional floodplain) should be accompanied by a flood risk assessment.

2.12 River Basin Management Plan

The Water Framework Directive requires a Management Plan to be published for each River Basin District. These are plans that set out the environmental objectives for all the water bodies within the district and how they will be achieved.

The regime has introduced the concept of safeguard zones, which identify a catchment or other zone around a point where water is abstracted for potable use and where actions may be taken to protect water quality, prevent deterioration, and so minimise the need for treatment. Where water is abstracted for human consumption the water body is designated as a Drinking Water Protected Area (DrWPA). If there is reasonable confidence that a DrWPA objective will not be met, a safeguard zone will be identified.

The WFD has also brought about Water Protection Zones. These areas are a regulatory mechanism to address diffuse water pollution by restricting or forbidding activities that are polluting the most vulnerable waters (e.g. DrWPA). They can be used if it appears there is a risk of a water not achieving good ecological and chemical status by 2015.

2.13 Radon

The Envirocheck report indicates that the site is within an area where the risk of Radon is considered low. Less than 1% of homes are above the UK “Action Level”.

2.14 Mining and Landfilling

2.14.1 Planning Policy for Mineral Use

The NPPF for England requires minerals planning authorities to promote sustainable use of mineral resources in their Local Plans. This includes defining mineral safeguard zones to ensure that specific mineral resources of local or national importance are not sterilised by non-mineral development (but not assuming that the identified minerals will be worked). If it is necessary for non-mineral development to take place then the local planning authority should set out policies to encourage the prior extraction of minerals, where practicable and environmentally feasible.

When determining planning applications local planning authorities must ensure that, amongst other matters, that there are no unacceptable impacts on the natural and historic environment, human health or aviation safety (taking into account cumulative effects from multiple sites); unavoidable noise, dust and particle emissions, and vibrations are controlled, mitigated or removed at source; and to not normally permit other developments in mineral safeguard zones.

The NPPF makes particular reference to the extraction of peat and coal. It stipulates that in their identification of mineral resources, authorities should not identify new sites or extensions to existing sites for peat extraction, and planning permission for such use should not be granted. Permission should also not be given for the extraction of coal unless the proposal is environmentally acceptable (or it can be made so), or if not, it provides national, local or community benefits which are far greater than the likely impacts.

2.14.2 Mining

An attempt has been made to identify any mining operations, past and present that have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Envirocheck datasheets supplied by Landmark
- Records held by Local Authority / Environment Agency
- Old Ordnance Survey maps and plans
- Geological maps

With reference to the above data there are no recorded mines within a 1km radius of the site. However, an area of a worked ground can be identified on the geological map located approximately 265m east of the site, possibly associated with the construction of the Goodge Street underground station.

2.14.3 Landfilling

An attempt has been made to identify any landfilling operations, past and present that have taken place in the vicinity of the site. The sources of information referenced in this element of the desk study include:

- Envirocheck datasheets supplied by Landmark
- Records held by Local Authority / Environment Agency
- Old Ordnance Survey maps and plans
- Geological maps

With reference to the above data there are no recorded landfills in the vicinity of the site. However, with reference to the historical activities on site the presence of made ground should not be overlooked.

2.15 Previous Ground Investigations

The findings of a number of ground investigations undertaken in the vicinity of the site have been provided for the preparation of this report. The stratigraphy of these sites is presented in Table 2.5 and Table 2.6. Figure 2 shows the locations of these ground investigations.

Table 2.5: Stratigraphy from Previous Ground Investigations (Elevations at Top of Stratum in mAOD)

Ground Investigation / Stratum	Fitzrovia Phase 1	Fitzrovia Phases 2 & 3	105 Tottenham Court Road	Sainsbury Wellcome Centre, Howland Street	Arthur Stanley House
Made Ground	22.6 to 26.2	24.9 to 27.4	26.9 to 28.0	24.8	See Note 1.
Lynch Hill Gravel	21.5 to 22.6	21.3 to 24.4	22.4 to 25.2	22.9	19.7 and 20.3
London Clay Formation	19.4 and 21.9	21.0 and 22.1	20.2 to 21.9	18.9	17.4 and 17.7
Lambeth Group	1.2 and 2.5	1.1	3.4 to 4.2	-	1.3
Groundwater	-	24.0	23.80 to 24.05	22.5	21.21 to 21.36

Note: Two boreholes were excavated from sub-basement level during the ground investigation at Arthur Stanley House. Therefore, the elevations and thicknesses of the Made Ground are not consistent with the other records.

Table 2.6: Stratigraphy from Previous Ground Investigations (Thicknesses in m)

Ground Investigation / Stratum	Fitzrovia Phase 1	Fitzrovia Phases 2 & 3	105 Tottenham Court Road	Sainsbury Wellcome Centre, Howland Street	Arthur Stanley House
Made Ground	3.6 to 6.8	2.2 to 4.2	2.8 to 4.7	1.9	See Note 1.
Lynch Hill Gravel	0.4 to 0.9	0.3 to 2.5	0.5 to 5.0	4.0	2.0 and 2.9
London Clay Formation	18.2 to 19.4	21.0	16.3 to 18.0	19.1	16.1
Lambeth Group	Not proven	Not proven	3.6 to 5.0 (Upper Mottled Clay proven)	-	Not proven

Note: Two boreholes were excavated from sub-basement level during the ground investigation at Arthur Stanley House. Therefore, the elevations and thicknesses of the Made Ground are not consistent with the other records.

An accumulative depiction of all the available previous ground investigations is explicitly discussed in the Ground Investigation Data report (AECOM, 2017).

Ground Conditions

03

3. Ground Conditions

3.1 Conceptual Ground Model

All the exploratory holes from previous Ground Investigations (historical BGS boreholes and those referenced in Section 2.15) encountered a variable thickness of Made Ground overlying Lynch Hill Gravel overlying Weathered London Clay. The Weathered London Clay stratum is underlain by London Clay and Lambeth Group. This confirms the stratigraphical succession suggested by the published geological records.

A summary of the general succession of strata for the site, which forms the Conceptual Site Ground Model is presented in Table 3.1 below.

Table 3.1: Conceptual Site Ground Model

Stratum	Depth of Top of Stratum m bgl (m AOD)	Thickness (m)
Made Ground	G.L. (26.7)	3.8
Lynch Hill Gravel	3.8 (22.0)	3.7
Weathered London Clay	7.7 (16.6)	0.6
London Clay	7.8 (13.4)	16.2
Lambeth Group	28.2 (1.7)	–[1]

Notes:
[1] Not defined for the lowest encountered stratum.

3.2 Made Ground

3.2.1 Description

The investigations revealed a variable thickness of Made Ground across the site / adjacent sites, ranging from 21.6mAOD to 25.4mAOD.

The Made Ground was found to be highly variable in nature and reference should be made to the fieldwork records for detailed descriptions of the materials encountered.

3.2.2 Standard Penetration Testing

Six in-situ Standard Penetration Tests (SPTs) were undertaken within the Made Ground, with the SPT “N” values obtained ranging from 3 to 27. The results are plotted against depth and elevation in Figure 6.

3.2.3 Undrained Shear Strength

The Undrained Shear Strength is neglected for the Made Ground for all engineering purposes.

3.3 Lynch Hill Gravel

3.3.1 Description

The Lynch Hill Gravel stratum was encountered at depths ranging from 18.01mAOD to 20.31mAOD. The thickness of the unit ranges from 3m to 4m.

3.3.2 Standard Penetration Testing

Six in-situ SPTs were undertaken within the Lynch Hill stratum, with the “N” values obtained ranging from 8 to 27. The results are plotted against depth and elevation in Figure 6.

3.3.3 Particle Size Distributions (PSD)

PSD testing was undertaken on 7 bulk samples collected from the Lynch Gravel at varying depths. The results of all the PSD tests are plotted on Figure 10. The PSD charts are included within the factual report.

3.4 Weathered London Clay

3.4.1 Description

The Weathered London Clay Stratum was encountered at depths ranging from 16.01mAOD to 17.6mAOD. The thickness of the unit ranges from 1m to 3m.

3.4.2 Standard Penetration Testing

Four in-situ SPTs were undertaken within the Lynch Hill stratum, with the "N" values obtained ranging from 8 to 48. The results are plotted against level in Figure 6.

3.4.3 Natural Moisture Content

Two moisture content tests were undertaken within the Weathered London Clay stratum at varying depths. The results indicated that the natural moisture content was 27%. The results of the moisture content tests are plotted against level in Figure 8.

3.4.4 Atterberg Tests

Two Atterberg Tests were undertaken on samples collected form the Weathered London Clay stratum. The plastic limit ranged from 26% to 28% (average 27%) while the liquid limits ranged from 69% to 73% (average 72%). The plasticity index ranges from 45% to 47% (average 46%). These results classify the clay to be of high to very high plasticity. The plasticity charts for the both the Weathered London Clay and the London Clay Strata are given in Figure 9.

The modified plasticity index, as defined in the NHBC Standards classifies the material as high volume change potential.

3.4.5 Undrained Shear Strength

The undrained shear strength of the material has been determined by 2 laboratory triaxial tests and from 2 in-situ SPTs with values derived after the empirical correlation by Stroud (1988) using $f_1 = 4.5$. The results ranged from $36kN/m^2$ to $216kN/m^2$. Plots of undrained shear strength against level are presented in Figure 7.

3.4.6 Desiccation

The presence, or otherwise, of significant desiccation within the potentially shrinkable soil has been assessed using Driscoll's appropriate criteria of LL x 0.4 and PL + 2% and reference to the undrained shear strength and moisture content profiles, (Figures 7 and 8). On the basis of this assessment the soil does appear to have been desiccated at the time of sampling.

3.5 London Clay

3.5.1 Description

The London Clay stratum was encountered at depths ranging from 2.1m to 16.1m AOD. One hole penetrated the full thickness of the London Clay to the underlying Lambeth Group, indicating a thickness of 13.2m in that hole.

3.5.2 Standard Penetration Testing

Eighteen in-situ SPTs were undertaken within the Lynch Hill stratum, with the "N" values obtained ranging from 22 to 50. The results are plotted against depth and elevation in Figure 6.

3.5.3 Natural Moisture Content

Twenty moisture content tests were undertaken within the London Clay stratum at varying depths. The results indicated that the natural moisture content ranged from 20% to 33%. The results of the moisture content tests are plotted against level in Figure 8.

3.5.4 Atterberg Tests

Fifteen Atterberg Tests were undertaken on samples collected form the London Clay stratum. The plastic limit ranged from 20% to 27% while the liquid limits ranged from 60% to 80% (average 72%). The plasticity index ranges from 44% to 46% (average 45%). These results classify the clay to be of high to very high plasticity. The plasticity chart for the both the Weathered London Clay and the London Clay Strata is given in Figure 9.

The modified plasticity index, as defined in the NHBC Standards 2011 ranges from 44% to 46% which classifies the material as high volume change potential.

3.5.5 Undrained Shear Strength

The undrained shear strength of the material has been determined by 13 laboratory triaxial tests and from 18 in-situ SPTs with values derived after the empirical correlation by Stroud (1988) using f_1 = 4.5. The results ranged from 99kN/m^2 to 900kN/m^2. Plots of undrained shear strength against elevation are presented in Figure 7.

3.5.6 Desiccation

The presence, or otherwise, of significant desiccation within the potentially shrinkable soil has been assessed using Driscoll's appropriate criteria of LL x 0.4 and PL + 2% and reference to the undrained shear strength and moisture content profiles, (Figures 7 and 8). On the basis of this assessment the soil does appear to have been desiccated at the time of sampling.

3.6 Groundwater

Groundwater was encountered during fieldwork at the depths indicated in Table 3.2.

Table 3.2: Summary of Groundwater Observations During Fieldwork

Borehole / Trial Pit(1)	Groundwater Depth (mbgl)	Groundwater Elevation (mAOD)	Stratum(2)
Ch_BH1	5.4	21.2	Lynch Hill Gravel
Ch_BH2	4.5	20.36	Made Ground
Ch_BH3	4	21.11	Lynch Hill Gravel
Ch_WS3	4.7	20.58	Lynch Hill Gravel
Ch_WS5	3.1	22.17	Lynch Hill Gravel
ASH_CC01	0.21	21.58	–
ASH_CC02	0.29	21.55	–
ASH_CC03A	0.23	21.5	–
ASH_CC05	0.22	21.48	–
ASH_CC09	0.21	21.45	–
ASH_CC11	0.21	2.56	–
ASH_CC53	0.32	21.56	–
ASH_CC12	0	21.01	Lynch Hill Gravel
ASH_CC13	0	21.01	Lynch Hill Gravel

Notes:
(1) By the prefixes "Ch_" and "ASH_" it is denoted that the hole is from Charlotte Street and the Arthur Stanley House Ground Investigations respectively.
(2) By "–" it is meant that the monitoring installation was implemented within a structure.

The results of the groundwater monitoring programme undertaken following the completion of boreholes is summarised in Table 3.3.

Table 3.3: Summary of Groundwater Monitoring Results

Borehole[1]	Depth Below Ground Level		Elevation		Stratum[2]
	Min (mbgl)	Max (mbgl)	Min (mAOD)	Max (mAOD)	
ASH_CC01	0.46	0.53	21.58	21.65	–
ASH_CC02	0.54	0.58	21.55	21.59	–
ASH_CC03A	0.49	0.59	21.5	21.6	–
ASH_CC05	0.47	0.61	21.48	21.62	–
ASH_CC09	0.44	0.57	21.45	21.58	–
ASH_CC11	0.54	0.63	21.56	21.65	–
ASH_CC53	0.57	0.61	21.56	21.6	–

Notes:
(1) By the prefixes "Ch_" and "ASH_" it is denoted that the hole is from Charlotte Street and the Arthur Stanley House Ground Investigations respectively.
(2) By "–" it is meant that the monitoring installation was implemented within a structure.

The findings indicate groundwater within the Lynch Hill Gravel in the new basement location, at an average elevation between 21.5m and 21.6m AOD. The direction of groundwater flow appears to be towards the east, with a low hydraulic gradient of 0.001.

3.7 Summary of Geotechnical Parameters

3.7.1 Introductory notes

The parameters presented in this Section have been derived from SPT correlations and laboratory tests when possible. However, the amount of data for the particular site of interest is very limited and these parameters are indicative only. Wide-ranged sensitivity analyses on any calculations based on these parameters have been conducted and this is the reason why the adopted parameters for some analyses might be slightly different that those presented here.

3.7.2 Made Ground

A summary of geotechnical parameters for the Made Ground is provided in Table 3.5.

Table 3.4: Summary of Geotechnical Parameters for Made Ground

Parameter	Unit	Value / Range	Justification
C_u	kN/m^2	22	Lab test results / correlation with SPT CIRIA 143
$Ø_u$	degrees	0	Reasonable assumption
C'	kN/m^2	0	Reasonable assumption
Ø'	degrees	22	Conservative estimation
Bulk Density	Mgm^{-3}	1.8	Conservative Estimation & Lab test results (Charlotte Street Ground Investigation Report)
E_u	kN/m^2	10000	Correlation with SPT CIRIA 143 (E_u = 1000 SPT-N)
E'	kN/m^2	6000	Tomlinson 7th Edition, p. 74 (E' = 0.6 E_u) Correlation with E_u Tomlinson 7th Edition, p. 74)

3.7.3 Lynch Hill Gravel

A summary of geotechnical parameters for the Lynch Hill Gravel is provided in Table 3.5.

Table 3.5: Summary of Geotechnical Parameters for Lynch Hill Gravel

Parameter	Unit	Value / Range	Justification
C'	kN/m^2	0	Reasonable assumption
Ø'	degrees	30	Conservative estimation
Bulk Density	Mgm^{-3}	1.95	Conservative Estimation & Lab test results (Charlotte Street Ground Investigation Report)
E'	kN/m^2	14400	Correlation with SPT CIRIA 143 p. 87 (E' = 130 C_u)

3.7.4 Weathered London Clay

A summary of geotechnical parameters for the Weathered London Clay is provided in Table 3.5.

Table 3.6: Summary of Geotechnical Parameters for Weathered London Clay

Parameter	Unit	Value / Range	Justification
C_u	kN/m^2	50	Lab test results / correlation with SPT CIRIA 143
$\acute{Ø}_u$	degrees	0	Reasonable assumption
C'	kN/m^2	0	Reasonable assumption
$\acute{Ø}$'	degrees	21	Conservative estimation
Bulk Density	Mgm $^{-3}$	1.96	Conservative Estimation & Lab test results (Charlotte Street Ground Investigation Report)
E_u	kN/m^2	10000	Correlation with SPT CIRIA 143 (E_u = 1000 SPT-N)
E'	kN/m^2	6000	Correlation with SPT CIRIA 143 p. 87 (E' = 130 C_u)

3.7.5 London Clay

A summary of geotechnical parameters for the London Clay is provided in Table 3.5.

Table 3.7: Summary of Geotechnical Parameters for London Clay

Parameter	Unit	Value / Range	Justification
C_u	kN/m^2	50 + 10 z	Lab test results / correlation with SPT CIRIA 143
$\acute{Ø}_u$	degrees	0	Reasonable assumption
C'	kN/m^2	0	Reasonable assumption
$\acute{Ø}$'	degrees	23	Conservative estimation
Bulk Density	Mgm $^{-3}$	1.96	Conservative Estimation & Lab test results (Charlotte Street Ground Investigation Report)
E_u	kN/m^2	400 C_u	Correlation with SPT CIRIA 143
E'	kN/m^2	130 C_u	Correlation with SPT CIRIA 143

Foundations and Ground Engineering

04

4. Foundations and Ground Engineering

4.1 Details of the Development

The proposed development is for the former Middlesex Hospital, including the listed Union Work House building that fronts Cleveland Street. The Work House is retained and the development behind this comprises a two to seven storey building with a new single storey basement and roof plant.

The new basement will be generally 2m to 3m deeper than the existing Work House basement, with a proposed structural slab level at 22.80m AOD. Secant bored pile walls will be constructed around the perimeter of the new basement to form perimeter support for the basement excavation. A layout plan of the proposed basement and surrounding buildings is included as Figure 3.

4.2 Geotechnical Hazards

The following ground-related hazards have been identified during the investigation:

- Variable Made Ground deposits
- Changes in stratigraphy, levels for Lynch Hill Gravel, London Clay and lower stratigraphy
- Variable existing foundation details
- Obstructions comprising previous foundations
- Possibility of archaeology and/or burial remains
- Shallow groundwater within the excavation area
- Shrinkable clay soils

4.2.1 Stratigraphy

The presence of Made Ground across the site, which varies in properties and thickness, makes the depth to the underlying Lynch Hill Gravel variable. This combines with slight level changes in the surface of the London Clay across the site to make the Lynch Gravel thickness variable. More precise levels for these surfaces site wide will be investigated further in the next investigation stage, with a focus on the northwest corner where there are underpinning works and the perimeter secant wall will be designed to support four columns.

4.2.2 Existing Substructures (Foundations / Basements / Services / Tunnels)

The existing basement to the hospital and the Work House building has been surveyed and plans are provided in the Phase 1 report. A number of pits have been excavated with the hospital basement areas and these indicate both brick and concrete foundations. This includes survey for the service tunnel and external ground levels surrounding the site. The scheme has been developed in a manner that retains the existing basement, with a secant piled wall around the perimeter of the new basement with two areas in the north west corner that utilise underpinning to retain the existing structure.

4.2.3 Archaeology

The desk study by MoLAS indicates the site does not lie in a Local Authority archaeology priority areas and it generally has a low potential for archaeological remains. In one of the six previous trial holes disarticulated human remains were identified in a culvert. The report notes the following for the basement development:

> "Appropriate excavation would be required for any human remains that would be disturbed by the proposed development (i.e. full excavation for articulated remains). For disarticulated human remains full excavation may not be required and could be removed by an exhumation contractor under a watching brief."

4.2.4 Groundwater

Previous groundwater monitoring from the local site investigation boreholes has identified groundwater within the Lynch Hill Gravel, and an average elevation of ~21.5mAOD is indicated for the site location. This level may fluctuate and further installations and groundwater monitoring is recommended in Section 5.

Groundwater is present in the shallow aquifer overlying the London Clay, and testing from an adjacent site with a similar profile did not indicate any risk of desiccation.

4.3 Foundations

4.3.1 General

In view of the nature and thickness of the Made Ground and the building loads piled foundations are recommended for the new building and basement construction.

4.3.2 Piled Foundations

The construction of either bored and continuous flight auger (CFA) piles are recommended at this site. Bored piles may require temporary casing into the London Clay due to the Lynch Hill Gravel and possible presence of groundwater.

Detailed pile design is outside the scope of this report. Preliminary pile design is undertaken in accordance with BS EN 1997-1:2004 and using the UK National Appendix document.

Calculated working loads using the conceptual ground model assume the presence of Made Ground, which does not contribute shaft friction. Shaft friction is provided in the Lynch Hill Gravel, London Clay and Lambeth Group strata, where piles penetrate to this level.

4.4 Basement Excavation

The perimeter of the basement excavation will be supported by a secant bored piled wall, and this may comprise hard firm CFA or bored piles. There is also the possibility that perimeter piles may be bored using cased CFA methods. The use of secant piles will protect against the ingress of any unstable ground in the short and long term and allow installation and support prior to excavation. The basement excavations are likely to be braced with a single level propping system, with both horizontal and raking props. Where raking props are installed a berm will remain and the excavation will be sequenced to help control movements.

In the north-west corner of the site the retained building is to be underpinned. At the joint between the secant piled wall and the underpinning grouting methods may be used where required. Further groundwater monitoring will be carried out prior to basement construction to assess groundwater levels prior to construction.

Excavation within the basement area should be possible using conventional site plant. Breakers may be necessary to remove existing foundations, slabs and service runs.

4.4.1 Basement Heave

For this single storey basement the excavation is primarily in Made Ground. Basement heave is not considered significant given the geometry and nature of the basement structure, the presence of new piled foundation bases within the footprint of the basement and the limited excavation depth. This will be assessed further in the next design stage. Heave will be controlled by the installation of piles to the perimeter of the basement and within the basement for piled foundations.

4.5 Retaining Walls

A perimeter wall assessment that has been carried out and this is reported in the Ground Movement Assessment Report. The following characteristic soil parameters in Table 4.1 are used.

Table 4.1: Geotechnical Parameters for Preliminary Retaining Wall Assessment

Parameters		Stratum			
		Made Ground	Lynch Hill Gravel	Weathered London Clay	London Clay
Case A[1]					
Angle of shearing resistance	φ'	22	30	21	23
Drained cohesion	c' (kN/m²)	0	0	0	0
Undrained shear strength	s_u (kN/m²)	20	–	50	50 to 67.5
Bulk unit weight	γ_b (kN/m³)	18	19.5	19.6	19.6
Young's modulus – undrained	E_u (kN/m²)	10,000	–	10,000	20,000 to 27,000
Poisson's ratio – undrained	ν_u	0.5	–	0.5	0.5
Kr ratio (ν/1- ν)	K_r	1	–	1	1
Young's modulus – drained	E' (kN/m²)	2,860	14,400	5,200	6,300 to 8,925
Poisson's ratio – drained	ν'	0.25	0.25	0.2	0.2
Kr' ratio (ν /1- ν)	Kr'	0.33	0.33	0.25	0.25
Case B[2]					
Angle of shearing resistance	φ'	22	30	21	23
Drained cohesion	c' (kN/m²)	0	0	0	0
Undrained shear strength	s_u (kN/m²)	20	–	50	50
Bulk unit weight	γ_b (kN/m³)	18	19.5	19.6	19.6
Young's modulus – undrained	E_u (MN/m²)	10,000	–	10,000	20,000
Poisson's ratio – undrained	ν_u	0.5	–	0.5	0.5
Kr ratio (ν/1- ν)	K_r	1	–	1	1
Young's modulus – drained	E' (MN/m²)	2,860	14,400	5,200	6,300
Poisson's ratio – drained	ν'	0.25	0.25	0.2	0.2
Kr' ratio (ν /1- ν)	K_r'	0.33	0.33	0.25	0.25

Notes 1:

1. The active and passive earth pressure coefficients are calculated by WALLAP.

Notes 2:

[1] In Case A the secant pile wall is assessed along the northwest – southeast direction
[3] In Case B the secant pile wall is evaluated along the southwest – northeast direction

A groundwater level of 21.5m AOD has been identified within the Lynch Hill Gravel.

4.6 Drainage

Current drainage is to the local surface water network and the new drainage measures will use the same design approach.

4.7 Chemical Attack on Construction Materials

Further testing will be carried out on soil and groundwater samples and the results of these chemical tests used to assess the Aggressive Chemical Environment for Concrete (ACEC) Class and the Design Sulphate Class for the site.

Recommendations for Further Work

05

5. Recommendations for Further Work

This Geotechnical Interpretative Report provides details of the work carried out at planning application stage for the basement impact assessment. This report will be updated and revised following further ground investigation works at the site. The investigation works will include geo-environmental elements to further assess the chemical nature of the made ground and natural materials that will be excavated and to investigate and report on the presence or absence of ground gas.

The following scope of work for the investigation is noted:

- Two deep (cable percussion) boreholes to 30m below ground level to investigate the deeper ground profile, in-situ tests, and sampling for laboratory testing to inform the detailed foundation design
- Three to four shallow (window sampler) boreholes up to 12m below ground level to investigate the shallower ground profile, and enable groundwater and gas installations within the Lynch Hill Gravels and for in-situ testing, sampling for laboratory testing to inform the geotechnical and geo-environmental aspects of the project
- Trial pits at selected locations (hand tool excavations) to investigate existing foundations
- Geotechnical and geo-environmental laboratory testing
- Factual Report

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06

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Figures

Figures

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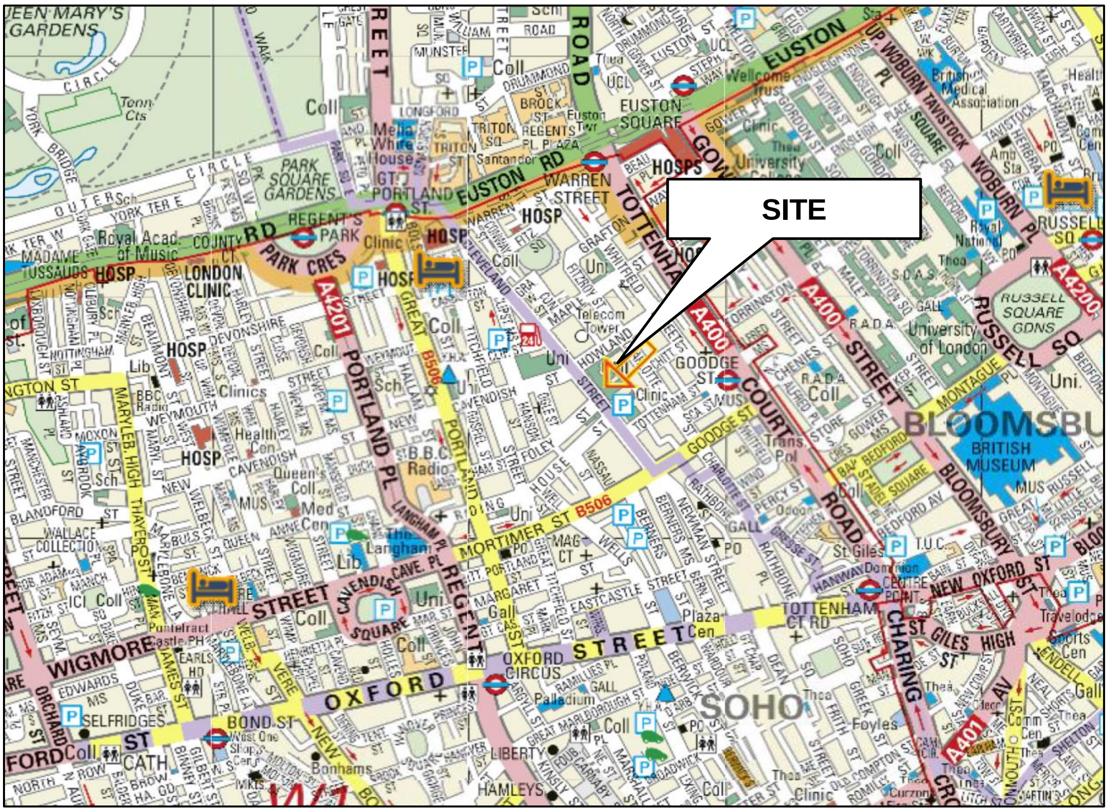

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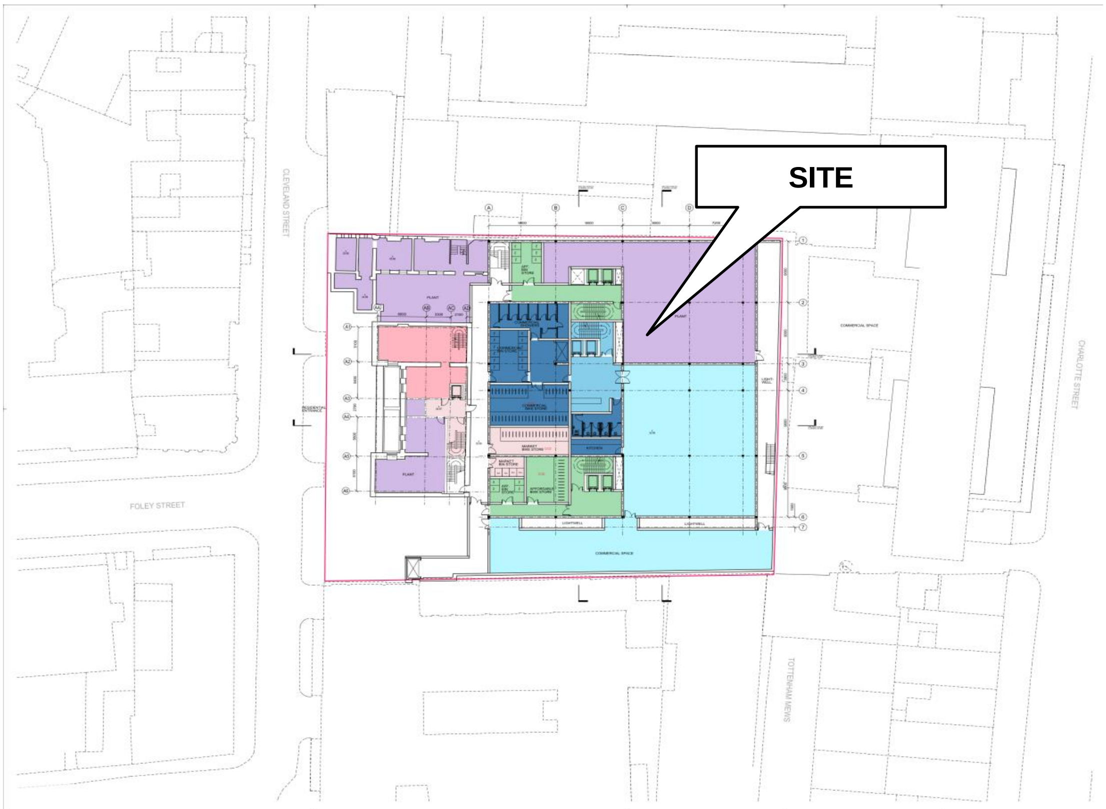

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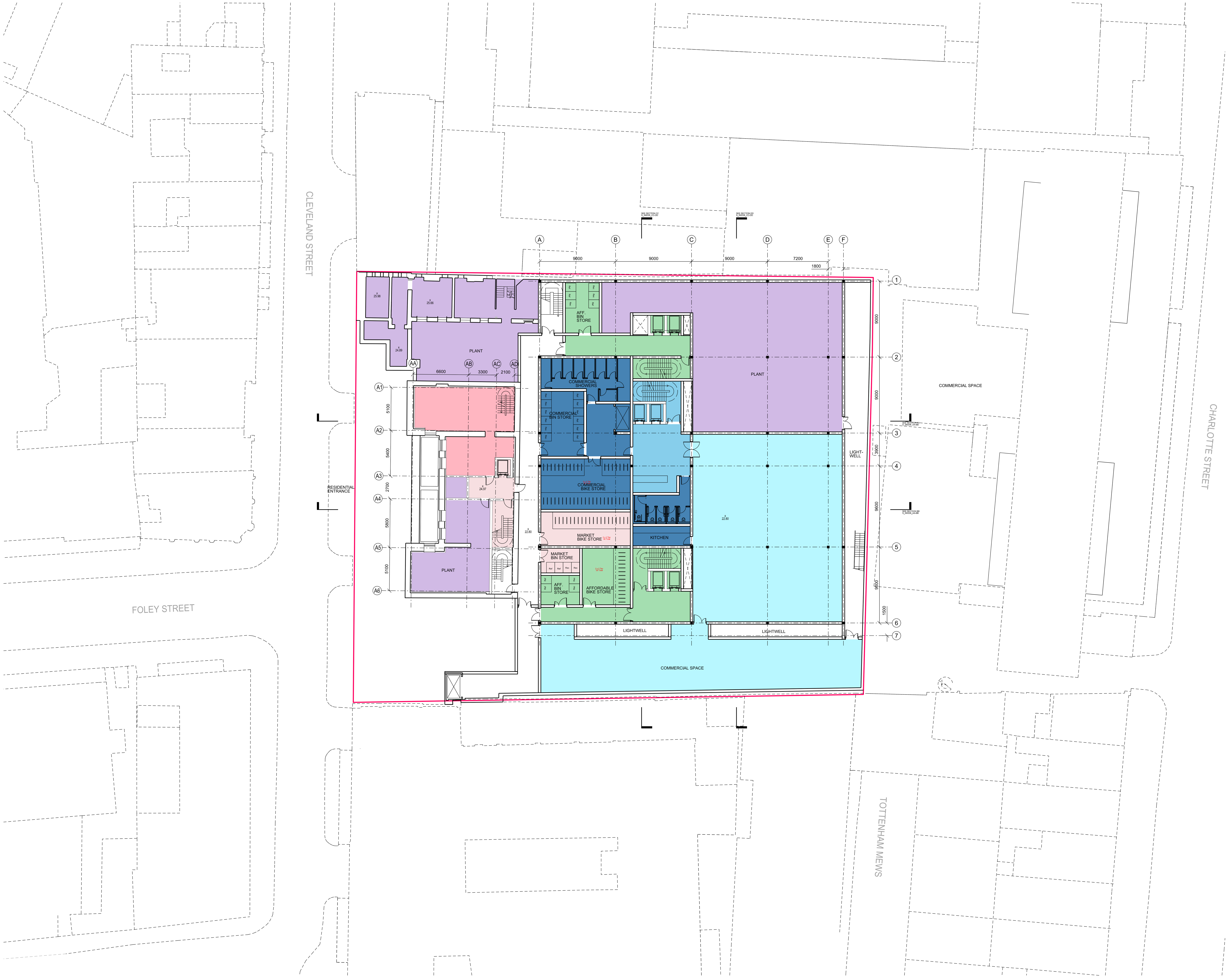

Notes
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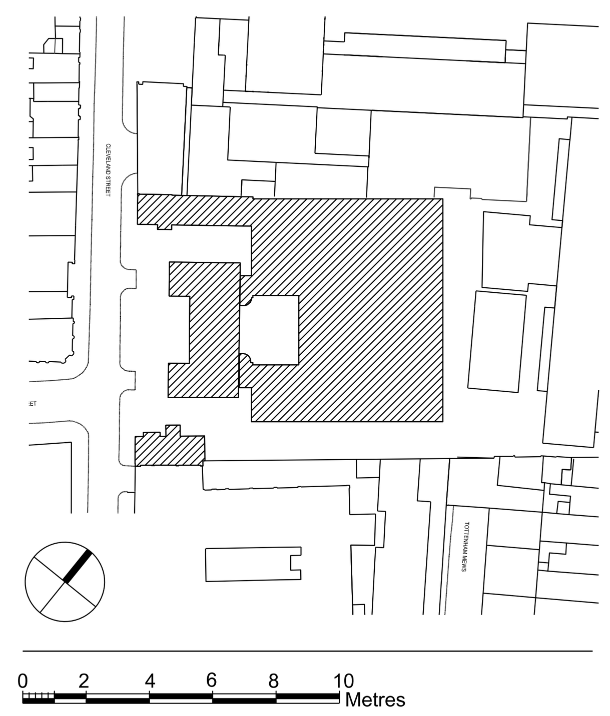
Key plan



*Information based on Survey done by others

- Affordable Housing (Legacy Units)
- Affordable Housing Circulation & Support Areas
- Market Housing
- Market Housing Circulation & Support Areas
- Affordable Housing (Nurse/Apprentice)
- Affordable Housing (Nurse/Apprentice) Circulation & Support Areas
- Commercial Office
- Commercial Office Support
- Commercial/ Office Circulation
- Shared Plant/Ancillary

No. Description Date By
Revisions

Structural Consultant | Services Consultant

Project Manager | Cost Consultant

Project Title
Middlesex Annexe Hospital

Client
University College London Hospitals Charity (UCLHC)

Drawing Title
General Arrangement Level B1

Project Number: LD15 078.00
Drawing Number: P_B1_GA
Revision:

Scale @ A1
1:200

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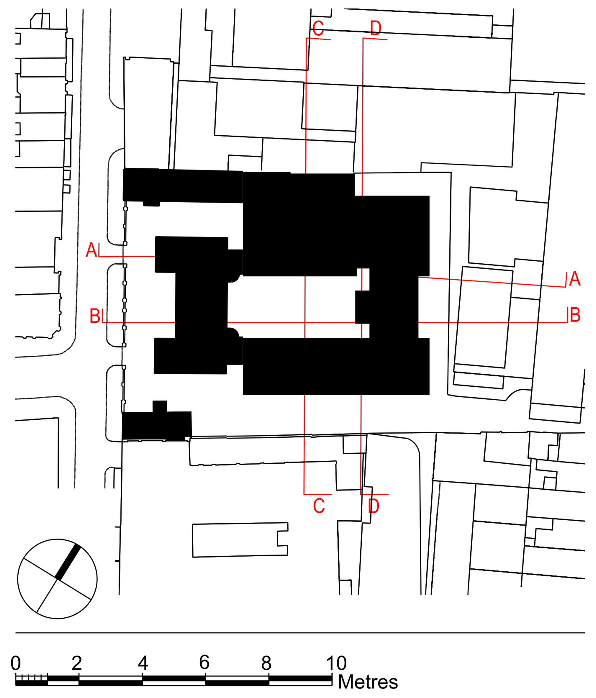
Key plan



*Information based on Survey done by others

- Affordable Housing (Legacy Units)
- Affordable Housing Circulation & Support Areas
- Affordable Housing
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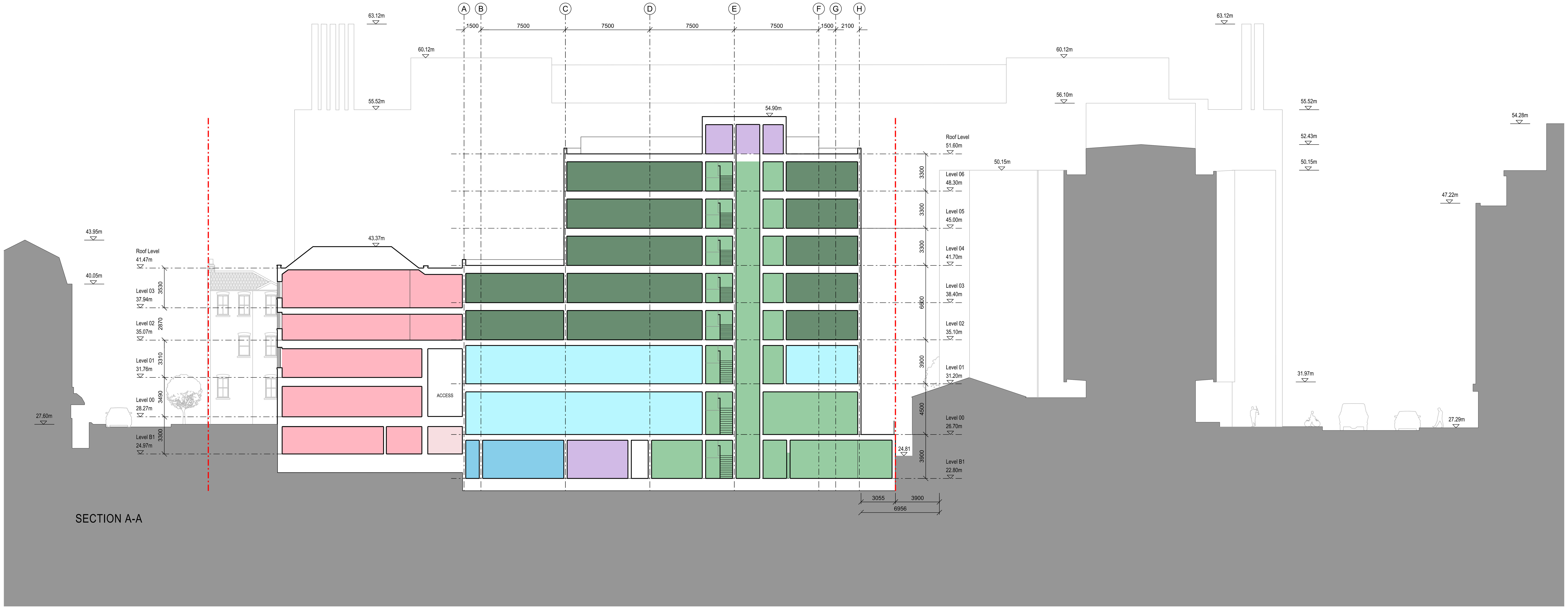
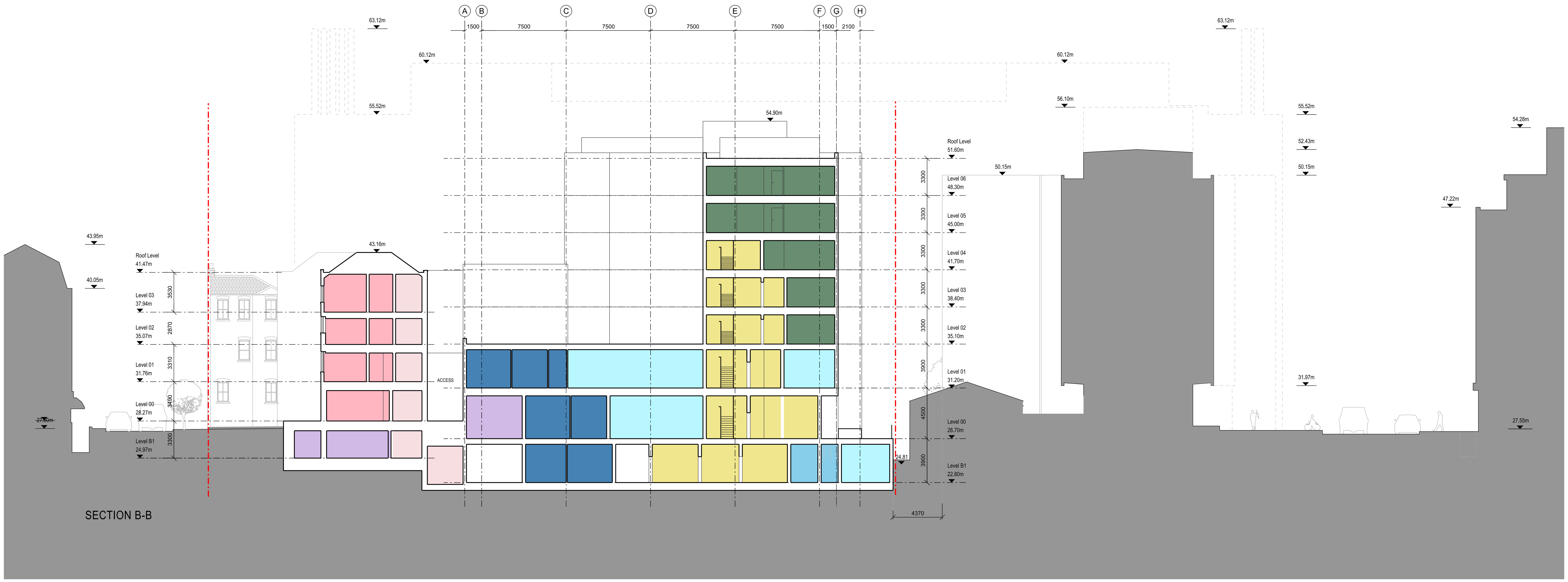
- Commercial Office Support
- Commercial/ Office Circulation
- Shared Plant/Ancillary



SECTION A-A



SECTION B-B

No.	Description	Date	By

Revisions

Structural Consultant

Services Consultant

Project Manager

Cost Consultant

Project Title
Middlesex Annexe Hospital

Client
University College London Hospitals Charity (UCLHC)

Drawing Title
Sketch Option 09
Sections AA & Section BB

Project Number: LD15 078.00
Drawing Number: S_SKE09_AA-BB
Revision:

Scale @ A1
1:200

Date
16-03-07

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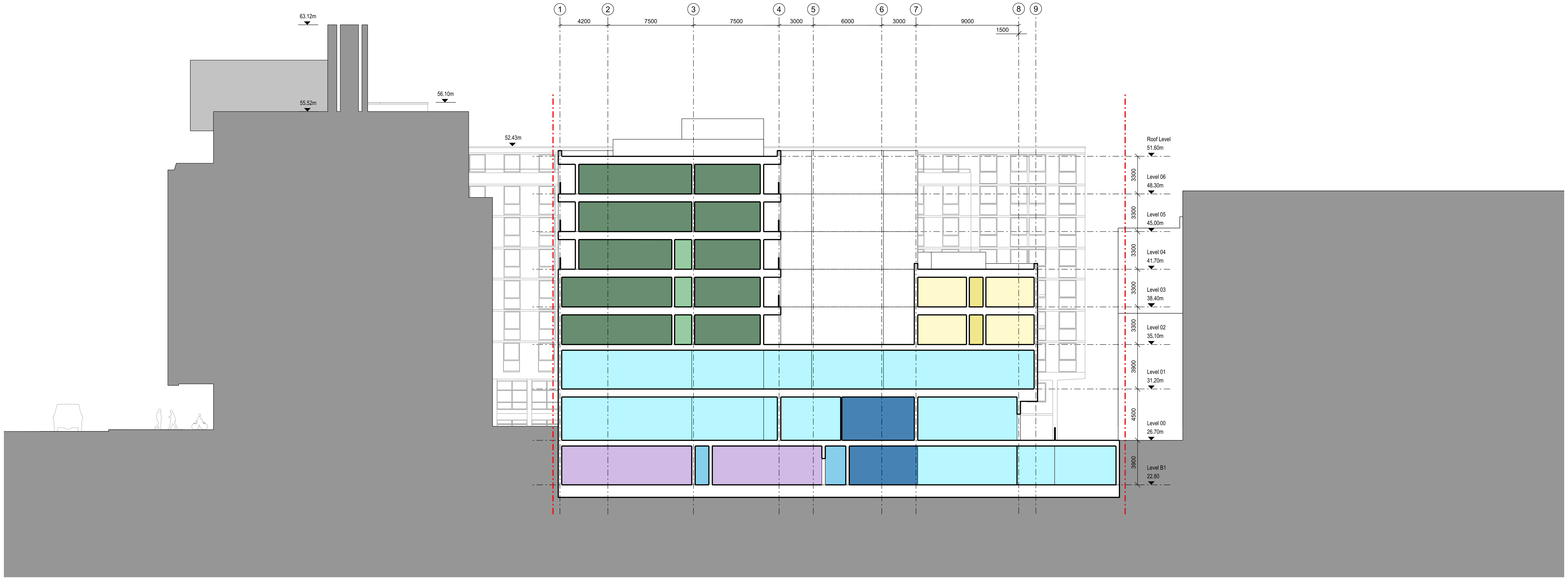
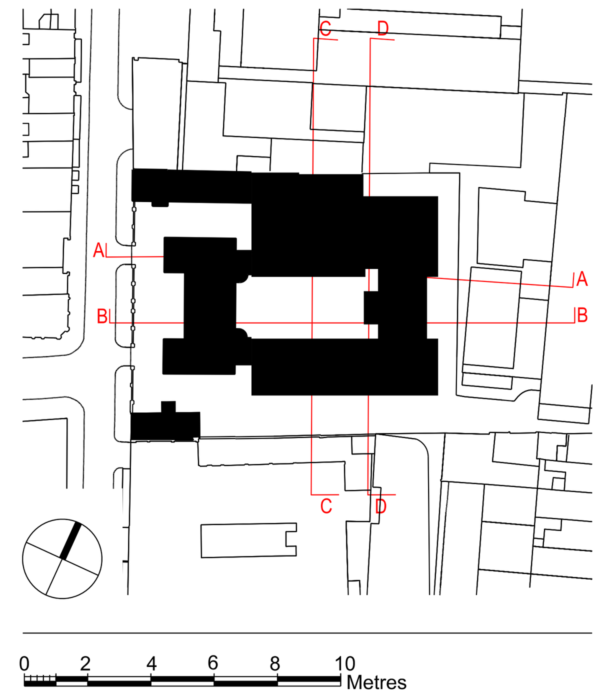


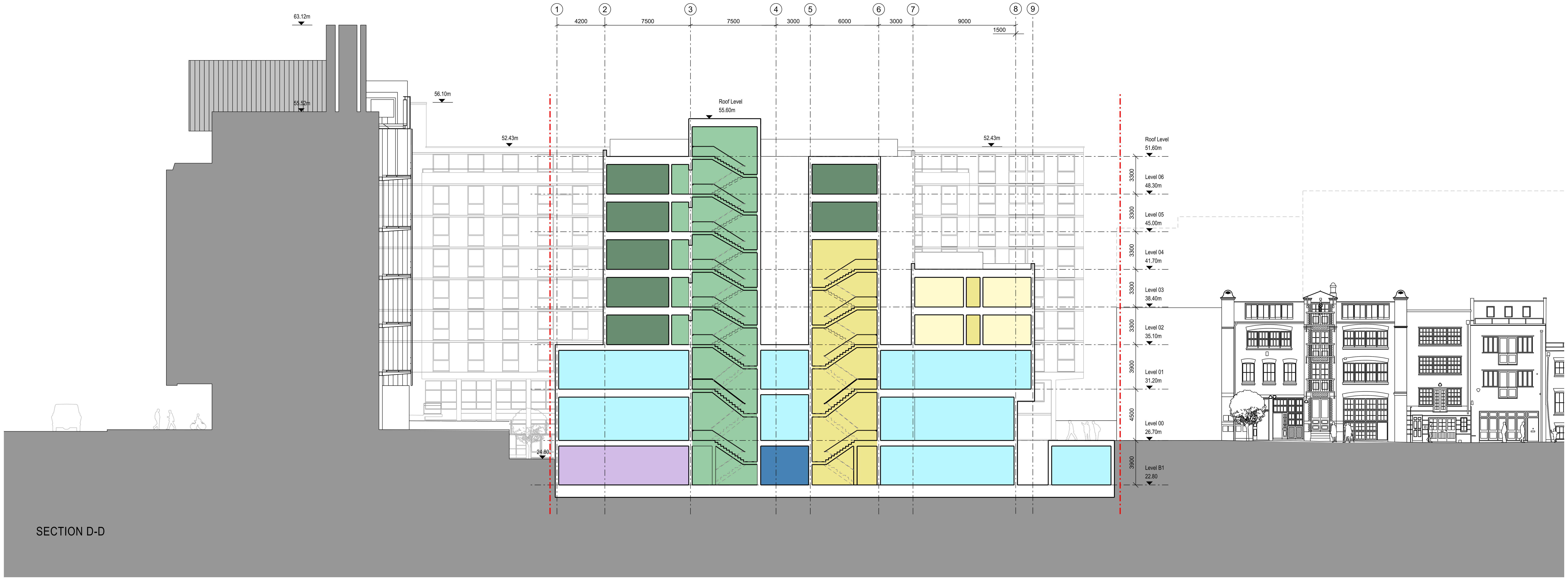
Notes
- All dimensions to be checked on site
- Do not scale off this drawing
- All dimensions are shown in mm unless otherwise stated
- Refer to drawing issue sheet for purpose of issue
- If in doubt ask
- © Llewelyn Davies

Key plan



*Information based on Survey done by others

- Affordable Housing (Legacy Units)
- Affordable Housing Circulation & Support Areas
- Affordable Housing
- Market Housing
- Market Housing Circulation & Support Areas
- Affordable Housing (Nurse/Apprentice)
- Affordable Housing (Nurse/Apprentice) Circulation & Support Areas
- Commercial Office
- Commercial Office Support
- Commercial/ Office Circulation
- Shared Plant/Ancillary



No. Description Revisions | Date | By

Structural Consultant | Services Consultant

Project Manager | Cost Consultant

Project Title
Middlesex Annexe Hospital

Client
University College London Hospitals Charity (UCLHC)

Drawing Title
Sketch Option 09
Section CC & Section DD

Project Number	Drawing Number	Revision
LD15 078.00	S_SKE09_CC-DD	

Scale @ A1
1:200

Date
16-03-07

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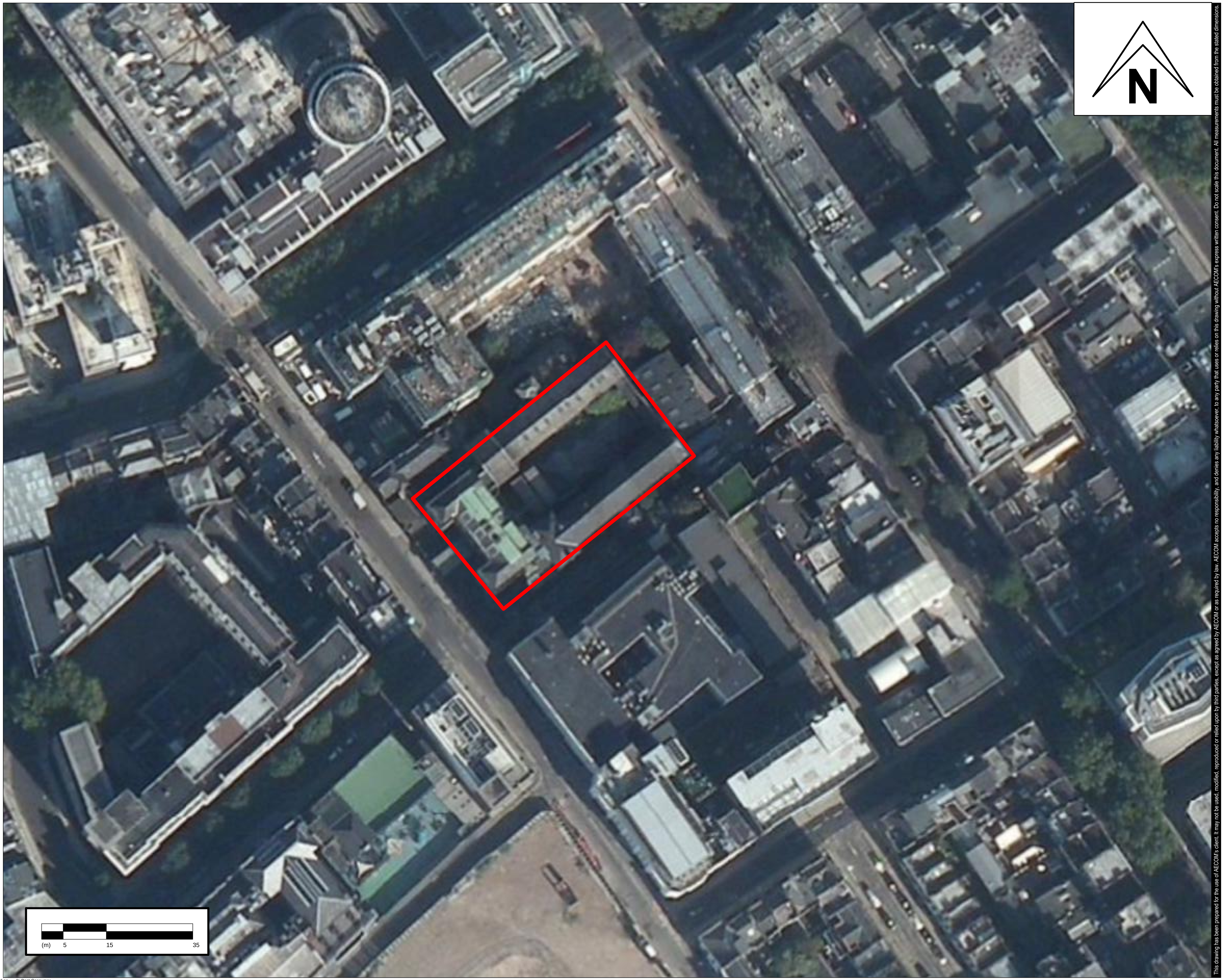

AECOM

PROJECT

MIDDLESEX HOSPITAL ANNEX

CLIENT

UNIVERSITY COLLEGE LONDON HOSPITALS CHARITY

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GENERAL NOTES

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	05/04/2017	FIRST ISSUE

KEY PLAN

PROJECT NUMBER

60516144

SHEET TITLE

Figure 3
Site Boundary

SHEET NUMBER

60516144/GIR/03

ISO A1 594mm x 841mm Approved: PAS Checked: PAS Designer: EZ Project Management Initials:

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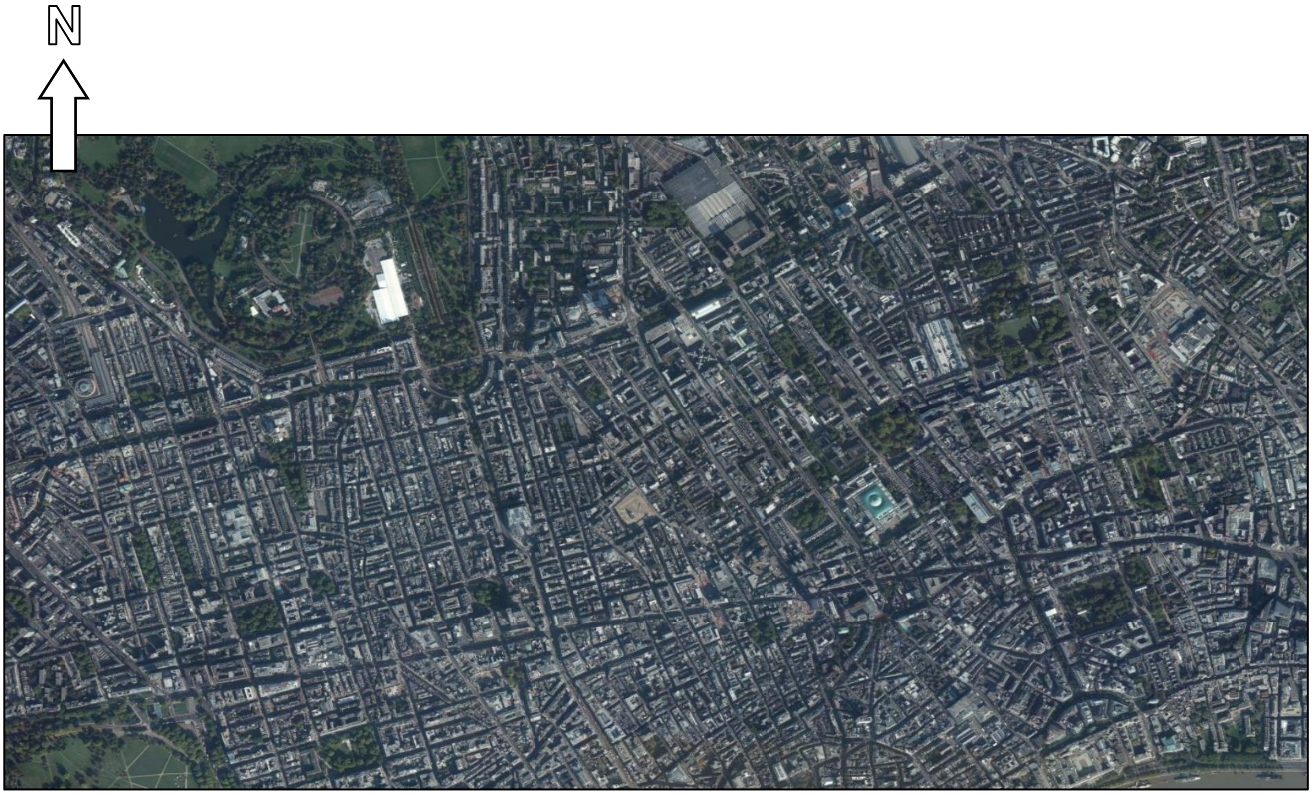

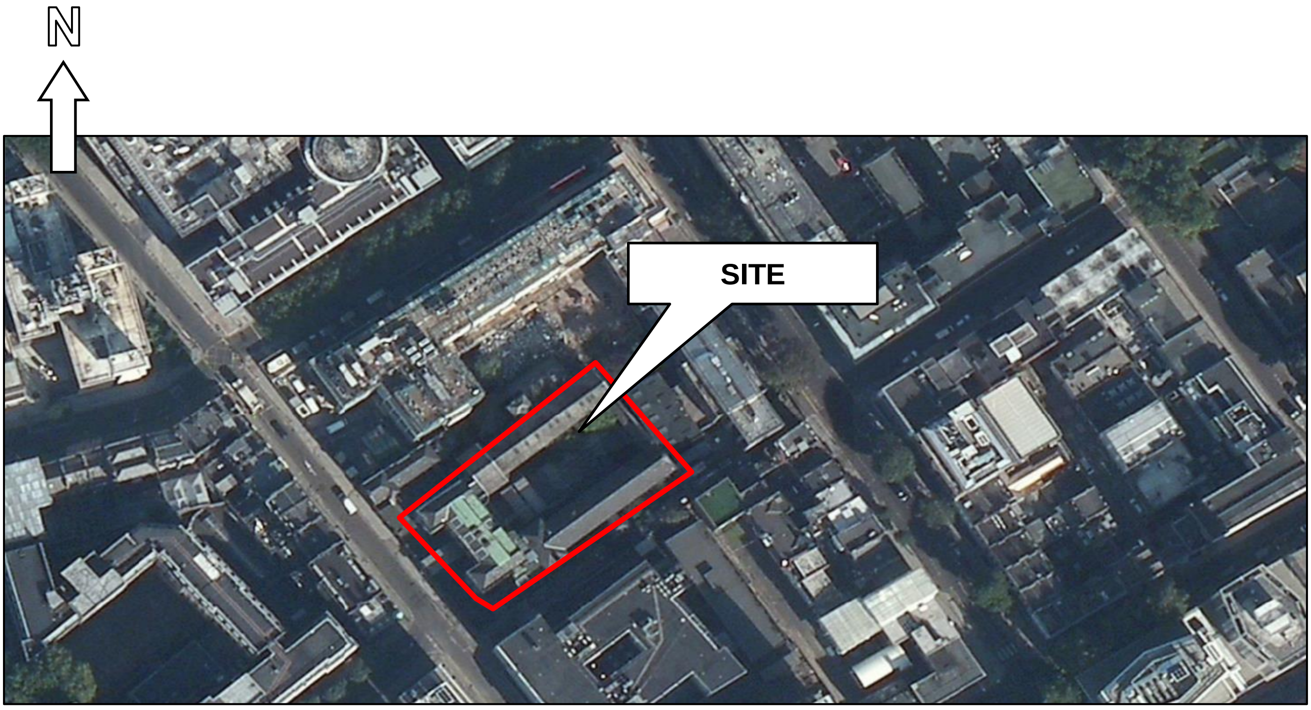

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Made By: NP	Apr-17	2016 Aerial Photograph	
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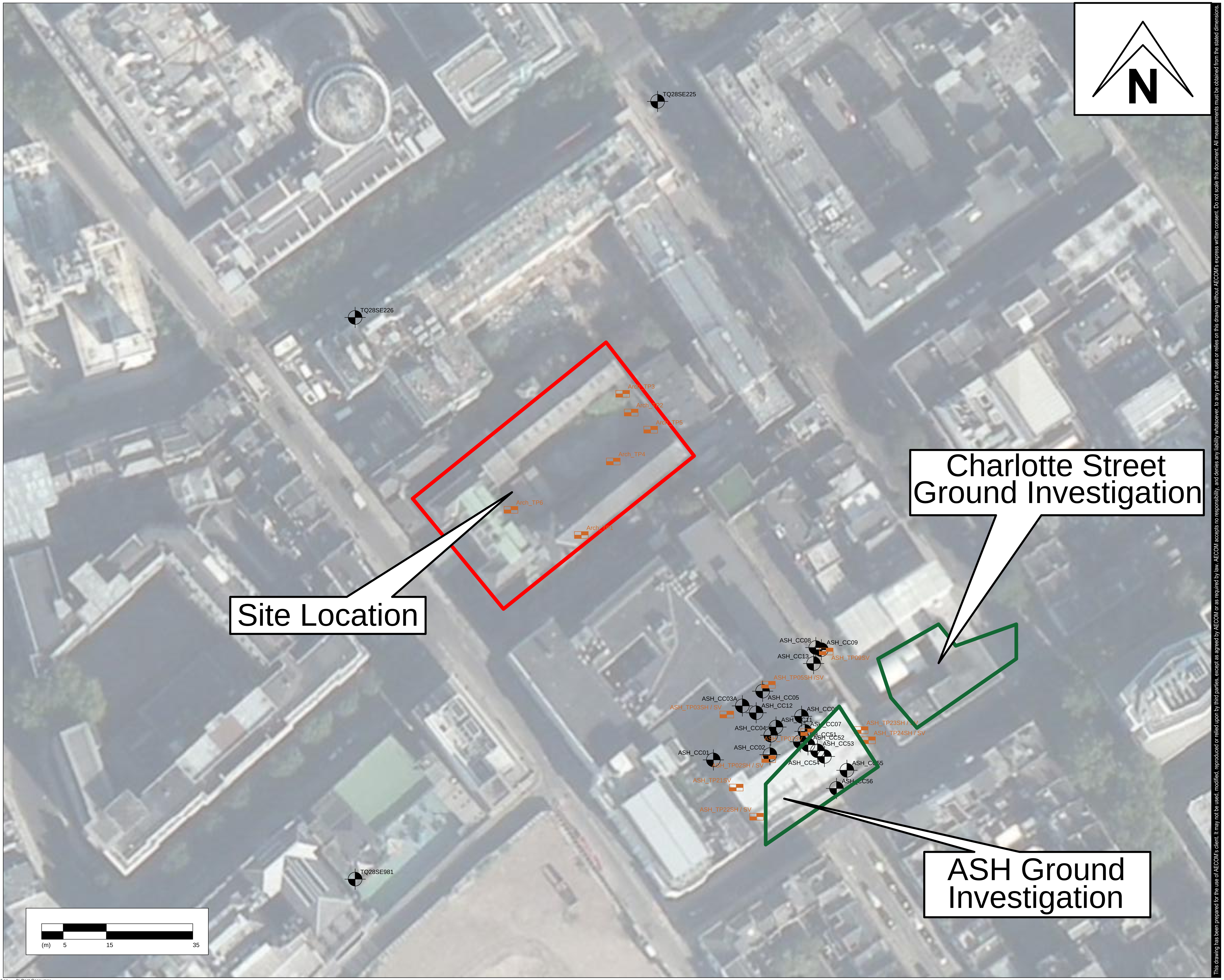
App:	PAS	Rowan House Driving Academy	
		Project Reference	Figure No.
		60516144	4



N

AECOM

PROJECT

MIDDLESEX
HOSPITAL ANNEX

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COLLEGE LONDON
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GENERAL NOTES

1. All Ground Investigation (GI) holes are denoted with a prefix:
ASH_: Arthur Stanley House GI
Arch_: Archaeological GI

2. Amongst the Archaeological Ground Investigation, Arch_TP4 was not implemented due to obstructions including buried services.

ISSUE/REVISION

I/R	DATE	DESCRIPTION
01	05/04/2017	FIRST ISSUE

KEY PLAN

TP Trial Pit Notation

BH Borehole Notation

PROJECT NUMBER

60516144

SHEET TITLE

Figure 5
Historical, Previous and Archaeological Ground Investigations

SHEET NUMBER

60516144/GIR/05

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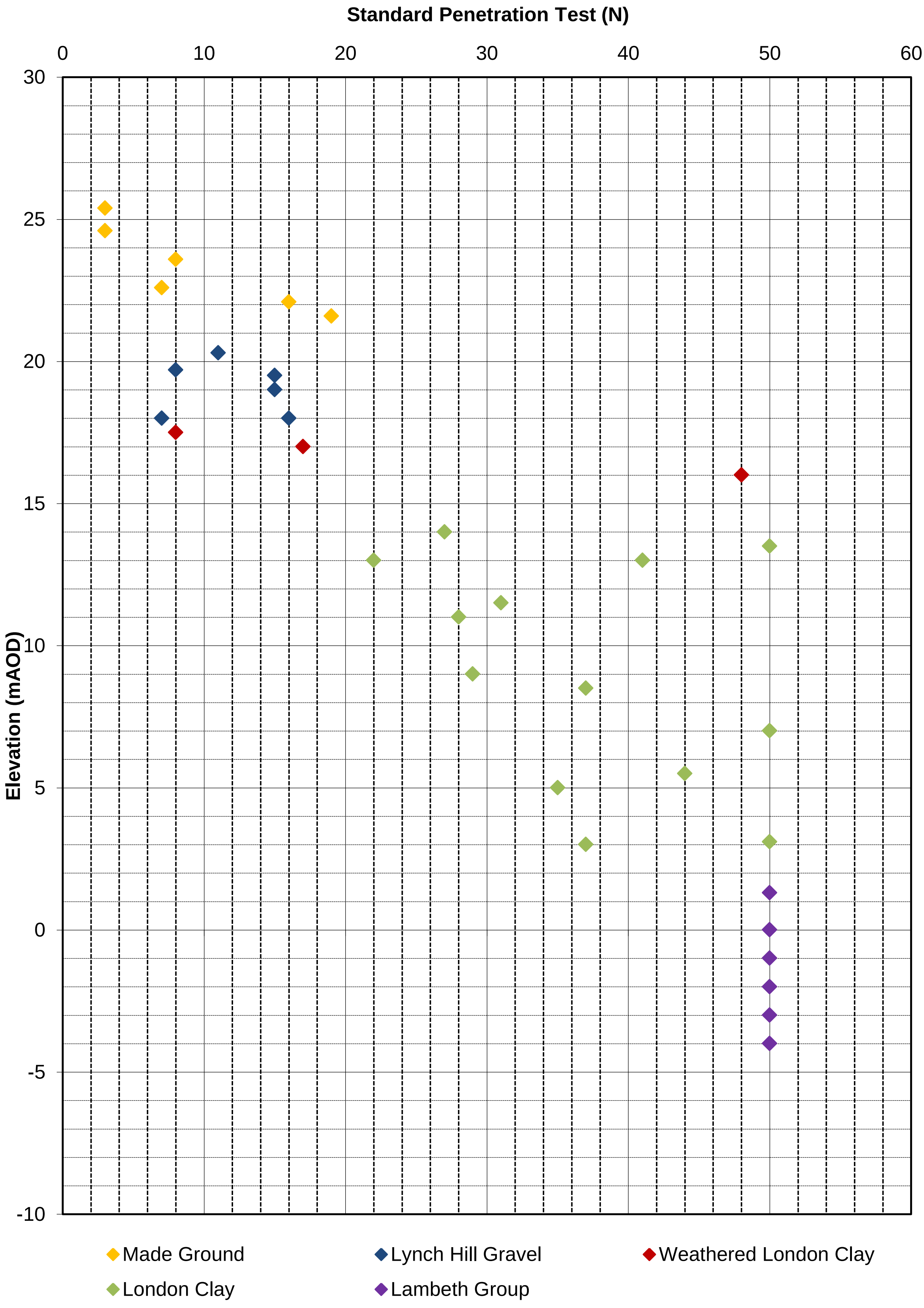

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Made by:	EZ	Date	Apr-17		
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				Figure no.	6

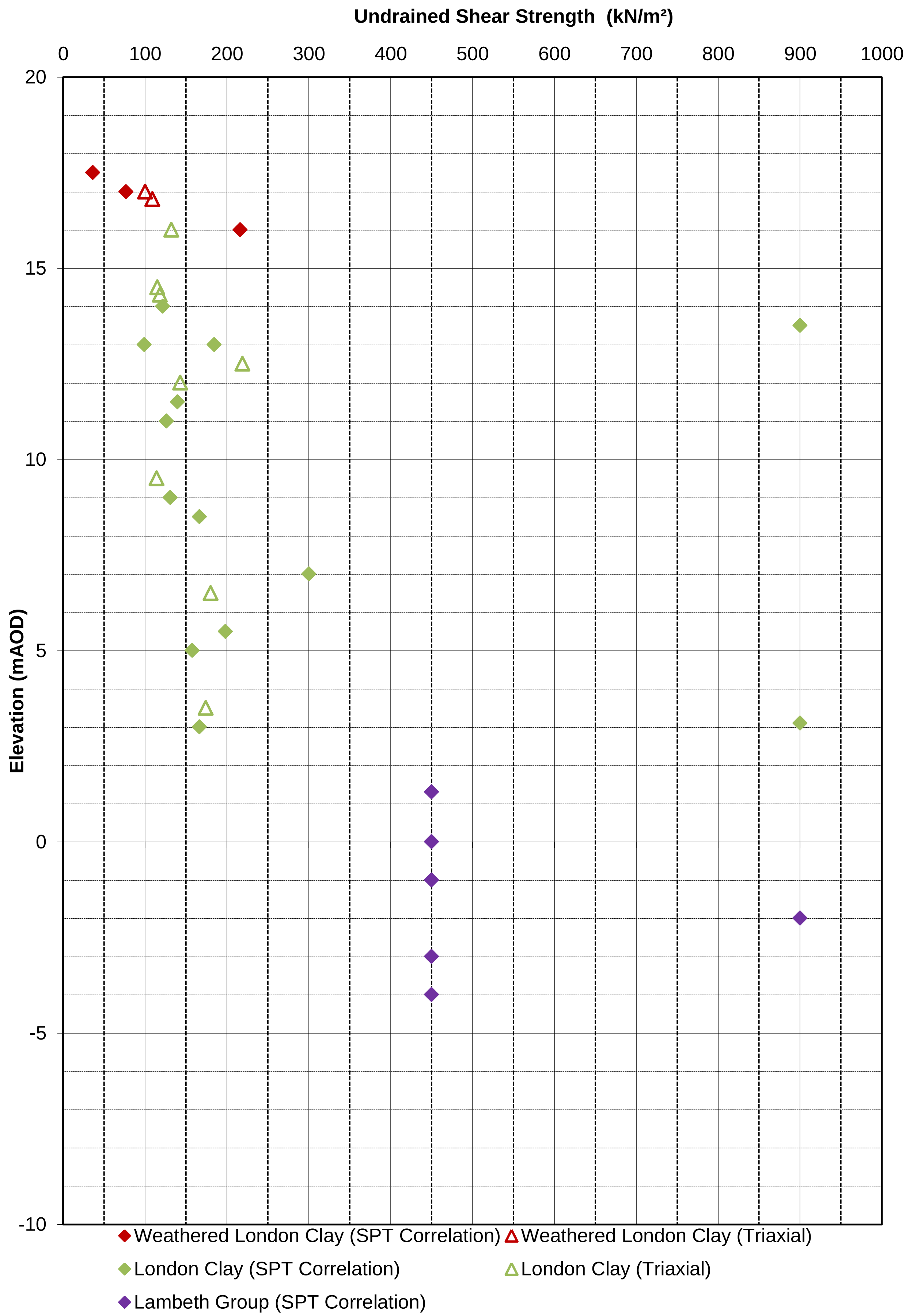

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				Figure no.	7

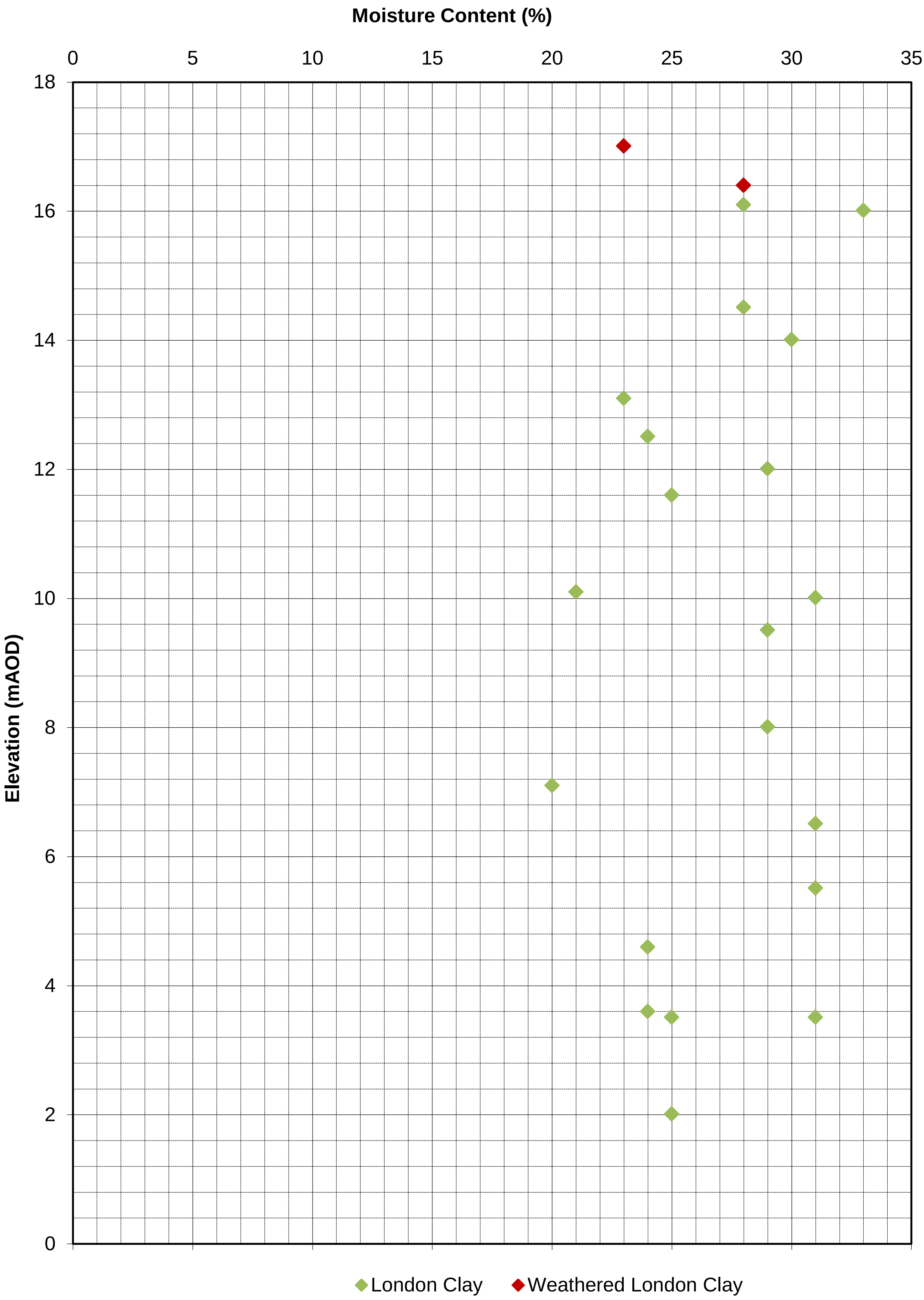

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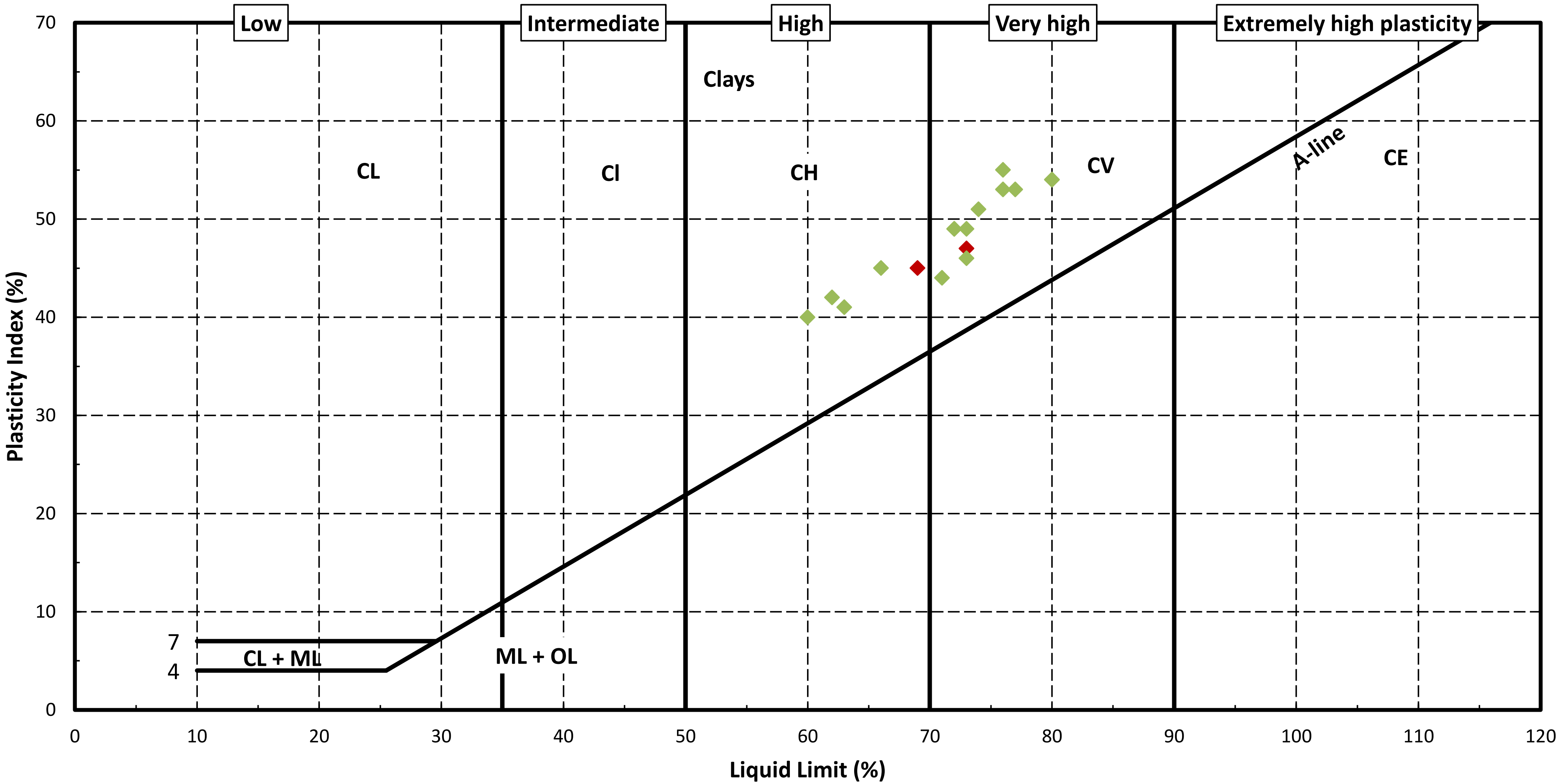
				Figure no.	**8**



Chk:	PAS	App.:	PAS	Site: University College London Hospitals Charity (UCLHC)
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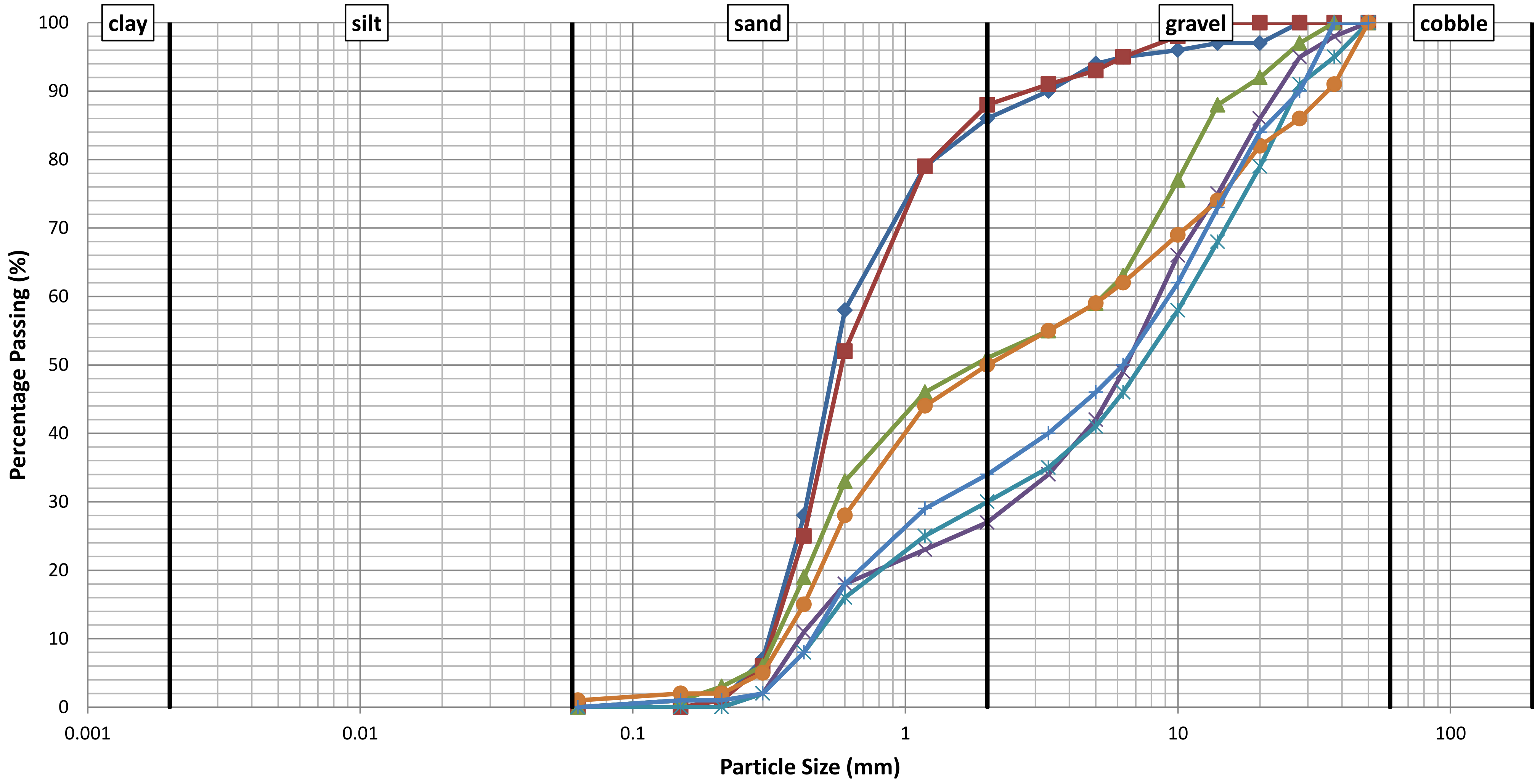
				Figure no. 9



Chk:	PAS	App.:	PAS	Site:	Rowan House Driving Academy
Made by:	EZ	Date	Apr-17		
AECOM				Title:	Particle Size Distribution - Lynch Hill Gravel
				Figure no.	10