REMEDIATIO□ & E□ABLI□G WORKS STRATEGY

For□ er Withington Hospital
Cavendish Road
Manchester
M20 1LB

Prepared for:

Bellway

E3P Report: 10-□33-R2
Issued: October 201□



e3p | Environmental | Energy | Engineering

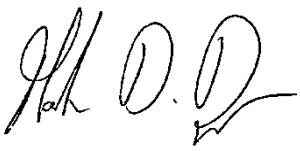
E3P

Heliport Business Park,
Liverpool Road,
Eccles,
Manchester,
M30 7RU

Tel : + 00 (0) 161 707 9612
http:\\www. e3p.co.uk

Registered in England
No.: 807255262

□□ALITY ASS□RA□CE

REMARKS	Final
DATE	September 2016
PREPARED BY	N Sellars
QUALIFICATIONS	MEarthSci, FGS
SIGNATURE	
CHECKED BY	D Cox
QUALIFICATIONS	
SIGNATURE	BSc, FGS, AIEMA
AUTHORISED BY	M Dyer
QUALIFICATIONS	BSc, FGS, AIEMA, MIEnvSc, CEnv
SIGNATURE	
PROJECT NUMBER	10-933

Executive Summary	
Site Address	Former Withington Hospital, Cavendish Road, Manchester, M20 1LB
□ational Grid Reference	E383850, N392450
Site Area	1.99Ha
Bac□ground	E3P has been instructed by Bellway Homes to develop a Remediation Strategy and Enabling Works Performance Specification for the proposed residential development at the site located off Cavendish Road in Didsbury. The E3P Remediation & Enabling works strategy has been produced in due consideration of the Geo-Environmental Site Investigations undertaken by E3P in June 2015 and June 2016. Bellway Homes intend to construct a low rise residential development with associated garden and landscaped areas, access road and infrastructure. The current development layout details the construction of circa 79 no. detached and semi-detached dwellings
Contaminated Land Assessment	
Hu□ an Health Ris□ Assess□ ent	The Tier I Human Health risk assessment has identified the presence of marginally elevated non-volatile PAHs compounds and asbestos within the shallow Made Ground deposits across the central portion of the site in proximity to the former main hospital building. Elevated TPH C12-C21 compounds have been identified in TP202 in the south eastern sector. No chlorinated solvents, dioxin or furan compounds were identified above the Tier 1 assessment criteria for the proposed residential end use within the areas targeted during the supplementary investigations. Due to the site wide presence of elevated PAHs within the Made Ground deposits, all garden / landscaped external areas will require the installation of a 600mm chemically suitable cover system (comprising 450mm subsoil and 150 topsoil), thereby removing the exposure pathway and ensuring no unacceptable risk to the future site users. Asbestos in the form of chrysotile / amosite – bitumen and loose fibres have been identified within a number of Made Ground deposits at the site. As such, it will be necessary to design a phase of remediation and enabling works where methodologies are agreed to carefully manage these impacted soils and place them in a legislatively complaint manner that will negate any possibility of future exposure. With regards to the elevated TPH compounds, these present a potential volatilisation to indoor air risk. These elevated concentrations have only been identified within one area of the site and are therefore considered to be a localised hotspot. Therefore, remediation in the form of a hotspot removal should be instigated in accordance with an approved remediation strategy.

Executive Summary	
Controlled Waters Risk Assessment	The site is deemed to be located within a moderate to high risk setting for controlled waters due to the presence of a Secondary A Aquifer in the shallow drift overlying a Principal Aquifer in the underlying bedrock. However, the presence of low permeability clay with discontinuous sand lenses will significantly reduce the overall risk profile. In this instance, given the low solubility of contaminants exceeding the GAC values within the soils and groundwater, and presence of underlying cohesive soils at depth acting as an aquatard effectively limiting the vertical and lateral migration of any mobile contaminants, it is considered that the site poses no unacceptable degree of risk to controlled waters or the wider environ.
Ground Gas	Elevated CO2 causes the site to fall into Characteristic Situation 2 / Amber 1 and therefore gas protection measures are required.
Coal Mining & Historical Workings	The site is not considered to be at risk from mining or quarrying related issues.
Geotechnical Considerations	The remediation and enabling works will be delivered in a manner that will seek to ensure: • *Where shallow stratum suitable of supporting a shallow spread foundation is encountered, care should be taken to minimise the disturbance to natural drift deposits;* • *Where deep Made Ground is present (>1.50m) the stratum should be prepared in a manner that will facilitate re-engineering using a Vibro Stone Column (VSC);* • *If VSC is proposed for plots located within the influence of trees, the stratum should be prepared to mitigate the potential risk associated within volumetric instability in cohesive soils; and,* • *Engineer all up-filled materials beneath highways to sub-grade in accordance with the requirements of this specification to ensure a CBR >5% in the sub-grade and 15% on the capping.*

Executive Summary	
Su□ □ary of Site Re□ediation & Enabling Wor□s	The site Remediation / Enabling Works Strategy provides a comprehensive specification for the regeneration of the land to negate identified pollutant linkages and construct a development platform that will be geotechnically suitable for the proposed end use. The salient features of the Remediation & Enabling Works Strategy are summarised below: • Implement all works in strict accordance with UK Environmental Permitting and Local Planning Authority Requirements; • Controlled removal of all trees and vegetation; • Investigation of areas below current structures; • Removal and treatment of all invasive plans species (if required); • Demolitions and Removal of all relict foundations and buried features in their entirety; • Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials; • Excavation, delineation and validation of TP202 hydrocarbon hotspot; • Validation sampling and leachate testing to confirm material retained on-site pose no unacceptable risk to the residential end users, controlled waters or wider environ; • Importation of suitable material (if required) to achieve the required development levels; and, • Replacement of material in accordance with the E3P enabling specification & engineering requirements.
Su□ □ary of Build Phase Mitigation Re□uire□ ents	The developer's works will also include the completion of the following additional elements: • Provision of a 600mm cover system using certified material with appropriate validation within proposed garden areas, comprising 450mm subsoil overlain by 150mm topsoil; • Provision of a 300mm cover system using certified material with appropriate validation within proposed areas of Public Open Space and soft landscaping; and, • Installation of ground gas protection measures to achieve Characteristic Situation 2 / Amber 1.

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Appendix IV E3P Remediation / Validation Criteria
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Appendix VI United Utilities Potable water Supply Assessment

1. I□TROD□CTIO□

1.1 Bac□ground

E3P has been instructed Bellway Homes Manchester to develop a Remediation Strategy and Enabling Works Performance Specification for the proposed residential development at the site located to the south of Cavendish Road in Didsbury

1.2 Report Objectives

The objectives of this report are to:

- Prepare an overview of Contaminated Land Remediation requirements;
- Evaluate feasible remedial technologies;
- Assess the most appropriate earthworks solution to ensure the delivery of the optimum development platform;
- Define validation criteria to demonstrate the successful implementation of a site Remediation & Enabling works plan;
- Specify Geotechnical Engineering Performance Requirements; and,
- Ensure the safe, cost effective and regulatory compliant redevelopment of the site.

1.3 Scope of Wor□s

The development of the risk management strategy for the subject site includes the following tasks:

- Identification the relevant pollutant linkages;
- Review of site characteristics;
- Identification of geotechnical constraints;
- Development of remedial objectives;
- Selection of appropriate remedial technology; and,
- Development of remedial strategy.

1.□ Previous Wor□s

The following phases of Geo-Environmental investigations have previously been carried out at the site:

E3P: *E3P Geo-Environmental Site Investigation Report (ref:10-541-R1) dated June 2015 Prepared for: CBRE*

E3P: *E3P Geo-Environmental Site Investigation Report (ref:10-933-R1) dated June 2016 Prepared for: Bellway Homes (Manchester)*

To inform the assessment of the potential risk to contaminated land within the context of the proposed residential development and to inform the preparation of the Remediation Strategy the pertinent points from the above reports are summarised within Section 2.0.

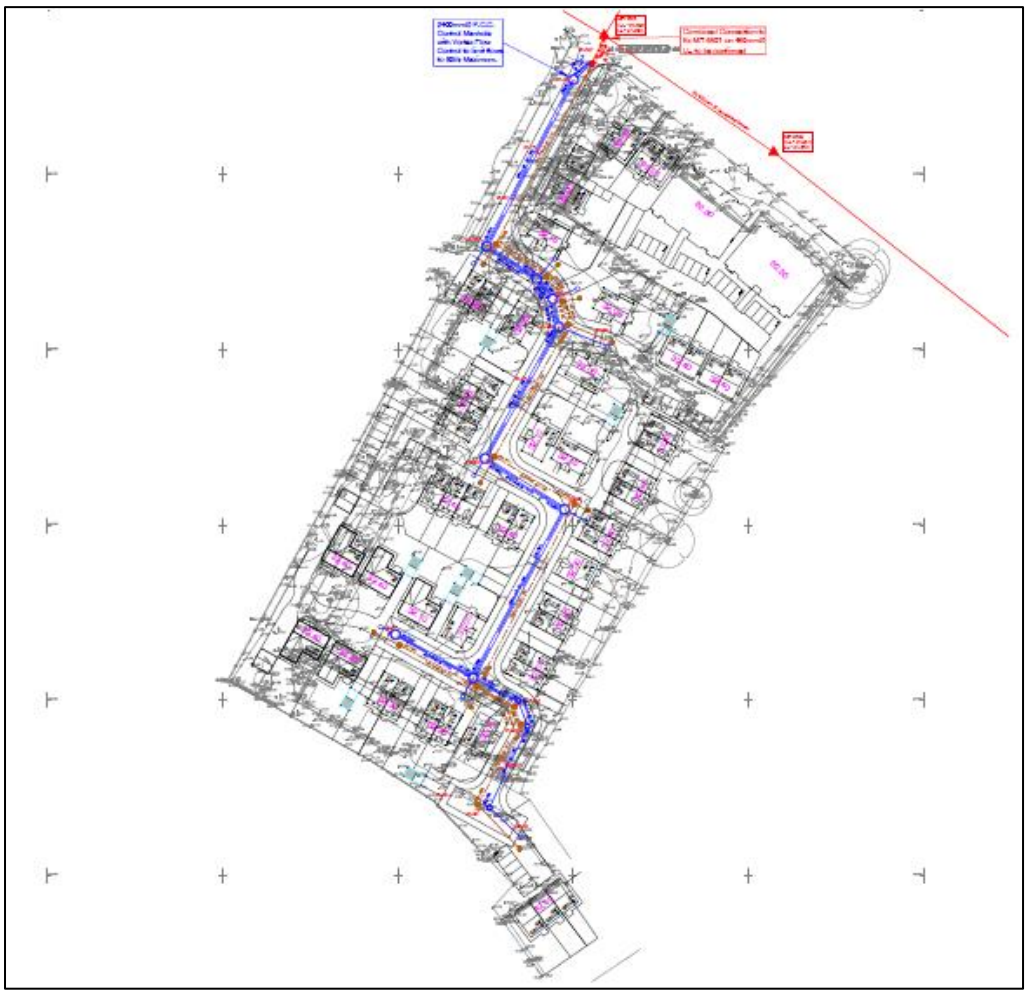
For the avoidance of any doubt, the E3P Geo-Environmental Site Investigation Report should be read both as a precursor and in conjunction with this document.

1.5 Redevelop□ent Plan

E3P understands that Bellway Homes intend to construct a low rise residential development comprising circa 50 low rise dwelling comprising terraced, semi-detached and detached housing and 2 No. three storey apartment blocks at the northern site boundary.

The development will incorporate private gardens, driveways, adopted estate roads & service and drainage infrastructure. The proposed development plan is included in Appendix III and is shown as a snapshot in Figure 1.1 below.

Figure 1.1 Proposed Development



1. Summary of Parties Involved

FUNCTION / INTEREST	NAME OF PARTY
Local Planning Authority	Manchester City Council
Developer	Bellway Homes Manchester
Geo-Environmental Consultant	E3P
Main Contractor	Bellway Homes
Remediation / Enabling Works Contractor	ADM Regeneration
Human Health Regulator	Manchester City Council
Controlled Waters & Waste Regulator	Environment Agency

1.7 Regulatory Correspondence

Bellway Homes Manchester are in the process of submitting a detailed Planning Application to Manchester City Council for the proposed redevelopment of the site for low rise residential housing with associated adopted estate roads and infrastructure.

It is presumed that as part of the planning approval process, the Planning Authority will undertake consultation with the pertinent statutory consultees which will include:

- *Environmental Health / Contaminated Land Officer at the Local Authority (or external advisor); and,*
- *Environment Agency Planning Liaison.*

1.8 Site Details

Site Address	Former Withington Hospital, Cavendish Road, Manchester, M20 1LB
National Grid Reference	E383850, N392450
Site Area	1.99Ha
Tenure	Freehold

All acronyms used within this report are defined in the Glossary presented in Appendix II.

A site location map is presented in Appendix III as Drawing 10-933-001.

1. Site Summary

SITE DESCRIPTION & SETTING		
Occupancy/use	The subject site is a roughly rectangular parcel of land located circa 5.5km south of Manchester City Centre and can be segregated into three distinctive sectors; the northern portion comprises a former disablement centre and associated asphalt car parking area, the central (former main hospital building) is void of all structures following recent demolition activities while the southern sector remains in use by NHS services with a furniture factory accessed via a road along the western extent of the site.	
Environmental Setting	*Drift Geology*	GlacioFluvial Deposits (Sand and Gravel) underlain by Glacial Till (Clay).
	Bedrock Geology	Wilmslow Sandstone Formation
	Hydrogeology	Secondary A Aquifer within the Superficial Drift (moderate to high risk receptor) overlying Principal Aquifer in the solid rock (high risk receptor) but no Source Protection Zone (SPZ).
	Surface Water	There are no surface watercourses in influencing distance to the site.
	Source Protection Zone	None
	Groundwater Sensitivity	Principal Aquifer with no extraction within 1km.
	Surface Water Safeguarding Zone	None
	Groundwater Safeguarding Zone	None
Site History	A review of the pertinent Ordnance Survey mapping dating from circa 1840s to the present day indicates the site was historically utilised as a nursery for plant cultivation with a small track transecting north south at the eastern boundary and a series of small undefined buildings at the southern margin of the site. In the early to mid 20th century, the site was utilised as a recreational ground / playing fields associated with the adjacent school. It is possible that some low level land raising occurred. The first notable development was the construction of the Withington Hospital complex in the 1970's with the three main buildings that remain to the present day.	
Landfill Sites & Ground Gases	No recorded landfill / waste treatment sites are present within influencing distance of the proposed development, as such underlying Made Ground is considered to be the only potential low-level source of hazardous ground gas.	

1.10 Su□ □ary of Reported Ground Conditions

E3P has prepared a detailed Site investigation report (Ref: 10-933-R1) dated February 2015, the summary of reported ground conditions is summarised below:

S□MMARY OF GRO□□D CO□DITIO□S	
Made Ground	Made Ground was encountered across all areas of the site to a maximum proven depth in excess of 2.0m bgl and varied across the distinct sectors of the site. Across the northern profile of the, Made Ground generally comprised a gravelly sand and/or sandy gravel of limestone, sandstone, brick and infrequent coal underlying areas of soft-standing gravelly clay (WS101) and asphalt (WS104 & WS105) to depths of between 0.35m - 0.75m bgl. The central portion of the site is predominantly sandy gravel of limestone within the upper horizons (near surface hard core), underlain by sandy gravel of concrete, brick, glass and timber with cobbles / boulders of concrete and/or a gravelly clayey sand with gravel of sandstone, limestone, brick and concrete extending to depths of between 0.65m – 1.40m bgl. The ground investigation identified three in-situ concrete slabs remaining at the surface and possible in-situ basement structures at depth a number of locations. Underlying the thick concrete slab in the eastern sector at a brown sandy gravel was encountered to 0.90mbgl with gravel of concrete and limestone. The natural sandy drift deposits were identified beneath the made ground. Underlying the thick concrete slab in the northern central sector at Made Ground comprised a slightly gravelly sand with gravel of sandstone underlain by natural sandy drift deposits at 1.20mbgl. A number of buildings still occupy large areas of the north and southern profile with associated asphalt hard-standing underlain by a gravelly sand with gravel of brick, ash, asphalt, sandstone and limestone to depth of between 0.57m – 1.00m bgl. A number relict foundations and underground obstructions were encountered across the site, predominantly the central sector underlying the former main hospital building which resulted in the termination of a number of trials pits and relocation of 8 No. window sample probeholes. Further obstructions, relict foundations and historic infrastructure are anticipated beneath the buildings to be demolished in the north and southern sectors.
Topsoil	No topsoil that would be deemed suitable for re-use has been identified within any of the exploratory hole locations.

S□MMARY OF GRO□□D CO□DITIO□S	
Drift	Drift deposits were encountered within all locations where Made Ground was penetrated from depths of between 0.35m to 1.50m bgl to a maximum proven depth in excess of 13.30m bgl. Drift deposits were not encountered within all exploratory holes due to the inability to penetrate the full depth of Made Ground due to obstructions and instability associated with granular fill material. The superficial deposits were generally consistent across the site and comprised a Medium Dense fine to coarse occasionally gravelly SAND overlying a firm to very stiff occasionally sandy CLAY at depth in excess of 3.60m bgl to completion at 13.30m bgl.
Bedroc□	The bedrock geology was not encountered, however the deep boreholes confirmed very stiff high strength clay with an inferred undrained shear strength in excess of 400kN/m2 at circa 12.0m bgl.
Groundwater	Groundwater strikes were generally encountered as perched within the shallow Made Ground and seepages / standing water at depth between 0.70 and 2.80m bgl.

2. E3P CO□TAMI□ATIO□ RISK ASSESSME□T

2.1 Bac□ground

E3P has completed a Tier 1 Qualitative Contaminated Land Risk Assessment to determine them potential risk to human health, controlled waters and the wider environ, This assessment is documented in full within the E3P Geo-Environmental Site Investigation Report and for clarity is summarised below.

2.2 Hu□an Health Ris□ Su□ □ary

The E3P Tier 1 Qualitative Human Health Risk Assessment identified concentrations of the following determinants at or above the screening criteria for the assessment of no unacceptable degree of risk to human health.

- Benzo(a)Anthracene;
- Chrysene;
- Benzo(b)Fluoranthene;
- Benzo(a)Pyrene;
- Dibenzo(a,h)Anthracene; and
- Asbestos
- TPH C12-C16
- TPH C16-C21

All of the identified elevated concentrations with the exception of TPH C12-C16 have primary exposure pathways related to dermal contact and ingestion of soils, inhalation of particulate and consumption of home-grown vegetables. The risk to chronic human health associated with the elevated concentrations of non-volatile PAH compounds can be mitigated through the installation of a 600mm chemically validated cover system in all proposed private gardens, and a 300mm chemically validated cover system within all soft landscaping and Public Open Space to remove any potential for direct exposure to impacted soils.

With regards to the elevated C12-16 TPH compounds, these present a potential volatilisation to indoor air risk. These elevated concentrations have only been identified within one area of the site and are therefore considered to be a localised hotspot. It will be necessary to implement a process of delineation, removal and remediation of the impacted soils the wider site enabling works. The hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity.

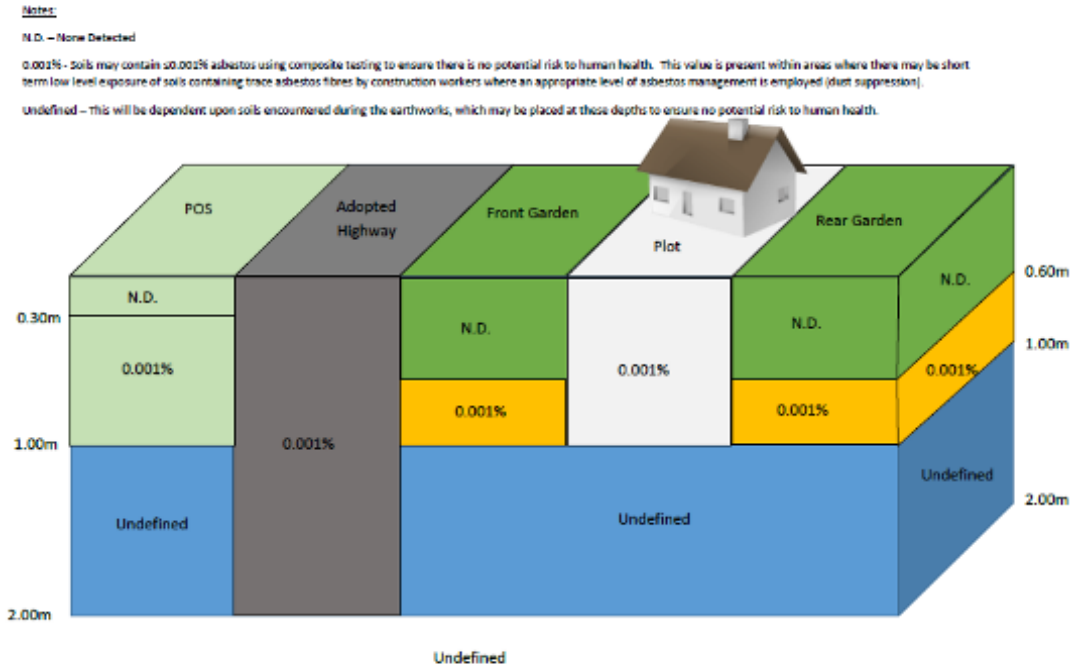
Asbestos (Chrysotile / Amosite – Bitumen / Loose Fibres) were identified within 7 No. samples analysed from across all areas of the site.

In addition quantification analysis identified 0.002% Chrysotile in the shallow made ground in TP208 and <0.001% Chrysotile in the shallow made ground in WS201.

E3P has produced as asbestos specific CSM which identifies the locations that asbestos impacted soils may be placed in a residential setting to ensure there is no unacceptable level of risk to the future site users, included below as Figure 2.1.

The site will have a large scale enabling works package to achieve the development platform and to allow for the installation of clean cover within all soft landscaped areas. These works will be extended to construct ‘road boxes’ and infrastructure corridors and as such the material will managed in such a way as to ensure no future exposure.

Figure 2.1 Asbestos Conceptual Site Model



Given the presence of semi volatile TPH hotspots, asbestos fibres within the Made Ground and site wide impact by non-volatile inorganic PAH, a suitably detailed remediation strategy will be required to document the safe handling, management and placement of all Made Ground so as to ensure that no unacceptable degree of risk is presented to construction workers or future site occupants.

At this time no specific sources of as yet unidentified contamination have been identified within the buildings that remain and thus have not been fully investigated. However, it will be necessary to undertake a watching brief during demolition with appropriate validation sampling and analysis to confirm the absence of any potentially volatile phase contaminants of concern.

It is concluded that the site will be suitable for the proposed residential end use subject to the completion of the afore mentioned supplementary assessments and the following build phase mitigation items:

- *Management of soils to ensure all materials impacted by asbestos fibres are placed in areas of low sensitivity during the site enabling works;*
- *Use of potable water supply infrastructure that will be compliant with UKWIR assessment criteria;*
- *Construction of all dwellings with ground gas mitigation measures that conform to CS2 requirements of BS8485; and,*
- *Construction of a 600mm clean cover system to all areas of private garden in accordance with the detailed methodologies herein.*

2.3 Controlled Waters Contamination Risk Summary

Risk Profile	Discussion	Risk Rating & Rationale
Source Protection Zone (SPZ)	No	Low
Distance to the closest groundwater extraction point.	>1000m	Low
Aquifer Classification in Superficial Drift Deposits	Secondary A	Low to Moderate – Shallow sandy gravels are underlain by low permeability clay soils to depths in excess of 10.0m which will offer significantly reduce the potential for mobile phase contaminants to migrate towards a viable receptor.
Aquifer classification in Bedrock.	Principal	High
Surface water or Groundwater protection Zones.	No	Low
Viability for Anthropogenic soil in direct contact with aquifer (drift or bedrock).	Yes	Moderate to High – Variable Made Ground with low level (predominantly insoluble) hydrocarbon impact is present in the neat surface.
Is the site underlain by low permeability Drift to depths in excess of 10.0m	Yes	Yes – The overall risk classification is reduced due to the known presence of in excess of 10.0m of low permeability clay soil extending to depths in excess of 10.0m bgl beneath the shallow granular soils.
Is the site located within 50m of a surface water course	No	No – The risk to a surface water is negligible given the absence of a viable receptor within influencing distance of the site.
Summary The ICSM developed within the context of the site setting has only identified a single viable pollutant risk which would be the downward migration of potentially mobile phase soluble contaminants towards the underlying principal aquifer. However, the overall sensitivity of this receptor is reduced given the absence of any ground water abstraction and thus the potential for the creation of a complete pollutant linkage.		

In due consideration of the identified pollutant linkage, a Tier 1 controlled water risk assessment was completed by E3P as part of the E3P Geo-Environmental Site Investigation, the findings of which are summarised below:

The laboratory analysis confirms the assessment within the initial conceptual site model (CSM) that the main constituents of concern were likely to include heavy metals and PAHs. The maximum recorded concentrations are outlined below:

The elevated concentrations of arsenic and lead exceed the DWS and EQS marginally, however these heavy metal compounds are largely immobile and given that the site is underlain by low permeability clay soils, there is no viable exposure pathway to an identified

receptor. It is therefore concluded that the there is no potential for any significant risk to controlled waters given the absence of a viable pollutant linkage.

A marginal exceedance of benzo[g,h,i]perylene & indeno(1,2,3-cd]pyrene has been identified within a sample recovered from WS113 where the reported concentration exceeded the Tier 1 EQS of 0.02ug/l. This PAH compound is largely insoluble and as with the heavy metals any potential for either lateral or vertical migration will be impeded by the presence of stiff low permeability clay.

It should be noted the Tier 1 assessment criteria provides a conservative review, which may over-state the risk, as the inorganic determinants identified above are predominantly of a low solubility suggesting that the recorded concentrations are more likely to represent suspended solid in the sample matrix than actual groundwater concentrations.

Given the presence of a notable thickness of low permeability clay which will inhibit the migration towards the only identified receptor (being the Principal Aquifer), it is considered that the site poses no significant risk to controlled waters given the absence of a complete pollutant linkage

2. Ground Gas

The potential impact on the development from ground gases has been assessed with reference to standards and guidelines published in CIRIA Report 665 (Assessing risks posed by hazardous ground gases to buildings, 2007). However, it is recommended that the full ground gas assessment and recommended protection measures are agreed with the local authority prior to their adoption on-site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

The Phase I Desk Study and subsequent ground investigation has identified the following potential sources of ground gas:

- Made Ground located across the site from historical development and demolition activities (to a proven depth >2.0m bgl);

During the monitoring visits completed to date, no significantly elevated concentrations of methane have been recorded within any of the probeholes.

Marginally elevated concentrations of carbon dioxide have been recorded in WS101 exceeding the action threshold of 5% as defined by CIRIA 665. WS101 is located at the northern site boundary immediately adjacent to the vacant building that is yet to be demolished.

The monitoring has been undertaken during periods of both high / low and falling / rising atmospheric pressure; demonstrating worst case scenario.

In accordance with the methodology outlined with the CIRIA publication C665, E3P have utilised the results of the ground gas monitoring surveys to calculate a tentative Gas Screening Value (GSV). The maximum GSV calculated for methane was 0.00253 l/hr (WS114) and for carbon dioxide was 0.05373 l/hr (WS103)

In accordance with the methodology outlined with the CIRIA publication C665 and BS8485, E3P has utilised the results of the ground gas monitoring surveys to calculate a tentative Gas Screening Value (GSV).

The calculated GSVs reflect the absence of any significant flow with CIRIA C665 stating that in instances where the maximum GSV for carbon dioxide and methane is <0.07 l/hr and typical methane and carbon dioxide are less than 1% v/v and 5% v/v respectively, then this is equivalent to Characteristic Situation 1.

The current industry guidance within CIRIA665 and BS8485 requires that where CO2 in excess of 5% is identified, the ground gas classification be increased to CS2 / Amber 1 requiring ground gas mitigation measures in the construction of new dwellings.

GAS PROTECTIO□ SCORES FOR THE STR□CT□RAL BARRIER	**SCORE**
a) **Floor and substructure design**	
Precast suspended segmental subfloor (i.e. beam and block).	0
Cast in situ ground bearing floor slab (with only nominal mesh reinforcement.	0.5
Cast in situ monolithic reinforced ground bearing raft or reinforced cast in situ suspended floor slab with minimal penetrations.	1 or 1.5
Basement floor and walls conforming to BS 8102:2009, Grade 2 waterproofing.	2
Basement floor and walls conforming to BS 8102:2009, Grade 3 waterproofing.	2.5

PROTECTIO□ ELEME□T SYSTEM		**SCORE**	**COMME□TS**
Gas protection scores for ventilation protection □easures			
(a) Pressure relief pathway (usually formed of low fines gravel or with a thin geocomposite blanket or strips terminating in a gravel trench external to the building)		0.5	Whenever possible a pressure relief pathway (as a minimum) should be installed in all gas protection measures systems. If the layer has a low permeability and / or is not terminated in a venting trench (or similar), then the score is zero.
(b) Passive sub floor dispersal layer: Media used to provide the dispersal layer are: • *Clear void* • *Polystyrene void former blanket* • *Geocomposite void former blanket* • *No-fines gravel layer with gas drains* • *No-fines gravel layer*	Very good performance	2.5	The ventilation effectiveness of different media depends on a number of different factors including the transmissivity of the medium, the width of the building, the side ventilation spacing and type and the thickness of the layer. The selected score should be assigned taking into account the recommendations in Annex B of BS8485:2015. Passive ventilation should be designed to meet at least "good performance".
	Good performance	1.5	
(c) Active dispersal layer, usually comprising fans with active abstraction (suction) from a sub floor dilution layer, with roof level vents. The dilution layer may comprise a clear void or be formed of geocomposite or polystyrene void formers.		1.5 to 2.5	This system relies on continued serviceability of the pumps, therefore alarm and response systems should be in place. There should be robust management systems in place to ensure the continued maintenance of the system, including pumps and vents. Active ventilation should always be designed to meet at least "good performance".

PROTECTIO□ ELEME□T SYSTEM	SCORE	COMME□TS
(d) Active positive pressurization by the creation of a blanket of external fresh air beneath the building floor slab by pumps supplying air to points across the central footprint of the building into a permeable layer, usually formed of a thin geocomposite blanket.	1.5 to 2.5	This system relies on continued operation of the pumps, therefore alarm and response systems should be in place. The score assigned should be based on the efficient "coverage" of the building footprint and the redundancy of the system. Active ventilation should always be designed to meet at least "good performance".
(e) Ventilated car park (floor slab of occupied part of the building under consideration is underlain by a basement or undercroft car park)	4	Assumes that the car park is vented to deal with car exhaust fumes, designed to *Buildings Regulations 2000, Approved Document F [9].*
Gas protection score for the gas resistant □e□brane		
Gas resistant membrane meeting all of the following criteria: • *Sufficiently impervious to the gases with a methane gas transmission rate <40.0 ml/day/m²/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method_;* • *Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;* • *Sufficiently strong to withstand in-service stresses (eg settlement if placed below a floor slab);* • *Sufficiently strong to withstand the installation process and following trades until covered (eg penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, dropping tools etc);* • *Capable, after installation, of providing a complete barrier to the entry of the relevant gas; and,* • *Verified in accordance with CIRIA C735.*	2	The performance of membranes is heavily dependent on the quality and design of the installation, resistance to damage after installation and integrity of joints. For example, a minimum 0.40mm thickness (equivalent to 370g/m² for polyethylene) reinforced membrane (virgin polymer) meets the performance criteria opposite. If a membrane is installed that does not meet all the criteria opposite then the score is zero.

Bellway Homes utilise a either a cast in-situ suspended floor slab with no sub-floor void or a '

In this instance it is assumed that Bellway Homes will construct the proposed dwellings using either of the following mitigation measures (depending on sub-structure design) and specification to achieve the 3.5 points required to ensure protection in accordance with CS2.

Cast In-situ Suspended Floor Slab (No sub-floor void).

- *Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA with integrity testing and independent validation. –* ***2 points.***

- *Reinforced concrete cast in situ suspended slab with minimal service penetrations and water bars around all slab penetrations and at joints.* ***1.5 points.***

Beam & Block or Pre-Cast Suspended

- *Clear Void with Telescopic Ventilation to ensure 'Very Good Performance'. –* ***2.5 points.***

- *Proprietary gas resistant membrane installed to reasonable levels of workmanship/in line with current good practice under CQA and independent validation. –* ***2 points.***

3. SITE REMEDIATIO & E ABLI G WORKS

3.1 Overview of Wor s

Prior to the commencement of works on-site, the contractor must establish all necessary plant, equipment and site welfare facilities as is necessary to complete the contract within the agreed timescales to the rationale as outlined in Table 3.1 (below).

Table 3.1 – Enabling Wor s Schedule

RE-1	**Pre-Co ence ent Regulatory Co pliance** Prior to commencement of any works on-site, all reports relating to the assessment of risk to contaminated land should be submitted to the regulatory authorities to gain written approval. All relevant Standard Rules Permits should be registered with the EA. The LAPC Part B Notification for deployment of mobile crushing plant should be implemented prior to the establishment of equipment on-site. If the proposed volume of soils to be re-used (excluding crushed materials) exceeds the parameters of the Standard Rules Permit, a CL:AIRE MMP Qualified Declaration should be made by the contractor having obtained full written approval for the Remediation Strategy from the LPA and Environment Agency. It is not anticipated that there will be any requirement to treat any materials on-site (such as hydrocarbon impact soil or groundwater), however should any previously unidentified contractor must either notify the EA of their intention to complete a minor works operation or arrange for the deployment of the appropriate Environmental Permit for the specified operation.
RE-2	**Environ ent & uisance Control** Management of all works so as to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels. Ensure that all works are completed in a manner so as not to create any structural risk to the adjacent highways. Implement all temporary works as necessary to support excavations throughout the duration of the works. In the event that a complaint is made in respect of dust emissions, noise or vibration levels, remedial measures and a programme of ongoing monitoring should be agreed with the local authority and implemented on site.
RE-3	**Ris to Infrastructure** Site works should be completed in a manner that ensures no risk of disturbance to the adjacent infrastructure.
RE-	**Pre-Co ence ent Supple entary Site Investigation** Structures were still present in the north and south of the site during the E3P site investigation in 2016. As part of the site inspection and watching brief during demolition, it will be necessary to undertake a supplementary phase of sampling within these areas to clearly delineate the extent of any impacted soils, asses the statistical relevance of any elevated concentrations within the isolated areas and determine options for excavation, ex-situ treatment on-site and replacement within an area of no future sensitivity.

RE-5	**Identification, Isolation and Treat□ ent of Invasive Plants** At this time no invasive plant species have been identified, however the contractor must satisfy themselves with respect to the absence of any species deemed invasive prior to the commencement of works on-site. The contractor shall employ a suitably qualified expert to investigate the presence of invasive plant species on or adjacent to the site. If invasive plant species are identified, these will be treated in strict accordance with the Environment Agency Code of practise and in accordance with an approved method statement. If invasive plant species are identified at the site boundary, a suitable barrier shall be installed to prevent any future re-infestation of the subject site. If any invasive species are treated, a validation report should be prepared documenting all identified invasive plant species, their location and the treatment methodology. Where materials are removed from site all Waste Transfer Notes / Duty of Care certificates should be included within the validation statement.
RE-□	**Site Clearance and De□ olition Operations** Demolition of on-site structures and general site clearance & provision of welfare, offices and site security as per the contract requirements. The site is currently overgrown with self-seeded vegetation; this material should be removed in a controlled manner with full compliance with any ecological mitigation measures that are required for the works. Any such measures are outside the scope of this report. All vegetation should either be stockpiled at a pre-agreed location or alternatively removed from site in accordance with Waste Permitting Regulations.
RE-7	**Delineation, Excavation and Treat□ ent of Identified Asbestos I□ pact** Detectable asbestos fibres have been identified in seven locations, however due to the nature and age of the filled material is must be assumed that trace fibres are present throughout the Made Ground. The E3P Developed Conceptual Site Model demonstrates a suitable method for management of soils to negate any future risk. The contractor must ensure than all personnel working on-site are trained in the identification of ACM and the risk associated with impacted soils. Where any visual evidence of ACM is identified, these materials should be carefully segregated and removed from the soil matrices (if / where possible). Validation sampling of the processed Made Ground should be completed to demonstrate compliance with the Developed Conceptual Site Model. This process should be completed under strict controls to be devised and employed by the nominated contractor to ensure no potential for fibre release into ambient air. If necessary, reassurance air testing in accordance with the requirements of HSG 248 should be completed during the operation to move the soils to demonstrate the deployment of the required control procedures and safe working methods.

RE-8	**Delineation, Excavation, Treat□ ent & Disposal of I□ pacted Material** Prior to the commencement of the main earthworks (where possible) all known contamination hotspots should be clearly identified and demarked to facilitate the safe, legislatively complaint and sustainable removal and treatment of the area of concern. Elevated concentrations of C12-16 TPH compounds been identified within TP202 in the south east. E3P considers that excavation of made ground and potential off-site disposal of deleterious elements is required to remove the potential risk to human health and potentially the adjacent controlled water receptor. In order to reduce the requirement for off-site disposal, E3P recommends that large cobbles or boulders should be segregated for processing on-site. Material deemed to be impacted through either visual or olfactory observations or as a result of notable PID readings (>50ppm) will be excavated and stockpiled on an impermeable membrane. The membrane will be placed upon a clay containment bund and covered to negate the risk of soils leaching and dispersal of any odours and/or vapours. An E3P engineer will regularly monitor the stockpiled material with a PID to determine the need for boundary monitoring (albeit not anticipated). This material will then be subject to detailed laboratory analysis to determine the suitability for re-use or the requirements for off-site disposal. Upon completion of the delineation and excavation, the sides and base of the resulting void(s) will be chemically validated to confirm no impacted materials remain in situ. Validation samples will be collected at 10 linear meter centres from the side and base of the excavation. The results of this validation testing will be directly compared to the Remediation Target Values (as defined within Appendix IV of this report) to demonstrate that no unacceptable level of risk to human health, controlled waters or the wider environment remains.
RE-□	**Excavation, Brea□ing and Processing of All Above & Below Ground Structures** Obstructions, relict foundations, basements and infrastructure (apart from live services) are to be removed from the areas of proposed residential development to include plot footprints, rear gardens, private driveways, adopted highway and utilities infrastructure (road box) in their entirety. Artificially hard materials should be broken out and crushed. Stockpiles will be made, validation testing undertaken, and site won material reused on site where required. Materials will be processed as per the E3P chemical and geotechnical specification using licensed plant. The E3P drawings denote the extent of known historic features with obstructions, however it will be the contractor's responsibility to remove all obstructions. Obstructions encountered within the near surface soils will be chased to their full depth and removed; if not possible, the obstruction must be surveyed with the location communicated to E3P, the client and the developer. Where natural soils are present at a relatively shallow depth (northern sector), extreme care should be taken to ensure that the natural cohesive deposits remain undisturbed with a full reduced level survey to be completed to map the depth of filled / processed material.

RE-10	**Cut & Filling of Made Ground to Develop□ent Levels** The Made Ground is noted to be present to substantial depth in some areas of the site (>2.0m), is considered that it will be possible to utilise Vibro Replacement Stone Columns (VRSC) within areas of segregated and placed granular Made Ground to treat the currently unknown potential for differential settlement and ensure a uniform safe ABP in the order of 125kN/m2. Where the proposed enabling works levels require the current landform to be cut, extreme care should be taken so as not to disturb the underlying stratum prior to the placement of the appropriate platform in compliance with the E3P Geotechnical Specification. Where the development levels require material to be filled, site derived Made Ground must be sorted in a controlled manner prior to replacement in accordance with the requirements of this specification for the intended land use. The maximum dry density must be determined in laboratory conditions utilising UKAS accredited testing prior to the commencement of filling and compaction works. In-situ density testing us required to demonstrate compliance with the E3P Geotechnical Performance Specification.

RE-11

Replace□ent of Materials Geotechnical Engineering Re□uire□ents

Rationale

Material is to be backfilled in strict compliance with the E3P Geotechnical Engineering Specification as presented in detail within

Section 6 of this report which generally requires the following reinstatement and compaction criteria:

LA□D □SE	CO□STR□CTIO□ RE□ □IREME□T	RE□ □IREME□T
Footprint of proposed structure (2.0m on all elevations).	Pile Foundation	Backfill using general Method Compaction to CBR of 5% on Piling Mat.
	Vibro Stone Colum	Granular backfill with suitably graded granular aggregate with <10% fines. CBR >5% with suitable pile mat.
	Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Highways	Adopted Estate Road / Drainage	Method Compaction using DOT ensure CBR >5% in sub-grade (engineered fill) and 15% on capping layer.
Driveways	Private Drives & Car Parking	Method Compaction to CBR >5%
Gardens & POS	N/A	Method Compaction to ensure no settlement.

RE-12

Preparation of Ground for Vibro Stone Colu□ ns within Tree Influence

Where trees are present or within their total zone of influence the contractor must ensure that all cohesive soils are removed to the required depth with the subsequent replacement with granular a granular blanket to fully mitigate the potential for volumetric instability in the clay soils.

The zone of tree influence will be indicated within the Foundation Zoning Plan and all resultant excavations and subsequent backfilling must be inspected and approved by E3P.

The depth of the granular blanket required will be determined prior to the commencement of the works and in full agreement of the client but will nominally be equal to or in excess of 2.5 x foundation width.

RE-13

I□portation of Bul□ Fill

Where there is a net shortfall of material required to achieve the proposed ground levels, it will be necessary to import natural inert soils and aggregate as per the engineering requirements (Section 6).

Imported material must be certified as suitable for use in strict accordance with the E3P chemical and geotechnical performance criteria in conjunction with the required duty of care notes and waste transfer exemption.

If recycled aggregates are imported laboratory testing should be completed to demonstrate compliance with the WRAP Protocol. Where inert soils are imported laboratory testing should be completed in accordance with the requirements of the pertinent Environmental Permit (i.e. U1 Standard Rules) or CL:AIRE MMP for the re-use of clean naturally occurring soils.

RE-1	**Preparation of Garden for Cover Syste** As part of the land remediation works, garden areas will be prepared in a manner that will facilitate the placement of the clean cover system during the development phase of the woks. The preparation of the areas requiring clean cover is critical in ensuring delivery of the site in a manner that will ensure no risk to the proposed end users. Where Made Ground is deemed unsuitable for retention in a garden, the area will be subject to a reduced level dig to remove unsuitable material to a minimum depth of 600mm below finished garden level or verified natural stratum (whichever is the shallower). Excavated soil will be stockpiled pending the results of the appropriate validation testing (to be completed in accordance with this specification) prior to re-use in an area of no sensitivity or where necessary, this material will be removed from site in accordance with UK Waste Management Legislation. The placement of certified sub-soil and topsoil will be completed as part of the developer works / build phase mitigation plan. All garden areas where a cover system is required will be subject to plot specific independent validation.
RE-15	**Provision of Subsoil** The shallow natural drift deposits (predominantly granular soils) are deemed suitable for use within the upper 600mm of clean cover to residential gardens and areas of soft landscaping. It is therefore deemed viable to re-use and materials that are cut as part of the wider earthworks or through a soil inversion (regulated by an MMP) to generate the requited volumes of material. The garden and landscaped areas will require depth validation to satisfy the requirement of the Council Mortgage Lenders (CML) in order to demonstrate that the appropriate thickness has been provided as a growing medium.
RE-1	**Provision of Topsoil** No material that would be deemed suitable for use as topsoil is present on-site and as such there will be requirement to import suitable material for use within the proposed development. Topsoil will require testing in line with the schedule present within Section 4.5 and Table 3.3. The garden and landscaped areas will require depth validation to satisfy the requirement of CML in order to demonstrate that the appropriate thickness has been provided.
RE-17	**Re edial Verification Report** Collation of information relating to site clearance, chemical testing, remedial works, remedial verification, material movements and waste transfer documentation where appropriate. Complete remedial validation reported in line with regulatory guidance. This will include a detailed risk assessment. The report will be submitted to the Local Authority for approval following completion.

3.2 Second Phase Mitigation & Manage□ent – Build Phase

A second post Remediation & Enabling phase of works will be required to ensure the proposed development is constructed in a manner that incorporates the required mitigation measures to ensure the development is compliant with UK Building Regulations and the Local Authority Planning requirements.

Once the ground has been stabilised and rendered suitable for development, the builder will be required to undertake a second phase of remediation works to mitigate the identified theoretical risk to human health.

- Provision of a 600mm cover system over made ground encountered across the site, using certified material with appropriate validation within proposed garden areas. Natural drift deposits encountered within the upper 600mm of finished ground levels can be directly overlain with a suitable cover (minimum 150mm topsoil).
- Provision of 300mm certified cover system to all areas of soft landscaping and POS.
- Provision of appropriately assessed water supply pipes.
- Construction of all dwellings with the appropriate ground gas mitigation measures and corresponding independent validation.

3.3 Materials Manage□ent & Legislative Co□pliance

The processing of recycled aggregates will be completed using LAPC Part B Licensed Plant with the appropriate deployment notification to the Local Authority prior to commencement of works. All materials that are recovered as recycled aggregate will be compliant with the requirements of the WRAP protocol and the E3P validation testing requirements and as such would not be deemed to be a waste material.

A U1 Standard Rules Permit will be registered for the site which allows the re-use of up to 3000m3 of material within construction with up to 25,000m3 of material permissible to be re-used in the construction of roads.

A T5 Standard Rules permit allows the screening and recovery of up to 3000m3 of material for sub-sequent re-use in construction will also be registered.

All materials that are recovered under the WRAP Protocol, U1 or T5 exemptions must be analysed to demonstrate that they are both chemically and structurally suitable for use within the context of the development.

The relevant LAPC, U1, T5 and WRAP Licenses, Exemption and Protocols provides the legislative framework for material compliance during the site remediation and enabling works to be completed by the specialist contractor under the supervision or E3P.

Where necessary operations as outlined in detailed within the Remediation Enabling Works Rationale summarised above may be subject to regulation using the appropriate Environmental Permit, Standard Rules Exemption and ‘Materials Management Plan’ (MMP) to be created in accordance with Version 2 of the CL:AIRE Definition of Waste - Industry Code of Practice.

If required, the MMP will be created with due consideration to all proposed remediation and enabling works operations prescribed within this document and will be undertaken by a

Qualified Person and a signed declaration submitted to the EA prior to re-use of materials on the site.

3. Validation Sampling Protocol

In accordance with the current requirements of the regulatory authorities, validation samples will be collected from all materials that are to be subject to movement under the protocols outlined within this Remediation Strategy, or for materials to be imported onto site to facilitate the proposed residential development.

Upon removal of the hotspot of unsuitable made ground in the northern sector, validation samples will be collected from the base (2 No.) and sidewalls (4 No.) of the excavation to reasonably demonstrate no residual impact to the underlying strata.

Soil samples destined for chemical analysis will be collected at regular intervals in appropriate sampling containers. All samples will subsequently be stored in cooled boxes prior to submission to a UKAS / MCERTS accredited laboratory.

All samples will be collected using appropriate PPE and sampling equipment that will be cleaned at each sampling location.

A detailed copy of E3P Ltd sampling methodology, QA procedures and laboratory chain of custody forms will be documented within the site records and presented within the final validation report for the site.

Where material is found to contain concentrations of potential contaminants at levels in excess of the site specific screening criteria (as detailed within Appendix IV), E3P will undertake further assessment and recommendations on the appropriate use for the material in question, which may involve the disposal of such materials off-site to a suitable waste management facility.

The sampling frequency for materials to be managed under the Remediation Strategy is presented within Table 3.3.

Table 3.3 - Specification of Che□ical Validation Laboratory Analysis

Material □se	Testing Fre□uency	Suite of Analysis
Site Generated		
Site Generated 6F2	1 Sample Per 1000m^3	A / B / C / D
Site Won Made Ground General Backfill	1 Sample Per 250m^3	G
Site Won Made Ground General Backfill	1 Sample Per 1000m^3	A / B / C / D
Site Won Made Ground General Backfill	1 Sample Per 2000m^3	I
Site Won Natural Backfill	1 Sample Per 2000m^3	A / B / C / D
Site generated Sub-Soil *(450mm garden cover)*	1 Sample Per 250m^3	A / B / C / D
Site Generated Topsoil Cover *(150mm garden cover)*	1 Sample per 50m^3	A / B / C / D
Hotspot Validation Samples	1 Sample per 10m of linear excavation to base and sidewall.	E / G
Imported		
6F2	1 Sample Per 1000m^3	A / B / C / D
Subsoil Greenfield Source *(450mm garden cover)*	1 Sample per 200m^3	A / B / C / D
Subsoil Brownfield Source *(450mm garden cover)*	1 Sample per 50m^3	A / B / C / D
Topsoil Greenfield Source *(150mm garden cover)*	1 Sample per 200m^3	A / B / C / D
Topsoil Brownfield Source *(150mm garden cover)*	1 Sample per 50m^3	A / B / C / D
General Engineering Fill (Class 1 & 2 Soil)	1 Sample Per 1000m^3	A / B / C / D

□otes
Suites of Analysis
A) Speciated PAH
B) Speciated TPH (C5-C35)
C) Asbestos (ID)
D) CLEA Inorganic Heavy Metals
E) Speciated PAH, Banded TPH and VOCs
F) SVOC / Speciated TPH
G) On-site screening for VOC using calibrated PID
H) Lechate 2:1 Speciated PAH and Banded TPH
I) Leachate analysis of Inorganic heavy metals, TPH, sulphate and PAH.

All analysis prescribed above to be completed by UKAS accredited laboratory.

□. E□VIRO□ME□TAL MO□ITORI□G A□D VALIDATIO□

□.1 Site Manage□ ent

The tracking of materials will be based on the following hierarchy:

- The Principal Contractor will have the responsibility for setting out areas of the site on the basis of the contract specification;
- Operatives will have instructions only to excavate and to emplace materials in specified areas as assigned by the Site Manager / Foreman;
- The Site Manager (employed by the Principal Contractor) will issue daily instructions to drivers regarding the placement of materials sourced from specific stockpiles or areas, ensuring that appropriate documentary evidence is collected that details which materials are going where and why;
- The strategy for each day's work will be agreed with the E3P Consultant, who will be in attendance as required, prior to the commencement of the works. E3P will:
    - Inspect the excavation areas and certify that the correct materials are being excavated;
    - Conduct spot checks on loaded vehicles to ensure compliance with this Remediation Strategy;
    - Ensure that any loads which fail visual, olfactory or spot checks either remain on the vehicle or if unloaded are excavated and set aside. This material will be treated according to the recommendations of the E3P site engineer.
- All material imported and removed from site will have Duty of Care / Consignment Notes, copies of which will be retained on-site by the Site Manager; and,
- Materials directly reusable will be incorporated into the earthworks, subject to operational conditions and phasing of excavations, in which case they will be stockpiled prior to final placement.

□.2 Co□ pletion

Following the completion of the remediation works a report will be compiled by the Environmental Consultant detailing all site enabling works undertaken, waste consignment notes, and all site investigations, laboratory test certificates, and validation testing undertaken.

A certificate of completion of earthworks should be included within the report which should then be issued to The Local Authority for their approval.

E3P considers that with the adoption of the above best practices the site can be safely redeveloped. The site enabling works process and presence of any residual contamination (if this is the case) should be recorded for future reference by landowners /occupiers. Future development at the site where this may result in penetration of new areas of hard-standing should be subject to no less stringent measures with respect to assessment, and, where appropriate, monitoring than those set out above.

3 Mitigation of Risk from Soils with Asbestos Fibres

Pre-Commencement Works

Prior to the commencement of works the following activities will be undertaken:

- Induction of all people that will be involved with the proposed site works; and,
- All methodologies must be agreed upon by all parties involved.

Control, Monitoring and Reporting of General Aerial Emissions; Dusts and Particulates

Damping Down of Soils – Mitigate Particulate (Dust) Emission

During excavation as outlined within the detailed working methodologies, soils will be regularly damped down using water to control the generation of dust (this may also comprise precipitation). The contractor will determine the best form of dust suppression to be used when a detailed programme has been issued.

If any previously unidentified Asbestos Containing Materials are identified, these should be dealt with in strict accordance with the Control of Asbestos Regulations (2012) and industry best practise as detailed in CIRIA733.

General Control of Dust

The following control measures should be utilised to ensure that dust levels are kept to a minimum at all times:

- Where necessary, haul road, work areas and stockpiles will be damped down with water spray;
- The application of water to haul roads, work areas and stockpiles should be closely monitored by the resident engineer to ensure that soils are not saturated and therefore the potential for water run-off is appropriately mitigated;
- Once completed, any stockpiles will be sealed by compacting at the surface; and,
- Vehicle speeds and movements on site will be kept to a minimum (<5mph) during civil excavation works to reduce the potential to generate dust.

Personal Protective Equipment (PPE)

In accordance with the HSE Guidance Note EM6 (non-licensed asbestos works), E3P recommend that all site operatives present within the work area where potential asbestos impacted soils are being excavated are supplied with the following Personal Protective Equipment:

Overalls:

- Disposable overalls. Type 5 (BS EN ISO 13982-1) are suitable. Cotton overalls hold dust and need specialist laundering;
- Waterproof overalls for outdoor work;

- Use oversized overalls - this will help to prevent ripping at the seams;
- If the cuffs are loose, seal them with tape;
- Avoid wearing a long-sleeved shirt - these are difficult to cover properly;
- Wear the overall legs over footwear. Tucking them in lets dust into footwear; and
- Wear the hood over the RPE straps.

Failure to utilise and correctly employ PPE will result in immediate cessation of works. Works will not be permitted to recommence until the individual has undergone further training in the use of PPE or the individual removed from works area.

At this current time, with the levels of ACM identified within the soils, the above listed PPE is not considered to be required for all site personnel during the entire management of these soils.

When handling asbestos impacted soils during the enabling works, asbestos monitoring works should be conducted in accordance with but not limited to the following HSE legislation and guidance:

- Health & Safety at Work Act 1974;
- The Control of Asbestos Regulations 2006;
- Approved Code of Practice L143 “Work with materials containing asbestos”;
- Management of Health and Safety at Work Regulations 1999;
- HSE Guidance Note HSG248 ‘Asbestos, the analysts guide to sampling and analysis’; and,
- HSE Guidance Note HSG247 ‘Asbestos: The licensed contractors’ guide’.

If required, air monitoring in accordance with HSG248 will be undertaken intermittently throughout the duration of the works at a frequency to be determined by the contractor, entirely dependent on whether asbestos impacted soils are being handled at any one time. In general terms, during any one monitoring period, ten standard monitoring pumps will be run throughout the day, for the appropriate time period to achieve the required Limit of Detection (LOD). These slides will be analysed immediately by the on-site UKAS accredited laboratory.

Once any monitoring has been analysed by the on-site UKAS accredited laboratory, the results will be delivered to the Resident Engineer who will then follow the correct site procedure. The results will then be included within the Verification Report.

5. GEOTECH□ICAL E□GI□EERI□G SPECIFICATIO□

5.1 E3P Geotechnical Engineering Specification

The contractor should employ a suitably experienced engineer to be present on site during these earthwork operations to ensure soil suitability, placement, compaction and testing is undertaken in accordance with this specification and to ensure that any unforeseen circumstances, such as adverse weather, do not compromise the earthworks process.

Works should be halted during periods of intermittent or prolonged rainfall to ensure the materials are not placed in a manner that would result in softening of either the formation or the newly placed material. It will be the contractor's responsibility to determine appropriate weather conditions and determine the suitability of works.

Particular attention must be given to variable weather conditions when re-engineering clay soils as a moisture content fluctuation (2%+/-) of the tolerable limit will result in unacceptable degree of compaction loss.

5.2 Locally Won Fill Material

It is proposed to up-fill and level the site with material won from the development area. From the site specific investigations undertaken to date, it is expected that the majority of the soils won from the processing of demolition material will be granular and cohesive soil matrixes.

Due to climatic weather conditions and variance in long term differential settlement associated with even well compacted granular soils and the need to facilitate the future re-engineering using Vibro Replacement Stone Columns to support a shallow Re-Enforced Strip Foundation, it is essential that the cut and fill process is well controlled and materials are placed /. Compacted in accordance with this specification.

Where site won materials are to be used as fill to achieve the required development platform, they must be compacted to ensure in-situ densities that are in excess of 95% of the Maximum Dry Density as determined using a 4.5KG laboratory Procter Test.

Materials should only be compacted when the actual moisture content is within 2% (+/-) of the optimum for the soil matrices as determined by laboratory bench testing.

5.3 Classification of Fill Material

This Specification should be read in conjunction with the following:

- The Manual of Contract Documents for Highway Works, Volume 1, Specification for Highway Works, Series 600, Earthworks as amended in November 2005; and,
- Soils for Civil Engineering Purposes, BS1377, 1999.

5.3.1 General Classification

The contractor should ensure that all earthworks materials comply with Clause 601 of the Specification for Highway Works and shall fall into one of the other of the following general classifications as defined in Table 6/1 of the Specification for Highway Works.

- General granular fill (Class 1),
- General cohesive fill (Class 2), excluding class 2A and 2E,
- Selected granular fill (Class 6).

Table 5.1 Specification for Bac□fill Co□ paction

E3P Earthwor□s Geotechnical Co□ paction Specification					
Soil / Material Type	**Class**	**Description**	**Co□ paction E□uip□ ent**	**Layer Thic□ness**	**Roller Passes**
Granular Fill (**Sand** & gravel Matrices)	**1 A**	Sandy Gravel with some cobbles	>5000kg Vibrating Roller	225mm	4
	1 B	Sand or Gravel of same grading size	>5000kg Vibrating Roller	250mm	10
	1 C	Coarse gravels with many cobbles	>5000kg Vibrating Roller	400mm	5
Cohesive Fill (**Clay** with minor sand and gravel component)	**2 A**	Wet Clays	>100kg Metric Ton Vibrating Tamping Roller □**Sheep Foot O□LY**□	100-225mm	3
	2 B	Dry Clay	>5000kg Vibrating Roller or 1400kg Tamping (Trench Roller)	225mm or 125mm	4 or 12
	2 C	Gravelly Clay	>5000kg Vibrating Roller or 1400kg Tamping (Trench Roller)	225mm or 125mm	4 or 12
	2 D	Silty / sandy Clay	>5000kg Vibrating Roller or 1400kg Tamping (Trench Roller)	225mm or 125mm	4 or 12
Recycled Aggregate Crush. (<125mm Well Graded)	□**F2**	Any combination of inert hard materials other colliery spoil or rock with substantial amounts of clay like component.	>5000kg Vibrating Roller	250mm	6

5.3.2 □se of Fill Materials

In addition to any grading requirement the maximum particle size of any fill material shall be no more than two-thirds of the compacted layer thickness except that cobbles having an equivalent diameter of more than 150mm shall not be deposited within the restored surface level unless directed otherwise by the Engineer. Un-burnt colliery spoil, pulverised fuel ash or furnace bottom ash shall not be used as a fill material.

5.□ General Re□uire□ ents

The contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. He shall be responsible for maintaining the nature of the acceptable material so that when it is placed and compacted it remains acceptable in accordance with the Contract.

For the purposes of this contract, the proposed earthworks requirements have been split into distinct end use categories with the corresponding requirements for the earthworks specification assigned to individual areas.

Table 5.2 – Co□ paction / Bac□fill Re□uire□ ents

LA□D □SE	COMPACTIO□ METHODOLOGY & GE□ERAL PERFORMA□CE CRITERIA
Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Re-engineering of soils using Vibro Replace□ ent Stone Colu□ n □VRSC□to li□ it differential settle□ ent and increase net Allowable Bearing pressure □ABP□. **Building Structure Footprint** **□2.0□ on all elevations**	Materials to be placed in a controlled manner to facilitate the construction of **Vibro Replace□ ent Stone Colu□ ns □VRSC□.** Material must be 90% granular in composition with less than 10% fines which are classified as materials <0.60micron's in size. No material greater than 125mm in size is permitted with 90% of the soils placed conforming to grading <90mm. Material to be placed when actual moisture content is within tolerable limits of the optimum with specific attention to and soils which are notably wet of the optimum. Material to be placed in a manner so as to ensure a minimum CBR of 5% at formation to facilitate machine movement and piling mat construction. Where site won materials are used to up-fill levels must be compacted to an 'end product' performance specification where the in-situ density exceeds 95% of the maximum (determined by laboratory conditions).
Piled Foundation	Piled foundations will be required within plots that are sited within the 'stand-off' zone at the crown of the newly profiled site embankment. Backfill of material using method Compaction Specification to achieve CBR as required by developer for piling mat construction. Construction of Pile Mat to ensure CBR >5% by Plate Load Test.
Adopted Highways □□2.0□ fro□ bac□of footpath□.	Method Compaction – Highways Design Manual Series 600 with in-situ Validation Testing to meet requirement of adoptions authority. CBR >5% at sub-grade formation (prior to placement of Capping). CBR >15% within placed capping (during enabling works).
Private Drives	Method Compaction – Highways Design Manual Series 600 with CBR >5%.
Gardens, POS & Other External Areas	Material is to be placed in layers not exceeding 300mm and must be rolled using dedicated plant (no earth moving equipment) and in general compliance with the requirements of Highways Design Manual Series 600.

Acceptability shall be determined in accordance with Table 6/1 of the Highway Specification.

Laboratory testing for the purposes of determining acceptability and compaction requirements will be conducted by the Engineer.

Haulage of material to embankments or other areas of fill shall proceed only when sufficient spreading and compaction. Plant is operating at the place of deposition to ensure compliance with Clause 612 of the Highways specification.

No excavated acceptable material or unacceptable material required to be processed, other than surplus to the requirements of the Contract, shall be removed from the site.

Where the excavation reveals a combination of acceptable and unacceptable materials the Contractor shall carry out the excavation in such a manner that the acceptable materials are excavated separately for use in the Permanent Works without contamination by the unacceptable materials. Unless otherwise described in the Contract classes of fill material required to be deposited separately shall be excavated separately without contamination by other classes of material.

The Contractor shall make his own arrangements for stockpiling of acceptable material, and unacceptable material to be processed, and for the provision of site for purpose.

The Contractor shall ensure that he does not adversely affect the stability of excavations or fills by his methods of stockpiling materials, use of plant or sitting of temporary buildings or structures.

Topsoil shall wherever practicable be used immediately after its stripping and if not shall be stored in stockpiles of heights not exceeding 2.0m; topsoil shall not be stockpiled for more than two years. Topsoil shall not be unnecessarily trafficked either before stripping or when in a stockpile. Stockpiles shall not be surcharged or otherwise loaded and multiple handling shall be kept to a minimum.

Excavations requiring backfilling shall remain open only for the minimum period necessary.

The Contractor shall keep earthworks free of water including:

(i) Arranging the rapid removal of water:
  (a) shed on to the earthworks
  (b) entering the earthworks from any source

(ii) Provide where necessary temporary watercourses, drains, pumping and the like:

(iii) Discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable

(iv) Provide adequate means for trapping silt on temporary systems discharging into permanent drainage systems.

The Contractor shall carry out and maintain and groundwater lowering or other treatment required.

Where materials are designated either Class U1B or Class U2 (according to the Highways Specification), the Contractor shall carry out any special requirements for their handling. Where such materials are encountered during the progress of the Works, the Contractor shall

make all necessary arrangements for their safe handling and disposal after consultation with the appropriate environmental authority.

5.□.1 Construction of Fills – Highways

All fills shall be constructed:

(i) In the locations as shown in the contract drawings to the lines and levels stated therein;

(ii) Of classes of material complying with this specification;

(iii) By deposition, as soon as practicable after excavation, in layers to meet the compaction requirements as required for each Class of material as specified.

(iv) To the requirements of this clause and any other requirements for fill in this Specification.

Before commencing work on any area of fill the Contractor shall ensure that:

(i) The base is sound and stable by excavating and removing any topsoil as soft subsoil.

(ii) Base layers are not exposed until the fill layer is ready for placement.

(iii) Un-compacted material on the side slopes of previously backfilled zones shall be removed and benches of between 1.0m and 1.5m height cut in compacted fill immediately prior to deposition of the new fill to ensure that the new backfill placed against the slope is properly integrated.

Whenever fill is to be placed on surfaces inclined at 1 vertical to 7 horizontal or steeper, the surface shall be benched immediately prior to deposition of the fill in order to achieve horizontal basal surfaces. The benches shall be between 1.0m and 1.5m in height.

Areas of fill shall, unless otherwise permitted by the Engineer, be constructed evenly over their fullest possible extent and the Contractor shall carefully control and direct construction plant and other vehicular traffic uniformly over the area of compacted fill. The minimum plan dimensions of any one panel of backfilling shall be properly integrated with areas of previous backfilling. Damage by construction plant and other vehicular traffic shall be made good by the Contractor with material having the same characteristics and strength as the material had before it was damaged.

Temporary slopes within compacted and un-compacted backfill shall be formed at gradients which ensure stability.

5.□.2 Construction of Fills – Adopted Highways, Estate Roads & Car Par□

The Contractor shall carry out compaction upon the materials which require to be compacted, as soon as practicable after deposition.

Compaction shall be either method as required for the classes of fill in Table 6/1 which requires to be compacted.

The Contractor shall obtain permission from the Overseeing Organisation before carrying out compaction requirements as listed in Table 6/1 for the Class of material being compacted.

Method compaction shall be undertaken using the plant and methods appropriate to the compaction requirements as listed in Table 6/1 for the Class of material being compacted.

Earthmoving plant shall not be accepted as compaction equipment nor shall the use of a lighter category of plant to provide any preliminary compaction to assist the use of heavier plant to be taken into account when assessing the amount of compaction required for any layer.

If more than one class of material is being used in such a way that it is not practicable to define the areas in which each class occurs, the Contractor shall compact with plant operating as if only the material which required the greater compaction effort is being compacted.

If the results of field tests show densities which indicate the state of the compaction to be inadequate, if this is due to failure on the Contractor to comply with requirements of the Contract, the Contractor shall carry out such further work as is required to comply with the contract.

Refer to Clause 612/10 of the Highway specification for definition of plant to be used in accordance with this specified works.

The Contractor will be responsible for assessing the Class of Fill in accordance with Table 6/1 of the Highways Specification. Table 6/4 of the Highways Specification should then be employed to assess the method of compaction to be employed. The test results and method statements shall be submitted to the Consulting Engineers for approval.

5.5 Earthwor□s Material Tests

Prior testing of the potential sources of fill shall be undertaken by the Contractor and submitted to the Consulting Engineers for approval. This testing shall include, but not necessarily be limited to the compaction and backfill requirements detailed in Table 5.3, below.

Table 5.3 – Co□ paction / Bac□fill Re□uire□ ents

<table>
<tr><th>Land □se</th><th>Co□ paction Methodology & General Perfor□ ance Criteria</th></tr>
<tr><td>Liquid and plastic limits</td><td>BS1377: Part 2</td></tr>
<tr><td>Grading</td><td>BS1377: Part 2</td></tr>
<tr><td>Uniformity Co-efficient</td><td>Calculated from grading curve</td></tr>
<tr><td>Moisture content</td><td>BS1377: Part 2</td></tr>
<tr><td>Organic Matter (maximum 2.5% total organic content)</td><td>BS1377: Part 3</td></tr>
<tr><td>Water soluble sulphate</td><td>TRL Report 447 test No 1</td></tr>
<tr><td>Total sulphate content</td><td>TRL Report 447 Test No 4</td></tr>
<tr><td>Earthwor□ In-situ Tests
Subsequent to the filling and compaction of the material a series of in-situ tests shall be undertaken to confirm the success of the compaction process. This testing shall include but necessarily be limited to, the following:
<table><tr><th>TEST</th><th>TEST METHOD</th></tr><tr><td>Plate load tests</td><td>BS1377: Part 9</td></tr></table>Disposal of Materials
The contractor shall be responsible for the safe disposal of any excess of unsuitable material found on the Site.
Multi Point Moisture Condition Value (MCV) (to assess optimum moisture content)</td><td>Clause 632 (BS1377: Part 4)</td></tr>
<tr><td></td><td></td></tr>
<tr><td>Proctor compaction testing</td><td>BS1377: Part 4</td></tr>
</table>

□. RECORD KEEPI□G & VERIFICATIO□

□.1 Record Keeping

During the course of the remediation and site enabling works, the on-site E3P Consultant will undertake the following record keeping protocols:

- Detailed daily site diary including material movements;
- Sampling register, testing results, photographs, details of locations of hydrocarbon impacted soils (drawings), details of hotspot removals, details of consignment notes of any hydrocarbon impacted material that is required to be disposed of off-site; and,
- Detailed surveys (volumes).

Record keeping on site, in particular movements and analysis of specific material types, will be in the form of site diaries and a remediation excavation record. This record will remain on site and will be completed by the E3P on-site engineer during the course of the remediation and site enabling works.

□.2 Verification

The records listed above will then be compiled into a Validation Report produced by E3P on completion of the remediation and site enabling works, clearly referencing the origin of the materials used and testing carried out to confirm its suitability for use, where required. E3P will also prepare an as built development drawing clearly detailing the materials present on-site to be cross referenced with the supporting validation documentation.

The Validation Report will include the following:

- Remediation Strategy (including copies of confirmation from regulatory authorities agreeing criteria);
- Detailed surveys of all excavations and production of ‘as built’ drawings for the earthworks;
- Copy of Consignment Notes relating to the movement of wastes to a licensed waste management facility;
- Detailed drawings showing all sampling locations for both chemical and geotechnical testing;
- Chemical test results;
- Geotechnical test results;
- Details of Qualified Persons signed declaration; and,
- Monitoring results if undertaken (i.e. asbestos in air, gas water etc.)

7. CONTINGENCY PLAN

7.1 Previously Unidentified Contaminants

Should significantly impacted material be encountered during the development, then it will be excavated and stockpiled on an impermeable material and sampled and tested for an appropriate range of determinants.

Once the laboratory analysis of the material is available an assessment will be undertaken to determine whether it can be retained on-site as part of the Material Management Plan or whether it should be disposed off-site.

Depending on the nature of any such impact it may be necessary to undertake validation testing of the excavation faces in order to demonstrate that no such materials are left in-situ.

END OF REPORT

APPENDIX I
LIMITATIONS



1. This report and its findings should be considered in relation to the terms of reference and objectives agreed between E3P and the Client as indicated in Section 1.2.

2. For the work, reliance has been placed on publicly available data obtained from the sources identified. The information is not necessarily exhaustive and further information relevant to the site may be available from other sources. When using the information it has been assumed it is correct. No attempt has been made to verify the information.

3. This report has been produced in accordance with current UK policy and legislative requirements for land and groundwater contamination which are enforced by the local authority and the Environment Agency. Liabilities associated with land contamination are complex and requires advice from legal professionals.

4. During the site walkover reasonable effort has been made to obtain an overview of the site conditions. However, during the site walkover no attempt has been made to enter areas of the site that are unsafe or present a risk to health and safety, are locked, barricaded, overgrown, or the location of the area has not be made known or accessible.

5. Access considerations, the presence of services and the activities being carried out on the site limited the locations where sampling locations could be installed and the techniques that could be used.

6. Site sensitivity assessments have been made based on available information at the time of writing and are ultimately for the decision of the regulatory authorities.

7. Where mention has been made to the identification of Japanese Knotweed and other invasive plant species and asbestos or asbestos-containing materials this is for indicative purposes only and do not constitute or replace full and proper surveys.

8. The executive summary, conclusions and recommendations sections of the report provide an overview and guidance only and should not be specifically relied upon without considering the context of the report in full.

9. E3P cannot be held responsible for any use of the report or its contents for any purpose other than that for which it was prepared. The copyright in this report and other plans and documents prepared by E3P is owned by them and no such plans or documents may be reproduced, published or adapted without written consent. Complete copies of this may, however, be made and distributed by the client as is expected in dealing with matters related to its commission. Should the client pass copies of the report to other parties for information, the whole report should be copied, but no professional liability or warranties shall be extended to other parties by E3P in this connection without their explicit written agreement there to by E3P.

10. New information, revised practices or changes in legislation may necessitate the re-interpretation of the report, in whole or in part.

APPENDIX II
GLOSSARY



TERMS

AST	Above Ground Storage Tank
BGS	British Geological Survey
BSI	British Standards Institute
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes
CIEH	Chartered Institute of Environmental Health
CIRIA	Construction Industry Research Association
CLEA	Contaminated Land Exposure Assessment
CSM	Conceptual Site Model
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)
DWS	Drinking Water Standard
EA	Environment Agency
EQS	Environmental Quality Standard
GAC	General Assessment Criteria
GL	Ground Level
GSV	Gas Screening Value
HCV	Health Criteria Value
ICSM	Initial Conceptual Site Model
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)
ND	Not Detected
LMRL	Lower Method Reporting Limit
NR	Not Recorded
PAH	Poly Aromatic Hydrocarbon
PCB	Poly-Chlorinated Biphenyl
PID	Photo Ionisation Detector
QA	Quality Assurance
SGV	Soil Guideline Value
SPH	Separate Phase Hydrocarbon
Sp.TPH (CWG)	Total Petroleum Hydrocarbon (Criteria Working Group)
SPT	Standard Penetration Test
SVOC	Semi Volatile Organic Compound
UST	Underground Storage Tank
VCCs	Vibro Concrete Columns
VOC	Volatile Organic Compound
WTE	Water Table Elevation

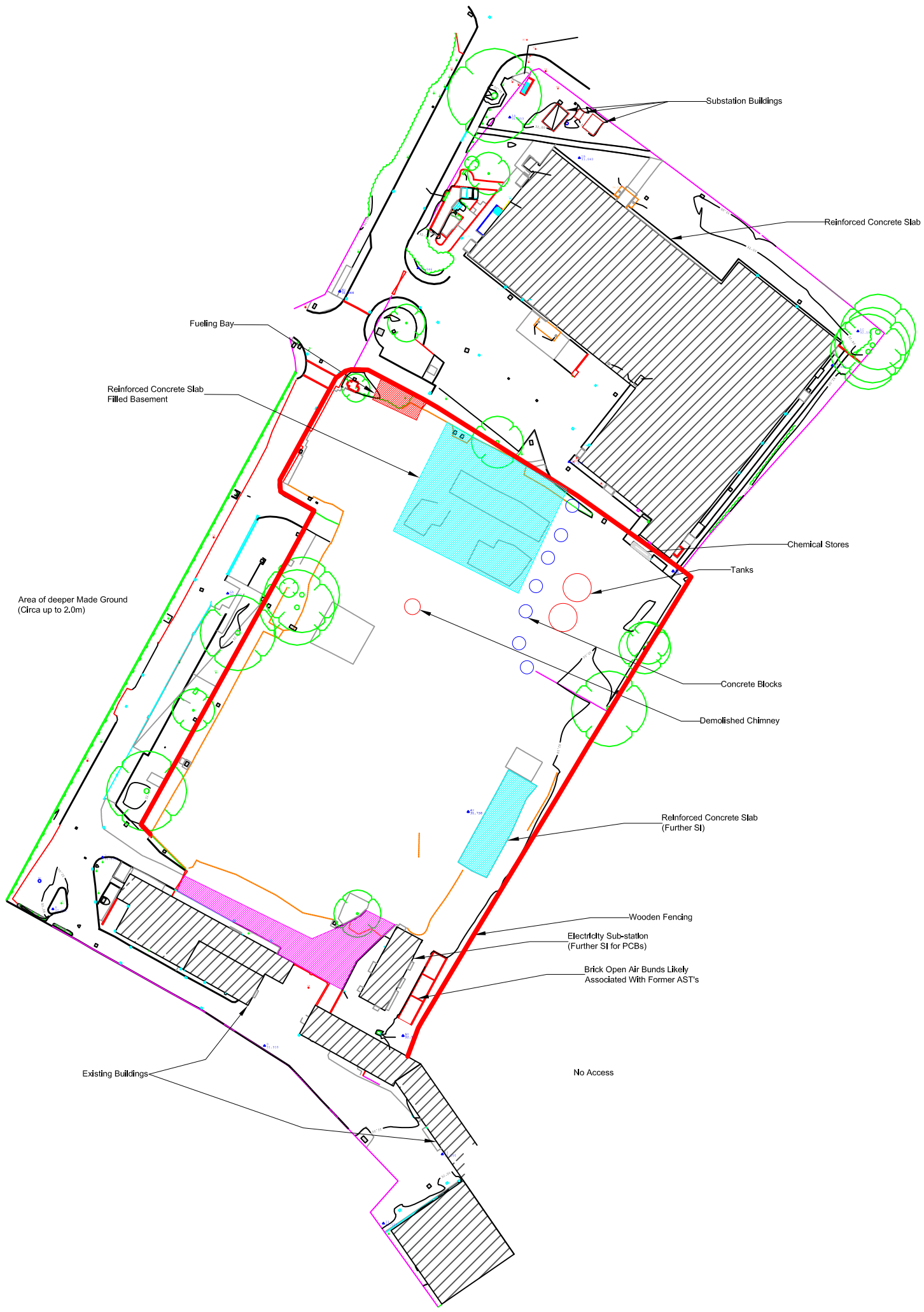
□□ITS

m	Metres
km	Kilometres
%	Percent
%v/v	Percent volume in air
mb	Milli Bars (atmospheric pressure)
l/hr	Litres per hour
µg/l	Micrograms per Litre (parts per billion)
ppb	Parts Per Billion

mg/kg	Milligrams per kilogram (parts per million)
ppm	Parts Per Million
mg/m^3	Milligram per metre cubed
m bgl	Metres Below Ground Level
m bcl	Metre Below Cover Level
mAOD	Metres Above Ordnance Datum (sea level)
kN/m^2	Kilo Newtons per metre squared
µm	Micro metre

APPENDIX III
DRAWINGS





Key:

Notes:

P1	-	09/06/2015	DRAFT	JN	MD
Phase	Revision	Date	Issue	Drawn	Authorised

Client: Bellway Homes

Job No: 10-933

Date: 11-06-2015

Drawing No: 002

Scale: 1:1000 @ A3

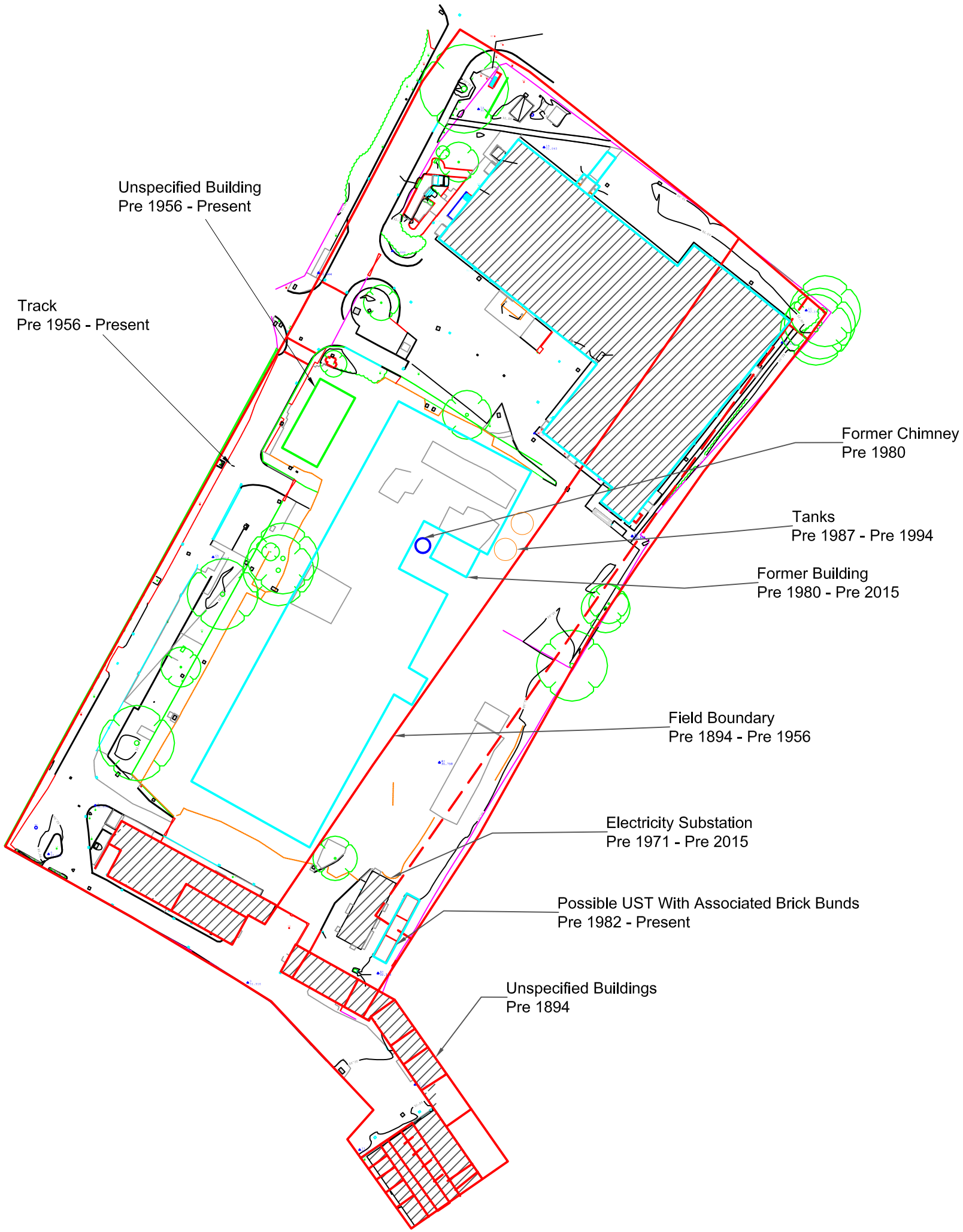
Job Title: Former Withington Hospital

Drawing Title: Site Features Plan

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Environmental Energy Engineering Partnerships Ltd
City Heliport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

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Key:

Historical Features

Current Structures

Notes:

P1 P1	R1 -	25/06/2015 09/06/2015	REVISION DRAFT	CB JN	MD MD
Phase	Revision	Date	Issue	Drawn	Authorised

Client: Bellway Homes

Job No: 10-933

Date: 25-06-2015

Drawing No: 003

Scale: 1:1000 @ A3

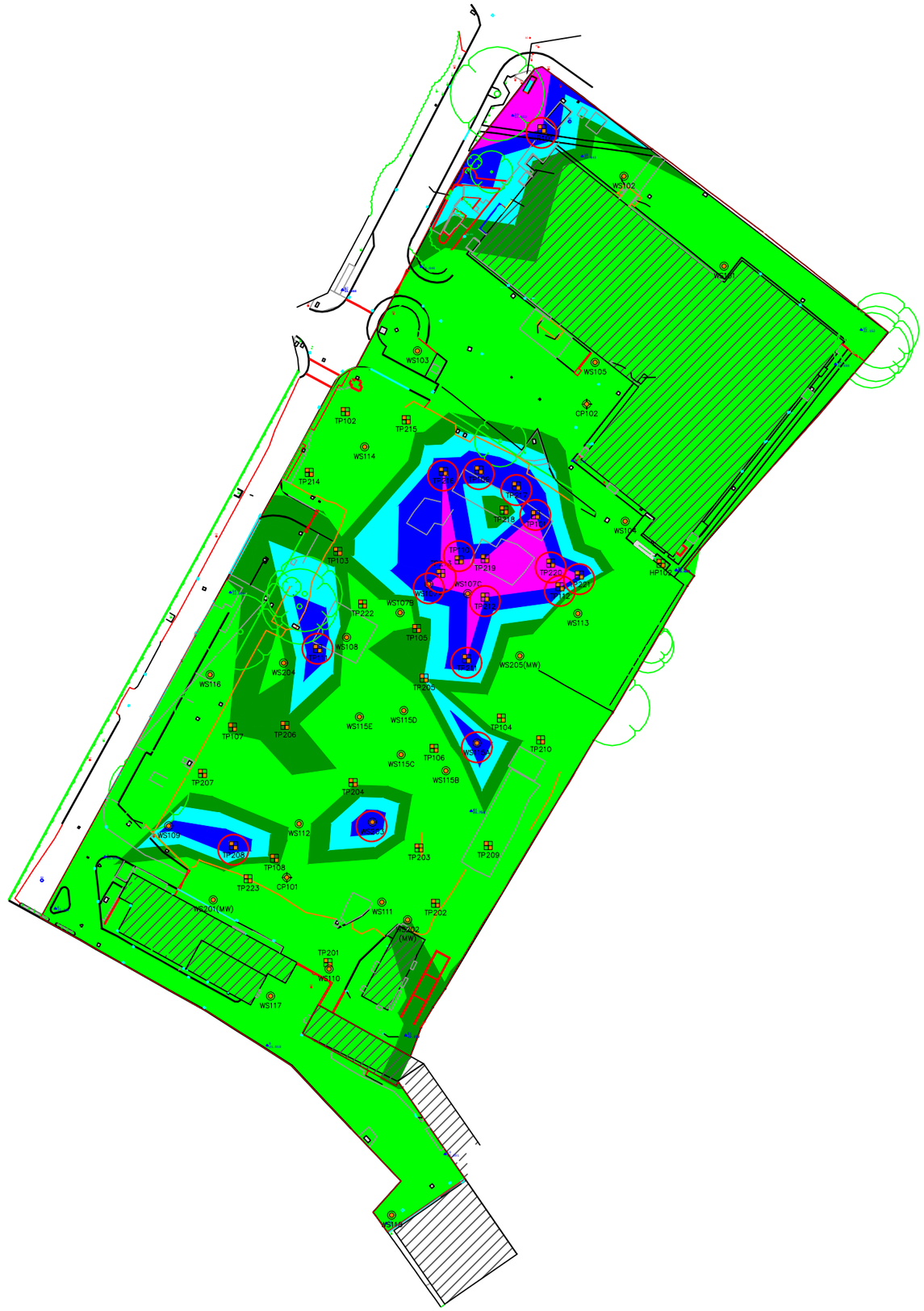
Job Title: Former Withington Hospital

Drawing Title: Historical Features Plan

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Environmental Energy Engineering Partnerships Ltd
City Hellport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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Key:

Location Symbols

- WS101 — Approximate Window Sample Probehole Location
- TP101 — Approximate Trial Pit Location
- HP101 — Approximate Hand Dug Pit Location
- CP101 — Approximate Cable Percussive Borehole Location
- TP201 — Approximate Trial Pit Location
- Where Rings Present Depth of Made Ground Cannot be Fully Determined

Shallow Spread Footings

- Depth of Made Ground 0.00 - 1.24m
- Depth of Made Ground 1.25 - 1.49m

Mass Trench Fill Footings

- Depth of Made Ground 1.50 - 1.74m
- Depth of Made Ground 1.75 - 1.99m
- Depth of Made Ground 2.00 - 2.24m

Engineered Footings

- Depth of Made Ground 2.25 - 2.49m
- Depth of Made Ground >2.50m

Notes:

Phase	Revision	Date	Issue	Drawn	Authorised
P1	-	10.06.2016	DRAFT	RW	MD

Client: Bellway Homes

Job No: 10-933

Date: 10-06-2016

Drawing No: 005

Scale: 1:1000 @ A3

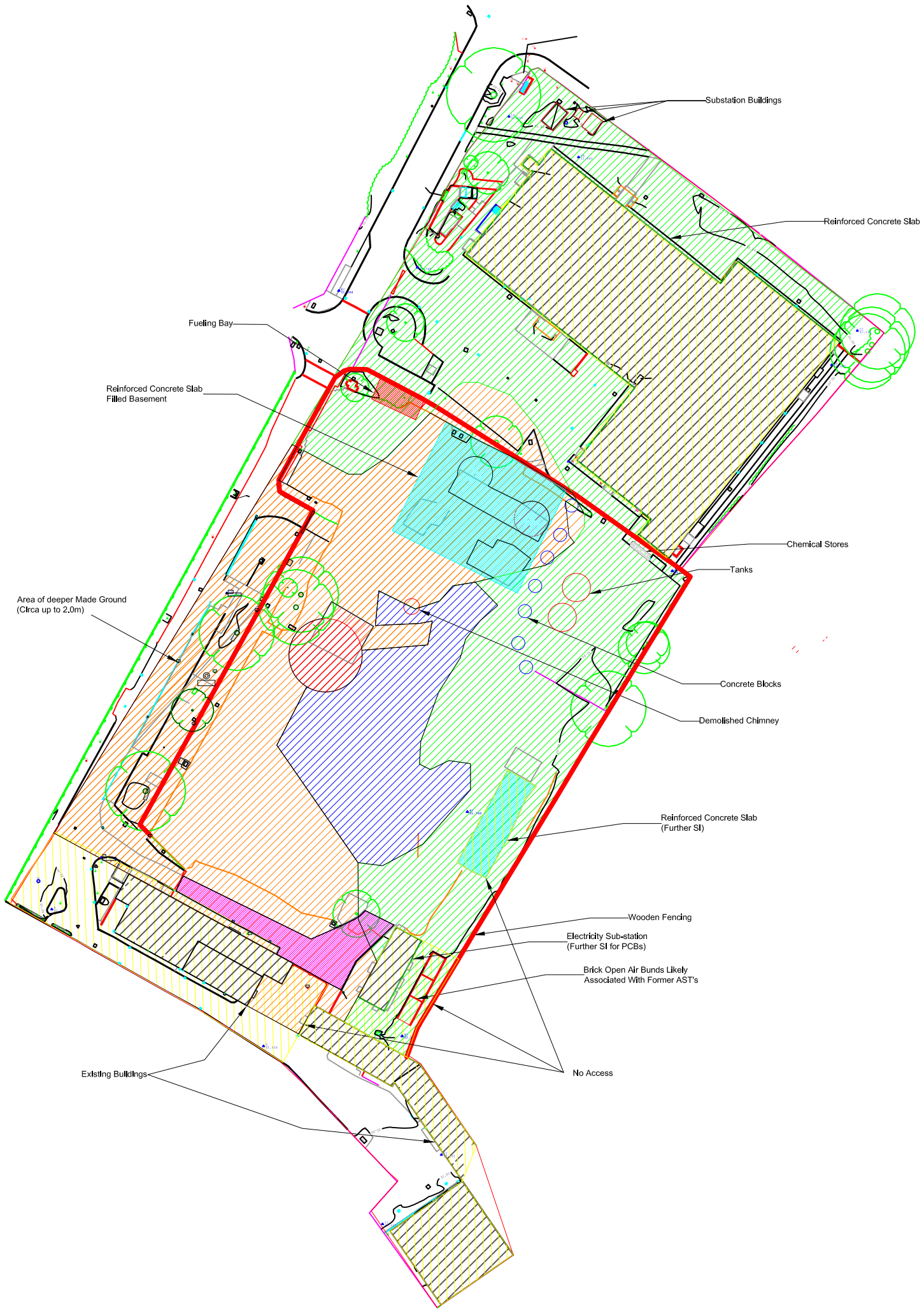
Job Title: Former Withington Hospital

Drawing Title: Depth of Made Ground Plan

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Environmental Energy Engineering Partnerships Ltd
City Heliport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
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Key:

Areas That Could Not be Investigated During Initial SI.

Notes:

P1 P1	R1 -	25/06/2015 11/06/2015	REVISION DRAFT	CB JN	MD MD
Phase	Revision	Date	Issue	Drawn	Authorised

Client: Bellway Homes

Job No: 10-933

Date: 25-06-2015

Drawing No: 006

Scale: 1:1000 @ A3

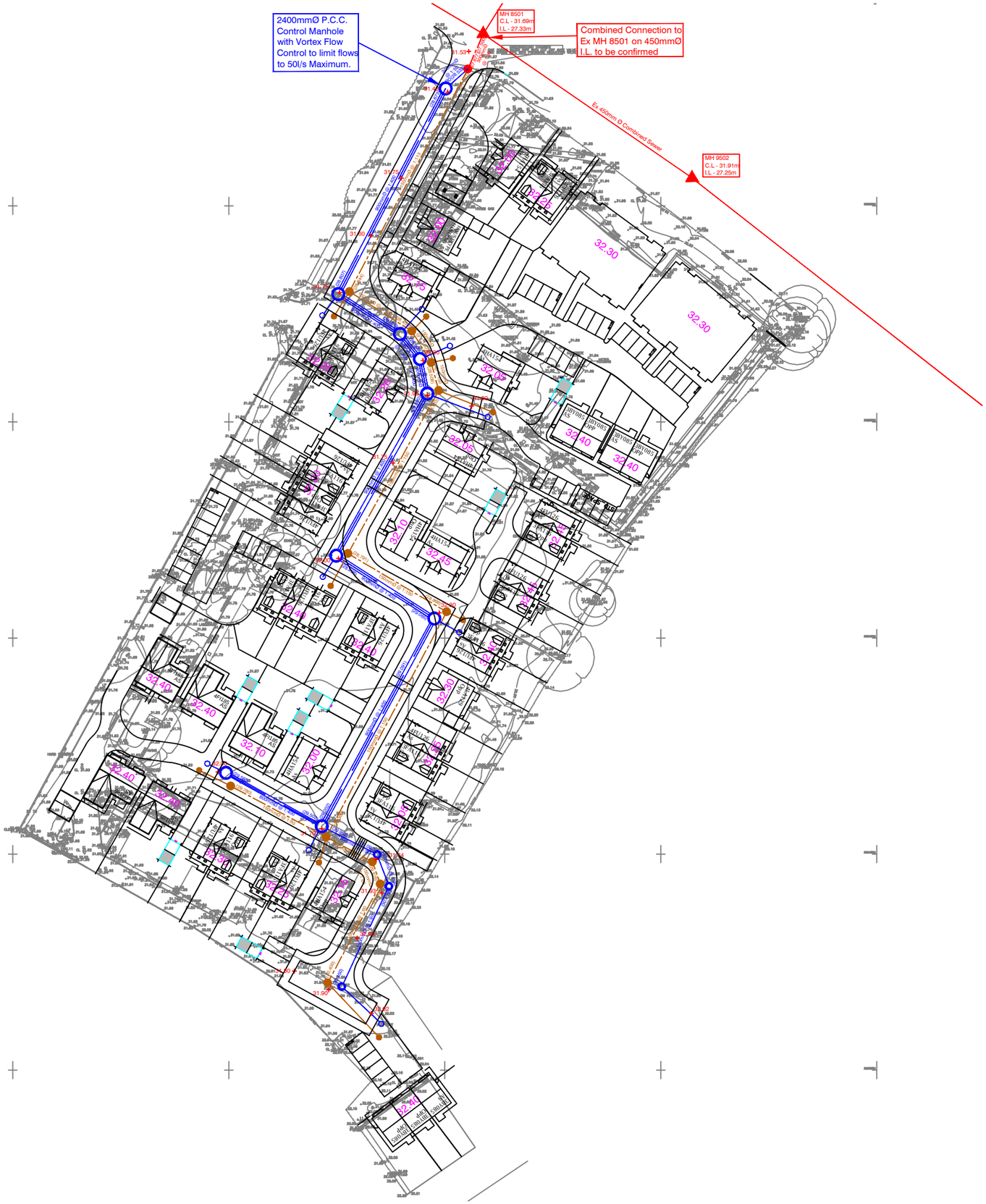
Job Title: Former Withington Hospital

Drawing Title: Development Constraints Plan

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Environmental Energy Engineering Partnerships Ltd
City Heliport & Business Centre
Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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2400mmØ P.C.C. Control Manhole with Vortex Flow Control to limit flows to 50l/s Maximum.
MH 8501
C.L - 31.69m
I.L - 27.33m
Combined Connection to Ex MH 8501 on 450mmØ I.L. to be confirmed
Ex.450mm Ø Combined Sewer
MH 9502
C.L - 31.91m
I.L - 27.25m
32.30
32.30
32.40
32.40
32.10
32.10
32.40
32.40
32.40

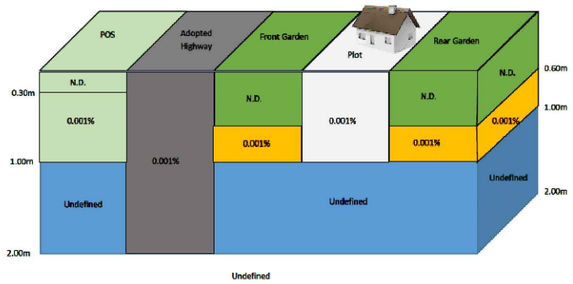


Asbestos in Soils Conceptual Site Model
Notes:

N.D - None Detected

0.001% - Soils may contain <0.001% asbestos using composite testing to ensure there is no potential risk to human health. This value is present within areas where there may be short term low level exposure of soils containing trace asbestos fibres by construction workers where an appropriate level of asbestos management is employed (dust suppression).

Undefined - This will be dependent upon soils encountered during the earthworks, which may be placed at these depths to ensure no potential risk to human health.



Location Symbols

WS101 — Approximate Window Sample Probehole Location (May 2016)

TP101 — Approximate Trial Pit Location (May 2016)

CP101 — Approximate Cable Percussive Borehole Location (May 2016)

HP101 — Approximate Hand Excavated Trial Pit Location (May 2016)

Remediation Issues

Area of Identified Asbestos

Area of identified TPH C12 - C21 (Aromatic)

Area of identified Non Volatile PAH's

Area of Historical Features

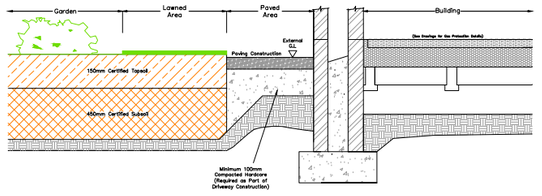
Remediation Issues

Item	*Plot Number*	*Active*
Garden Cover System	All	-
Hotspot Treatment	3-4, 15-16, 30-33, 53-58	-
CO_2 Membrane	All	-
CH_4 Membrane	N/A	-
Hydrocarbon Membrane	N/A	-
Hazardous Material Storage	N/A	-

Notes:

N.B: *All areas of identified contamination impact to soil and groundwater are estimated using best endeavors from historic and current intrusive investigation. However, the contractor must satisfy themselves of the potential extent of remediation works. The identified impact must be spatially delineated in accordance with the E3P Remediation strategy. The entire development site will require a 600mm chemically suitable cover system comprising of 150mm topsoil & 450mm subsoil installed in all proposed residential garden areas to mitigate the elevated contaminant concentrations.*

Indicative Construction for Garden Area (Residential)



P1	-	07-10-2016	DRAFT	JN	MD
Phase	Revision	Date	Issue	Drawn	Authorised

Client: Bellway Homes

Job No: 10-933

Date: 07-10-2016

Drawing No: 009

Scale: 1:1000 @ A3

Job Title: Former Withington Hospital

Drawing Title: Remediation Issues Plan

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Eccles, Manchester, M30 7RU
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
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APPE□DIX IV
E3P REMEDIATIO□
&
VALIDATIO□ CRITERIA



Hu□an Health Re□ediation Targets – Low Rise Residential End □se

Deter□inand	□nits	Within □00□ □ Cover Syste□ □Garden□	Hard Standing and □□00□ □ of cover syste□	Public Open Space 300□ □ Cover	Public Open Space □300□ □	Pathway
Arsenic	mg/kg	37(i)	□0(ii)	7□(iii)	□□0(iv)	1
Cad□iu□	mg/kg	11(i)	85(ii)	120(iii)	532(iv)	1
Chro□iu□ □Hexavalent□	mg/kg	□(i)	□(ii)	7.7(iii)	220(iv)	1
Lead	mg/kg	210(vi)	330(vii)	7□0(viii)	7□0(viii)	1
Ele□ental Mercury	mg/kg	1.2(i)	1.2(ii)	1□(iii)	30(iv)	2
□ic□el	mg/kg	180(i)	180(ii)	230(iii)	3□00(iv)	1
Seleniu□	mg/kg	250(i)	□30(ii)	1100(iii)	1800(iv)	1
Copper	mg/kg	2□00(i)	7100(ii)	12000(iii)	□□000(iv)	1
□inc	mg/kg	3700(i)	□0000(ii)	81000(iii)	170000(iv)	1
Phenol	mg/kg	280(i)(xi)	280(xiv)(xi)	7□0(iii)(xi)	7□0(iv)(xi)	2
□aphthalene	mg/kg	2.3(i)(xi)	2.3(xiv)(xi)	1200(iv)(xi)	1200(iv)(xi)	2
Acenaphthylene	mg/kg	170(i)(xi)	500(v)	15000(iii)(xi)	2□000(iv)(xi)	3
Acenaphthene	mg/kg	210(i)(xi)	500(v)	15000(iii)(xi)	2□000(iv)(xi)	1
Fluorene	mg/kg	170(i)(xi)	500(v)	□□00(iii)(xi)	20000(iv)(xi)	1
Phenanthrene	mg/kg	□5(i)(xi)	500(v)	3100(iii)(xi)	□200(iv)(xi)	3
Anthracene	mg/kg	500(i)(xi)	500(v)	7□000(iii)(xi)	150000(iv)(xi)	3
Fluoranthene	mg/kg	280(i)(xi)	500(v)	3100(iii)(xi)	□300(iv)(xi)	3
Pyrene	mg/kg	500(i)(xi)	500(v)	7□00(iii)(xi)	15000(iv)(xi)	3
Ben□o□a□Anthracene□	mg/kg	7.2(i)(xi)	11(ii)(xi)	2□(iii)(xi)	□□(iv)(xi)	3
Chrysene	mg/kg	15(i)(xi)	30(ii)(xi)	57(iii)(xi)	□3(iv)(xi)	3
Ben□o□b□Fluoranthene [iii]□	mg/kg	2.□(i)(xi)	3.□(ii)(xi)	7.1(iii)(xi)	13(iv)(xi)	3
Ben□o□□□Fluoranthene [iii]	mg/kg	77(i)(xi)	110(ii)(xi)	1□0(iii)(xi)	370(iv)(xi)	3
Ben□o□a□Pyrene [vii]□	mg/kg	2.2(i)(xi)	3.2(ii)(xi)	5.7(iii)(xi)	11(iv)(xi)	3
Indeno□123-cd□Pyrene	mg/kg	27(i)(xi)	□5(ii)(xi)	82(iii)(xi)	150(iv)(xi)	3
Diben□o□a,h□Anthracene	mg/kg	0.2□(i)(xi)	0.31(ii)(xi)	0.57(iii)(xi)	1.1(iv)(xi)	3
Ben□o□ghi□Perylene	mg/kg	320(i)(xi)	3□0(ii)(xi)	□□0(iii)(xi)	1□00(iv)(xi)	3
TPH C_5-$C_□$ □aliphatic□	mg/kg	□2(i)(xi)	□2(ii)(xi)	□2(ii)(xi)	10000(xiv)(xi)	2
TPH $C_□$-C_8 □aliphatic□	mg/kg	100(i)(xi)	100(ii)(xi)	100(ii)(xi)	10000(xiv)(xi)	2
TPH C_8-C_{10} □aliphatic□	mg/kg	27(i)(xi)	27(ii)(xi)	27(ii)(xi)	10000(xiv)(xi)	2
TPH C_{10}-C_{12} □aliphatic□	mg/kg	130(i)(xi)	130(ii)(xi)	130(ii)(xi)	10000(xiv)(xi)	2
TPH C_{12}-$C_{1□}$ □aliphatic□	mg/kg	1000(xiv)(xi)	1000(xiv)(xi)	1000(xiv)(xi)	10000(xiv)(xi)	1
TPH $C_{1□}$-C_{21} □aliphatic□	mg/kg	500(xiv)(xi)	500(xiv)(xi)	500(xiv)(xi)	10000(xiv)(xi)	1
TPH C_{21}-C_{35} □aliphatic□	mg/kg					1
TPH C_5-C_7 □aro□atic□	mg/kg	70(i)(xi)	70(xiii)(xi)	70(xiii)(xi)	10000(xiv)(xi)	2
TPH C_7-C_8 □aro□atic□	mg/kg	130(i)(xi)	130(xiii)(xi)	130(xiii)(xi)	10000(xiv)(xi)	2
TPH C_8-C_{10} □aro□atic□	mg/kg	3□(i)(xi)	3□(xiii)(xi)	3□(xiii)(xi)	10000(xiv)(xi)	2
TPH C_{10}-C_{12} □aro□atic□	mg/kg	7□(i)(xi)	7□(xiii)(xi)	7□(xiii)(xi)	10000(xiv)(xi)	2
TPH C_{12}-$C_{1□}$ □aro□atic□	mg/kg	1□0(i)(xi)	1□0(xiii)(xi)	1□0(xiii)(xi)	10000(xiv)(xi)	1
TPH $C_{1□}$-C_{21} □aro□atic□	mg/kg	2□0(i)(xi)	2□0(xiii)(xi)	2□0(xiii)(xi)	10000(xiv)(xi)	1
TPH C_{21}-C_{35} □aro□atic□	mg/kg	1000(xiv)(xi)	1000(xiv)(xi)	1000(xiv)(xi)	10000(xiv)(xi)	1

otes 1

Asbestos will be screened visually on-site by a qualified environmental consultant and where potential ACM is identified representative samples will be subject to quantitative analysis of 5&volume by weight. Should any ACM be identified within the soil matrices, further detailed % assessment would be required when the reported laboratory result exceeds the limit of detection for the analytical method at 0.01% by volume (weight).

otes 2

Excludes matrices where free product is observed;
Commercial Tier 1 GAC modelled to assume no exposure pathway; and,
No viable exposure pathway beneath hard standing and cover system.

otes 3

Main Exposure Pathways: 1 = Soil Ingestion, 2 = Vapour Inhalation (indoor), 3 = Dermal Contact & Ingestion, 4 = Dust Inhalation.
Abbreviations: GAC = General Assessment Criteria, n = number of samples, MC = Maximum Concentration; NA – Not Applicable (no exceedance of assessment criteria); Loc of MC = Location of Exceedances

(i) Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use **with** plant uptake.
(ii) Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use **without** plant uptake – these levels used below 600mm cover system within residential gardens as soils will be present within a residential setting yet soils will not be disturbed and garden plants will not reach these soils.
(iii) Value derived from LQM Suitable 4 Use Levels (S4ULs) for Public open Space (POS) residential.
(iv) Value derived from LQM Suitable 4 Use Levels (S4ULs) for Public Open Space (POS) park – these levels used below 300mm POS cover system as soils will not be disturbed by any future site users and exposure to these soils will be similar to a park end use.
(v) Value derived from LQM Suitable 4 Use Levels (S4ULs) alongside assessment with WM3 to ensure that materials remaining on site do not exceed the WM3 toxicity criteria for hazardous waste.
(vi) Value derived from Category 4 Screening Levels (C4SL) for residential land use **with** homegrown produce.
(vii) Value derived from Category 4 Screening Levels (C4SL) for residential land use **without** homegrown produce.
(viii) Value derived from Category 4 Screening Levels (C4SL) for Public open Space (POS) residential.
(ix) Value derived from Category 4 Screening Levels (C4SL) for Public Open Space (POS) park.
(x) Mercury – Based on elemental Mercury.
(xi) PAH and TPH levels used are for 1% SOM.
(xii) Xylenes based on p-xylene (o-xylene 2600mg/kg, m-xylene 3500mg/kg) and is capped by its solubility.
(xiii) Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use **with** plant uptake due to the volatilisation risk.
(xiv) BTEX is not SOM related due to inhalation pathway.

Remediation Targets – Comparison of Leachate Analysis with Tier 1 Screening Levels

DETERMI□A□D	□□ITS	SCREE□I□G VAL□E
Arsenic	µg/l	50[1]
Cadmium	µg/l	5[2]
Chromium	µg/l	2[1]
Copper	µg/l	5[1,3]
Total Cyanide	µg/l	1[1]
Lead	µg/l	4[1]
Mercury	µg/l	1[2]
Nickel	µg/l	50[1]
Selenium	µg/l	100[4]
Zinc	µg/l	10[5]
pH	-	6-9
Naphthalene	µg/l	10[1]
Benzo(a)pyrene	µg/l	0.05[7]
benzo[b/k]fluoranthene benzo[g,h,i]perylene & indeno(1,2,3-cd]pyrene	µg/l	0.10[6]
TPH C5-C6 (benzene)	µg/l	30[1]
TPH C6-C8 (toluene)	µg/l	50[1]
TPH C8-C10 (ethyl Benzene)	µg/l	20[1]
TPH C10-C12 (xylene)	µg/l	30[1]
TPH C12-C16 (naphthalene)	µg/l	10#[1]
TPH C16-C35	µg/l	50#

□otes

Solubility <0.01µg/l

1. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
2. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List I substances
3. Surface Waters (River Ecosystem) (Classification) Regulations 1994
4. WHO Guidelines for Drinking Water Quality. Third edition (2004)
5. Council Directive on the quality of fresh waters needing protection or improvement in order to support fish life (Freshwater Fish Directive)
6. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
7. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)

APPE□DIX V

Tree Survey

Ascerta

Landscape, Arboricultural & Ecological Solutions
for the Built Environment

Arboricultural Impact Assessment

Former Withington Hospital
Cavendish Road
Didsbury

September 2016

Rev.	Date	Details
A	13 September 2016	Minor revisions

Ascerta
Mere One, Mere Grange, Elton Head Road, St Helens WA9 5GG
T: 0845 463 4404 F: 0845 463 4405 E: info@landscapetreesecology.com
www.landscapetreesecology.com

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Appendix 1	Tree Data Tables in accordance with Table 1 of BS5837: 2012
Appendix 2	Drawing P.634.15.01 *Tree Survey* Drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing*
Appendix 3	The Manchester City Council (Land at the Former Withington Hospital Site) Tree Preservation Order 2013 The Manchester City Council (Land at the Former Withington Hospital Site) Tree Preservation Order 2015

EXECUTIVE SUMMARY

A survey of the existing trees on and adjacent the site of the former Withington Hospital, Cavendish Road, Didsbury has been carried out by a suitably qualified and competent Arboriculturist in accordance with British Standard 5837: 2012 *Trees in relation to design, demolition and construction – Recommendations*.

The purpose of the survey and of this report is to identify the impact of the proposed development of the site on trees, both within and immediately adjacent the site, in accordance with the provisions of BS5837: 2012.

The development of the site will involve the construction of 74 residential dwellings in a mix of detached, semi-detached, townhouses and apartments, which will require the removal of a small number of existing trees and which, in the absence of suitable controls, has the potential to have an indirect impact on a number of the trees proposed for retention.

Mitigation for the impact of the development can be provided in the form of the following:

- The erection of protective fencing in advance of the commencement of the development to safeguard the root systems of retained trees;
- The agreement, in advance of the commencement of the development, together with the implementation during the construction phase, of a methodology for the protection of retained trees.

Compensation for the impact of the development, together with landscape and biodiversity enhancements can be achieved by way of the following:

- The planting of trees and shrubs as part of a comprehensive landscape scheme to replace any trees lost and to integrate the development into the wider landscape;
- The planting of native hedges where possible to provide linear habitats that link to habitats located off site;
- The use of a mixture of native and ornamental species within planting schemes, where those species are suited to the site and local landscape.

A landscape scheme and planting schedule has been submitted with the application, incorporating the above recommendations.

1.0 Introduction

1.1 Ascerta has been instructed by Bellway Homes Ltd (Manchester Division) to carry out a survey of the trees within and immediately adjacent the site of the former Withington Hospital, Cavendish Road, Didsbury and to assess the potential impact of the development as proposed on trees within / adjacent the site in accordance with British Standard 5837: 2012 *Trees in relation to design, demolition and construction – Recommendations.*

1.2 The site was visited on 26 May 2016 by Alistair McLeod, a competent and qualified arboriculturist with 28 years experience of the UK and European arboricultural and landscape industries within the context of the planning system. During the site visit, a survey was carried out of the trees growing both on and immediately adjacent the site to the standards contained within BS5837: 2012. This report presents the results of the survey, provides an assessment of the impact of the development and includes recommendations for further actions, where applicable, in order to mitigate any potentially negative effects of the development on tree cover within the local landscape.

2.0 Objectives

2.1 Our client's objective is to develop the site by the construction of 74 residential dwellings.

2.2 Our objectives are as follows:

- Identify what arboricultural features exist presently within and adjacent the site and to record and categorise them in a manner consistent with BS5837: 2012;
- Identify which trees will need to be removed directly as a result of the proposed development of the site;
- Identify any indirect impact from the proposed development on trees proposed for retention;
- Provide an indication of what protection measures can be implemented as part of the development of the site to ensure the physical protection of retained trees;
- Provide recommendations for mitigation and compensation in terms of new planting or enhancement of existing features of arboricultural, landscape or ecological interest or importance;
- Provide any other recommendations to assist our clients in achieving their objectives whilst satisfying current legislation or policy guidance in relation to the woody vegetation on site.

3.0 Planning Policy & Relevant Legislation

3.1 The National Planning Policy Framework (March 2012) sets out the Government's planning policies for England and how these are expected to be applied. The Framework contains a presumption in favour of sustainable development, with sustainable development in the UK being defined under the UK Sustainable Development Strategy *Securing the Future.* This sets out five 'guiding principles' of sustainable development: living within the planet's environmental limits; ensuring a strong, healthy and just society; achieving a sustainable economy; promoting good governance; and using sound science responsibly.

3.2 The Framework seeks to facilitate the approval, without delay, of developments that meet the objectives of up to date Local Plans. Where proposed developments involve net gains for nature and biodiversity, this is to be seen as a positive improvement in the quality of the natural environment and thus in compliance with the objectives of the Framework.

3.3 The site lies within the Manchester Council administrative area and is subject to the policies contained within its Local Plan.

3.4 Checks made with Manchester City Council confirm that a number of the trees within the site are subject to statutory controls in the form of Tree Preservation Orders, copies of which are appended to this report. In advance of the commencement of any works to trees within or adjacent the site, those instructing and proposing to carry out such works should satisfy themselves that all appropriate consents are in place to prevent potential breach of legislation.

3.5 British Standard 5837: 2012 *Trees in relation to design, demolition and construction – Recommendations* provides current recommendations and guidance on the relationship between trees and design, demolition and the construction processes. It sets out the principles and procedures to be applied to achieve a harmonious and sustainable relationship between trees and structures.

3.6 Notwithstanding the aforementioned policies and legislation, consideration should also be given to any impacts from the proposed development in respect of the Hedgerow Regulations 1997 and the Forestry Act 1967 (and specifically the potential need for a felling licence), as well as existing UK and European legislation relating to wildlife and nature conservation.

4.0 Survey & Survey Methodology

4.1 We have been supplied with a digital copy of the topographical survey Ordnance Survey map for the site, which largely satisfies section 4.2 of BS5837: 2012. Features of arboricultural or landscape interest that have been excluded from the original plan (for example trees on or located off site but within a distance from the boundary of the site equal to or less than 12 times the stem diameter of that tree) have been added to the plan manually.

4.2 Our assessment of the soils within the site, based on local site conditions, geography, available soil maps and our own experience of soils across the United Kingdom, indicates that the soils on site are likely to contain a clay element, and that this will have a plasticity index in the low / medium range. Any further details or confirmation of the exact nature of soil conditions on site will require further, more rigorous sampling and analysis. It is not however anticipated that the clay content will cause specific issues relating to retention of trees given the impact of the development proposals, providing that consideration is given to this aspect in advance of and during the construction phase of the development. Provision will need to be made for the protection of soil structure in key areas during the construction phase and the repair of any damage post construction. Further details are provided throughout this report and final details can be secured via planning condition.

4.3 Our survey of the trees within and adjacent the site was carried out by a qualified and competent arboriculturist in accordance with sections 4.4 and 4.5 of BS5837: 2012 on 26 May 2016 during cloudy, dry weather conditions. Those trees surveyed have been numbered sequentially, although for the purposes of this project they have not been tagged. The trees have also been categorised in accordance with section 4.5 and Table 1 of the Standard.

4.4 Where relevant and where the quality of shrub masses and hedges justifies recording, details have been recorded to the tree survey plan and tree data tables.

4.5 Where trees are surveyed that require immediate attention, for example to abate a nuisance, prevent a serious hazard to life or property, or are affected by a pathogen or pest that could cause widespread damage unless it is controlled, notification will be issued to the relevant person or organisation such that appropriate action can be taken.

4.6 Root Protection Areas for those trees surveyed have been calculated in accordance with the formulas within section 4.6 and Annex C of the Standard and can be found within the tree data tables that accompany this report. The tree data tables also contain a key to abbreviations used and the rationale for determining Root Protection Areas for groups of trees and woodlands (where applicable).

5.0 Survey Results & Impact Assessment

5.1 **Existing Tree Cover:** Twelve individual and eleven groups of trees were recorded during our survey, the details of which can be found within Appendix 1 to this report and cross referenced with drawing P.634.15.01 *Tree Survey*.

5.2 **Direct Impact on Trees:** The development of the site as proposed will directly require the removal of T2, T3, G1, G2, T5, T6, T11, G6, T12 and parts of G7 & G8. Of those trees to be removed, only tree T2 is protected (*T1 of The Manchester City Council (Land at the Former Withington Hospital Site) Tree Preservation Order 2013)*. This tree is small, with limited landscape value, and is in decline both structurally and physiologically, therefore its loss will not detract from the overall value of the site and it can easily be replaced within the landscape proposal for the site. The rest of the trees proposed for removal are of low value and also easily replaced.

5.3 **Indirect Impact on Trees:** In the absence of suitable controls, the development may well have an indirect impact on a number of trees on and adjacent the site. Measures are therefore required during the construction phase, as described throughout this report, in order to safeguard retained trees for the long term benefit of the landscape.

5.4 **Context in the Wider Landscape:** The wider landscape comprises mainly residential dwellings with a moderate / high level of tree cover. The direct impact of the development is therefore considered likely to have a positive impact on the extent of canopy cover within the wider landscape through the provision of new planting as part of the development of the site.

5.5 **Hedgerows:** In accordance with the Hedgerow Regulations 1997, 'important' hedgerows (in the context of the Regulations) should not be removed without a Hedgerow Removal Notice issued by the relevant Local Authority, unless that removal is subject to an appropriate consent under the Town and Country Planning Act 1990. In this instance however, there are no hedgerows within or immediately adjacent the site that could be considered important in the context of the regulations.

5.6 **Potential Mitigation for Development Impacts:** Mitigation of the impacts from the development of the site can be provided in the form of replacement of trees lost to the development, the planting of new trees as part of a comprehensive landscape planting scheme, the erection of protective fencing to an agreed specification in a suitable location in advance of the commencement of the development and the use of site specific actions adopting modern methods of construction as agreed and documented within an appropriate Arboricultural or Tree Protection Method Statement, further details of which can be found throughout this report. Appropriate arboricultural and biodiversity enhancements in line with local and national planning policy can be achieved through the planting of trees, shrubs and where appropriate hedges, as part of the landscape proposals for the site. A detailed landscape scheme and planting schedule had been prepared by Landscape Design Solutions and submitted with the reserved matters application.

5.0 Survey Results & Impact Assessment (Continued)

5.7 **Potential for Shading & Nuisance:** Mature trees in urban and suburban areas add significant value and environmental benefits to properties; however, it is acknowledged that some land / property owners are averse to retaining trees close to buildings and areas of public use because of shading and other potential nuisances (leaf / fruit drop for example). Whilst efforts can be made to minimise the impact from shading by trees, it is almost inevitable that in some situations, whether in the short term from existing trees or in the long term from new trees, trees will cast shade on parts of properties, whether that be buildings, garden / open space or other areas of general use during part of the day. Generally, any shade cast from trees will be for relatively short periods and entirely acceptable given the accepted co-existence of large trees in an urban context. The acceptability or otherwise of shade is a somewhat subjective issue driven largely by land or property owner / occupier perceptions and in the majority of cases is not necessarily something that should be determined by a local planning authority. We do not consider in this case that shade will be excessive, or that any other ordinary circumstance arising from the presence of trees, for example from leaf or fruit drop, will constitute an unacceptable nuisance.

5.8 **Boundary Screening:** Trees located adjacent to the boundaries of the site make a welcome contribution to the screening of views and can be complemented by the planting of new trees and shrubs such as to filter views and integrate the development into the surrounding landscape.

5.9 **Long Term Spatial Constraints:** The proposed layout has been designed to meet the standards set by the local planning authority and is such that, where applicable, adequate space has been provided between new buildings and trees to limit the potential for future pressure to remove trees. Whilst it is not possible to predict what actions future occupiers will seek to take in respect of trees within or adjacent properties, the proposed detailed layout is considered acceptable from a design perspective and contributes to a balanced landscape.

5.10 **Existing Areas of Hard Standing:** There are a number of existing areas of hard standing across the site, remnants from the site's previous use. Where there is a risk of damage to retained trees from the proposed removal of these surfaces, for example adjacent T1, T4, T9 & T10, appropriate controls and safeguards will need to be implemented, for example the erection of suitable protective fencing in advance of the commencement of works and the careful breaking up and removal of surfaces using tools and equipment suitable for the task without causing unnecessary damage either to above or below ground parts of trees. This element of the project should be agreed in advance and documented within a suitable Method Statement. Specific areas of concern in this regard are marked on Drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing*.

5.0 Survey Results & Impact Assessment (Continued)

5.11 **Existing buildings/structures to be removed:** There are a number of existing buildings associated with the current / previous use of the site that have the potential to cause significant damage to retained trees during their demolition and removal. Specifically, the interface between buildings to be removed and existing boundary trees to be retained will require care during the demolition / remediation phase. Works should be controlled by way of an agreed methodology written into a suitable Method Statement, to include suitable physical protection and safeguarding measures for retained trees.

5.12 **Proposed Areas of Hard Standing:** Areas where proposed hard surfaces encroach within or are immediately adjacent root protection areas of retained trees are marked on drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing* appended to this report. The extent of precautionary measures and special construction methodologies required in order to safeguard the trees are also indicated on the drawing. All final details should be subject to a methodology agreed in advance of the commencement of the development.

5.13 **Proposed Buildings Located Adjacent / Within Root Protection Areas:** Drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing* appended to this report indicates areas where proposed built structures encroach within or are located immediately adjacent root protection areas of retained trees. The drawing also suggests appropriate measures for the safeguarding of retained trees, the final details for which should be agreed in advance and documented within a suitable Method Statement.

5.14 **Proposed Drainage & Domestic Services:** At the planning application stage of the project, details of proposed drainage arrangements and provision of utility services are generally not known. During the installation process however, general guidance can be obtained from the National Joint Utilities Group publication *Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees – Volume 4* such as to minimise the impact of works on retained trees.

5.15 **Working Space During the Construction Phase:** Considering the layout of trees on site and in some cases their close proximity to areas proposed for intense development activity, it is likely that working space across the site will be somewhat restricted, therefore some key activities may have the potential to cause harm to retained trees. Provision will therefore need to be made for the physical protection of retained trees and in particular their root systems during the construction phase. Drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing* indicates where appropriate measures will be required.

5.0 Survey Results & Impact Assessment (Continued)

5.16 **Access Facilitation Pruning:** There may be a limited number of areas within the site where an element of access facilitation pruning may be required, for example between the construction interface and trees off site within G5. Providing that these works are controlled and carried out to a minimum of the standards as contained within BS3998: 2010 *Tree work – Recommendations*, then the visual impact of the work will be minimal and will not detract from the overall landscape value of the site. Our preliminary recommendations for arboricultural works are stated within the Tree Data Tables at Appendix 2.

5.17 **Protection of Planting Areas:** It is often desirable to fence off areas that are to be newly planted to protect the soil structure; however, works will be required across the majority of the site, therefore there is little scope to set aside areas for such treatment. Provided that adequate provisions are made for ground preparations in advance of the landscape stage, there is unlikely to be a negative impact on the viability of newly planted stock.

5.18 **Requirement for an Arboricultural Method Statement:** It would be beneficial to agree and implement a Method Statement for Tree Protection (an Arboricultural Method Statement) to ensure that retained trees are adequately protected from the outset and that no unnecessary harm occurs during the construction phase. Section 6 of this report contains further details of the aspects of the development that could successfully be controlled, which can in turn be subject to a suitably worded planning condition.

5.19 **Planning for New Landscaping:** If not considered carefully at the design stage, new planting and landscaping can have an adverse impact on existing trees and cause long term problems for the built environment. Care should be taken in the design of new landscapes to prevent physical damage to retained trees during the planting process, and to ensure that schemes are designed to survive and thrive rather than compete for resources. Similarly new trees and shrubs should not be planted where they will cause damage to structures, either directly or indirectly in the future. Table A1 at Annex A of the Standard gives advice on minimum distances for new trees from structures to avoid direct damage from future tree growth. Further advice should be sought from the project arboriculturist and a suitably qualified and experienced engineer as to the potential indirect impact of trees on structures in the long term (from clay shrinkage subsidence). A landscape scheme and planting schedule has been prepared by Landscape Design Solutions. Subject to agreement with the local planning authority, the landscape proposal will provide suitable replacements for those trees removed, integrate the development into the wider landscape and enhance the general level of canopy cover across the site.

6.0 Tree Protection Measures

6.1 On the basis of the proposed layout and those trees proposed for retention, drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing* shows our preliminary recommendations for the physical protection of retained trees throughout the construction phase. The plan indicates the location of protective barriers, as well as the specification for construction of the protective fencing in accordance with Figures 2 & 3 of the Standard. These barriers will form a construction exclusion zone around the retained trees.

6.2 In addition to the erection of protective fencing, drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing* shows areas where it would be beneficial to agree a tree protection method statement between the project arboriculturist, design & construction teams and the local planning authority tree officer. The method statement will need to address and make allowance for the following:

- All forms of access required to the site;
- Site cabins and storage areas;
- Proposed parking for site personnel;
- Phasing of works;
- Space required for excavations (including foundation excavations);
- Any required special construction techniques (for example provision of porous surfaces);
- The location and construction methodology for installation of services in close proximity to retained trees & hedges;
- Any changes in ground levels and any resulting requirement for retaining structures;
- Proposed root zone enhancement measures;
- Working space for cranes, plant and scaffolding; and
- Management of waste products within the site.

6.3 Over and above the physical tree protection measures that should form the basis for the tree protection method statement, the following details should be provided within the method statement:

- Protection of the soil structure within the proposed planted areas (where applicable);
- Planting operations within the root protection areas of retained trees;
- Any required / additional precautions outside of construction exclusion zones in relation to the treatment & landscaping of garden or open space areas;
- System of arboricultural site monitoring / schedule of site visits and resulting actions.

7.0 Summary of Impacts & Potential Mitigation Factors

7.1 Table 1 below summarises the impacts of the development as proposed on tree cover within and immediately adjacent the site. Comments are also provided on potential mitigation, compensation or special measures required in order to minimise the impact of the development and safeguard trees proposed for retention.

Table 1: Summary of the impacts of the development on trees within / adjacent the site.

Issue	Affecting	Mitigation / Compensation / Special Procedures
Trees / hedges to be removed	T2, T3, G1, G2, T5, T6, T11, G6, T12 and parts of G7 & G8.	Appropriate compensation can be provided by way of new / replacement planting at the landscape stage of the project. Biodiversity enhancements can also be achieved through the landscape proposals.
Indirect physical impact on retained trees	Retained trees within and adjacent the site.	Tree protection fencing should be erected to an agreed specification in advance of the commencement of the development. Key areas where works are proposed within or immediately adjacent root protection areas of retained trees should be subject to a method statement, agreed in advance as a condition of planning consent.
Removal of existing hard standing	T1, T4.	Existing hard standing should be removed with care and no excavations permitted deeper than existing sub-base without adequate precautionary measures to prevent unnecessary damage to retained trees.
Provision of new / refurbished hard surfaces	T1, T4, T9, T10.	Suitable construction methodologies are achievable, with the use of geotextiles / porous surfaces where applicable. Sensitive excavations will be required with an element of root pruning when necessary. Works in this area to be overseen by project arboriculturist.
Demolition / remediation works	G4, G5, G9-G11.	Buildings to be demolished carefully, removing the structures away from tree stems. Such works should be subject to a tree protection method statement.
Construction of new buildings/structures	Retained trees within and adjacent the site.	Sections of foundations within and immediately adjacent root protection areas to be excavated sensitively, with machinery located outside of RPAs and roots pruned cleanly back to the soil surface when necessary. Works in these areas of the site to be subject to a tree protection method statement.
Provision of drainage / services	Retained trees within and adjacent the site.	Where existing services cannot be utilised, NJUG principles must be adopted to and adhered to.
Working Space	G4 & G5.	Working methodology to be agreed in advance.
Access Facilitation Pruning	G4 & G5.	All pruning works should be carried out to a minimum of the standards contained within BS3998: 2010 *Tree work – Recommendations*.
Protective Fencing	To be erected to an agreed specification in advance of the commencement of the development and retained in-situ throughout the course of the construction phase.	

7.2 On the basis of the above and the contents of this report, it is considered appropriate that a Method Statement for Tree Protection be prepared as a condition of planning consent to demonstrate how trees proposed for retention can be suitably safeguarded. The Method Statement should be adopted as a control document by site personnel.

8.0 Conclusions & Recommendations

8.1 The direct and indirect impacts on tree cover as a result of the development proposals are outlined within this report and mitigation proposed accordingly that seeks where possible to satisfy local and national planning guidance and policy. Where trees are proposed for removal, replacement planting should be undertaken as part of a landscape planting scheme for the site in line with local plan requirements and to integrate the development into the surrounding landscape. Arrangements for the safeguarding and physical protection of retained trees should be agreed and implemented in a manner consistent with current arboricultural management practices to minimise any potentially negative effects on long term tree cover.

8.2 We recommend that a landscape proposal be prepared for the site, to include where feasible provision for the planting of a mixture of native, as well as ornamental trees, shrubs and hedges, and implemented as a condition of planning consent. We also recommend that tree protection measures are implemented in accordance with a finalised version of drawing P.634.15.02 *Tree Constraints & Draft Protection Drawing* and that a tree protection / arboricultural method statement be prepared and implemented as a condition of planning consent for the development.

9.0 References

Department for Communities and Local Government (March 2012) *National Planning Policy Framework*;

British Standard 5837: 2012 *Trees in relation to design, demolition and construction – Recommendations*;

National Joint Utilities Group publication *Guidelines for the Planning, Installation and Maintenance of Utility Apparatus in Proximity to Trees – Volume 4.*

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Appendix 1

Site:	**P.634.1 Cavendish Rd, Didsbury**	Surveyor:	**Alistair McLeod**
Client:	**Bellway Homes Ltd**	Survey Date:	**Cloudy, dry**
Brief:	**Tree Survey to BS5837:2012**	Survey Conditions:	**26/05/2016**

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T. No	Species	Ht (m)	Stem DBH (mm)	RPA Radius (m)	Branch Spread N	S	E	W	Ht Crown Clearance (m)	Age Class	P Condition	Structural Condition & General Comments	Preliminary Recommendations	Est. (yrs)	Cat Grade
T1	Lime	14	580	6.96	6	5.5	4	6	3.5 S	M	G	Minor Basal growth.	Crown Lift to 4m. Secondary branches only. Remove basal growth.	30+	**B2**
T2	Hawthorn	6	340	4.08	3	3	4	2.5	1.7 NW	OM	F/P	Deadwood and dieback in upper canopy. Declining. Manhole 1.5m from base. Basal growth. Not suitable for retention.	Fell and replace.	10	**U**
T3	Laburnum	3.5	170	2.04	2	0.5	0.5	0.5	1.3	OM	P	Mostly dead.	Fell and replace.	≤10	**U**
T4	Lime	13	600	7.20	6	6	6	6	2.1 NE	M	G	Basal growth. Included unions at 2.1m.	Remove basal growth. Crown lift to 3.5m - secondary growth only.	30+	**B2**
G1	Cherry	10	250	3.00	6	6	6	6	1.1	EM/M	F	Low quality group. Included unions.	Fell and replace.	20+	**C2**
G2	Sycamore, Goat Willow and Elder	5	150	1.80	4	4	4	4	0	EM	F	Low quality scrub group.	Fell and replace.	30+	**C2**
T5	Birch	9	310	3.72	5	4	5	5	2	M	F	Major fork at 2m. Close to edge of tarmac. Location unsustainable.	Fell and replace.	20	**C1**
T6	Hawthorn	7	320	3.84	3	4	2	3	1.6 NE	FM	F	Dieback to branch tips. Declining. Close to manhole.	Fell and replace.	20	**C1**
T7	Lime	14	#580	6.96	5	5	5	5	2.5 E	M	G	Off site. Low branch.	Crown lift to 3m over site if necessary.	30+	**B2**
T8	Lime	14	#540	6.48	5	4	4	5	2.2 S	M	G	On boundary. Low branch.	Crown lift to 3m over site if necessary.	30+	**B2**
T9	London Plane	16	940	11.28	11.5	12.5	8	8	3 NE	M	G	Pruned in past. Long limb growing north over footpath. Possibly off site.	Reduce branch tips on limb growing north over footpath to alleviate weight on limb.	40+	**A2**
T10	London Plane	15	1040	12.48	9.5	10	10	6.5	3 S	M	G	Tarmac around base. Pruned in past.	No works required at this time.	40+	**A2**
T11	Hawthorn	6	370	4.44	4	3	3.5	3.5	1.7 E	OM	P	Pruned heavily in past. Declining.	Fell and replace.	≤10	**U**
G3	Jacquemontii Birch	6	100	1.20	1.5	1.5	1.5	1.5	1.9	SM	F/G	Planted in highway pavement.	No works required at this time.	30+	**B2**
G4	Sycamore and Norway Maple	17	310	3.72	7	7	7	7	0.5	EM	F	Boundary group. Self seeded.	Reduce branch tips back from site by 2-3m.	30+	**B2**

NOTE: The Category Grade applied to trees surveyed is consistent with the recommendations within Table 1 of BS5837: 2012, however this does not necessarily correlate with the visual importance of a tree within the wider landscape, nor does it dictate which trees should be retained at the cost of quality development. Where trees are to be lost to accommodate a development, recommendations will be made such as to provide suitable mitigation and compensation, and to integrate the development into the wider landscape.

Key to Abbreviations & Headings

T. No.: Tree number (T = Tree, G – Group, W = Woodland, H = Hedge, Cpt. = Compartment)
Stem DBH (Diameter at Breast Height): Measured at 1.5m above ground level*
Ht Crown Clearance: Canopy ground clearance
Structural Condition: Description of any observed defects
Cat. Grade: Tree quality assessment in accordance with BS5837: 2012

Species: Common name used
Root Protection Area Radius: Root Protection Area as per BS5837: 2012
Age Class: Y = Young, EM =Early Mature, M = Mature, OM = Over mature, D = Dead
Preliminary Recommendations: Made in respect of known / intended use of the site
* For groups of trees, the stem diameter of the largest tree in the group is generally used
# Denotes estimated DBH where access was not possible

Ht: Approximate height of tree from ground level in metres
Branch Spread: Extent of canopy spread in metres to each of the four cardinal points
P (Physiological) Condition: G = Good, F = Fair, P = Poor, D = Dead
Est. (yrs): Estimated remaining contribution in years

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Site:	**P.634.1 Cavendish Rd, Didsbury**	Surveyor:	**Alistair McLeod**
Client:	**Bellway Homes Ltd**	Survey Date:	**Cloudy, dry**
Brief:	**Tree Survey to BS5837:2012**	Survey Conditions:	**26/05/2016**

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T. No	Species	Ht (m)	Stem DBH (mm)	RPA Radius (m)	Branch Spread N	S	E	W	Ht Crown Clearance (m)	Age Class	P Condition	Structural Condition & General Comments	Preliminary Recommendations	Est. (yrs)	Cat Grade
G5	Lime and Sycamore	18	#520	6.24	6	6	6	6	2	M	F/P	Basal growth to Limes. Sycamores poor condition with northern one severely declining. Off site.	Cut back basal growth into site. Prune back branch tips where necessary.	20+	**B2/C2**
G6	Sycamore, Privet, Horse Chestnut, Norway Maple, Ash and Hawthorn	8	250	3.00	4	4	4	4	0	EM/M	P	Low quality boundary scrub.	Fell and replace.	20	**C2**
G7	Sycamore, Ash and Oak	15	480	5.76	7 See plan	7	7	7	1	EM	F/P	Low quality self seeded trees.	Remove those trees growing within boundary.	30+	**C2**
G8	London Plane, Ash, Hybrid Poplar, Sycamore and Hazel	17	#620	7.44	7 See plan	7	7	7	0.5	EM/M	F	Largely off site. Canopy overhang into site maximum 5m.	Prune canopy overhanging site back by 2-3m. Remove those trees within boundary.	30+	**B2**
T12	Horse Chestnut	11	470	5.64	4.5	4.5	2.5	4.5	2 S	EM	P	Low quality. Bleeding canker. Stem damage. Hard surfaces all round.	Fell and replace.	20	**C1**
G9	Hybrid Poplar, Cherry and Hazel	17	#540	6.48	7	7	7	7	-	EM/M	-	Off site. Could not inspect in detail.	No works required at this time.	30+	**B2**
G10	Cypress and Sycamore	10	300	3.60	3	3	3	3	-	EM	-	Off site. Could not inspect in detail.	No works required at this time.	30+	**B2**
G11	Eucalyptus, Purple Leaved Plum and mixed shrubs	6	100	1.20	3	3	3	3	-	EM	F	Off site. Could not inspect in detail.	No works required at this time.	30+	**B2**

NOTE: The Category Grade applied to trees surveyed is consistent with the recommendations within Table 1 of BS5837: 2012, however this does not necessarily correlate with the visual importance of a tree within the wider landscape, nor does it dictate which trees should be retained at the cost of quality development. Where trees are to be lost to accommodate a development, recommendations will be made such as to provide suitable mitigation and compensation, and to integrate the development into the wider landscape.

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Preliminary Recommendations: Made in respect of known / intended use of the site
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# Denotes estimated DBH where access was not possible

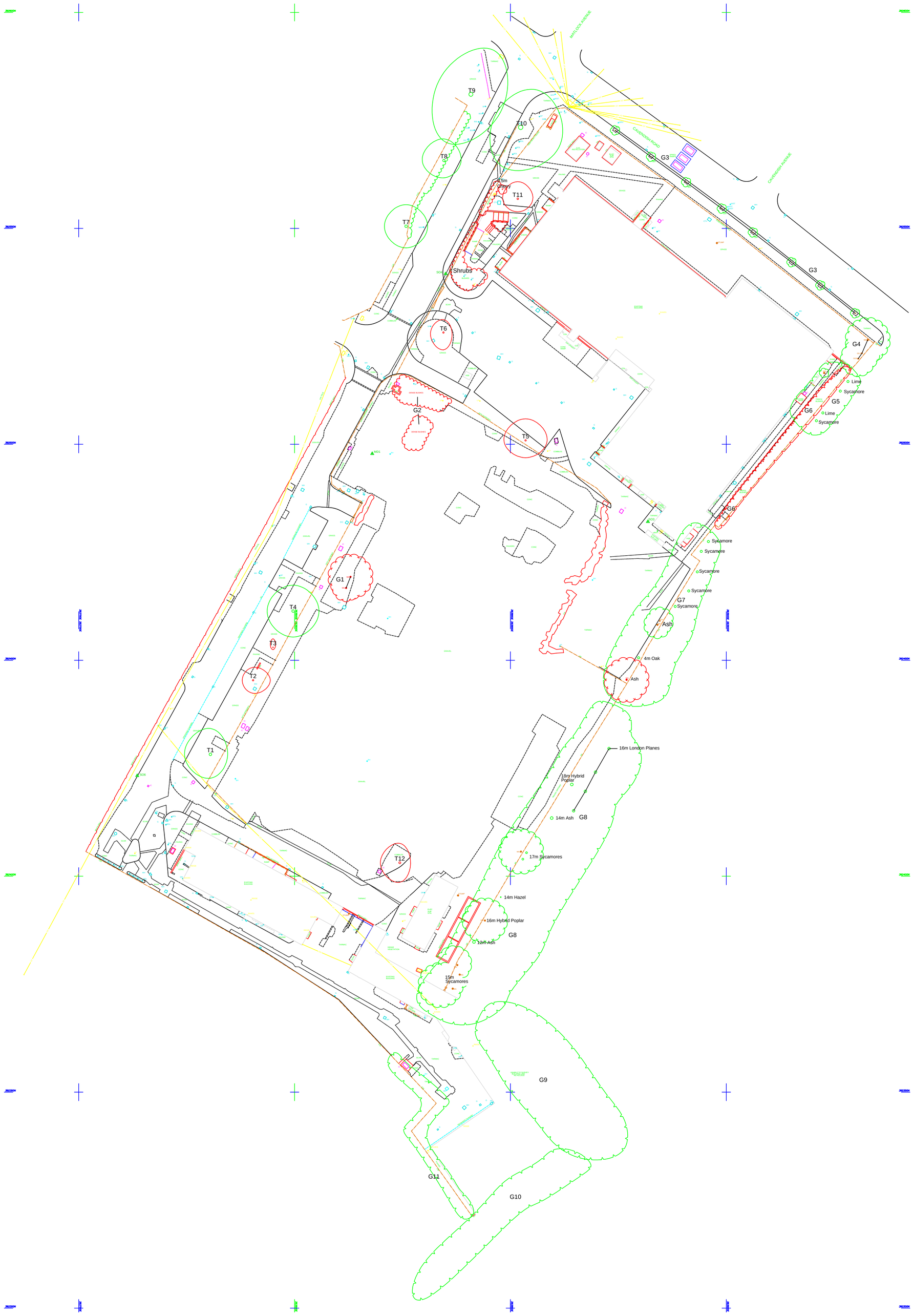
Ht: Approximate height of tree from ground level in metres
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Est. (yrs): Estimated remaining contribution in years

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Appendix 2



ALL COORDINATES RELATED TO LOCAL GRID LOCATED TO OS NG BY BEST FIT TO DETAIL, EXTRACTED FROM OS DIGITAL DATA.

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Mere One, Mere Grange
Elton Head Road, St Helens
Merseyside WA9 5GG
t: 0845 463 4404 f: 0845 463 4405
e: info@landscapetreesecology.com
Web: www.landscapetreesecology.com

REV	DESCRIPTION	DATE

CLIENT:
Bellway Homes Ltd

PROJECT:
Cavendish Road, Manchester

DRAWING TITLE:
Tree Survey

SCALE:	DRAWN BY:	DRAWING No:	REV:
1:500 @A1	CP	P.634.15.01	-
DATE: 26/05/2016	CHKD BY: AM		

KEY

Existing tree to be retained

Existing tree to be removed

DO NOT SCALE

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S:\All Jobs\634.15 Bellway Homes, Cavendish Road, Manchester\Drawings\P.634.15.01 Tree Survey