



Remediation & Geotechnical Enabling Works Strategy

Land at:
Openshaw Police Headquarters
Lawton Street
Openshaw
M11 2NT

Prepared for:



E3P Report: 11-404-R2 Rev 1
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PROJECT NUMBER	11-404

EXECUTIVE SUMMARY

Site Address	Greater Manchester Police, Lawton street, Openshaw, Manchester, M11 2NT
Grid Reference	388222E, 397050N
Site Area	0.79 Hectares
Background	E3P has been instructed by Greater Manchester Police (GMP) to prepare a Remediation and Enabling Works Strategy for the proposed development of the car park and land that forms part of the Openshaw Police Station. The E3P Remediation & Enabling works strategy has been produced in due consideration of the Geo-Environmental Site Investigation and Contaminated Land Assessments previously completed by E3P. The subject site is a rectangular parcel of land that is divided into a heavily vegetated area and a gravel car park to the west of the wider GMP site. The eastern half of the site previously featured a concrete helipad before its decommissioning, although the slab remains in place. The area surrounding the slab comprises compacted gravel and is currently use as parking for GMP and vehicles awaiting scrapping. The south western site sector, has several cabins and shipping containers that are used for storage.
Summary of Site Remediation & Enabling Works	This document provides a comprehensive specification for the regeneration of the land in a manner that will negate the identified pollutant linkages and ensure the development is suitable for the proposed end use. The salient features of the Remediation & Enabling Works Strategy are summarised below:  Excavation, and removal of all existing above and below ground structures beneath the proposed structural foundation;  Sorting, processing and segregation of all deleterious materials;  Materials deemed unsuitable for retention to be removed from site;  Location; isolation and management of any asbestos impacted soils;  Validation sampling to confirm all material retained on-site poses no risk to the identified receptors within the context of the CSM;  Processing of Made Ground to recycle aggregate as Class 6 Material;  Importation of chemically suitable materials (if required) to achieve the required development elevation;  Removal of any previously unidentified contamination hotspots;  Validation testing of materials placement to confirm suitability;  All works to be undertaken in strict accordance with UK Environmental Permitting and Local Planning Authority Requirements,

EXECUTIVE SUMMARY

Geotechnical Engineering Requirements	The nominated earthworks contractor will be responsible for the re-engineering of the sub-stratum in accordance with the E3P Performance specification to ensure delivery of the following key criteria:  Building Footprint (+2.0m on all elevations) will be subject to a process of remediation works to remove all relict foundations, infrastructure and oversize material. The resulting excavation will be backfilled with material that will be suitable for future Ground Improvement by the construction of Vibro Stone Columns to support a ground bearing floor slab and structural foundations;  External Hardstand to be remediated to remove all relict foundations and obstructions to a depth of >1.0m from the underside of formation with all voids and potential areas of instability removed to their full depth. Materials will be replaced and compacted to ensure compliance with the E3P Geotechnical specification with a CBR >5% at formation;  Drainage Infrastructure location to be cleared of all relict foundations and infrastructure to a minimum of 1000mm from the underside of invert with material to be backfilled in compliance with E3P geotechnical specification;  Placement of a suitable temporary works platform (Piling Mat) to be constructed using graded 6F2 aggregate to a minimum depth of 300mm with a CBR >15% at the top of formation;  Placement of a minimum 225mm capping layer comprising certified graded 6F2 within all areas of proposed external hard-stand with a CBR >12% at formation.
Summary of Build Phase Mitigation Works	<i>The developer's works will also include the completion of the following additional elements.</i>  Provision of certified soil material and appropriate validation within all landscaped areas; and,  Provision of appropriately designed water supply pipes.

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Drawing No 11-404 -002 – Historical Features

Drawing No 11-404 -003 – Exploratory Hole Location

Drawing No 11-404 -004 – Depth of Made Ground Plan

Drawing No 11-404 -005 – Conceptual Site Model

Drawing No 11-404 -006 – Development Constraints

Drawing No 11-404 -007 – Depth to Founding Strata

Appendix IV E3P Contamination Remediation / Validation Criteria

1. INTRODUCTION

1.1 Background

E3P has been instructed by Greater Manchester Police to prepare a Remediation & Geotechnical Enabling Works Strategy for a proposed commercial development of the car park and vegetated land within the grounds of the Openshaw Police Station, herein referred to as 'the site'.

1.2 Report Objectives

The objectives of this report are to:

-  Evaluate feasible remediation and ground engineering technologies;
-  Provide geotechnical performance criteria for the delivery of the site;
-  Define validation criteria to demonstrate the successful implementation of a site Remediation & Enabling works plan; and,
-  Ensure the safe, cost effective and regulatory compliant redevelopment of the site.

1.3 Scope of Works

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

-  Review of site characteristics;
-  Identification of geotechnical constraints;
-  Development of remediation and enabling works objectives;
-  Selection of appropriate remedial technology; and,
-  Development of remedial strategy.

1.4 Redevelopment Plan

GMP propose to construct a new two storey office building with associated car parking in the north-eastern sector of the site. There is also a possibility of an access road being constructed on the western boundary of the site.

1.5 Summary of Parties Involved

FUNCTION / INTEREST	NAME OF PARTY
Land Owner	Grater Manchester Police
Geotechnical / Environmental Consultant	E3P
Main Contractor	TBC
Remediation & Enabling Contractor	TBC
Regulator / Local Planning Authority	Manchester City Council
Controlled Waters Regulator	Environment Agency

1.6 Site Details

Site Address	Land at Openshaw Police Headquarters, Lawton Street, Openshaw, M11 2NT
National Grid Reference	388222E, 397050N
Site Area	0.72 Ha

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 11-404-001.

1.7 Site Summary

SITE DESCRIPTION & SETTING		
Occupancy/use	The subject site forms part of the current Greater Manchester Police (GMP) Station and comprises a compacted gravel car park in the eastern sector with land in the west comprising overgrown self-seeding vegetation. The site is relatively level, however the very south of the site slopes down approximately 2.00m to the adjacent railway and there is a gradual slope in the very west of the site. The site is bound by vegetation and palisade fencing to the north, south and west, with the eastern boundary open to the remainder of the police facility.	
	The car park in the east formerly featured a square concrete helipad to the south which has since been decommissioned. The remaining gravel area is used as storage for vehicles that are no longer suitable for use as well as employee parking. In addition to this, several rectangular portacabins and steel cargo crates have been placed for use as storage.	
	The vegetated area to the west has seen low level maintenance to keep a looping path through the grasses and plants and is utilised as an area for dog walking.	
Environmental Setting	<i>Drift Geology</i>	Glacial Till – Clay, Silt, Sand and Gravel
	<i>Bedrock Geology</i>	Chester Pebble Beds Formation - Sandstone.
	<i>Hydrogeology</i>	Secondary Aquifer (undifferentiated) in Drift overlying Principal Aquifer in the sandstone bedrock.
	<i>Surface Water</i>	The nearest water feature is Mill Brook located 250m south west of the site.
	<i>Source Protection Zone</i>	None
	<i>Groundwater Sensitivity</i>	Principal Aquifer with no abstraction within 1km.
	<i>Surface Water Safeguarding Zone</i>	None
	<i>Groundwater Safeguarding Zone</i>	None

SITE DESCRIPTION & SETTING

Site History	Historical maps confirm that until the early 1900's the site was predominantly undeveloped only occupied by a signal point to the western corner. The site was then developed into railway lines and sidings that were constructed across the site. The sidings were also associated with storage sheds, inspection pits and tanks. Through the late 1970's the railway sidings were removed leaving the site vacant whilst the existing police station was constructed immediately east of the subject site.
Landfill Sites & Ground Gases	It is anticipated that there will be deep Made Ground present on-site which could be a source of ground gas. There are 3No. Environment Agency licensed waste sites located within 250m of the site. The closest is located 71m north east of the site and is a composting facility which has been active since 2003. There is also a material recycling treatment plant and waste transfer station located 152m south west and 233m north respectively. There is a former landfill located 161m south west of the site of the site that was operational from 1985 to 1994. Other waste transfer or disposal sites within 250m of the site include a recycling facility located 116m west of the site and 230m south west.

1.8 Summary of Reported Ground Conditions

E3P has prepared a detailed Site investigation report (Ref: 10-266-R1) dated February 2015 and a supplementary investigation letter (Ref: 11-404-L3 Rev 1) dated December 2018, the summary of reported ground conditions is provided below:

SUMMARY OF GROUND CONDITIONS

Made Ground	Made Ground was encountered across the entire site to a maximum proven depth of 6.20m in CP102 and RBH1. The full thickness of Made Ground was only proven in five locations including the two cable percussion hole and the rotary open hole. The Made Ground generally comprised a surface layer of sandy gravel of limestone within the current car park area, or a gravelly clay in areas of soft standing to depths of between 0.20m and 0.40m bgl. Underlying the surface strata was generally a dark brown slightly sandy very clayey gravel with frequent cobbles and boulders. The cobbles and boulders generally comprise brick and sandstone. These strata were generally encountered to a depth of between 2.10m and 3.20m, where it was subsequently underlain by black red gravel and ash layer to between 3.90m and the maximum proven depth of 6.50m bgl. A greater thickness may be present.
Topsoil	No topsoil that would be suitable for re-use has been identified within any of the exploratory hole locations.
Drift	Drift deposits were only encountered within two exploratory holes due to the significant depths of the Made Ground. The underlying Clay was encountered at a shallowest depth of 2.50m bgl within TP104 in the north of the site, where it was encountered as a stiff medium strength silty CLAY with frequent gravel. This stratum was also recorded in WS106. Further investigation took place on return visits using cable percussive and rotary drilling techniques which confirmed CLAY drift deposits to a depth of

SUMMARY OF GROUND CONDITIONS

	18.50m bgl which overlay red brown fine SAND to a maximum proven depth of 43.00m bgl (RBH101).
Bedrock	Bedrock was not encountered during the investigation.
Groundwater	Groundwater was not encountered during the investigation.

1.9 Summary of Previously Completed Contamination Risk Assessment

A Phase 1 & 2 Site Investigation and Contaminated Land Risk Assessment has been completed by E3P on behalf of the developer, Grater Manchester Police, the findings of these investigations are documented within the E3P report (ref:11-404-R1) dated November 2016. The supplementary letter did not include a contamination assessment; The salient features of this report are summarised below.

Contamination Risk Assessment

Human Health

A Tier I human health risk assessment has been undertaken for the site identifying one exceedance of lead along with asbestos fibres throughout the-site.

It is proposed that the majority of the site will be overlain by hardstanding either beneath the car park areas or below the proposed structure thus breaking the pathway to the identified lead.

However, the asbestos impacted soils have had additional quantification analysis which found a maximum of 0.003% fibres within the samples, but at depths greater than 1.00m bgl. Subsequent management will be required as part of the remediation works in accordance with the E3P conceptual site model provided below:

E3P anticipate that the Made Ground will be unsuitable for retention within soft landscaping and as such it is likely that a 300mm clean cover (comprising 150mm topsoil and 150mm subsoil) will be required in all areas of soft landscaping to break the pollutant linkage.

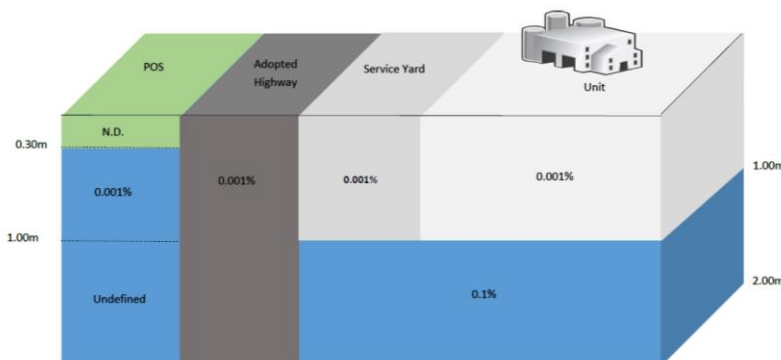
Figure A1 Asbestos in Soils Conceptual Site Model Commercial Development

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.



Controlled Waters

The site is considered that to pose a low risk to controlled waters due to the low solubility of identified constituents of concern; presence of low permeability strata likely to afford protection to the underlying aquifers; and the lack of surface water features and water abstractions in the local area.

Ground Gas	Ground gas monitoring for the site completed by E3P showed no elevated gas readings and therefore no gas precaution measures are required.
Potable Water Infrastructure	A well designed remediation and enabling works solution should ensure that all materials placed within the near surface pose no risk to potable supply infrastructure and thus facilitate the use of standard water supply pipe.

1.10 Summary of Previously Completed Geotechnical Assessment

Geotechnical Assessment	
Underground Obstructions	Cobbles of brick and boulders of sandstone were encountered throughout the Made Ground; however, no significant obstructions were encountered that hindered the progress of the trial pit excavations. However, given the former uses of the site, large obstructions cannot be ruled out.
Allowable Bearing Pressure (ABP)	The natural CLAY drift deposits encountered beneath the Made Ground have been assessed as being very stiff high strength with a net ABP in the order of 165kN/m² at circa 5.00m bgl increasing to +400kN/m² with depth.
Foundation Options	It is anticipated that on completion of the proposed site remediation and enabling works, the ground will generally comprise circa 2.50m to 5.00m of Made Ground overlying firm to very stiff CLAY soil. It is considered that the deep Made Ground is not considered suitable bearing stratum to support structural foundation given the depth of the placed Made Ground generally in excess of 4.0m across the entire site. When considering the identified ground conditions, it is considered that structural loadings should be supported by a piled foundation that will extend through the variable Made Ground bearing on the underlying stiff Clay to a maximum proven depth of 18.50m bgl. The depth for a piled foundation will be dependent on the location of the structure, nature of underlying ground conditions and design of the pile. Competent strata within the Clay has been identified within the cable percussive drilling to be circa 9m bgl however, rotary drilling proved a depth of very stiff clay to 18.50m overlying medium Sand to 43.00m bgl. Bedrock was not encountered during the investigation. Alternatively, there is potential for the structure to be supported by vibro replacement stone columns which would provide a net ABP in the order of 150kN/m² to support shallow pad foundations. However, existing site constraints in the form of historic structures and service networks should be considered as these have the potential to limit the application of vibratory ground improvement techniques. If higher bearing capacities are required, then consideration should be given to sleeving piles through Made Ground strata; pile groups; or increasing the diameter of the pile. A specialist contractor should be consulted to determine the most suitable method of piling.

Geotechnical Assessment

	An appropriately reinforced ring beam will be required between the piles to support the masonry walls. A survey of all trees and hedges on the site and within 30m of the site boundary should be undertaken to identify tree species, locations and heights. This information will be required to assess the effects of potential heave within the cohesive strata and the requirement for mitigation measures
Building Floor Slabs	A ground bearing slab will be viable but it will need to be constructed on a granular sub base with the thickness designed by a structural engineer to ensure that settlement tolerances are taken into consideration and that sufficient surface clays have been removed from tree influence areas to mitigate any seasonal volume changes in the clay influence zones.
Heave Precautions	Given the underlying Clay is classified Low Volume Change Potential, heave precautions will not be required to the internal face of a foundation. Where a ground bearing floor slab is to be constructed within the conjectured zone of tree influence, the clay will need to be removed to >50% of the foundation depth to ensure that any desiccated soil cannot swell and induce heave to the structure. Alternatively, it may be possible to design the structure to resist the influence of clay heave using exaggerated sub-base and additional re-enforcement within the slab to be designed by the Structural Engineer.
Soakaway Drainage	The Made Ground and underlying granular soils are impacted by low level inorganic compounds which would preclude the use of infiltration drainage systems.
Sulphate Assessment	Concrete classification will be predominantly DS1 AC1. One area has found elevated Sulphates that suggests the concrete classification DS-3 AC-3, however, following remediation this will in all likelihood be DS-1 AC-1.
CBR Design %	Made Ground can be re-engineered to ensure a CBR >5%. The natural clay soils could be compacted to achieve a CBR in the order of 3-5% depending on climatic conditions at the time of the works.
Cut / Fill	Development levels unknown at this time, however some cut fill will be required to construct the appropriate development platform. It is likely that surplus material will be generated during the excavation of the current car park. Due to the nature of the Made Ground it is likely that a proportion of this could be sorted and processed to form a recycled aggregate though consideration of the asbestos results will be needed.

2. SITE REMEDIATION & ENABLING WORKS

2.1 Overview of Works

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 2.1 (below).

<i>Enabling Works Schedule</i>	
RE-1	Pre-Commencement Regulatory Compliance 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	Environment & Nuisance 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.

Enabling Works Schedule

RE-3	Identification, Isolation and Treatment of Invasive Plants The contractor should undertake a full site survey to define the extents prior to the development of a method statement for the eradication of invasive plants. The contractor shall employ a suitably qualified expert to investigate the presence of invasive plant species on or adjacent to the site. Where invasive plant species are identified, these will be treated in strict accordance with the Environment Agency Code of Practice and in accordance with an approved method statement. Given that 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-4	Site Clearance Operations General site clearance & provision of welfare, offices and site security as per the contract requirements. The site is partially covered with self-seeded vegetation, this material should be removed in a controlled manner with full compliance with any ecological mitigation measures 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-5	Delineation, Excavation and Treatment of Identified Asbestos Impact Asbestos has been identified in multiple locations at depths greater than 1.00m bgl and given the nature and age of the current structures and infrastructure its presence is anticipated throughout the Made Ground. The E3P Developed Conceptual Site Model demonstrates a suitable method for management of soils to negate any future risk, this model is included within the later sections confirming protocol for the management of soils impacted by asbestos fibres. The contractor must ensure that 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.

Enabling Works Schedule

RE-5

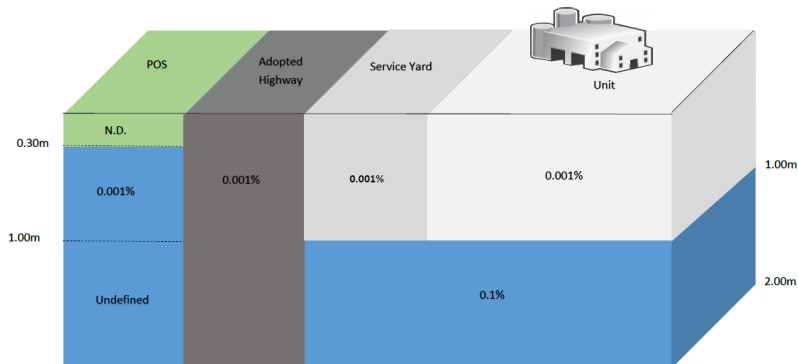
Figure A1 Asbestos in Soils Conceptual Site Model Commercial Development

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.



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-6

Excavation, Breaking and Processing of All Above & Below Ground Structures

Obstructions, relict foundations and infrastructure (apart from live services) are to be removed from the areas of proposed structural foundation (in their entirety), infrastructure and external areas to a minimum depth of 1.0m from the underside of sub-base or pipe bedding.

Artificially hard materials should be broken out and crushed. Stockpiles will then be subject to validation testing to confirm the materials suitability for reuse on site where required. Materials will be processed as per the E3P chemical and geotechnical specification using licensed plant.

Where natural soils are present at a relatively shallow depth, 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-7

Importation of Bulk Fill

Where there is a net shortfall of geotechnically suitable material required to achieve the proposed enabling works levels, it will be necessary to import or win from the wider land holding, natural inert soils and aggregate as per the engineering requirements (Section 6).

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.

It shall not be acceptable to import any material to the subject site that would be classified as Hazardous Waste using Technical Guidance WM3: Waste Classification - Guidance on the classification and assessment of waste.

Enabling Works Schedule

RE-8	Removal of Excess soil The contractor will remove all spoil deemed to be 'excess' from site in strict accordance with UK Management Legislation. Processed aggregate will not be deemed waste / excess and as such all material will be retained on-site by the developer. The contractor must not remove any materials deemed aggregate without the prior written consent of the client. The contractor will manage all spoil in such a manner to ensure all material deemed excess is classified as inert. The contractor will supply all waste transfer records and corresponding Environmental Permit for the waste receiver site.
RE-9	Remedial Verification Report Collation of all 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.

2.2 Materials Management & Legislative Compliance

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 12,000m³ 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.

2.3 Post Remediation Constraints

Post remediation constraints for the site will include:

-  *Sub surface concrete should be designed in accordance with Design Sulphate Class DS-1, Aggressive Chemical Environment for Concrete Classification Ac-1s in accordance with recommendations provided in BRE Special Digest 1 (2005);*
-  *Polyethylene potable water supply pipes will be required for the complete site, subject to the completion of a United Utilities Risk Assessment;*
-  *Placement of clean sub-soil and topsoil in soft landscaped areas; and,*
-  *Foundation strategies should take into account the properties of the strata left in-situ.*

2.4 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 commercial development.

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 materials are 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 3.2 (below).

Table 2.2 - Specification of Chemical Validation Laboratory Analysis

Material Use	Testing Frequency	Suite of Analysis
Site Generated 6F2	1 Sample Per 1000m ³	A / B / C / D
General Made Ground Fill	1 Sample per 2500m ³	G
Backfill Materials (site processed)	1 Sample Per 2000m ³	A / B / C / D

Notes

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

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

3. WORKING METHODOLOGIES – ASBESTOS CONTAINING MATERIALS

3.1 Working Methodologies

Asbestos fibres have been identified within the Made Ground deposits therefore it is necessary to develop and document all proposed working methodologies to be adopted by all people involved with the proposed handling of material where Asbestos Containing Material (ACM) has been identified.

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.

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.

In the event that a greater level of asbestos is identified within the soils, or that small amounts of lagging are encountered within the soils, additional PPE and in-situ HSG248 monitoring will be required to be worn by site personnel present within the working area.

3.2 Asbestos Air Monitoring

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’.

Air Monitoring Procedures

Air monitoring in accordance with HSG248 will be undertaken intermittently throughout the duration of the works at a frequency of once or twice per week, 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.

3.3 Placement of Asbestos Impacted Soil

If Trace asbestos fibres are identified within isolated Made Ground samples analysed further works will be required to ensure no unacceptable risk to the identified receptors and construction workers.

The site will have a large scale enabling works package to achieve the development platform and to allow for the cut and fill earthworks to ensure the sustainable and economic use of spoil. 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.

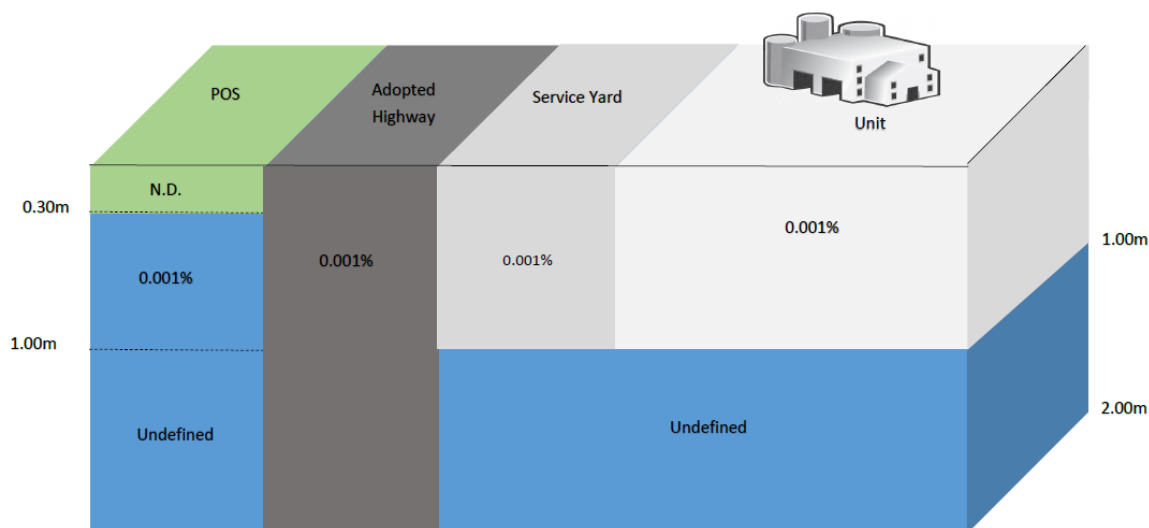
Figure A1 Asbestos in Soils Conceptual Site Model Commercial Development

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.



4. ENVIRONMENTAL MONITORING AND VALIDATION

4.1 Site Management

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.

4.2 Completion

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.

5. E3P GEOTECHNICAL ENGINEERING SPECIFICATION

The overarching philosophy of the Geotechnical Engineering works will be the delivery of a development platform that meets the following key criteria.

-  **Building Footprint** (+2.0m on all elevations) will be subject to a process of remediation works to remove all relict foundations, infrastructure and oversize material. The resulting excavation will be backfilled with material that will be suitable for future Ground Improvement by the construction of Vibro Stone Columns to support a ground bearing floor slab and structural foundations;
-  **External Hardstand** to be remediated to remove all relict foundations and obstructions to a depth of >1.0m from the underside of formation with all voids and potential areas of instability removed to their full depth. Materials will be replaced and compacted to ensure compliance with the E3P Geotechnical specification with a CBR >5% at formation;
-  **Drainage Infrastructure** location to be cleared of all relict foundations and infrastructure to a minimum of 1000mm from the underside of invert with material to be backfilled in compliance with E3P geotechnical specification;
-  Placement of a suitable temporary works platform (Piling Mat) to be constructed using graded 6F2 aggregate to a minimum depth of 300mm with a CBR >15% at the top of formation;
-  Placement of a minimum 225mm capping layer comprising certified graded 6F2 within all areas of proposed external hard-stand with a CBR >12% at formation.

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 fine grained soils as a moisture content fluctuation (2% +/-) of the tolerable limit will result in unacceptable degree of compaction loss without appropriate modification and stabilisation. The contractor will be responsible for extensive control testing to demonstrate that the optimum moisture content for all engineering material is within the pre-defined control limits.

Where relict structures / infrastructure has been removed, the reduced level excavation should be formed in a manner where the sides are graded at no greater than a 45° angle that will facilitate the resulting backfilling of the excavation with Class 1 / 2 or 6 soils that are to be engineered to achieve the required performance specification.

The contractor will be responsible for proof rolling and where necessary Ground Improvement in the sub-stratum to ensure it is compacted with all potential variable stratum or soft spots to be removed and replaced with material that is engineered in accordance with the requirements of this specification.

The contractor will undertake to provide a detailed survey of all reduced level excavations with survey positions of a maximum 25m grid increasing to 5m centres where a change in topography greater than 500mm occurs at any one point. The reduced level survey is to be provided to the supervising engineer for review and approval prior to the backfill of the excavation and placement of structural fill material.

In general, all soils (excluding certified recycled and quarried aggregates) must be engineered to achieve the following performance criteria:

-  Moisture content to be within 2% (+/-) of the defined optimum / control value;
-  CBR to meet the required performance spec for the relevant stratum in each and every engineered soil layer; and,
-  Maximum deformation under Plate Load to meet the geotechnical specification within each and every compacted layer.

5.1 Locally Won Fill Material

It is proposed to up-fill and level some areas of the site with an element of material won from the development area.

Due to climatic weather conditions and variance in long term differential settlement associated with even well compacted cohesive and granular soils and the need demonstrate compliance with the E3P End Product performance specification, it is essential that the cut and fill process is well controlled and materials are placed and compacted in accordance with this specification.

The materials utilised within the general structural up-fill will be engineered by the contractor to ensure compliance with Series 600 of the Highways Design Manual for a Class 7 Structural Fill.

Materials to be used within the engineered sub-base replacement layer will be engineered and compacted in accordance with the requirements of the Highways Design Manual for stabilised sub-base replacement.

5.2 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.

5.2.1 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 or 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).

Materials can be engineered in accordance with the Methods for General Cohesive Fill (Class 1 or 2) however it is essential the performance criteria of a Class 7A Material is achieved.

5.2.2 Use 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.

Prior to the additional of any stabilising agents, laboratory bench testing will be undertaken in accordance with the method and rationale as outlined within the DMRB HA74/07.

For any stabilisation works certain limiting factors must be considered by the contractor in their design:

-  Soils can only be stabilised through the addition of lime/OPC when the ambient air temperature is >7 degrees; and,
-  Ground temperatures cannot fall below 3 degrees.

In addition to any grading requirement for a material type 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.

Prior to the commencement of any works, the following laboratory tests are to be completed by the contractor to demonstrate suitability of materials for use as a structural fill and where required to provide bench testing to confirm the applicability of stabilisation agents.

Pre-Commencement Earthworks Testing Frequency / Performance

To determine the geotechnical classifications of any material to be placed and compacted in layers, representative samples will be taken at a frequency of **1 per 1,000m³** and submitted for Particle Size Distributions (PSDs), maximum dry density, natural and optimum moisture content determinations.

To determine the geotechnical classifications of any cohesive material to be placed and compacted in layers, representative samples will be taken (following removal of any inclusions of oversize material, metal, timber, plastic, etc.) at a frequency of **1 per 1,000m³** and submitted for liquid and plastic limits, plasticity index and natural moisture content determinations. Organic matter determinations shall be prescribed at the discretion of the supervising consultant, dependent on visual observations.

For an unaltered fill material to be deemed suitable for use, the natural moisture content must be within 2% (+/-) of the optimum to achieve the required maximum dry density. Where the laboratory test indicates that the soil parameters are outside this requirements, stabilising agents should be added to assess suitability for use to the contractor's own design.

5.3 General Performance Requirements – Engineered Fill

The contractor shall employ only plant and working methods which are suited to the materials to be handled and traversed. The contractor 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 5.1 Specification for Geotechnical Engineering Works - Ground Bearing Floor Slab

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY / 1 PER:	PERFORMANCE REQUIREMENT
MOT Sub-Base (Engineers Drawing)	MOT – Type 1	Max Deformation & CBR by Plate Load	1000m2	CBR to be >30%
		PSD	1000m3	Type MOT 1 Grading
		Frost Susceptibility	5000m3	<5% Heave
300mm Engineered Capping (Pile Mat)	Recycled graded 6F2 Aggregate	Max Deformation & CBR by Plate Load	2000m2	>15% & <5mm settlement 200kN/m2
		CBR by LWD	1000m2	>15%
Engineered Up-Fill (Suitable for VSC)	Engineered Cohesive	In-situ Density	1000m2	>100% of Max DD (2.5kg) <5% Air Voids >95% of Max DD (4.5kg) <5% Air Voids
		Max Deformation & CBR by Plate Load	4000m2 (placed)	>10% & <6mm settlement 200kN/m2
		CBR by LWD	1000m3	>10%
	Engineered Granular	Max Deformation & CBR by Plate Load	4000m2 (placed)	>10% & <6mm settlement 200kN/m2
		CBR by LWD	1000m3	>5%
Base of Formation	Granular or Cohesive	Hand Shear vane	500m2	Cu >30kN/m2

Table 5.2 Specification for Geotechnical Engineering Works – External Hardstand

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY / 1 PER:	PERFORMANCE REQUIREMENT
MOT Sub-Base (Engineers Drawing)	MOT – Type 1	Max Deformation & CBR by Plate Load	1000m2	CBR to be >30%
		PSD	1000m3	Type DOT 1 Grading
		Frost Susceptibility	5000m3	<5% Heave
225mm 6F2 Capping	Stabilised Subbase Replacement or Suitable Aggregate	Max Deformation & CBR by Plate Load	1000m2	>30% & <6mm settlement 150kN/m2
		CBR by LWD	1000m2	>15%
Base of Formation (1000mm underside)	Granular or Cohesive	CBR by LWD	1000m2	>3% & <14mm settlement 100kN/m2

Notes:

Maximum dry density shall be determined by obtaining representative samples of all material that will be engineered using laboratory determinations to confirm the Optimum Moisture Content & Maximum Dry Density for soils in either the unaltered or modified (stabilised) state.

CBR by Plate Load will utilise a 450mm Plate with the test to be conducted in strict accordance with BS1377 (Part 9). Note this will mean the loading of the test until all movement of the plate has stopped, i.e. until the average settlement rate is less than 0.02mm per 5 minute interval. A minimum modelled load of 150Kn/m2 will be applied to all PLT Testing for the purposes of this contract.

In-situ density method to be selected by the contractor with written approval required from the supervising organisation in terms of appropriateness of application.

The depth of differing stratum as indicated within the E3P specification is for guide purposes only and the contractor must refer to the Structural Engineers drawings for specific build up requirements.

Where soil is to be stabilised and used as an engineered fill material the contractor will be required to provide a site specific method statement for the proposed works to be fully inclusive of laboratory bench testing to demonstrate the suitability for use.

Acceptability shall be determined in accordance with Table 6/1 of the Highway Specification & DMRB HA 74/07.

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 is completed. Plant that 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 siting 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 any 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.

5.3.1 Construction of Fills

All fills shall be constructed:

- (i) In the locations as shown in the contract drawings to the lines and levels stated therein; this includes any localised deeper excavations at the position of the existing building footprint;
- (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. A soft spot is defined as a cohesive soil with a $C_u < 40 \text{ kN/m}^2$ or relative density deemed to be 'loose'.
- (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.

5.3.2 Construction of Fills – General Procedures

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.

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.

E3P Earthworks Geotechnical Compaction Specification					
Soil / Material Type	Class	Description	Compaction Equipment	Layer Thickness	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 ONLY)	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)	6F2	Any combination of inert hard materials other colliery spoil or rock with substantial amounts of clay like component.	>5000kg Vibrating Roller	250mm	6

5.4 Completion

Following the completion of the geotechnical engineering works a report will be compiled by E3P detailing all site enabling works undertaken, waste consignment notes, and all site investigations, laboratory test certificates, and validation testing undertaken.

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

6. GAS MITIGATION MEASURES

Ground gas monitoring classified the site as CS1 therefore, it is considered that gas protection measures will not be required.

7. CHEMICAL VALIDATION OF CLEAN COVER SYSTEM

7.1 Chemical Testing

The Remediation Strategy for the site, with respect to human health of the future site users includes the provision of a chemically suitable clean material to be installed in all landscaped areas; the construction of the clean cover / placement of clean material shall consist of:

-  150mm subsoil; and,
-  150mm topsoil.

In accordance with the current requirements of the regulatory authorities, validation samples will be collected from all materials that are to be imported or re-used on site to confirm the proposed development will pose no unacceptable risk to human health or the wider environ.

Subsoil and topsoil shall be free of any deleterious materials, such as buildings materials, timber, plastics etc and conform to the requirements of BS 3882:2007.

Topsoil will be imported from a known source prior to stockpiling on-site in a controlled manner to facilitate the appropriate validation testing to demonstrate that the material is suitable for use within the context of the proposed development.

The agreed sampling frequency for these materials is presented in Table 7.1.

Table 7.1 **Specification of Materials Validation Laboratory Analysis**

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site generated Sub-Soil	1 Sample Per 100m ³	A / B / C / D
Imported subsoil	1 sample per 100m ³	A / B / C / D
Imported Topsoil	1 sample per 50m ³	A / B / C / D

Notes – Table 6.1

Suites of Analysis
A) Speciated PAH
B) Banded TPH (C5-C35)
C) Asbestos (ID)
D) CLEA Inorganic

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

Source testing certificates and validation testing of the imported materials shall be provided and is required to comply with the criteria set out in Appendix IV.

7.2 Placement of Chemically Suitable Cover System

Proposed landscaped areas within the development require a chemically suitable cover system in order to break the exposure pathway between the end user and the contaminants.

Procedure for Placement:

-  If proposed utilities are to be overlain by a cover system, the clean cover should be placed prior to installation of these utilities;
-  All chemically unsuitable soils in the upper 300mm of the landscaped areas will have been excavated during the Remediation & Enabling Works;
-  Landscaped areas need to be backfilled with 150mm chemically validated subsoil, with 150mm topsoil overlaying this. **Subsoil and Topsoil are required to be confirmed as chemically suitable prior to installation of the cover system.**

7.3 Landscape Validation Procedure

The placement of subsoil, topsoil and corresponding validation will be documented within the Site Completion Report (to be issued on the completion of all landscape cover systems).

A physical membrane barrier will be placed at the base of all landscaped areas.

All landscaping will have a 150mm thickness of subsoil and minimum 150mm thickness of topsoil (to constitute 300mm clean cover), each area will be independently validated with photographic evidence to confirm that a suitable cover system has been installed within all areas of soft landscaping.

The procedure outlined below documents the protocol for the validation of landscape cover systems not placed during the Remediation & Enabling Works Phase.

PROCEDURE	METHOD
Chemical Validation	Subsoil and topsoil utilised within the cover system are required to be confirmed as chemically suitable prior to installation of the cover system. Materials should be stockpiled in a dedicated lay down area pending inspection by E3P and chemical analysis.
Trial Holes	The trial holes within landscaped areas must be excavated to the full depth of the cover system, revealing the underlying geotextile membrane.
Validation	E3P will attend site and measure the thickness of the cover system, providing an assessment to the site manager whilst on site. Photographic evidence will be taken of the cover system, demonstrating the depth and materials which make up the cover system and the location of the trial hole in relation to the development.
Validation Certificate	E3P will issue a specific validation certificate to demonstrate that the required subsoil and topsoil has been placed in each area of landscaping, along with the chemical analysis.
Completion Report	Upon completion of all landscaped areas within the development, a Completion Report will be issued providing the confirmation that all remediation requirements have been achieved.



Photographs 1 and 2: Examples of validation photographs demonstrating clean cover.

8. RECORD KEEPING & VERIFICATION

8.1 Record Keeping

During the course of the remediation and site enabling works, the site manager 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 site manager during the course of the remediation and site enabling works.

8.2 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 onsite 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.)

9. CONTINGENCY PLAN

9.1 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.

10. SUMMARY OF BUILD PHASE WORKS

For the avoidance of any doubt, the following works are required to be instigated, documented and validated as part of the site construction works:

-  Independent validation of all landscape cover systems placed within areas of landscaping by an independent consultant the construction works;
-  Production of all-encompassing completion report for the entire development referenced within this Validation Strategy.

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 been 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

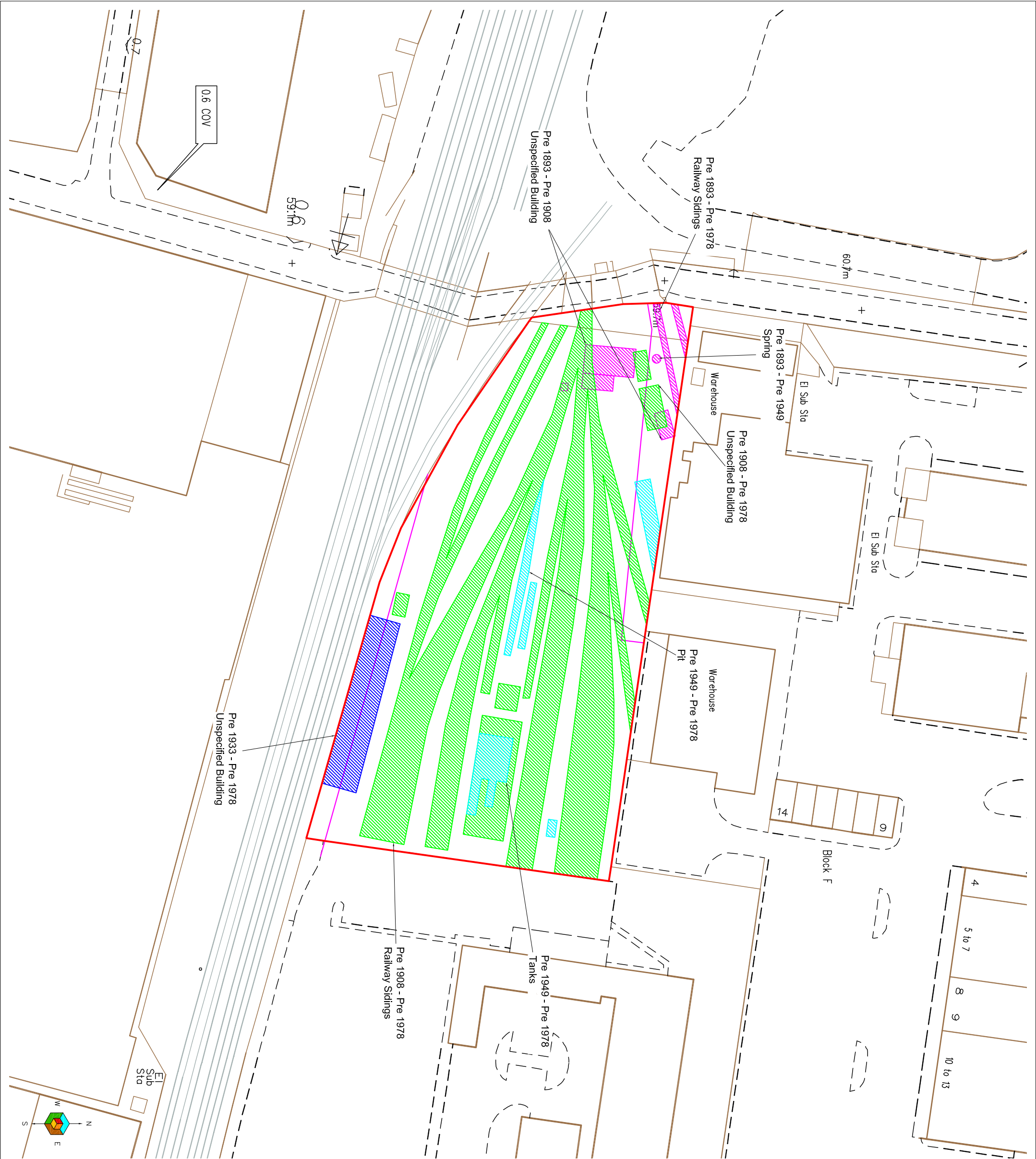


TERMS

AST	Above Ground Storage Tank	SGV	Soil Guideline Value
BGS	British Geological Survey	SPH	Separate Phase Hydrocarbon
BSI	British Standards Institute	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
BTEX	Benzene, Toluene, Ethylbenzene, Xylenes	SPT	Standard Penetration Test
CIEH	Chartered Institute of Environmental Health	SVOC	Semi Volatile Organic Compound
CIRIA	Construction Industry Research Association	UST	Underground Storage Tank
CLEA	Contaminated Land Exposure Assessment	VCCs	Vibro Concrete Columns
CSM	Conceptual Site Model	VOC	Volatile Organic Compound
DNAPL	Dense Non-Aqueous Phase Liquid (chlorinated solvents, PCB)	WTE	Water Table Elevation
DWS	Drinking Water Standard	m	Metres
EA	Environment Agency	km	Kilometres
EQS	Environmental Quality Standard	%	Percent
GAC	General Assessment Criteria	%v/v	Percent volume in air
GL	Ground Level	mb	Milli Bars (atmospheric pressure)
GSV	Gas Screening Value	l/hr	Litres per hour
HCV	Health Criteria Value	µg/l	Micrograms per Litre (parts per billion)
ICSM	Initial Conceptual Site Model	ppb	Parts Per Billion
LNAPL	Light Non-Aqueous Phase Liquid (petrol, diesel, kerosene)	mg/kg	Milligrams per kilogram (parts per million)
ND	Not Detected	ppm	Parts Per Million
LMRL	Lower Method Reporting Limit	mg/m³	Milligram per metre cubed
NR	Not Recorded	m bgl	Metres Below Ground Level
PAH	Polycyclic Aromatic Hydrocarbon	m bcl	Metre Below Cover Level
PCB	Poly-Chlorinated Biphenyl	mAOD	Metres Above Ordnance Datum (sea level)
PID	Photo Ionisation Detector	kN/m²	Kilo Newtons per metre squared
QA	Quality Assurance	µm	Micro metre
SGV	Soil Guideline Value		

APPENDIX III DRAWINGS





- Historical Features**
- Pre 1893 (Railway Sidings, Spring, Unspecified Building)
 - Pre 1908 (Railway Sidings, Unspecified Building)
 - Pre 1933 (Unspecified Building)
 - Pre 1949 (Tanks, Pit)

Notes:

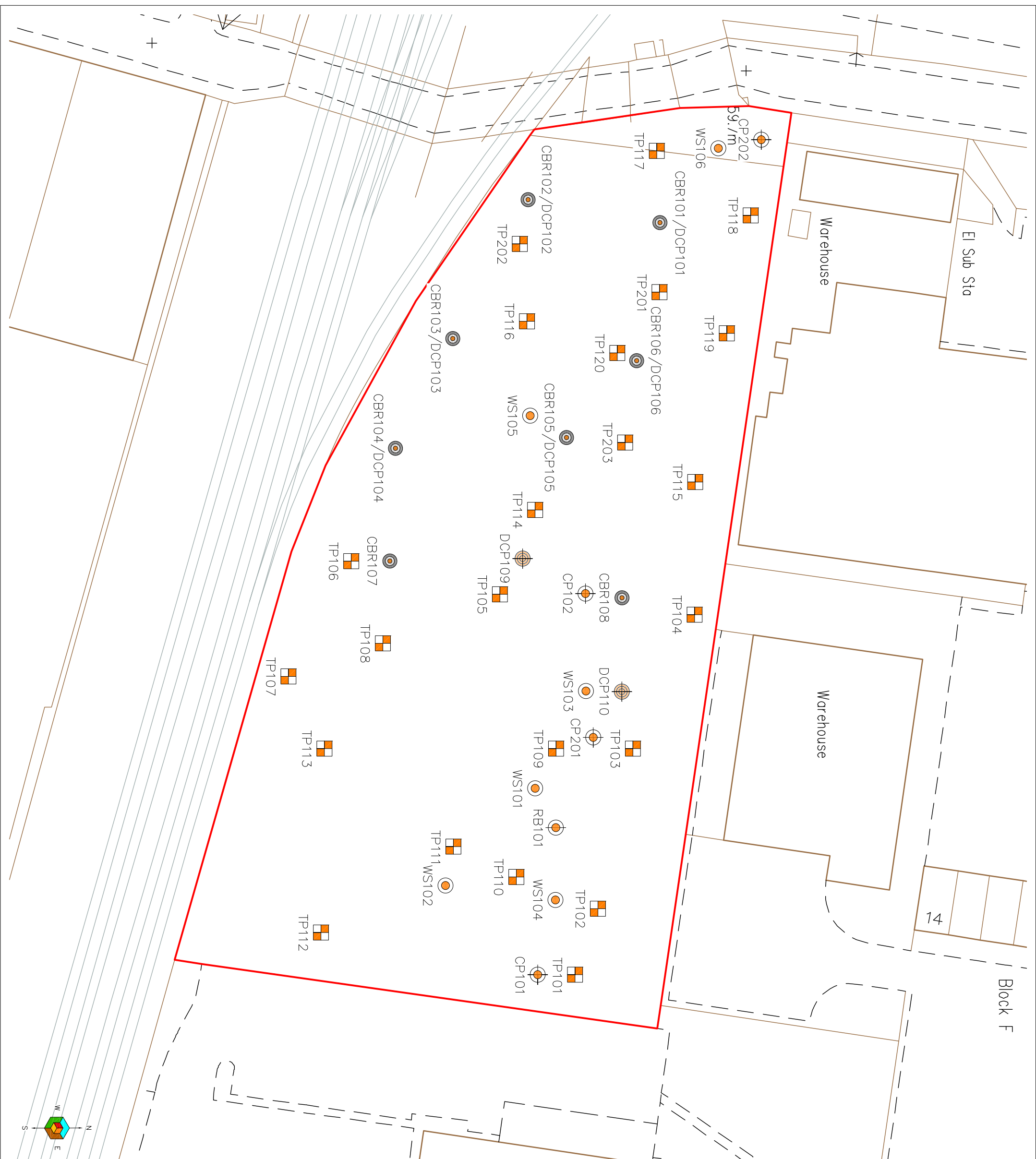
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Phase	Revision	Date	Issue	Drawn	Authorised
Greater Manchester Police		Job No:	11-404	Date:	13-09-2016
		Drawing No:	003	Scale:	NTS @ A3

Job Title:	Greater Manchester Police Station, Openshaw	Drawing Title:	Historical Features Plan
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Key	
Location Symbols	
	Approximate Window Sample Probehead Location
WS101	
	Approximate Trial Pit Location
TP101	
	Approximate Cable Percussive Borehole Location
CP101	
	Approximate Rotary Borehole Location
RB101	
	Approximate California Bearing Ratio Test Location
CBR101	
	Approximate California Bearing Ratio Test Location And Plate Load Test Location
CBR101 / DCP101	
	Approximate Dynamic Cone Penetrometer Test Location
DCP101	

Phase	Revision	Date	Issue	Drawn	Authorised
P1	R4	26-07-2018	REVISION	HM	MD
P1	R3	18-07-2018	REVISION	HM	MD
P1	R2	16-07-2018	REVISION	HM	MD
P1	R1	16-09-2016	REVISION	CB	MD
P1	-	13-09-2016	DRAFT	JN	MD

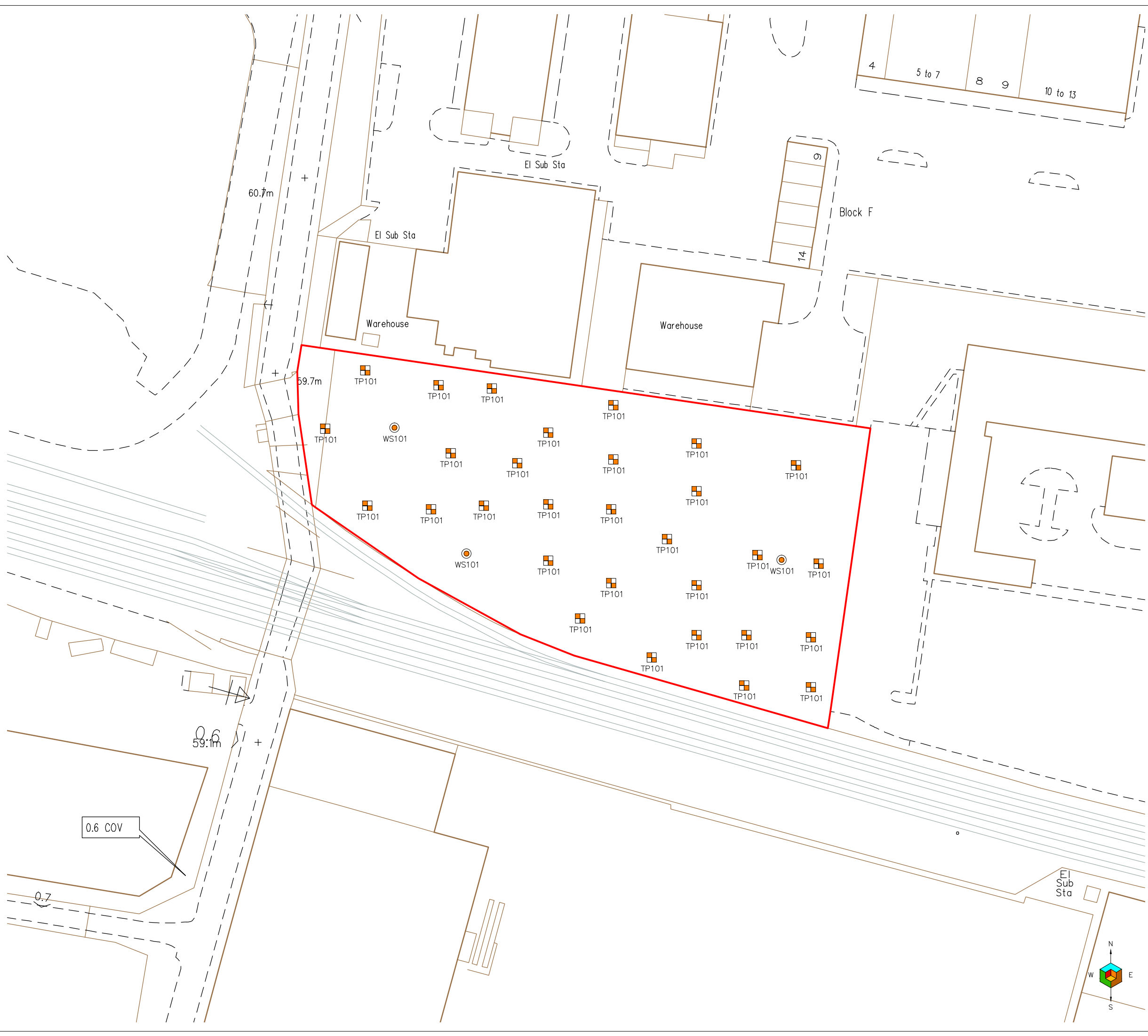
Client:	Greater Manchester Police	
Job No:	11-404	Date:
Drawing No:	003	Scale:
		NTS @ A3

Job Title:	Drawing Title:
Greater Manchester Police Station, Openshaw	Exploratory Hole Location Plan



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Key:

Location Symbols

 WS101

Proposed Window Sample Probehole Location

 TP101

Proposed Trial Pit Location

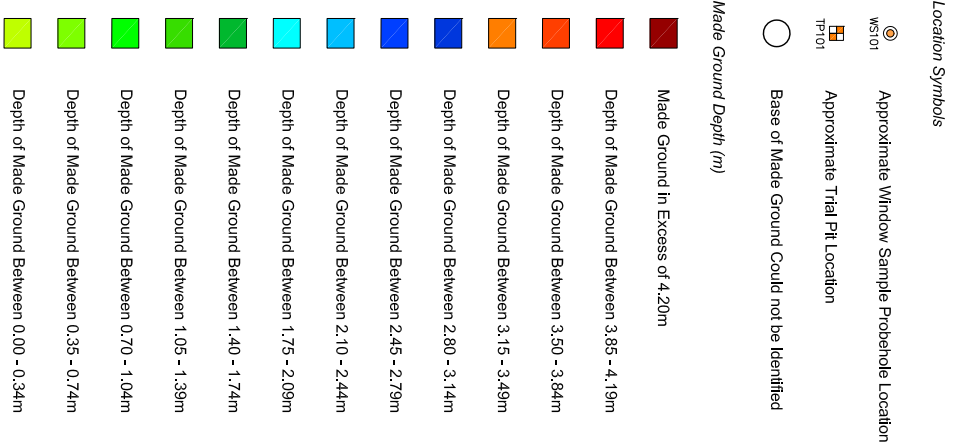
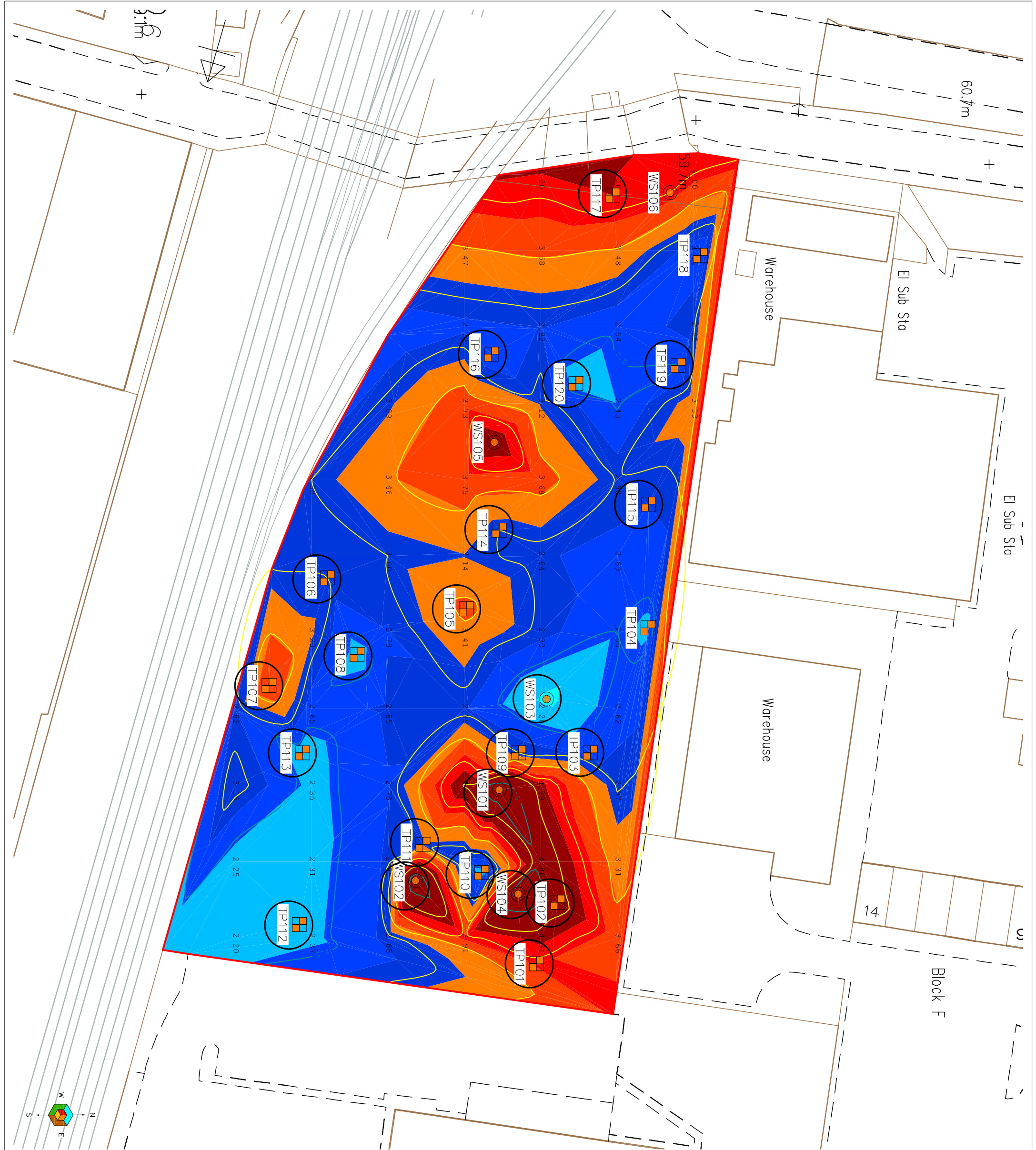
Notes:

P1	-	13-09-2016	DRAFT	JN	MD
Phase	Revision	Date	Issue	Drawn	Authorised
Client: Greater Manchester Police			Job No: 11-404	Date: 13-09-2016	
			Drawing No: 003	Scale: NTS @ A3	
Job Title: Greater Manchester Police Station, Openshaw			Drawing Title: Proposed Exploratory Hole Location Plan		



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Notes

P1	-	27-09-2016	DRAFT	CB	MD
Phase	Revision	Date	Issue	Drawn	Authorised
Client:		Greater Manchester Police	Job No:	11-404	Date:
			Drawing No:	004	Scale:
				NTS @ A3	

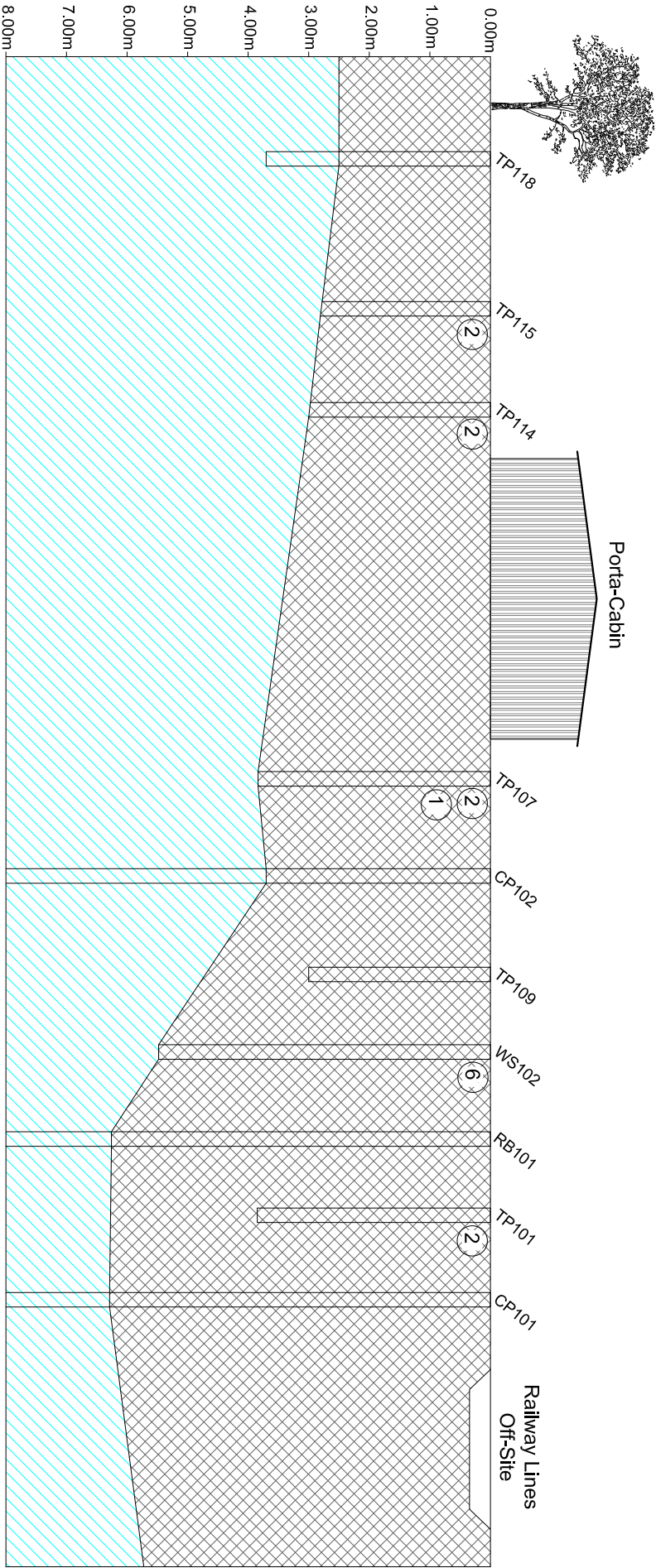
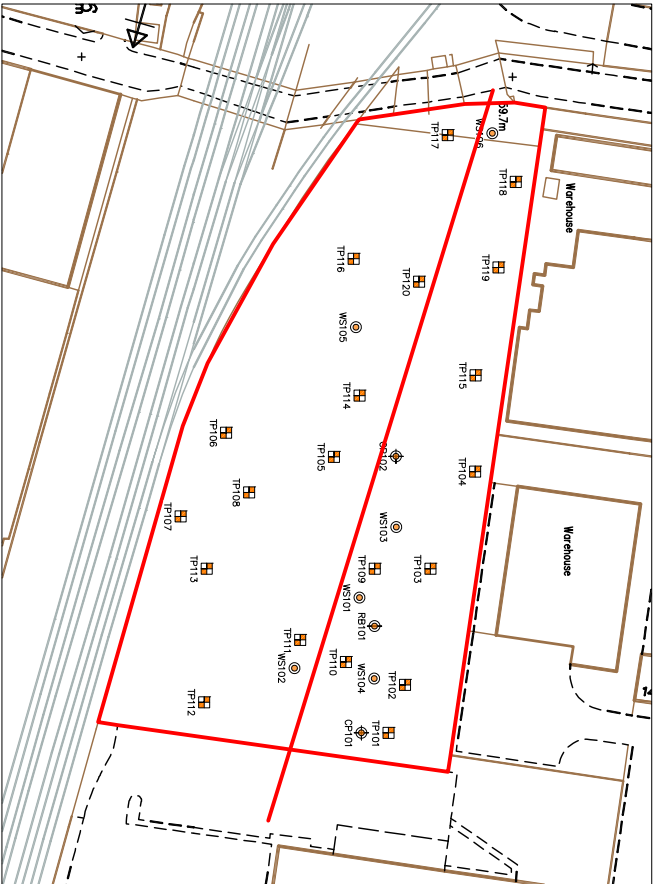
Job Title:	Greater Manchester Police Station, Openshaw	Drawing Title:	Depth of Made Ground Plan
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ID	SOURCE	EXPOSURE	Potential Pathway
HUMAN HEALTH			
1	Acrometic heavy end Hydrocarbons & Non Volatile Polycyclic Aromatic Hydrocarbon (PAH)	Dermal Contact and Ingestion Consumption of Home-grown Produce	Construction Workers & Residential End Users
2	Asbestos Containing Materials (ACM)	Fibre / Dust Inhalation	Construction Workers, Residential End Users & Third Party Property
3	Hazardous Ground Gases	Inhalation Accumulation	Construction Workers Residential End Users
CONTROLLED WATERS			
4	Water Soluble Mobile Contaminants	Vertical Migration Lateral Migration	Secondary & Aquifer Surface Water Courses
BUILDING & INFRASTRUCTURE			
6	pH & Sulphate	Corrosion of Concrete	Foundations / Concrete
7	VOC, TPHs Phenols, pH	Chemical Corrosion	Potable Water Supply



- Key:
- Conceptual Site Model
 - Porta-Cabin
 - Site Boundary
 - Made Ground
 - Clay

Notes:			

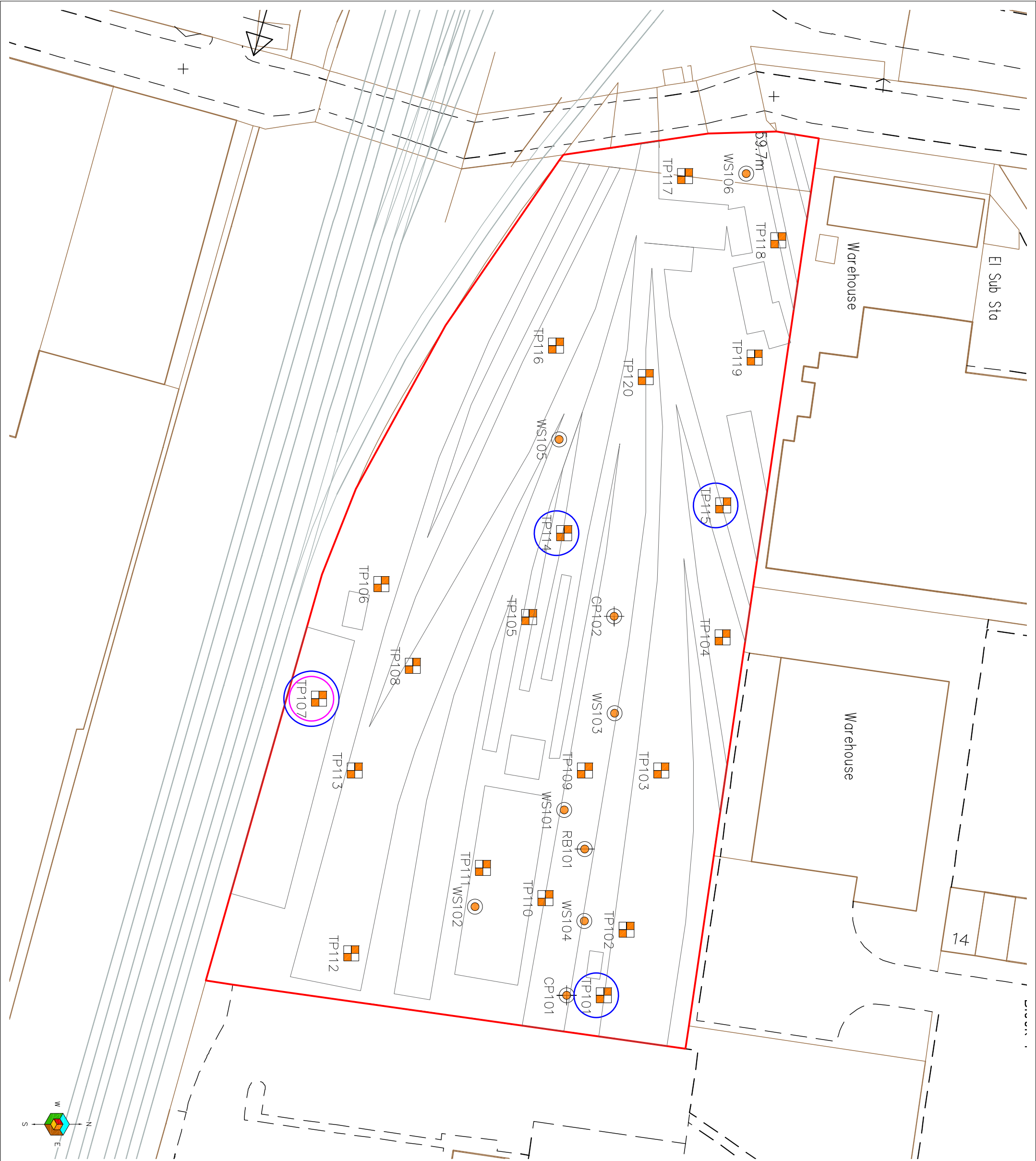
P1	-	09-11-2016	DRAFT	CB	MD
Phase	Revision	Date	Issue	Drawn	Authorised
Client:			Job No:	11-404	Date: 09-11-2016
Greater Manchester Police			Drawing No:	005	Scale: NTS @ A3

Job Title:	Greater Manchester Police Station, Openshaw	Drawing Title:	Conceptual Site Model
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- Location Symbols**
- WS101 Approximate Window Sample Probehole Location
 - TP101 Approximate Trial Pit Location
 - CP101 Approximate Cable Percussive Borehole Location
 - RB101 Approximate Rotary Borehole Location
 - Elevated Lead
 - Identified Asbestos Within Made Ground
 - Approximate Location of Historical Features

Notes:

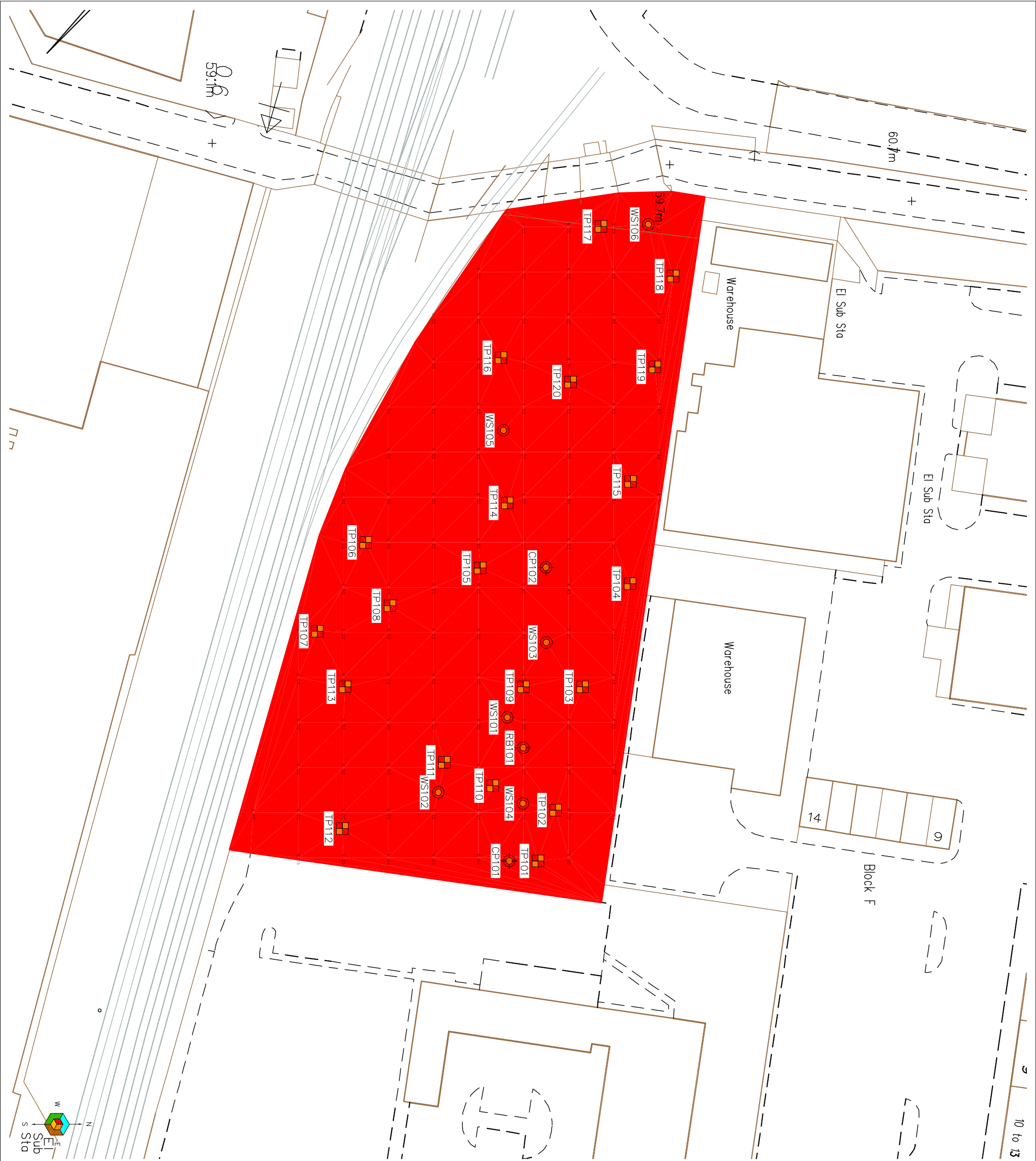
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	Revision	Date	Issue	Drawn	Authorised
Client:		Job No:	11-404	Date:	14-11-2016
Greater Manchester Police		Drawing No:	006	Scale:	NTS @ A3

Job Title:	Drawing Title:
Greater Manchester Police Station, Openshaw	Development Constraints Plan



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Key:

Location Symbols

- WS101 Approximate Window Sample Probehole Location
- TP101 Approximate Trial Pit Location
- CP101 Approximate Cable Percussive Borehole Location
- RB101 Approximate Rotary Borehole Location

Shallow Spread Footings

- Depth to Founding Strata 0.00 - 1.24m
- Depth to Founding Strata 1.25 - 1.49m

Mass Trench Fill Footings

- Depth to Founding Strata 1.50 - 1.74m
- Depth to Founding Strata 1.75 - 1.99m
- Depth to Founding Strata 2.00 - 2.24m

Engineered Footings

- Depth to Founding Strata 2.25 - 2.49m
- Depth to Founding Strata >2.50m

Notes

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P1	-		DRAFT		CB	MD
	Phase	Revision	Date	Issue	Drawn	Authorised
Greater Manchester Police			Job No:	11-404	Date:	14-11-2016
			Drawing No:	007	Scale:	NTS @ A3

Job Title:	Greater Manchester Police Station, Openshaw	Drawing Title:	Depth to Founding Strata Plan
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APPENDIX IV
E3P REMEDIATION
&
VALIDATION CRITERIA



Remediation Validation Target Values

Determinand	Units	Within Landscaping Cover System *	Under Hard Standing and >600mm of cover system**	Pathway
Arsenic	mg/kg	40	640	1
Cadmium	mg/kg	85	190	1
Chromium (Hexavalent)	mg/kg	6	33	1
Lead	mg/kg	200	1100	1
Elemental Mercury	mg/kg	1.2	58	2
Nickel	mg/kg	180	980	1
Selenium	mg/kg	430	12000	1
Copper	mg/kg	7100	68000	1
Zinc	mg/kg	40000	730000	1
Cyanide	mg/kg	791	791	1
Phenol	mg/kg	210	210	1
Asbestos	%	NFD	NFD	4
Naphthalene	mg/kg	2.3	190	2
Acenaphthylene	mg/kg	2900	83000	3
Acenaphthene	mg/kg	3000	84000	1
Fluorene	mg/kg	2800	63000	1
Phenanthrene	mg/kg	1300	22000	3
Anthracene	mg/kg	31000	520000	3
Fluoranthene	mg/kg	1500	23000	3
Pyrene	mg/kg	3700	54000	3
Benzo(a)Anthracene	mg/kg	11	170	3
Chrysene	mg/kg	30	350	3
Benzo(b)Fluoranthene	mg/kg	3.9	44	3
Benzo(k)Fluoranthene	mg/kg	110	1200	3
Benzo(a)Pyrene	mg/kg	3.2	35	3
Indeno(123-cd)Pyrene	mg/kg	45	500	3
Dibenzo(a,h)Anthracene	mg/kg	0.31	3.5	3
Benzo(ghi)Perylene	mg/kg	360	3900	3
TPH C ₅ -C ₆ (aliphatic)	mg/kg	42	3900	3
TPH C ₆ -C ₈ (aliphatic)	mg/kg	100	3200	2
TPH C ₈ -C ₁₀ (aliphatic)	mg/kg	27	7800	2
TPH C ₁₀ -C ₁₂ (aliphatic)	mg/kg	130	2000	2
TPH C ₁₂ -C ₁₆ (aliphatic)	mg/kg	1100	9700	2
TPH C ₁₆ -C ₂₁ (aliphatic)	mg/kg	65000	59000	1
TPH C ₂₁ -C ₃₅ (aliphatic)	mg/kg	370	1600000	1
TPH C ₅ -C ₇ (aromatic)	mg/kg	860	26000	1
TPH C ₇ -C ₈ (aromatic)	mg/kg	47	56000	2
TPH C ₈ -C ₁₀ (aromatic)	mg/kg	250	3500	2
TPH C ₁₀ -C ₁₂ (aromatic)	mg/kg	1800	16000	2
TPH C ₁₂ -C ₁₆ (aromatic)	mg/kg	1900	36000	2
TPH C ₁₆ -C ₂₁ (aromatic)	mg/kg	1900	28000	1
TPH C ₂₁ -C ₃₅ (aromatic)	mg/kg	42	28000	1

* Values based on LQM S4UL for Residential without plant uptake 1% SOM and General Assessment Criteria (GAC) developed by CIEH / LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM

** Values based on LQM S4UL for Commercial 1% SOM and General Assessment Criteria (GAC) developed by CIEH / LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM

Note 1

Exceedance of any determinand shall initiate further assessment by the Environmental Consultant to determine if there is a plausible Source – Pathway – Receptor Linkage with respect to human health and controlled waters.

Depending on this assessment additional material may need to be removed from site, subject to WM3 Waste Classification.

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 %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).

It shall not be acceptable to import any material to the subject site that would be classified as Hazardous Waste using Technical Guidance WM3: Waste Classification - Guidance on the classification and assessment of waste.

Notes 2

Excludes matrices where free product is observed – this will require separate assessment and DQRA.

Notes 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

Constituent	Origin of Risk Assessment Value
Arsenic	2014 LQM/CIEH S4ULs
Cadmium	2014 LQM/CIEH S4ULs
Chromium	2014 LQM/CIEH S4ULs
Lead	2014 LQM/CIEH S4ULs
Mercury	2014 LQM/CIEH S4ULs - methylmercury
Nickel	2014 LQM/CIEH S4ULs
Selenium	2014 LQM/CIEH S4ULs
Copper	2014 LQM/CIEH S4ULs
Zinc	2014 LQM/CIEH S4ULs
Cyanide - Total	2014 LQM/CIEH S4ULs
Phenols - Total.	2014 LQM/CIEH S4ULs
Naphthalene	General Assessment Criteria (GAC) developed by CIEH / LQM Suitable 4 Use Levels with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM
Acenaphthylene	
Acenaphthene	
Fluorene	
Phenanthrene	
Anthracene	
Fluoranthene	
Pyrene	
Benzo(a)Anthracene	
Chrysene	
Benzo(b/k)Fluoranthene	
Benzo(a)Pyrene	
Indeno(123-cd)Pyrene	
Dibenzo(a,h)Anthracene	
Benzo(ghi)Perylene	
TPH C ₅ -C ₆ (aliphatic)	
TPH C ₆ -C ₈ (aliphatic)	
TPH C ₈ -C ₁₀ (aliphatic)	
TPH C ₁₀ -C ₁₂ (aliphatic)	
TPH C ₁₂ -C ₁₆ (aromatic)	
TPH C ₁₆ -C ₂₁ (aromatic)	
TPH C ₂₁ -C ₃₅ (aromatic)	
1,2 Dichloroethene	S4ULs – 2015- General Assessment Criteria (GAC) developed by CIEH / LQM the using CLEA 1-06 with supporting data from SR3, SR7 and existing Tox report where applicable. 1% SOM
Trichloroethane	
Tetrachloroethane	
Tetrachloroethene	
Tetrachloromethane	
Trichloroethene (TCE)	
Trichloromethane	
Chloroethene (VC)	