



e3p

Remediation and Enabling Works Strategy
New Street (Phase 3), Littleborough

Reference: 15-075-R3
Date: March 2023



REMEDIATION AND ENABLING WORKS STRATEGY

Land to the west of New Street
Littleborough
OL15 8HW

Prepared for:

Russell Homes Ltd

Report Ref: 15-075-R3

Date Issued: 3rd March 2023



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EXECUTIVE SUMMARY

Site Address	New Street, Littleborough OL15 8HW
National Grid Reference	E 392610, N 415790
Site Area	~3.39 Ha
Background	Russell Homes Ltd has instructed E3P to develop a remediation and enabling works strategy for the proposed residential development at the site located to the west of New Street, Littleborough. The E3P Remediation and Enabling Earthworks Strategy has been produced in due consideration of the geoenvironmental site investigation and contaminated land assessments previously undertaken by E3P.

CONTAMINATED LAND RISK ASSESSMENT

Human Health Risk Assessment	The Tier I assessment identified exceedances of non-volatile PAH compounds, naphthalene and asbestos in the Made Ground. Asbestos (amosite) has been identified within two locations within the Made Ground. The quantification confirmed the concentrations to be >0.001% indicative of trace fibres, and as such it will be necessary to carefully manage these impacted soils and place them in a legislatively compliant manner that will negate any possibility of future exposure. With respect to the non-volatile PAHs external areas will be covered by hard-standing or a suitable cover system in all soft landscaped areas, thereby removing the exposure pathway to future site users. Elevated naphthalene has been recorded within the Made Ground soils, which may pose a theoretical risk to future site users through vapour inhalation. The impacted soils will be excavated for off-site disposal, and the soils left in-situ chemical validated to confirm no residual impact remains. It is possible that, as yet unidentified contaminant impact is present within localised hotspots at the site. It is considered that any such contamination could be addressed by the delineation, excavation and treatment of impacted soils.
Controlled Waters Risk Assessment	The developed conceptual site model did not identify a potentially complete pollutant linkage and, as such, the site is deemed to pose no significant risk to controlled waters or the wider environ.
Ground Gas	Preliminary ground gas monitoring suggests that the site can be classified as CS1/Green. However, precautionary CS2/Amber 1 measures are recommended due to the presence of Made Ground. The ground gas monitoring regime should be completed to accurately determine the mitigation required for the site.
Invasive Plants	No invasive plant species have been identified within the site boundary.
Potable Water Supply	A contaminant risk assessment was not completed in accordance with the UKWIR assessment framework, this will be required on the remediated ground upon completion of the enabling works.



Waste Management Compliance for Historic Landfilled Materials	The southwest sector is occupied by a historical landfill where the material was deposited under a Waste Management License. Materials originating from a licensed waste management license is regulated under the Waste Framework Directive (WFD). Furthermore, materials originating from future excavations (both during remediation or construction) cannot be recovered for re-use using the normal processes and protocols such as the CL:AIRE DoW CoP. The material deposited in this sector appears to be essentially inert, comprising construction and demolition materials and soils. Remediation options for this sector of the site warrant robust consideration given that options for re-use would either be an application for a new Environmental Permit (Deposit for Recovery – DFR) or the onsite processing of material to recover the fractions that would cease to be a waste with the off-site disposal of all non-recoverable portions. E3P would recommend that a waste management and recovery strategy be defined to facilitate the safe and economic re-use of material from landfill. A volume of 'waste' will require removal from site; this should be considered as part of a site viability assessment. All excavated materials¹ generated during the site enabling works and development activities which are either re-used at other locations within the development boundary or are subject to treatment prior to replacement at the same point is considered a waste.
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GEOTECHNICAL ASSESSMENT

Relict Sub-Structures	Relict substructures, infrastructure and materials deemed geotechnically deleterious are present throughout the site. All such materials will require removal from beneath proposed structures and infrastructure to the depths and extents as defined within this specification.
Adverse Ground Conditions	All potentially infilled ponds and historical features where deleterious/putrescible material is identified should be located and subject to the necessary remediation works. Due to the presence of peat and a historic landfill, the presence of highwalls should be considered and also the potential for both differential settlement potential and long term secondary creep within these areas.
Proposed Foundations	The overarching aim of the remediation and enabling earthworks will be the construction of a development platform that will ensure suitability of the site for a low-rise residential development. At present, the possible foundation types may include the following:  Strip/trench foundations bearing into the competent firm to stiff CLAY or medium dense SAND (likely to be in the area of cut where shallow natural soils will be present);  Deep Mass Trench to be completed in areas where competent stratum is identified at greater depth or in areas of tree influence;



	✳ Raft foundations could be constructed within areas of reduced strength superficial drifts and engineered Made Ground. These structures will need to be designed with suitable settlement analysis. ✳ Ground improvement using bottom feed vibro stone column (VSC) to support a shallow reinforced concrete strip foundation where ground conditions are unsuitable for strip/trench (typically in areas of poor / variable ground conditions or deeper Made Ground); and ✳ Driven piled foundations (in areas of soft clays, tree influence, infilled pond or areas of peat), albeit the use of pile foundations will be restricted within areas of shallow mine workings. The proposed foundation for each of the proposed residential units will be confirmed on completion of the Foundation Zoning Plan and an addendum to this report will be provided.
Highways and Infrastructure	All proposed adopted roads will be constructed in accordance with the geotechnical engineering requirements as defined within the MCHW Series 600. Specific engineering and compaction of materials will be completed in strict accordance with the geotechnical specification contained within this report. All materials outside of structural/infrastructure development will be engineered and compacted to ensure consolidation associated with self-weight settlement is limited to < 50 mm in accordance with the E3P specification.
Coal Mining Risk Assessment Proof Drilling and Grouting Methodology	The Coal Authority abandonment plan confirmed the absence of any recorded seams within the upper 80m of the subsurface, however, it is critical to confirm the absence of unrecorded coal seams underlying each plot. Therefore, the sequence for the proof drill and grouting works will be to advance a borehole beneath each residential plot, If a coal seam is encountered which does not have sufficient rock cover (10x seam thickness), the location will be subject to Drill and grouting on a 6m grid, reduced to 4.5m and 3.0m centres accordingly, subject to Grout takes. If sufficient rock cover is present, grouting will not be required. The <i>Specification for Consolidation of Abandoned Mine Workings</i> details the above scope in greater detail.
Earthworks and Surcharge	Where it is proposed to raise current ground levels, settlement analysis will be required to determine the potential for consolidation of the low-strength natural soils and Made Ground induced by the addition of a surcharge pressure. As and when detailed design levels are determined, settlement analysis should be completed to ensure that the predicted settlement is within the tolerable limits for the design.



REMEDIATION AND ENABLING WORKS

Objectives	The remediation and enabling works will be delivered in a manner that will seek to ensure that the site is prepared to deliver the optimum foundation solution for the proposed structures, infrastructure and highways. The geotechnical foundation zoning plan and structural engineer's drawings should be referenced to determine the proposed foundation solution.
Remediation and Enabling Works	The site remediation and 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 and enabling works strategy are summarised as follows: ✳ Implementing all works in strict accordance with UK Environmental Permitting and local planning authority requirements. ✳ Controlled removal of all trees and vegetation. ✳ Removal and treatment of all invasive plant species (as required) in accordance with specialist contractor method statement, validation and independent certification. ✳ Management of all anthropogenic material impacted by trace asbestos fibre in a controlled and legislatively compliant manner. ✳ Identification, delineation and removal of peat and organic materials within infilled ponds. ✳ Removal of all structures, relict foundations and buried features in their entirety. ✳ Removal of all materials considered geotechnically deleterious. ✳ Excavation and processing of landfill/waste material in a legislatively compliant manner; ✳ Further assessment, delineation and treatment (or removal) of Naphthalene impacted soils; ✳ Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials to geotechnical specification. ✳ Proof drilling and consolidation of any unrecorded shallow mine workings underlying the site; ✳ 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. ✳ Replacement of material in accordance with the E3P enabling specification and engineering requirements.



BUILD PHASE REQUIREMENTS

Summary of Build-Phase Mitigation Requirements	The developer's works will also include the completion of the following additional elements: ✦ Provision of a 600 mm cover system using certified material with appropriate validation within proposed private gardens, comprising 450 mm subsoil (potentially site-won natural drift deposits) overlain by 150 mm topsoil; ✦ Provision of a 300 mm cover system using certified material with appropriate validation within proposed POS / landscaped areas, comprising 150 mm subsoil (potentially site-won natural drift deposits) overlain by 150 mm topsoil; and ✦ Construction of appropriate potable water supply infrastructure (subject to UKWIR risk assessment); and ✦ Installation of appropriate ground gas protection measures in line with CS2 / Amber 1 (subject to final ground gas risk assessment).
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TABLE OF CONTENTS

EXECUTIVE SUMMARY	1
1. INTRODUCTION	8
1.1. Background	8
1.2. Report Objectives	8
1.3. Scope of Works.....	8
1.4. Previous Works.....	8
1.5. Redevelopment Plan	9
1.6. Summary of Parties Involved.....	10
1.7. Regulatory Correspondence	10
1.8. Site Details	10
1.9. Site Summary.....	11
1.10. Summary of Reported Ground Conditions	13
2. E3P CONTAMINATION RISK ASSESSMENT	15
2.1. Background	15
2.2. Human Health Risk Summary	15
2.3. Ground Gas	17
2.4. Controlled Waters Contamination Risk Summary	17
2.5. Potable Water Supply Infrastructure	18
3. SITE REMEDIATION AND ENABLING WORKS	19
3.1. Remediation Technology	19
3.2. Overview of Works.....	19
3.3. Validation Sampling Protocol	30
3.4. Remediation Contractors Site Management and Responsibility.....	32
4. MATERIALS MANAGEMENT AND LEGISLATIVE COMPLIANCE.....	33
4.1. approach & methodology	34
4.2. Mobile environmental treatment permit	34
4.3. Operation No.1 - Primary 'Physical' Treatment.....	35
4.4. Operation No.2 – Manufacture Of Recycled Aggregates	35
4.5. Operation No.3 – Validation Of Fines.....	36
4.6. Expected Waste Materials	37
4.7. Validation Criteria	38
4.7.1. Fines Material.....	38
4.8. Recycled Aggregates.....	39
5. ENVIRONMENTAL MONITORING AND VALIDATION	42
5.1. Site Management	42
5.2. Completion.....	42
6. GEOTECHNICAL ENGINEERING SPECIFICATION.....	43
6.1. E3P Geotechnical Engineering Specification.....	43
6.2. Locally Won Fill Material	43
6.3. Classification of Fill Material	44
6.3.1. General Classification.....	44
6.3.2. Pre-Commencement Earthworks Testing Frequency / Performance.....	44
6.3.3. Use of Fill Materials	46
6.4. General Requirements.....	46
6.4.1. Construction of Fills – Highways	48
6.4.2. Construction of Fills – Adopted Highways, Estate Roads and Car Park	49
6.4.3. Unacceptable Material.....	50
6.5. Earthworks Material Tests	51
6.6. Current and Proposed Site Topography and Slope Interaction	51



7. RECORD-KEEPING AND VERIFICATION.....	52
7.1. Record-Keeping	52
7.2. Verification.....	52
8. CONTINGENCY PLAN	53
8.1. Previously Unidentified Contaminants	53
9. SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE.....	54
9.1. Placement of Cover System	54
9.1.1. Procedure for Placement of Chemically Suitable Cover System	55
9.2. Ground Gas and Vapour Protection Measures	58
9.3. Potable Water Supply – Contaminant Assessment Criteria	61
APPENDIX I LIMITATIONS.....	62
APPENDIX II GLOSSARY	64
APPENDIX III DRAWINGS	67
APPENDIX IV E3P REMEDIATION/ VALIDATION CRITERIA.....	69
APPENDIX V E3P MATERIAL IMPORT CRITERIA	74
APPENDIX VI CONTRACTOR PRE-COMMENCEMENT CHECK SHEET	76
APPENDIX VII CONTRACTOR COMPLETION CHECK SHEET	79

DRAWING LIST

15-075-002	Proposed Development Plan
15-075-005	Exploratory Hole Location Plan
15-075-018	Contamination Issues Plan
15-075-015	Development Constraints Plan



1. INTRODUCTION

1.1. BACKGROUND

Russell Homes Ltd has instructed E3P to develop a remediation and enabling works strategy for the proposed residential development for a parcel of land to the west of New Street, Littleborough, herein referred to as the site.

1.2. REPORT OBJECTIVES

The objectives of this report are to:

- ✳ Prepare 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 and 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 WORKS

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

- ✳ Identification of 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.

1.4. PREVIOUS WORKS

The following phases of geoenvironmental investigations have previously been carried out at the site:

- ✳ **E3P Ltd** – *Method Statement for Draining Waterbody*. Ref: Report No. 15-075-L1, dated January 2022. Prepared for Russell Homes Ltd.
- ✳ **E3P Ltd** – *Phase I Geo-Environmental Assessment*. Ref: Report No. 15-075-R1-2, dated July 2022. Prepared for Russell Homes Ltd.
- ✳ **E3P Ltd** – *Phase II Geo-Environmental Site Assessment*. Ref: Report No. 15-075-R2, dated January 2023. Prepared for Russell Homes Ltd.
- ✳ **E3P Ltd** – *Specification for Consolidation of Abandoned Mine Workings*. Ref: Report No. 15-075-L2, dated January 2023. Prepared for Russell Homes Ltd.



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 report are summarised within Section 2.

For the avoidance of any doubt, the above E3P reports should be read both as a precursor to and in conjunction with this document.

1.5. REDEVELOPMENT PLAN

Russell Homes intend to construct a low-rise residential development comprising 62 No. Residential dwellings with associated access, gardens, public open space, attenuation basin, estate roads and adopted utility infrastructure.

The Proposed Development Scheme is presented in Drawing 15-075-002 (Appendix III) and Figure 1.1 below.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.6. SUMMARY OF PARTIES INVOLVED

Function / Interest	Name of Party
Local Planning Authority	Rochdale Metropolitan Borough Council
Developer	Russell Homes Ltd
Geoenvironmental Consultant	E3P
Main Contractor	TBC
Remediation/Enabling Works Contractor	TBC
Human Health Regulator	Rochdale Metropolitan Borough Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Rochdale Metropolitan Borough Council

1.7. REGULATORY CORRESPONDENCE

Russell Homes Ltd are in the process of submitting a detailed planning application to the local planning authority 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 adviser);
- ✳ Environment Agency planning liaison; and
- ✳ The Coal Authority.

1.8. SITE DETAILS

Site Address	Land off New Street, Littleborough, OL15 8HW
National Grid Reference	E 392610, N 415790
Site Area	~3.39 Ha

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

A site location plan is presented in Appendix III as Drawing 15-075-001.



1.9. SITE SUMMARY

TABLE 1.1 SITE DESCRIPTION AND SETTING

Occupancy/Use	The site comprises an undeveloped parcel of land located to the west of New Street in Littleborough. The site is variable in topography with undulating land. Generally, the site topographically falls from 150 m AOD in the north to 140 m AOD in the south. A steep slope is present in the northwest. The central-southern sector has been subject to overland flooding attributed to the accumulation of surface water in recent years. It is understood this occurred due to blockages within failing surface water drainage. A narrow drainage channel/stream runs from the northern site boundary where the woodland is present, in a southeast direction towards New Street. The drainage channel was full during the site investigation, with water flowing in a south-easterly direction. A pond decommission was undertaken by E3P in March 2022; however, a large volume of surface water is still present within the central and eastern site. A spring is also located at the western site boundary. The site is surfaced by soft standing ground comprising short grassland and self-seeding vegetation. An area of dense woodland is present in the far north of the site. E3P undertook a badger walkover, identifying four setts within the dense woodland. Invasive species including Himalayan Balsam have been identified within the northern section of the site. Sporadic semi-mature and mature trees are present in the central portion and along the site boundaries. Reeds and rushes are present at the edge of the pond located on site. Services have been identified on site including overhead telecommunication cables within the eastern site, and manholes associated with waste water from the northwest site boundary, running south across the site.	
Environmental Setting	Drift Geology	Glacial Till – CLAY, SAND, GRAVEL; and Alluvium (South, Centre) – CLAY, SILT, SAND, GRAVEL.
	Bedrock Geology	Pennine Lower Coal Measures Formation – MUDSTONE, SILTSTONE AND SANDSTONE.
	Hydrogeology	The Glacial Till deposits are classified as Secondary Undifferentiated, and the Alluvium is a Secondary A Aquifer. The solid geology is classified as a Secondary A Aquifer.
	Hydrology	A spring is recorded in the west of the site. A narrow drainage channel/stream runs from the northern site boundary where the woodland is present, in a southeast direction towards New Street. A pond is located in the central / eastern sector of the site. The River Roch (main river) is located 52 m south. There are no licensed potable groundwater abstractions in the vicinity of the site (<750m).



	Flood Risk	The central site has been identified as a Flood Zone 2 associated with the site pond. The remaining site is unaffected by flooding from rivers.
	Subsidence Hazard	No hazard identified in data searches.
Site History	Historical mapping suggests that the southeast sector of the site was developed circa 1910 as part of Lower Mill Cottage to the east. The structures were no longer recorded by 1960. Tanks have been identified adjacent to the northwest boundary, located off site pre 1910 until c. 1960. An area of surface water is located in the central sector of the site, this appears to have gradually increased in size since circa 2000 when two small ponds were recorded, with it now indicated to encompass a notable portion of the development site area. A watercourse flows from northwest to southeast from the earliest available mapping dated 1851. Wells were recorded in the west of the site from 1851; however, these are no longer shown by 1893. A spring is recorded at the western boundary from circa 1930. A sandpit and clay pit is recorded in the far north of the site from circa 1930, these features were subsequently backfilled. Between circa 1930 and 1960, allotment gardens were located in the east of the site.	
Landfill Sites and Ground Gases	A historic landfill and registered landfill is recorded in the south of the site. Inert waste was deposited between March 1988 and December 1990. The site has undergone some historic ground working; the Made Ground may produce hazardous ground gases such as methane and carbon dioxide.	
Radon	Unaffected – No Special Precautions Required.	
Coal Mining Risk Assessment Proof Drilling and Grouting Methodology	The Coal Authority abandonment plan confirmed the absence of any recorded seams within the upper 80m of the subsurface, however, it is critical to confirm the absence of unrecorded coal seams underlying each plot. Therefore, the sequence for the proof drill and grouting works will be to advance a borehole beneath each residential plot, If a coal seam is encountered which does not have sufficient rock cover (10x seam thickness), the location will be subject to Drill and grouting on a 6m grid, reduced to 4.5m and 3.0m centres accordingly, subject to Grout takes. If sufficient rock cover is present, grouting will not be required. The <i>Specification for Consolidation of Abandoned Mine Workings</i> details the above scope in greater detail.	



1.10. SUMMARY OF REPORTED GROUND CONDITIONS

E3P has prepared a detailed Site Investigation Report (Ref: 15-075-R3-1, dated January 2023). The summary of reported ground conditions is given in Table 1.2.

TABLE 1.2 SUMMARY OF GROUND CONDITIONS

MADE GROUND	Made Ground was encountered within thirty exploratory hole locations across the site. Generally, Made Ground identified within the southern section of the site comprised gravelly clay with angular mudstone, sandstone, and brick (reworked topsoil) with underlying brown and black very gravelly clay and clayey gravel with frequent cobbles and occasional boulders. Cobbles were encountered as brick, concrete, mudstone, and sandstone, with isolated areas containing asphalt, ceramic, plastic, and glass. Boulders were identified as concrete and mudstone. Slag was encountered within two locations (TP101 and TP103). Peat was encountered as pockets of spongy black fibrous peat within the Made Ground deposits of TP103 and TP105. Made Ground comprising similar material to the southern site was identified within the eastern site (TP123, TP124, and TP125 west). An isolated area of Made Ground was encountered in TP127 located within the northeast site in an area where historical ground workings have been identified. The made ground comprised sandy gravel of fine to coarse, angular glass, ash, and brick to a proven depth of 0.90 m bgl. Further isolated areas of Made Ground were identified across the site, identified within all cable percussive and rotary boreholes. Generally, Made Ground comprised gravelly clay, with gravel of fine to coarse, angular brick, ash, and concrete, and areas of reworked topsoil comprising gravelly, sandy clay with frequent rootlets.
Topsoil	Topsoil was encountered within twenty exploratory hole locations between ground level and 0.40 m bgl. Topsoil comprised dark brown to brown sandy CLAY with frequent rootlets within the north and west site, with slightly gravelly, sandy CLAY in the eastern site. Gravel was noted to be subrounded to rounded of mudstone and sandstone. Light orangish brown, slightly gravelly very sandy CLAY with gravel of fine to coarse, subrounded mudstone and sandstone was identified within one location, TP126 in the northeast site.
Drift	The natural drift geology was identified within forty-six of the fifty-two exploratory hole locations. Drift deposits were not encountered within six locations where the depth of Made Ground was unproven. Generally, cohesive deposits comprised firm to stiff gravelly, sandy CLAY was encountered within the southern site, underlying Made Ground deposits, with interbedded medium dense SAND and GRAVEL. Isolated areas of soft CLAY and loose SAND and GRAVEL were noted within the southern site. Exploratory holes within the northwest section of the site identified granular deposits comprising reddish brown clayey, gravelly fine to coarse SAND with underlying SAND and GRAVEL to circa 13.30 m bgl, before encountering CLAY (RB105).



	Generally, soft low strength very silty CLAY and sandy CLAY with areas of PEAT was identified within the northern section of the site. Rotary boreholes identified interbedded SAND, GRAVEL and CLAY deposits underlying sandy CLAY. Peat was identified as pockets of spongy brown fibrous PEAT within TP115 and WS108 between 0.50 m bgl and 1.70 m bgl. Layers of PEAT were identified within the northern section of the site in exploratory hole TP115 between 2.65 – 2.80 m bgl. Spongy brown fibrous PEAT with a slight organic odour was identified within the eastern section of the site, in close proximity to the pond. The maximum recorded thickness of the PEAT is 0.20 m, recorded at 1.10 m bgl (WS110). Surrounding exploratory holes within the eastern site identified underlying granular deposits of medium dense to dense SAND and GRAVEL, with isolated areas of very soft very low strength, to soft low strength silty, sandy CLAY (TP119). Silt was identified within CP104 between 3.00 – 12.20 m bgl, and RB109 between 1.40 – 12.30 m bgl, with underlying cohesive and interbedded granular deposits. In areas surrounding the site pond, particularly within the northern and eastern section of the site, significant depths of SILT were identified with areas of PEAT and isolated areas of very soft CLAY. Water strikes were identified within shallow drift deposits.
Bedrock	Bedrock was encountered within all rotary borehole locations at a depth of between 33.10 m bgl to 36.30 m bgl, to a proven depth of 56.00m bgl. The bedrock comprised MUDSTONE with interbedded SANDSTONE.
Groundwater	Groundwater was identified within twenty-eight exploratory hole locations during the intrusive investigations. Water strikes were encountered as slow to fast seepages through silty, sandy, or gravelly CLAY, granular deposits, and Made Ground. One exploratory hole location, TP116 identified a water strike within PEAT deposits at 1.00 m bgl. Running sands was identified within TP 118 and TP121 at 1.00 m bgl. Subsequent groundwater monitoring recorded groundwater at depths of between 1.35m and 6.80m bgl. Two monitoring wells were flooded during the monitoring visits to date (CP103 and WS110).



2. E3P CONTAMINATION RISK ASSESSMENT

2.1. BACKGROUND

E3P has completed a Tier 1 Qualitative Contaminated Land Risk Assessment to determine the potential risk to human health, controlled waters, and the wider environ.

This assessment is documented in full within the E3P Geoenvironmental Site Assessment report and, for clarity, is summarised in the following sections of this document.

2.2. HUMAN HEALTH RISK SUMMARY

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:

- ✳ Asbestos (amosite) at 0.001% (trace fibres)
- ✳ Naphthalene
- ✳ Phenanthrene
- ✳ Benzo(a)Anthracene
- ✳ Chrysene
- ✳ Benzo(b)Fluoranthene
- ✳ Benzo(a)Pyrene
- ✳ Dibenzo(a,h)Anthracene
- ✳ TPH C12-C16 (aromatic)
- ✳ TPH C16-C21 (aromatic)

The majority of the identified elevated concentrations have primary exposure pathways related to dermal contact and ingestion, soil ingestion and consumption of homegrown produce.

Non-Volatile PAH

These recorded exceedances can be mitigated by the installed of a 600 mm chemically suitable cover system within all proposed private gardens, POS and landscaped areas.

The specific design and installation process for the appropriate cover systems are clearly defined within Section 9.2. However, industry best practice will require the following minimum depths of certified clean cover:

- ✳ Private gardens where homegrown vegetables can be cultivated – 600 mm;
- ✳ Landscaped areas within private dwellings – 300 mm;
- ✳ Public open space – 300 mm.

All areas where a cover system is placed will require an underlying geotextile membrane.

It is anticipated that the full 600mm clean cover systems will be required in areas where Made Ground remain in-situ beneath garden plots, which will likely be within the central and southern sectors.



Volatile PAH

Elevated naphthalene has been recorded at numerous locations at depths of between 0.80m and 2.50m bgl within the Made Ground at the site, which may pose a risk to future site users through vapour inhalation.

Further assessment is recommended to clearly define the full extent of the volatile impact to determine if this is a gross site wide issue, restricted to the former landfill or localised to discreet hotspots.

At this time (until further assessment is completed), it must be considered that this material represents an unacceptable risk associated with volatilisation to indoor air and odour nuisance that cannot be mitigated through the construction of a clean cover system.

The further works are discussed in more detail in RE-10 (Section 3.2).

Asbestos

Asbestos fibres in the form of amosite fibres have been identified in Made Ground deposits at TP101 at 2.50 m bgl (<0.001%) and chrysotile fibrous debris in TP109 at 1.40 m bgl (<0.001%). The asbestos-impacted soils can remain in-situ at their existing depths in accordance with the below CCSM.

No visual signs of ACM were encountered during the ground investigation; it is, therefore, likely that only trace fibres are present in localised areas of the site. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 4.1.

FIGURE 4.1 ASBESTOS RISK MITIGATION CONCEPTUAL SITE MODEL



Notes

ND None Detect

0.001% Soils may contain $\leq 0.001\%$ asbestos using composite testing to ensure there is no potential risk to human health. This value is present within areas where there may be a 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)

0.1% Soils at a depth of $>1.00\text{m}$ bgl may contain $<0.1\%$ asbestos using composite testing where they will not be likely to be disturbed in the future and will therefore be in an area of low sensitivity. Risk assessment completed in accordance with Asbestos JIWG risk assessment tools.

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

Isolated areas of topsoil and the majority of subsoil has been analysed and is likely to be suitable for re-use, however further samples will be required to confirm this.

Due to the depths of Made Ground encountered, as well as the visual and olfactory evidence of hydrocarbons noted, it is recommended that further targeted sampling and assessment is required in areas where the full depth of Made Ground was not encountered (TP101, TP109, TP110, TP111, TP123, and TP124), which typically correlates with the area noted as the former landfill.

2.3. GROUND GAS

Preliminary ground gas monitoring suggests that the site can be classified as CS1/Green, although this classification is subject to the completion of the overall monitoring programme.

It may be prudent to allow for CS2 gas protection measures as a precaution for design purposes due to the presence of landfilled Made Ground in the southern sector and underlying historic coal mining.

It is recommended that the full ground gas assessment and recommended protection measures (if applicable) are agreed upon with the local authority prior to their adoption on-site.

2.4. CONTROLLED WATERS CONTAMINATION RISK SUMMARY

Elevated concentrations of heavy metals have been encountered within groundwater, surface water, and leachate samples submitted for chemical analysis when compared to the Environmental Quality Standards.

The interbedded cohesive deposits underlying the site will serve to inhibit vertical migration towards the underlying Unproductive and Secondary A Aquifer. However, impacted groundwater has the potential to migrate laterally towards the Rich Roch.

Furthermore, it should also be noted the site is currently uncapped, rainfall is therefore not currently being intercepted and subsequently infiltrates freely into the underlying the Made Ground, potentially mobilising the identified contaminants.

The proposed development will largely encapsulate the site, thus limiting the potential for infiltration and therefore leaching potential of any contaminants towards River Roch.

As the m-BAT screening tools have confirmed, the surface water receptors are not at risk from heavy metal contaminants. Therefore, although heavy metals exceed EQS thresholds, the heavy metal concentrations are bioavailable and therefore do not pose a risk to aquatic ecosystems.

In light of the above, and considering the distance from the site to the River Roch ($\sim 52\text{m}$ south), the site is not considered to pose an unacceptable level of risk to controlled waters.



2.5. POTABLE WATER SUPPLY INFRASTRUCTURE

A contaminant risk assessment completed in accordance with the UKWIR assessment framework identified elevated concentrations of potentially volatile/soluble hydrocarbon compounds and it will be necessary to delineate the impacted soils where present at locations that could potentially impact the potable water infrastructure should be suitable to remediation with robust validation testing.

If unacceptable concentrations remain post-remediation, then potable water infrastructure should be constructed in accordance with a suitably robust risk assessment and design compliant with UKWIR.



3. SITE REMEDIATION AND ENABLING WORKS

3.1. REMEDIATION TECHNOLOGY

It is considered that the following combination of remediation technologies provides the most sustainable, viable and economic solutions that will ultimately result in the successful remediation for the site(s):

- ✿ Delineation and treatment of volatile impacted soils (subject to further assessment);
- ✿ Installation of CS2 / Amber 1 ground gas protection measures (to be confirmed);
- ✿ Construction of appropriate potable water supply infrastructure; and
- ✿ Installation of a suitable **cover system** in all proposed private garden, landscaping, and public open space to remove any potential for direct exposure to impacted soils in the Made Ground left in-situ.

3.2. 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 the following subsections.

For the avoidance of any doubt, the proposed operations as set out herein document the required performance objectives and validation sampling protocols; however, the specific methods of work deployed to ensure the remediation objectives are achieved in a compliant manner on site will be the responsibility of the appointed contractor.

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 reused (excluding crushed materials) exceeds the parameters of the Standard Rules Permit, a CL:AIRE Materials Management Plan (MMP)-qualified declaration should be made by the contractor, having obtained full written approval for the remediation strategy from the LPA and Environment Agency.

All excavated materials¹ generated during the site enabling works and development activities which are either re-used at other locations within the development boundary or are subject to treatment prior to replacement at the same point are considered a waste.

Where any excavated material is defined within the scope of the CL:AIRE Definition of Waste Code of Practice (DoWCoP), meets a suitable for use criteria and will be re-used at the site of origin, this material can achieve 'end of waste' status through full conformance with the DoWCoP.



This includes the generation of a Materials Management Plan and a subsequent peer review and declaration submission from a CL:AIRE approved 'Qualified Person'. This also includes any clean, naturally occurring soils (sub/topsoil) from a suitable off site donor location for re-use on the development.

With specific reference to this development, materials excavated within the historic licenced landfill area do not meet the scope of the DoWCoP and will remain as a legal waste until 'end of waste' status is achieved through other means. For those landfill materials considered inert in nature such as concrete, bricks, ceramics, glass, stone etc. these can be separated from the excavated material and then further processed in line with the Waste & Resources Action Programme (WRAP) Quality Protocol for the Production of Recycled Aggregates from Inert Waste to achieve 'end of waste' status. Any excavated materials considered as 'non-conforming' and unsuitable for re-use in the development will be separated, placed into suitable holding containers in readiness for off site recovery or disposal in line with the waste 'Duty of Care' requirements. Any fine matrix material generated as part of the screening process to segregate the various fractions of excavated landfill waste does not currently have a defined end of waste criteria to allow their subsequent re-use on site. In the absence of any criteria, the developer or nominated contractor will therefore be required to make an approach to the Environment Agency to seek a case specific agreement and end of waste criteria to meet the Waste Framework Directive 'end of waste' test. This should take the form of detailed risk based approach, defined waste treatment activities² and post treatment validation/criteria testing to confirm this material is suitable for use and would exhibit similar geotechnical and geoenvironmental properties to that off naturally occurring materials (i.e. does not generate gasses, leach metals, pH imbalance etc.) ensuring no environmental or human health impact. Due to the current suspension of the EA national 'End of Waste' approvals panel dialogue should occur with the applicable area senior technical specialist for contaminated land and groundwater with further correspondence with the local area waste team if required.

The recovery and re-use of landfilled material is discussed in more detail in Section 4.1.

At this time, it is not anticipated that there will be any requirement to treat any materials on site (such as hydrocarbon-impacted soil or groundwater); however, this will need to be confirmed following further assessment of the volatile impacted soils as detailed further in RE-10.

Should any previously unidentified contamination be encountered, the contractor must either notify E3P and, if appropriate, relevant regulators of their intention to complete a minor works operation or arrange for the deployment of the appropriate environmental permit for the specified operation.

¹ Excluding clean, naturally occurring top soil that will be re-used at the same development for the same purpose.

² Treatment must be undertaken in line with the Environment Agency Environmental Permit 'SR2008 No 27: Mobile Plant for the Treatment of Soils and Contaminated Material, Substances or Products'. Prior to works commencing, the permit holder (appointed contractor) will notify the EA of the plan to use the permit through the issue of the MPP2 Permit Deployment Form.



RE-2 – Environment and Nuisance Control

Management of all works is required so as to ensure that no environmental nuisance is created through dust emissions, noise or vibration levels.

All works are to be completed in a manner so as not to create any structural risk to the adjacent highways.

Temporary works are to be implemented 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 – Risk to Infrastructure

Site works should be completed in a manner that ensures no risk of disturbance to the adjacent infrastructure.

The Contractor shall take reasonable precaution against the damage of existing services. The contractor shall carry out all searches/investigations to identify and locate any buried utilities and services they consider necessary prior to start of works and are responsible for determining and protecting any existing services or arranging any diversion needed to allow the earthworks to be undertaken.

The contractor shall carry out all searches/investigations to identify and locate any above ground utilities and services they consider necessary prior to start of works and are responsible for determining and implementing any protection and safety methodologies to allow the earthworks to be undertaken.

RE-4 – Site Clearance Operations

General site clearance and provision of welfare, offices and site security are to be determined as per the contract requirements.

The site is surfaced by soft standing ground comprising short grassland and self-seeding vegetation. An area of dense woodland is present in the far north of the site.

All vegetation should either be stockpiled at a pre-agreed location or alternatively removed from site in accordance with waste permitting regulations.

All root networks are to be removed in accordance with the requirements of the NHBC/LABC.



RE-5 – Identification, Isolation and Treatment of Invasive Plants

Himalayan balsam has been recorded on the southern fringes of the woodland in the very northern portion of the site, which is to be retained.

However, further growth and spread of invasive species could have occurred since and the enabling works contractor must satisfy themselves with respect to the extent of all 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 encountered, these will be treated in strict accordance with an approved method statement to be submitted to the supervising consultant for review prior to the instigation of any works.

Where invasive plant species are identified at the site boundary, a suitable barrier shall be installed to prevent any future reinfestation of the subject site.

Upon completion of the eradication of any and all invasive species, 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-6 – Delineation, Excavation and Treatment of Peat

The presence of compressible peat soils in the vicinity of the current pond represents a significant geotechnical hazard in terms of the proposed site infrastructure. The peat soils exhibit significant, and unquantifiable potential for instant and long term differing settlement with the potential for consolidation of the material by up to 30-50% of the material volume.

A number of geotechnical engineering solutions exist to mitigate the potential adverse effect associated with unacceptable degrees of differential and total settlement within peat soils to the underside of the highway, private drives, utilise and service infrastructure. The final development solution will require a specific geotechnical design to consider the static and dynamic loading implied by the development and the maximum tolerable settlement.

Suggested options to mitigate the risk associated with the peat are set out below:

- ✿ Excavation of the near surface compressible peat soils beneath roads, pavement and private driveways, the resulting excavation can be backfilled with site derived material to be placed to a geotechnical compaction specification (**please refer to RE-7 overleaf**);
- ✿ Installation of 'band drains' prior to inducement of constant surcharge pressure to achieve required settlement prior to construction of engineered platform utilising geo-grid and aggregates; and
- ✿ Use of structural support system such as extensive piling to support all roads, service corridors and infrastructure combined with geo-grid and aggregate platform to support highway, pavement and driveway.

E3P understand the peat soils will be excavated as part of the removal of the current site pond.



RE-7 – Draining of Waterbody, Delineation and Infilling of Existing Ponds

The existing pond at the site is to be infilled and any geotechnically unsuitable material removed.

This process is defined in detail in the *Method Statement for Draining Waterbody*.

Prior to the commencement of the main earthworks (where possible), the pond will need to be drained and subject to further investigation to assess the nature of materials and extent of any deleterious elements.

The location of pond is presented in the Site Features Plan (Drawing No. 15-075-004).

All materials that are deemed to be organic, and thus exhibiting unsatisfactory geotechnical properties, must be removed, with the resulting excavation to be backfilled with materials deemed compliant with the E3P Geotechnical Performance Specification with appropriate compaction for the intended land use.

A suitably qualified geotechnical engineer will need to monitor the works and confirm when all unsuitable material has been excavated and removed from beneath any proposed structure or infrastructure.

RE-8 – Delineation, Excavation and Treatment of Identified Asbestos Impact

Detectable asbestos fibres have been identified in the deeper Made Ground soils at two locations (TP101 and TP109), at concentrations of <0.001%, inferred as trace fibres.

At the current depths, based on the concentrations and the Asbestos CSM (see Section 2.2), the impacted soils can remain in-situ and are therefore not considered to pose a residual risk.

It can be reasonably assumed that due to the age and composition of the Made Ground soils, trace fibres may be present elsewhere across the site. The E3P Developed Conceptual Site Model demonstrates a suitable method for management of soils to negate any future risk.

The contractor must ensure that all personnel working on site are trained in the identification of ACM and the risks 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 HSG248 should be completed during the operation to move the soils to demonstrate the deployment of the required control procedures and safe working methods.



RE-9 – Excavation, Breaking and Processing of All Above- and Below-Ground Structures

Obstructions, relict foundations 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.

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, 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 – Delineation, Excavation and Treatment of Identified Volatile Impact

Elevated concentrations of naphthalene have been identified at several locations across the site within the shallow Made Ground at depth of between 0.80m and 2.50m bgl. E3P recommend further analysis and assessment is completed to determine if the volatile impact is site-wide, restricted to the extent of the former landfill or within local hotspots.

At this time (until further assessment is completed), it must be considered that this material represents an unacceptable risk associated with volatilisation to indoor air and odour nuisance that cannot be mitigated through the construction of a clean cover system.

Where it is not viable to delineate and remove these materials, it is recommended that vapour proof membranes are installed to plots overlying these areas. However, E3P believe it may be prudent to install vapour monitoring tubes to the impacted areas in order to undertake a DQRA based on as measured vapour concentrations. This assessment may demonstrate a lower risk from vapours and thus remove the requirement for a vented sub-floor void and chemically resistant membrane.

If the volatile impact is confirmed (through further assessment) to be localised in 'hotspots', then a watching brief should be completed during remediation works to monitor the locations where the impact has been identified and remediation measures need to be carefully considered to reduce the potential for cross contamination as part of the wider enabling works.

Material deemed to be impacted through either visual or olfactory observations or as a result of notable PID readings (> 50 ppm) 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.

The naphthalene impacted soils will be subject laboratory analysis to determine the suitability for disposal off-site in a legislatively compliant manner. Upon completion of the delineation and excavation, the sides and base of the resulting void(s) where impacted material is present will be chemically validated to confirm that no impacted materials remain in situ.

The results of this validation testing will be directly compared to the site-specific remediation targets (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.



In the likely event that any as yet unidentified contaminant is identified, this will be the subject of further investigation including laboratory analysis and subsequent assessment of risk within the context of the agreed parameters. Where a theoretical risk to either human health, controlled waters or the wider environs is identified, appropriate remediation works are to be instigated.

RE-11 – Removal of Deleterious Material

The E3P Ground Investigation identified potentially deleterious wastes within the former landfilled Made Ground at the site.

The re-use of this material needs to be carefully considered.

The material can be processed under a compliant permit for re-use. It is also possible to reduce the waste volume through screening to recover salvageable materials for processing and an engineering product. This will be subject to the requirements of the cut and fill operation.

All potentially deleterious materials will be delineated, stockpiled and removed from site by the contractor to a licensed waste facility. Prior to the commencement of the main works, the contractor, under the supervision of E3P, will undertake to complete further confirmatory ground investigations to satisfy themselves with regards to the extent of any buried anthropogenic deleterious materials that are unsuitable for retention within a low-rise residential development.

Alternatively, if this material is underlying proposed landscaping / POS, it would be feasible to remain in-situ and capped by a suitable cover system subject to the overall environmental risk.

RE-12 – Replacement of Materials, Geotechnical Engineering Requirements

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 reinstatement and compaction criteria presented in Table 3.1.

Unless specific instruction is issued from the client, plots should be prepared for a

- ✳ Strip/trench foundations bearing into competent firm to stiff CLAY or medium dense SAND (likely to be in area of cut where shallow natural soils will be present);
- ✳ Deep Mass Trench to be completed in areas where competent stratum is identified at greater depth or in areas of tree influence;
- ✳ Raft foundations could be constructed within areas of reduced strength superficial drifts and engineered Made Ground. These structures will need to be designed with suitable settlement analysis.
- ✳ Ground improvement using bottom feed vibro stone column (VSC) to support a shallow reinforced concrete strip foundation where ground conditions are unsuitable for strip/trench (typically in areas of poor / variable ground conditions or deeper Made Ground); and
- ✳ Driven piled foundations (in areas of soft clays, tree influence, infilled pond or areas of peat). Piles to be designed in due consideration of any unrecorded shallow mine workings.



TABLE 3.1 GEOTECHNICAL ENGINEERING WORKS SCHEDULE

Land Use	Construction Requirement	Requirement
Footprint of Proposed Structure (2 m on All Elevations)	Pile Foundation	Backfill using general method compaction to CBR of 5%.
	Vibro-Stone Column	Particle size distribution (PSD confirmed as < 125 mm with no more than 10% fines (0.63 micron). Or Compaction to achieve > 95% of the laboratory determined maximum dry density (DD) with < 5% air void ratio. CBR > 6% with suitable pile mat. PSD testing of backfill material at 1 sample per 2000 m ³ to confirm.
	Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Highways	Adopted Estate Road/Drainage	Manual of Contract Documents for Highways Works (MCHW) Series 600 ensuring CBR > 5% in subgrade (engineered fill).
Driveways	Private Drives and Car Parking	Method compaction to CBR > 5%.
Gardens and Public Open Space	N/A	Method compaction to ensure no settlement.

RE-13 – Construction of Temporary Working Platform

For the proposed plots which are to be prepared in a manner that will facilitate piled foundations, a temporary working platform will be constructed.

The specific design for such a platform should be obtained from E3P; however, as a minimum this will comprise:

- ✿ Proof rolling of the subgrade to ensure a California bearing ratio (CBR) > 3%; and
- ✿ Temporary Works Platform Design required to confirm the thickness of pile mat.

The platform will require design upon receipt of the piling rig specification and pile layout design to ensure that a suitable platform design is adopted.

The plots numbers for which piled foundations are to be installed will be confirmed on completion of the Foundation Zoning Plan for the site, taking into account the wider cut and fill operations to create the development platform.

The impacted plots will be listed in an addendum to this report.



RE-14 – Preparation of Gardens and Landscaped Areas for Cover System

The private gardens and landscaped areas (and tree pits) will be prepared in a manner that will facilitate the placement of the clean cover system during the development phase of the works.

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 placed (or currently present) in private garden areas, the area will be capped with a 600mm cover system of chemically suitable materials upon a geotextile break layer.

The landscaped areas will be capped with a 300mm cover system. Where proposed tree pits are located, the cover system may require deepening to 600mm bgl.

Excavated natural soils (from any cutting excavation) will be stockpiled pending the results of the appropriate validation testing (to be completed in accordance with this specification) prior to reuse.

Made Ground soils will all be placed in areas of no sensitivity or, where necessary, this material will be removed from site in accordance with UK waste management legislation.

The placement of certified subsoil and topsoil will be completed as part of the developer works/build-phase mitigation plan. All private gardens and landscaped areas where a cover system is required will be subject to independent validation.

RE-15 – Provision of Subsoil

The shallow natural drift deposits (predominantly cohesive soils) may be suitable for use within the upper 600 mm of clean cover to residential gardens and areas of soft landscaping.

It is therefore deemed viable to reuse materials that are cut as part of the wider earthworks or through a soil inversion (regulated by an MMP) to generate the required volumes of material.

However, further analysis of soils to be cut as part of the enabling works will be required to confirm the chemically suitable of this material for recovery and re-use.

The garden and landscaped areas will require depth validation to satisfy the requirement of the Council of Mortgage Lenders (CML) in order to demonstrate that the appropriate thickness has been provided as a growing medium.



RE-16 – Provision of Topsoil

Suitable topsoil is present on site which can potentially be re-used. However, further analysis of topsoil material will be required to confirm the chemically suitable of this material for recovery and re-use.

In the event of a net shortfall, there will also be a requirement to import suitable material for use within the proposed development.

Topsoil will require testing in line with the schedule present within Section 3.5 and Table 3.2.

The garden and landscaped areas will require depth validation to satisfy the requirements of the CML in order to demonstrate that the appropriate thickness has been provided.

RE-17 – Independent Validation: Watching Brief

Given the site history and potential contamination sources identified within the ICSM, a degree of uncertainty remains with regard to the potential for as yet unidentified contamination impact within the near-surface soils and groundwater.

It will therefore be necessary to instigate the site-wide remediation and enabling works under the supervision of a suitably qualified and independent specialist. The specialist is required to attend site as and when appropriate to monitor works, record ground conditions and fully investigate all potential sources of as yet unidentified contamination.

RE-18 – Validation of Materials for Potable Water Supply Infrastructure

A UKWIR risk assessment will be required this once the Made Ground has been processed upon completion of the enabling works and the material tested and measured against WIR thresholds in relation to the proposed pipelines depths.

All materials where organic hydrocarbon impact is identified at concentrations above the UKWIR assessment criteria for a polyurethane pipe within the proposed locality of potable water supply infrastructure should be delineated and removed by the remediation contractor under the supervision of the geoenvironmental consultant.

Validation sampling should be completed at 10 m chainage at depths of 0.75 m and 1.50 m within the locality of the potable supply pipes where impacted material is removed, with samples analysed for all pertinent volatile and semi-volatile hydrocarbons.

Upon successful remediation of all impacted materials, the post-remediation validation testing will be reviewed by a qualified person to inform an updated UKWIR assessment to be reviewed and approved by the statutory adoption authority.

If unacceptable concentrations remain following remediation, then potable water infrastructure should be constructed in accordance with a suitably robust risk assessment and design compliant with UKWIR.



Where imported material is required to construct the potable water infrastructure pipework, this material will need to comply the requirements of UKWIR pipework thresholds for the specified pipework. For the avoidance of doubt, the PE thresholds are presented in Section 9.3.

Failure to meet the required specification may necessitate further remedial works.

RE-19 – Waste Soils Surplus to Requirements

In the event that a surplus of excavation material is present on site, this, in most cases, will be deemed to be a waste in accordance with the Waste Framework Directive (Article 3(1) Waste Framework Directive 2008/98/EE). The waste producer – but ultimately, the landowner – is responsible for the compliant disposal of such materials.

A formal waste classification assessment must be undertaken, irrespective of any future options or considerations for those materials that will be removed from site. Waste classification should only be made following the Environment Agency *Technical Guidance WM3 – Guidance on the Classification and Assessment of Waste*.

To remove the surplus material from site it will either need to be sent to a disposal site (landfill), to a permitted treatment facility or, dependent on the waste classification assessment, it may be suitable for use on a permitted land improvement or restoration operation.

Subject to suitability, these soils can be transferred to the receiving site, subject to an approved permit or materials management plan following guidance in the CL:AIRE *Definition of Waste: Code of Practice*.

RE-20 – Remedial Verification Report

Collation of information relating to site clearance, chemical testing, remedial works, remedial verification, material movements and waste transfer documentation is required, where appropriate.

Complete remedial validation is to be 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.



3.3. 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 and enabling works strategy, or for materials to be imported onto site to facilitate the proposed residential development.

If any hotspots of unsuitable (impacted) Made Ground is to be undertaken, validation samples will be collected from the base (two samples) and sidewalls (four samples) 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 personal protective equipment (PPE) and sampling equipment, which 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 with 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 III), 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.



TABLE 3.2 SPECIFICATION OF CHEMICAL VALIDATION LABORATORY ANALYSIS

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site-Generated		
Site-Generated 6F2	1 Sample per 1000 m ³	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 250 m ³ where visual and/or olfactory impact is identified	G
Site-Won MADE GROUND General Backfill	1 Sample per 1000 m ³	A/B/C/D
Site-Won MADE GROUND General Backfill	1 Sample per 2000 m ³	I
Site-Won Natural Backfill	1 Sample per 2000 m ³	A/B/C/D
Site-Generated Subsoil (450 mm Garden Cover)	1 Sample per 250 m ³	A/B/C/D
Site-Generated Topsoil Cover (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Hotspot Validation Samples	1 Sample per 10 m of linear excavation to base and sidewall	E/G
Imported		
6F2	1 Sample per 1000 m ³	A/B/C/D
Subsoil Greenfield Source (450 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Subsoil Brownfield Source (450 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
Topsoil Greenfield Source (150 mm Garden Cover)	1 Sample per 200 m ³	A/B/C/D
Topsoil Brownfield Source (150 mm Garden Cover)	1 Sample per 50 m ³	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m 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. Leachate 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.

A minimum of three samples will be required from any one source.

Details of the source of any imported soils will be provided by the appointed earthworks contractor.



3.4. REMEDIATION CONTRACTORS SITE MANAGEMENT AND RESPONSIBILITY

The appointed remediation contractor will take full and overarching responsibility for all methods of work required to complete the site remediation and enabling operations to ensure the delivery of the site and the completion of the objectives in a safe, legislatively compliant manner that ensures no pollution to the subject site or the wider environs.

For individual remediation operations as set out within this performance specification, the contractor will provide site-specific methods of work for individual operations pertaining to the removal and treatment of contaminated liquids and soils. For each and every operation as set out herein, the contractor will provide a written methodology of works to be supplied to the supervising geoenvironmental engineer prior to the instigation of operations on site.

The site manager will be responsible for documentation of each day's activities with a full recorded schedule of works completed and corresponding site-specific method statements that have been utilised to ensure the completion of the task to the required standard.



4. MATERIALS MANAGEMENT AND 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 Exemption will be registered for the site, which allows the reuse of up to 5000 T of prescribed material within construction, with up to 25,000 T of material permissible to be reused in the construction of roads. It should be noted that only 1000 T of material described as sand, stones or clay soil classified as waste can be reused with a U1.

A T5 Exemption, allowing for the screening and recovery of up to 5000 T of permissible material for subsequent reuse 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 licences, exemptions and protocols provide the legislative framework for material compliance during the site remediation and enabling works to be completed by the specialist contractor under the supervision of E3P.

Where necessary, operations as outlined within the remediation enabling works rationale summarised in this report may be subject to regulation using the appropriate environmental permit, standard rules exemption and materials management plan, to be created in accordance with version 2 of the CL:AIRE *Definition of Waste: Code of Practice (DoW CoP)*.

It is noted that if material is to be imported utilising the CL:AIRE DoW CoP from an alternative development site, then only chemically certified, clean, naturally occurring material can be transferred.

If required, the MMP will be created with due consideration of all proposed remediation and enabling works operations prescribed within this document and will be undertaken by a qualified person with a signed declaration submitted to the EA prior to reuse of materials on the site.

The importation of material for use within the proposed construction of a development platform will be subject to the compliance with the E3P protocol for the importation of materials as set out within the specification for material import included within Appendix IV of this report.



4.1. APPROACH & METHODOLOGY

The following approach and methods will be undertaken in regard to the remediation and treatment of landfill excavated wastes.

4.2. MOBILE ENVIRONMENTAL TREATMENT PERMIT

- ✳ Landfill material identified in the site investigation reports along with its proposed excavation for remediation means it is legally classified as a waste (Article 3 – Waste Framework Directive 2008). Any further handling of this material is waste treatment and subject to regulation by the EA in the form of an environmental permit in accordance with The Environmental Permitting (England and Wales) Regulations 2010 (as amended).
- ✳ With due consideration of the development needs and the nature of the recorded landfill material, E3P understand the applicable environmental permit will be 'SR2008 No 27: Mobile Plant for the Treatment of Soils and Contaminated Material, Substances or Products'. This permit allows the operator to use any of the following technology and associated plant/equipment to facilitate the treatment/remediation, including the use of technology and plant in combination. Applicable processes can include:
 - Air sparging.
 - Bioremediation – insitu and exsitu (windrows, biopiles, in-vessel bioreactors).
 - Bioventing.
 - Chemical treatment (including oxidation, dehalogenation).
 - Ex-situ treatment of pumped groundwater (chemical treatment, biological treatment, air stripping, filtration, carbon adsorption).
 - Soil Vapour Extraction (including dual phase SVE).
 - Solidification.
 - Stabilisation.
 - Thermal treatment (including thermal desorption and steam injection).
 - Treatment plant for sorting and separation; and,
 - Treatment plant for blending, mixing, bulking, screening, shredding, particle size reduction and/or particle separation in order to facilitate remedial action.

Discussions with the developer have identified a specialist remediation contractor who already hold this permit in place in readiness for deployment to site – this will avoid the need to initially apply for the permit. Prior to works commencing, the permit holder (appointed contractor) will notify the EA of the plan to use the permit through the issue of the MPP2 Permit Deployment Form.

Included in the MPP2 form, the operator will provide site specific information to show how the project proposes to:

- ✳ Control pollution from the treatment process.
- ✳ Control and manage emissions to avoid pollution to the environment and harm to human health.



The introductory note page of this environmental permit it states:

This permit allows waste recovery activities. Please note that any processed materials will continue to be regulated as waste until they meet the end of waste test in accordance with Article 6 of Directive 2008/98/EC. You can demonstrate that you have met the end of waste tests by following either:

- a) meeting all the criteria set out in any relevant and applicable EU End of Waste regulations; or,*
- b) a case by case assessment taking into account the applicable case law, which includes meeting all the requirements of a relevant and applicable Quality Protocol or Defined Industry Code of Practice (e.g. CL:AIRE Development Industry Code of Practice).*

The remediation strategy will form part of the approval process of the mobile environmental permit deployment. The remediation strategy, coupled with the MPP2 form, will provide references to the actual treatment activities and therefore we have excluded their mention in this document.

4.3. OPERATION NO.1 - PRIMARY 'PHYSICAL' TREATMENT

The initial phase of treatment will incorporate the excavation of landfill materials from the landfill boundary areas to the required depth. Subject to confirmation in the remediation contractors 'method of works'.

The material is largely 'inert' therefore, there is no perceived risk associated with excavation or on-site stockpiling prior to processing.

Large, clearly identifiable waste material types will be removed by the plant operator and segregated in readiness for removal off-site or for further on-site 'secondary' treatment. Any waste material destined to leave the site will be temporarily held in an appropriate waste container prior to collection.

4.4. OPERATION NO.2 – MANUFACTURE OF RECYCLED AGGREGATES

The WRAP Quality Protocol for the Manufacture of Recycled Aggregates from Inert Waste is a criteria that allows defined inert waste materials to be regarded as having achieved 'end of waste' status in line with Article 6 of the Waste Framework Directive 2008.

Through the use of the techniques implemented with the mobile environmental permit, suitable inert waste materials that conform to the WRAP Protocol (e.g. concrete, bricks, glass etc.) will be segregated from the main body. These waste fractions will then be further processed to generate a recycled aggregate that meets a specific engineering standard for re-use on the site (in line with the remediation strategy).

To meet the requirements of a recognised engineered standard (e.g. Class 1 or 6 as defined in Street & Highway Works 600: Earthworks), further processing in the form of 'crushing' will be undertaken (the process will be included as part of the Environmental Permit deployment). Segregated inert wastes will be fed using an excavator into the feed hopper of the crusher, an operative will be stationed on the pre-crush feed conveyor to perform quality assurance checks and manually remove any non-conforming materials prior to its input into the crusher teeth. Any non-conforming materials removed will be placed into containers as per Operation No. 1. The crusher teeth will be set to meet the maximum particle size of the required product specification (e.g. 125mm for 6F5).

The resultant output from this process will be sampled and analysed to prove it meets the recognised standard/specification required. By fully conforming with the WRAP Quality Protocol the resultant aggregate can be regarded as achieving 'end of waste' status.



The key document associated with the WRAP Quality Protocol is the 'Factory Production Control' - a set of procedures (management system) focusing on the production process to ensure that product quality is consistently maintained to the required specifications. The key parts of this are:

- ✿ Standards & specifications to be used.
- ✿ Waste acceptance criteria.
- ✿ Production process & equipment.
- ✿ Records & documentation.
- ✿ Sampling & analysis.
- ✿ Testing frequencies.

Whilst there is no specific requirement to submit this for regulatory approval, these can be made available during the regulatory approvals process for this remediation strategy and mobile environmental permit deployment. The approved remediation contractor will ensure their Factory Production Control procedure is fully compiled prior to these operations commencing.

4.5. OPERATION NO.3 – VALIDATION OF FINES

In the absence of any 'end of waste' protocol for the fine matrix material (post primary treatment) for this material to meet the 'end of waste' test they must be shown to meet an agreed set of criteria from both a geo-chemical and geo-technical and if returned to the ground must exhibit properties that would not impact human health or controlled waters.

Those fines generated during the primary treatment process are likely to include the contaminants associated with the findings of the previous site investigations.

In order for these to be considered suitable for re-use, they will initially be subject to validation testing.

This validation testing will be based on those detailed in section 4.8.1 below.

Each of the stockpile will be subject to the initial validation testing as per section 4.8.1. Should the stockpile meet the agreed criteria and validation test requirements they will be clearly marked as approved in readiness for its re-use as bulk fill and re-engineered back into the void space in compliance with SHW 600: Earthworks Specification.

Any batched stockpiles that fail to meet the agreed criteria will be held in quarantine and clearly identified as such and located away from other site activities and stockpiles. At this point, a determination will be made as to what further treatment would be required in order for this batch of fine material to meet the agreed re-use criteria. Due to the nature of the material, it is assumed that the most likely form of treatment will either be ex-situ (on-site) solidification or stabilisation.



4.6. EXPECTED WASTE MATERIALS

Table 4.1 has been generated to detail the waste management options and treatments to be applied to each material type:

Table 4.1 ANTICIPATED EXCAVATED WASTE TYPES

Type	Grading ¹	Waste Code ²	Waste Management Option	Treatment or Disposal Route
Asbestos (Cement Bonded & AIB)	Haz	17-06-05	Removal off site ³	Hazardous Waste Landfill
Asbestos (other)	Haz	17-06-01	Removal off site ⁵	Hazardous Waste Landfill
Brick	Inert	17-01-02	Re-use on Site ⁴	WRAP Quality Protocol
Cardboard	Non-Haz	19-12-01	Removal off site ⁵	Reprocessing ⁵ / Refuse Derived Fuel
Ceramic (inc pottery, tiles)	Inert	17-01-03	Re-use on site ⁶	WRAP Quality Protocol
Colliery Spoil (fines material)	Non-Haz / Haz	17-05-03 or 17-05-04	Re-use on site ⁶	Solidification & Stabilisation (where applicable)
Concrete	Inert	17-01-01	Re-use on Site ⁶	WRAP Quality Protocol
Fibreglass	Non-Haz	17-06-04	Removal off site ⁵	Non-hazardous Landfill
Electric Cable	Non-Haz	17-04-11	Removal off site ⁵	Metal reprocessing ⁷
Galligu	Non-Haz / Haz	TBC	TBC	TBC
Glass (inc. bottles)	Inert	17-02-02	Re-use on Site ⁶	WRAP Quality Protocol
Metal (Ferrous & Non-Ferrous)	Non-Haz	17-04-07	Removal off site ⁵	Metal reprocessing
Nylon Rope	Non-Haz	17-02-03	Removal off site ⁵	Refuse Derived Fuel
Paper	Non-Haz	19-12-01	Removal off site ⁵	Refuse Derived Fuel
Plastic (hard-various grades)	Non-Haz	17-02-03	Removal off site ⁵	Reprocessing ⁷ – Refuse Derived Fuel

¹ These gradings are generally accepted for the material type but can differ subject to further testing.

² As with footnote 3 – the waste codes vary depending on whether they are hazardous or non-hazardous.

³ All waste to be removed off site will be handled in line with waste management 'Duty of Care' requirements and be subject to waste classification in line with the EA Technical Guidance for Waste Classification: WM3.

⁴ Subject to meeting 'end of waste' criteria and validation testing.

⁵ Reprocessing will be considered if the material can be clearly segregated and suitable for acceptance by the reprocessor.



Type	Grading ¹	Waste Code ²	Waste Management Option	Treatment or Disposal Route
Plastic Bottles	Non-Haz	17-02-03	Removal off site ⁵	Reprocessing ⁷ – Refuse Derived Fuel
Plastic (Flexible)	Non-Haz	17-02-03	Removal off site ⁵	Refuse Derived Fuel
Polystyrene	Non-Haz	17-02-03	Removal off site ⁵	Refuse Derived Fuel
Rubber	Non-Haz	19-12-04	Removal off site ⁵	Refuse Derived Fuel
Soil & Stone (fines material)	Non-Haz / Haz	17-05-03 or 17-05-04	Re-use on site ⁶	Solidification & Stabilisation (where applicable)
Textiles	Non-Haz	19-12-08	Removal off site ⁵	Refuse Derived Fuel
Timber	Non-Haz	17-02-01	Removal off site ⁵	Reprocessing ⁷ / Refuse Derived Fuel
Tyres	Non-Haz	19-12-04	Removal off site ⁵	Reprocessing ⁷ / Refuse Derived Fuel
Wood	Non-Haz	17-02-01	Removal off site ⁵	Reprocessing ⁷ / Refuse Derived Fuel

4.7. VALIDATION CRITERIA

4.7.1. FINES MATERIAL

Chemical

The following information details the proposed validation testing and frequency in order to meet and 'end of waste' criteria and the subsequent test approvals as requested by EA prior to works commencing.

With regard to the planning consent validation process, post-primary and/or secondary treatment fines material (referred to in table 4.6 as 'Site Won MADE GROUND Backfill') will be analysed in respect to the following determinands:

- ✳ US EPA16 speciated PAH's
- ✳ TPH (C5 – C35)
- ✳ Asbestos (ID)
- ✳ CLEA inorganic metals

These specific tests will be undertaken on a proposed frequency of 1 no. sample per 2500m³. In addition, leachate analysis will be undertaken of the fines material covering the following:

- ✳ Inorganic metals
- ✳ TPH
- ✳ PAH's
- ✳ Sulphates



These samples will be taken a frequency of one sample per 2000m³.

The approved criteria 'target' levels are shown in Appendix IV – E3P Remediation & Validation Criteria and covers both the human health remediation targets for low rise residential end use along with the remediation targets for the comparison of groundwater/leachate analysis with Tier 1 screening values (e.g. EQS screening values and drinking water standards).

Geotechnical

In line with section 4.1 of this remediation strategy the post processed fines must fall within the designated material use class of SHW600: Earthworks Table 6/1:

-  Class 1 – General Granular Fill
-  Class 2 – General Cohesive Fill (excluding Class 2a & 2e)

Sampling, analysis and approval must be undertaken prior to any backfilling into the former landfill void spaces. These, along with the specific compaction and backfill performance criteria levels must be met, and these are defined in table 7.3 of this remediation strategy. Material that fails to meet the required geo-technical performance criteria will not be returned to the void space and will either be subject to further processing or off-site removal in line with duty of care and waste classification requirements.

Specific to the fines materials generated from the processing of the excavated landfill material, to supplement the geotechnical validation tests shown in Table 4.4 'Classification of Constituents' testing will also be undertaken to confirm the physical make up of the post treated fines. In a similar nature to the WRAP Quality Protocol the validation process will look to confirm that the constituents of the fines consist of materials with the material codes (Rc, Ru, Rb, Ra, Rg) and the value of X group materials (e.g. plastic, wood, rubber, metal etc.) do not exceed 1% of the total mass of the population sampled (see Table 4.4).

4.8. RECYCLED AGGREGATES

Geotechnical

The following information details the required validation testing and frequency that is required to show conformity with the WRAP Quality Protocol. The information below provides a summary to the details that will be incorporated into the Factory Production Control Procedure by the approved remediation contractor. With respect to the North Leigh Park Development all recycled aggregates will be processed as a Class 6F5 – Selected Granular Material (Coarse Grading).

The following Table 4.2 specifies the tests required by the EA for recycled aggregates from inert waste. Table 4.3 details the supplementary tests that are required for 6F5 material in respect of SHW600.



TABLE 4.2 – WRAP QUALITY PROTOCOL: SUMMARY OF TESTING REQUIREMENTS & FREQUENCIES

End Use Class	Standard/Specification	Test	British Standard Test Reference	Minimum Test Frequency ⁶
All End Use Classes (e.g. Class 1, 2, 6, 7) ⁷	BS EN 13242 - Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.	Particle Size Distribution ⁸	EN933-1	1 per week
		Particle Density & Water Absorption	EN1097-6	1 per month
		Resistance to Fragmentation (Los Angeles Coefficient) ⁹	EN1097-2	1 every 6 months
		Classification of Constituents (see Table 9)	EN933-11	1 per month
		Water Soluble Sulphate ⁹	EN1744-1	1 per month

TABLE 4.3 – SHW600: EARTHWORKS - SUMMARY OF TESTING REQUIREMENTS

End Use Class	Standard/Specification	Test	British Standard Test Reference	Minimum Test Frequency
Class 6F5	BS EN 13242 - Aggregates for unbound and hydraulically bound materials for use in civil engineering work and road construction.	Laboratory Dry Density & Optimum Water Content	BE EN 13285	1no. sample per 1000m ³
		Water Content	BS EN 1097-5	1no. sample per 1000m ³
		Bitumen ⁹ Content	BS EN 12697-1 or BS EN 12697-39	1 per month
		⚠ Total Sulphur & Sulphide ¹	⚠ EN1744-1	⚠ 1no. sample per 1000m ³

Note: Based on the descriptions of the landfill waste from previous site investigations applicable tests for 'Volume Stability of Blast Furnace Slag' & 'Volume Stability of Steel (Basic Oxygen Furnace & Electric Arc Furnace) Slag' are not considered applicable.

The above Table 4.3 does not include references to any post placement, in-situ compaction tests such as California Bearing Ratio (BS1377-4). Refer to Table 6.1 for further details on the compaction testing requirements.

⁶ Frequencies are defined in terms of a production week or similar and/or production day. These periods should be defined by the producer depending on the throughput of the plant/equipment. Production week can be defined as the period of even consecutive days comprising at least five production days or the period taken to complete five production days, whichever is longer.

⁷ Excludes 6F2 as BS1377 standard does not meet WRAP Quality Protocol requirements.

⁸ Test required for both WRAP Quality Protocol & SHW600: Earthworks.

⁹ Does not apply if the Class Ra (asphalt) content of the recycled aggregate is 20% or less.



TABLE 4.4 – CLASSIFICATION OF CONSTITUENTS – CLASSIFICATION GROUPS (BS EN 933-11)

Material Code	Constituents
Rc	Concrete, concrete products, mortar, concrete masonry units
Ru	Unbound aggregate, natural stone, hydraulically bound aggregate
Rb	Clay masonry units (i.e. bricks and tiles), calcium silicate masonry units, aerated non-floating concrete.
Ra	Bituminous materials
Rg	Glass
FL	Floating material in volume
X	Cohesive (e.g. clay and soil), metals, wood, plastic, rubber, gypsum plaster.

Notes: Maximum permitted for constituents **X**: 1% by mass. Maximum permitted for constituent **FL**: <10cm³/kg unbound.

Chemical

In addition to the testing specifications and frequencies stipulated in the WRAP Quality Protocol (see Table 4.3, 4.4, 4.5) Table 6.3 also requires chemical validation testing of site generated recycled aggregates.

The chemical testing covers US EPA16 PAH's, TPH (C5 – C35), asbestos identification and CLEA inorganic metals. This supplementary chemical testing is a requirement of the planning consent validation process and is supplementary to the requirements of the WRAP Quality Protocol. T

he testing frequency is bases upon volumes generated rather than production timescales. The testing frequency to be undertaken is set at 1no. sample per 2500m³.



5. ENVIRONMENTAL MONITORING AND VALIDATION

5.1. 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.
- ✿ An E3P consultant, who will be in attendance as required, 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; and
 - Ensure that any loads that 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.
- ✿ E3P will conduct an audit of waste consignment notes. 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.
- ✿ 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.

5.2. 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 hardstanding should be subject to no-less-stringent measures with respect to assessment and, where appropriate, monitoring, than those set out herein.



6. GEOTECHNICAL ENGINEERING SPECIFICATION

6.1. E3P GEOTECHNICAL ENGINEERING SPECIFICATION

The overarching philosophy of the site enabling works will be the delivery of the following:

- ✳ Strip/trench foundations bearing into competent firm to stiff CLAY or medium dense SAND (likely to be in area of cut where shallow natural soils will be present);
- ✳ Deep Mass Trench to be completed in areas where competent stratum is identified at greater depth or in areas of tree influence;
- ✳ Raft foundations could be constructed within areas of reduced strength superficial drifts and engineered Made Ground. These structures will need to be designed with suitable settlement analysis.
- ✳ Ground improvement using bottom feed vibro stone column (VSC) to support a shallow reinforced concrete strip foundation where ground conditions are unsuitable for strip/trench (typically in areas of poor / variable ground conditions or deeper Made Ground); and
- ✳ Driven piled foundations (in areas of soft clays, tree influence, infilled pond or areas of peat). Pile design will make due consideration of any unrecorded shallow mine workings.
- ✳ Engineer all areas of proposed adopted road and private drive to be compliant with the E3P Geotechnical Specification with CBR and elevation defined by the client.

In the event that it is not possible to prepare the site in a manner that will achieve the required foundation solution, the supervising engineer and client should be contacted at the first available opportunity.

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 ($\pm 2\%$) of the tolerable limit will result in an unacceptable degree of compaction loss.

6.2. LOCALLY WON FILL MATERIAL

It is proposed to cut and fill to 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 natural site won soils will be cohesive soil matrices, with limited granular soils.

Due to climatic weather conditions and variance in long-term differential settlement associated with even well-compacted granular soils, and the need to facilitate future re-engineering using vibro-replacement stone columns to support a shallow reinforced 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 4.5 kg laboratory Proctor test.

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

6.3. 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 February 2016; and
- ✿ BS 1377-1:2016 Methods of test for soils for civil engineering purposes. General requirements and sample preparation.

6.3.1. 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 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; or
- ✿ Selected granular fill (Class 6).

6.3.2. 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 2,000m³** and submitted for particle size distributions (PSDs). Maximum Dry Density and 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.

Representative samples of all proposed backfill shall be taken at a frequency of **1 per 3000m³ (minimum 3nr)** and submitted for Dry Density / Optimum Moisture Content analysis using either a 4.5Kg or 2.5kg rammer to determine the optimum moisture content and maximum dry density for the engineering of structural fill.

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.



TABLE 6.1 E3P EARTHWORKS GEOTECHNICAL COMPACTION SPECIFICATION

SOIL/MATERIAL TYPE	CLASS	DESCRIPTION	COMPACTION EQUIPMENT	LAYER THICKNESS	ROLLER PASSES
Granular Fill (Sand and Gravel Matrices)	1 A	Sandy Gravel with some cobbles	> 5000 kg vibrating roller	225 mm	4
	1 B	Sand or Gravel of same grading size	> 5000 kg vibrating roller	250 mm	10
	1 C	Coarse gravels with many cobbles	> 5000 kg vibrating roller	400 mm	5
Cohesive Fill (Clay with Minor Sand and Gravel Component)	2 A	Wet Clay	> 1000 kg vibrating tamping roller (sheep foot only)	100–225 mm	3
	2 B	Dry Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
	2 C	Gravelly Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
	2 D	Silty/Sandy Clay	> 5000 kg vibrating roller or 1400 kg tamping (trench roller)	225 mm or 125 mm	4 or 12
Recycled Aggregate Crush (< 125 mm Well Graded)	6F2	Any combination of inert hard materials, other colliery spoil, or rock with substantial amounts of clay-like component	> 5000 kg vibrating roller	250 mm	6



6.3.3. 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 150 mm 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.

6.4. GENERAL REQUIREMENTS

The contractor shall employ only plant and working methods that 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 earthwork's specification assigned to individual areas.

TABLE 6.2 COMPACTION/BACKFILL REQUIREMENTS

LAND USE REQUIREMENT	COMPACTION METHODOLOGY AND GENERAL PERFORMANCE CRITERIA
Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depth.
Re-Engineering of Soils Using Vibro-Replacement Stone Column (VRSC)	Materials to be placed in a controlled manner to facilitate the construction of vibro-replacement stone columns (VRSC). to limit differential settlement and increase net Allowable Bearing Pressure (ABP) These works are to be completed within the building structure footprint and +2 m of all elevations. Material must be 90% granular in composition with less than 10% fines (which are classified as materials < 0.6 microns in size). No material greater than 125 mm in size is permitted, with 90% of the soils placed conforming to grading < 90 mm. Material is to be placed when actual moisture content is within tolerable limits of the optimum, with specific attention to soils that are notably wetter than 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 upfill, levels must be compacted to an "end product" performance specification where the in-situ density exceeds 95% of the maximum (determined by laboratory conditions).



LAND USE REQUIREMENT	COMPACTION METHODOLOGY AND GENERAL PERFORMANCE CRITERIA
	Where rock is present at a shallow depth, the remediation contractor will ensure the substratum is prepared to ensure that a minimum of 1000 mm of appropriately graded granular material is present to the underside of the proposed doubly reinforced concrete strip foundation. The substratum must be prepared to ensure a vibro-stone column treatment depth is not less than 80% of the immediate adjacent profile.
Piled Foundation	All plot footprint (+ 2 m) must be free of any deleterious elements, tree roots and obstructions > 150 mm. Where upfill is proposed, material is to be placed using method compaction specification to achieve a CBR as required by the developer for piling mat construction. Piling mat is to be placed and constructed in accordance with the approved geotechnical engineer's temporary works design.
Adopted Highways (+ 2 m from Back of Footpath)	<i>Method Compaction – MCHW Specification For Highway Works Series 600</i> is to be followed, with in-situ validation testing to meet requirement of adoptions authority. A CBR > 5% is required at subgrade formation (prior to placement of capping).
Estate Roads	<i>Method Compaction – MCHW Specification For Highway Works Series 600</i> is to be followed to achieve a CBR > 5%.
Gardens, POS and Other External Areas	Material is to be placed in layers not exceeding 300 mm and must be rolled using dedicated plant (no earth moving equipment) and in general compliance with the requirements of <i>MCHW Specification For Highway Works Series 600</i>.

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

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 with sufficient spreading and compaction. Plant is operating at the place of deposition to ensure compliance with Clause 612 of the *Specification for Highway Works*.

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 their own arrangements for the stockpiling of acceptable material, and unacceptable material to be processed, and for the provision of site for this purpose.

The contractor shall ensure that they do not adversely affect the stability of excavations or fills by their 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 m. 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:

- ✿ Arranging the rapid removal of water:
 - shed on to the earthworks; and
 - entering the earthworks from any source;
- ✿ Provide, where necessary, temporary watercourses, drains, pumping and the like;
- ✿ Discharge accumulated water and groundwater into the permanent outfalls of the drainage system where practicable; and
- ✿ Provide adequate means for trapping silt on temporary systems discharging into permanent drainage systems.

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

Where materials are designated either Class U1B or Class U2 (according to the *Specification for Highway Works*), 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.

6.4.1. CONSTRUCTION OF FILLS – HIGHWAYS

All fills shall be constructed:

- ✿ In the locations as shown in the contract drawings to the lines and levels stated therein;
- ✿ Of classes of material complying with this specification;
- ✿ By deposition, as soon as practicable after excavation, in layers to meet the compaction requirements as required for each class of material as specified; and
- ✿ 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:



-  The base is sound and stable by excavating and removing any topsoil as soft subsoil;
-  Base layers are not exposed until the fill layer is ready for placement; and
-  Uncompacted material on the side slopes of previously backfilled zones shall be removed and benches of between 1.0 m and 1.5 m 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 1.0 m and 1.5 m 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 uncompacted backfill shall be formed at gradients that ensure stability.

6.4.2. CONSTRUCTION OF FILLS – ADOPTED HIGHWAYS, ESTATE ROADS AND CAR PARK

The contractor shall carry out compaction upon the materials that 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 that require 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 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 that indicate the state of the compaction to be inadequate, then if this is due to failure of 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 *MCHW Specification for Highway Works* for definition of plant to be used in accordance with these specified works.



The contractor will be responsible for assessing the class of fill in accordance with Table 6/1 of the *Specification for Highway Works*. Table 6/4 of the *Specification for Highway Works* 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.

6.4.3. UNACCEPTABLE MATERIAL

The contractor is solely responsible for ensuring full and detailed analysis of all reported ground conditions and areas of risk in terms of the potential for unacceptable material to be present within the proposed earthworks. Limitations in the available information should be highlighted to the supervising engineer prior to the commencement of earthworks. The contractor is to make full and unequivocal arrangements to investigate the potential presence for unsuitable materials within the earthworks and construction of highway fill. All unsuitable materials are to be identified for removal in accordance with this specification.

Unacceptable material Class U1A shall be:

Material which does not comply with the permitted constituents and material properties of MCHW Table 6/1 and contract specific Appendix 6/1 for acceptable material; and;

Material, or constituents of materials, composed of the following unless otherwise described in contract specific Appendix 6/1:

- ✧ Peat, materials from swamps, marshes and bogs;
- ✧ Logs, stumps and perishable material;
- ✧ Materials in a frozen condition;
- ✧ Clay having a liquid limit determined in accordance with BS 1377: Part 2, exceeding 90 or plasticity index determined in accordance with BS 1377: Part 2, exceeding 65; and,
- ✧ Material susceptible to spontaneous combustion except unburnt colliery spoil complying with sub-Clause 15 of this Clause;(ii)unacceptable material

Unacceptable material Class U1B shall be:

Contaminated materials, including controlled wastes (as defined in the Environmental Protection Act 1990 Part IIA) whose level of contamination is above that given either in contract specific Appendix 6/14 or in contract specific Appendix 6/15, but excluding all hazardous wastes (as Volume 1 Series 600 Specification for Highway Works Earthworks W2 Amendment – February 2016 defined in the Hazardous Waste (England and Wales) Regulations 2005) and radioactive wastes (as defined in the Radioactive Substances Act 1993).3(02/16).

Unacceptable material Class U2 shall be:(i) hazardous waste (as defined in the Hazardous Waste (England and Wales) Regulations 2005) and radioactive waste (as defined in the Radioactive Substances Act 1993).4(02/16).

Where required in contract, unacceptable material (other than Class U2) shall be processed by mechanical, chemical or other means to render the material acceptable for use in the permanent works in accordance with the requirements of Table 6/1 and contract specific MCHW Appendix 6/1.



6.5. EARTHWORKS 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 6.3.

TABLE 6.3 COMPACTION/BACKFILL REQUIREMENTS

LAND USE	COMPACTION METHODOLOGY and GENERAL PERFORMANCE CRITERIA				
Liquid and Plastic Limits	BS 1377: Part 2				
Grading	BS 1377: Part 2				
Uniformity Coefficient	Calculated from grading curve				
Moisture Content Multi-point moisture condition value (MCV) (to assess optimum moisture content).	BS 1377: Part 2				
Organic Matter (Maximum 2.5% Total Organic Content)	BS 1377: Part 3				
Water Soluble Sulphate	TRL Report 447 Test No 1				
Total Sulphate Content	TRL Report 447 Test No 4				
Earthwork 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><td>Test</td><td>Test Method</td></tr><tr><td>Plate Load Tests (Equivalent CBR of 5%)</td><td>BS 1377: Part 9</td></tr></table>	Test	Test Method	Plate Load Tests (Equivalent CBR of 5%)	BS 1377: Part 9	Clause 632 (BS 1377: Part 4)
Test	Test Method				
Plate Load Tests (Equivalent CBR of 5%)	BS 1377: Part 9				
Disposal of Materials The contractor shall be responsible for the safe disposal of any excess of unsuitable material found on the site.					
Proctor Compaction Testing	BS 1377: Part 4				

6.6. CURRENT AND PROPOSED SITE TOPOGRAPHY AND SLOPE INTERACTION

The site is variable in topography with undulating land. Generally, the site topographically falls from 150 m AOD in the north to 140 m AOD in the south. A steep slope is present in the northwest.

To construct a suitable development platform for the proposed development, a significant cut and fill earthworks will be undertaken.



7. RECORD-KEEPING AND VERIFICATION

7.1. 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.

7.2. 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 (e.g. asbestos in air, gas water).



8. CONTINGENCY PLAN

8.1. 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 of 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.



9. SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE

This document details the construction works that are required to ensure full compliance with the remediation Strategy, Regulatory Authorities, Building Control & Warranty Providers;

The following should be implemented during the build phase of the development:

- ✚ Laboratory testing of the imported subsoil and topsoil; and
- ✚ Placement of imported subsoil and topsoil within all private garden and landscaped / POS areas.
- ✚ Construction of appropriate potable water supply infrastructure (subject to UKWIR risk assessment); and
- ✚ Installation of appropriate ground gas protection measures in line with CS2 / Amber 1 (subject to final ground gas risk assessment).

9.1. PLACEMENT OF COVER SYSTEM

The Remediation and Enabling Works 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 garden and landscaped areas; the construction of the clean cover / placement of clean material shall consist of:

- ✚ 150mm topsoil; and 450mm subsoil cover system, with geotextile membrane (break layer) in all private gardens which overlie Made Ground deposits across the site; and
- ✚ 300mm topsoil in all landscaped areas. The depth of cover system within the tree pits may require deepening to 600m bgl.

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.

Initial testing of site won subsoil to classify its re-use on site has been completed as part of the remediation works undertaken. Therefore, further analysis of subsoil will be required to achieve the testing frequencies outlined within the remediation strategy and in the event of importation of additional material during construction.



Testing requirements for topsoil and subsoil are presented in Table 9.1.

TABLE 9.1 SPECIFICATION FOR SOIL TESTING

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Subsoil Greenfield Source (150 mm Cover)	1 Sample per 200 m ³	A/B/C/D
Subsoil Brownfield Source (150 mm Cover)	1 Sample per 50 m ³	A/B/C/D
Topsoil Greenfield Source (150 mm Cover)	1 Sample per 200 m ³	A/B/C/D
Topsoil Brownfield Source (150 mm Cover)	1 Sample per 50 m ³	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 1000 m 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.

9.1.1. PROCEDURE FOR PLACEMENT OF CHEMICALLY SUITABLE COVER SYSTEM

Private gardens need to be backfilled with 450mm chemically validated subsoil, with 150mm topsoil overlaying this.

Landscaped and POS areas need to be backfilled with 150mm chemically validated subsoil, with 150mm topsoil overlaying this.

Topsoil and subsoil is required to be confirmed as chemically suitable prior to placement.

The placement of clean material will be undertaken during the build phase works of the project.

The placement of the cover system and corresponding validation will be documented within the Garden Validation Letters (to be issued on completion of the contractor's works).

If natural drift deposits are encountered, excavation can cease here.

E3P will collect photographic evidence of the placement of 150mm of certified topsoil and 450mm of subsoil on completion of construction works. This element will also be checked by the Building Control Officer as part of the site completion prior to issuing of a CML certificate.

The garden validation procedure is detailed in Table 9.2.



TABLE 9.2 GARDEN VALIDATION PROCEEDURE

PROCEDURE	METHOD
Chemical Validation	Imported sub-soils and topsoil will need to be chemically analysed to confirm suitability for use with the proposed cover system prior to installation and completion of the private garden and landscaped areas. E3P will issue an email to the appropriate party with an assessment of the chemical suitability of both subsoils and topsoil. If acceptable the materials can be installed to the required depth at which time the plot will be deemed complete following a validation procedure by a suitability qualified E3P engineer.
Trial Holes	Trial holes are deemed necessary for all plots to confirm sufficient depth of cover system has been installed in all private garden and landscaped areas.
Validation	Photographic evidence will be taken by E3P of the subsoil and topsoil placement demonstrating the depth and practical completion of works are required for each and every plot.
Validation Certificate	Once the photographs of the placement of the cover system, E3P will issue a plot specific validation certificate to demonstrate that the required subsoil and topsoil has been placed in the required private garden and landscaped areas along with the chemical analysis.
Completion Report	Upon completion of all private garden and landscaped areas within the development, a Completion Report will be issued providing the confirmation that all remediation requirements have been achieved.



Plate 1 provides an example of a garden validation photographs that will be required for each plot.

PLATE 1 EXAMPLE PLOT COVER SYSTEM VALIDATION

Plot No: 4 (Car Park Landscaping)		
Depth of Strata (m bgl)	0.00-0.30	Validated TOPSOIL
Depth of Cover System Materials		Depth of Cover System Materials
		
Depth of Cover System at Ground Level and in Relation to Unit / Structure 		



9.2. GROUND GAS AND VAPOUR PROTECTION MEASURES

The ground gas monitoring is ongoing and the final assessment currently awaited.

As a precautionary measures, due to the landfill located within the site boundary and underlying coal measures, E3P recommend the site be classified as Characteristic Situation 2 / Amber 1 which will require specialist mitigation measures to be constructed in accordance with BS8485 (2015)+A1(2019).

This is to be assumed for any plots outside of the areas of potential vapour risk until completion of the further assessment and any post remediation gas monitoring.

The presence of volatile compounds within the Made Ground soils represents a long term risk associated with vapour ingress to future site dwellings, it is therefore required that selected dwellings be designed and constructed with specialist membranes that will ensure no ingress to the critical receptor.

Membranes will be installed by a qualified person who will be vetted and approved by the supervising environmental consultant with their details to be provided to the LPA within the verification report. The installer will prepare the pre-construction documentation and qualifications as detailed overleaf prior to commencement of any works.

All verification works will be completed by an environmental specialist with suitable experience or a person who has completed formal training by CL:AIRE for the installation of membranes to be protective of gas and vapour ingress to new dwellings. The verification process will be completed in accordance with the guidance as set out within CIRIA 735 and 748.

Specifically for vapour membranes, the verification process will ensure: compliance with the specific requirement in CIRIA 748:

FIGURE 9.1 – CIRIA 748 VERIFICATION REQUIREMENT

Verifier (consultant⁴ or third party qualified and experienced installer¹) to conduct thorough verification (visual) inspection of all plots, and after placement of reinforcement if no protection provided. All joints, pipe penetrations etc air lanced to ASTM D4437. Consideration given to need for/scope of integrity testing (eg initially on 30 to 50 per cent of plots then falling to 0 to 10 per cent of plots if acceptable results obtained and no concerns raised by visual inspections)³.

Details of both the installer and verifier for each dwelling will be recorded on a plot specific verification letter report to be provided to the LPA for approval.

Integrity testing will be completed by a qualified specialist on a ratio of one in three plots to be subject to testing across the complete development area where vapour membranes are deemed necessary.



Depending on the outcome of the ground gas risk assessment, the installation and verification process for vapour membranes will include the following key attributes.

1. Membrane to be installed by NVQ Level 2 installer;
2. Prior to commencement of any works, the specialist contractor will produce a detailed installation plan and method statement. CQA Procedures and qualifications for all parties involved in the construction process. This CQA and Verification plan will be subject to approval by the supervising consultant and will be included within the validation statement to be issued to the LPA;
3. Verification consultant will be deemed suitably competent, this will be either chartered status with suitable experience or formal training in CIRIA 735;
4. The first five and every third plot thereafter will be subject to air lancing integrity testing in accordance with an internationally recognised standard. The installer and integrity tester will provide the methodology for their works. The independent verifier will be in attendance during the integrity test works;
5. A detailed verification report will be prepared for each and every plot to be installed with a vapour membrane.

The validation inspection is to include the items that are detailed within Table 9.3.

TABLE 9.3 GROUND GAS MITIGATION MEASURES VALIDATION ITEMS

INSPECTION	METHOD
Product Verification	Confirmation that suitable products have been installed to consist of photographs of product types, labels on packaging and delivery tickets.
Wall Cavity Inspection	Confirmation that gas membrane spans the external wall cavity above the periscopic vents.
General Condition	The membrane is to be inspected to ensure there are no tears, punctures or rips.
Jointing	The engineer is to check the overlaps between membranes are correctly sealed with sufficient overlaps.
Service Entry Points	Verification of the presence of preformed tophats sealed to the pipe and membrane as per the construction detail.
Passive Venting Systems	The engineer should verify the presence of vents at 2m centres on at least 3 of the external walls. Verification of the stone venting layer and presence of pipes to be supplied by photographic records from site.

Examples of gas membrane verification photographs provided in Plate 2.

It should be noted that these are for illustrative purposes only as each site will have a site-specific gas membrane specification.



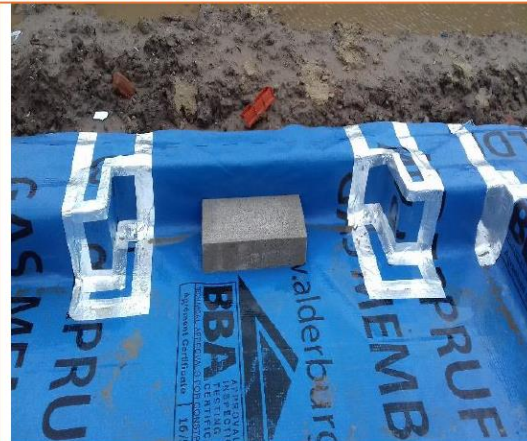
PLATE 2 EXAMPLE GAS MEMBRANE VERIFICATION

Plot – 236

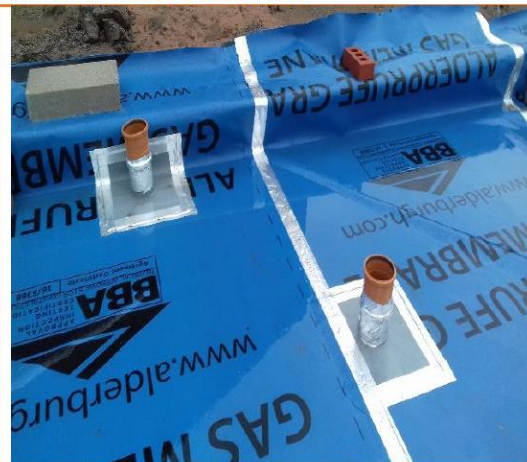
General Condition of Membrane-Good Condition



Verification of Joints and Seals-Good Condition



Verification of Service Penetrations-Good Condition



9.3. POTABLE WATER SUPPLY – CONTAMINANT ASSESSMENT CRITERIA

Table 9.4 (below) provides a summary of the threshold concentrations that must not be exceeded within remediated ground at pipeline depth in order to PE pipe works to be acceptable for the proposed development.

TABLE 9.4 PIPELINE SELECTION PE THRESHOLD CONCENTRATIONS

Contaminant Group	PE-threshold
Total VOC	0.5
Total BTEX And MTBE	0.1
Total SVOCs (Excluding PAH and those substances marked with an *)	2
EC5-EC10 Aliphatic and Aromatic Hydrocarbons	2
EC10-EC16- Aliphatic and Aromatic Hydrocarbons	10
EC16-EC40 Aliphatic and Aromatic Hydrocarbons	500
Phenols (From SVOC Analysis)*	2
Cresols and Chlorinated Phenols (From SVOC Analysis)	2
Ethers*	0.5
Nitrobenzene*	0.5
Ketones*	0.5
Aldehydes*	0.5
Amines	Fail

Upon completion of the remedial works a full UKWIR Risk Assessment should be undertaken.

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

ACM	Asbestos-containing material	MMP	Materials management plan
ADS	Acoustic design statement	ND	Not detected
AST	Above-ground storage tank	NDP	Nuclear density probe
BGS	British Geological Survey	NMP	Noise management plan
BSI	British Standards Institute	NPSE	Noise policy statement for England
BTEX	Benzene, toluene, ethylbenzene, xylenes	NR	Not recorded
CA	Coal Authority	PAH	Polycyclic aromatic hydrocarbon
CBR	California bearing ratio	PCB	Polychlorinated biphenyl
CIEH	Chartered Institute of Environmental Health	PI	Plasticity index
CIRIA	Construction Industry Research Association	PID	Photo ionisation detector
CLEA	Contaminated land exposure assessment	POS	Public open space
CML	Council of Mortgage Lenders	PPE	Personnel protective equipment
CoC	Contaminants of concern	ProPG	Professional practice guidance
CSM	Conceptual site model	QA	Quality assurance
DNAPL	Dense non-aqueous phase liquid (chlorinated solvents, PCB)	SGV	Soil guideline value
DWS	Drinking water standard	SPH	Separate-phase hydrocarbon
EA	Environment Agency	SPT	Standard penetration test
EQS	Environmental quality standard	SVOC	Semi-volatile organic compound
FFL	Finished floor level	TPH	Total and speciated petroleum hydrocarbon
GAC	General assessment criteria	TPH CWG	Total Petroleum Hydrocarbon (Criteria Working Group)
GL	Ground level	UKWIR	United Kingdom Water Infrastructure Risk
GSV	Gas screening value	UST	Underground storage tank
HCV	Health criteria value	VCC	Vibro-concrete column
ICSM	Initial conceptual site model	VOC	Volatile organic compound



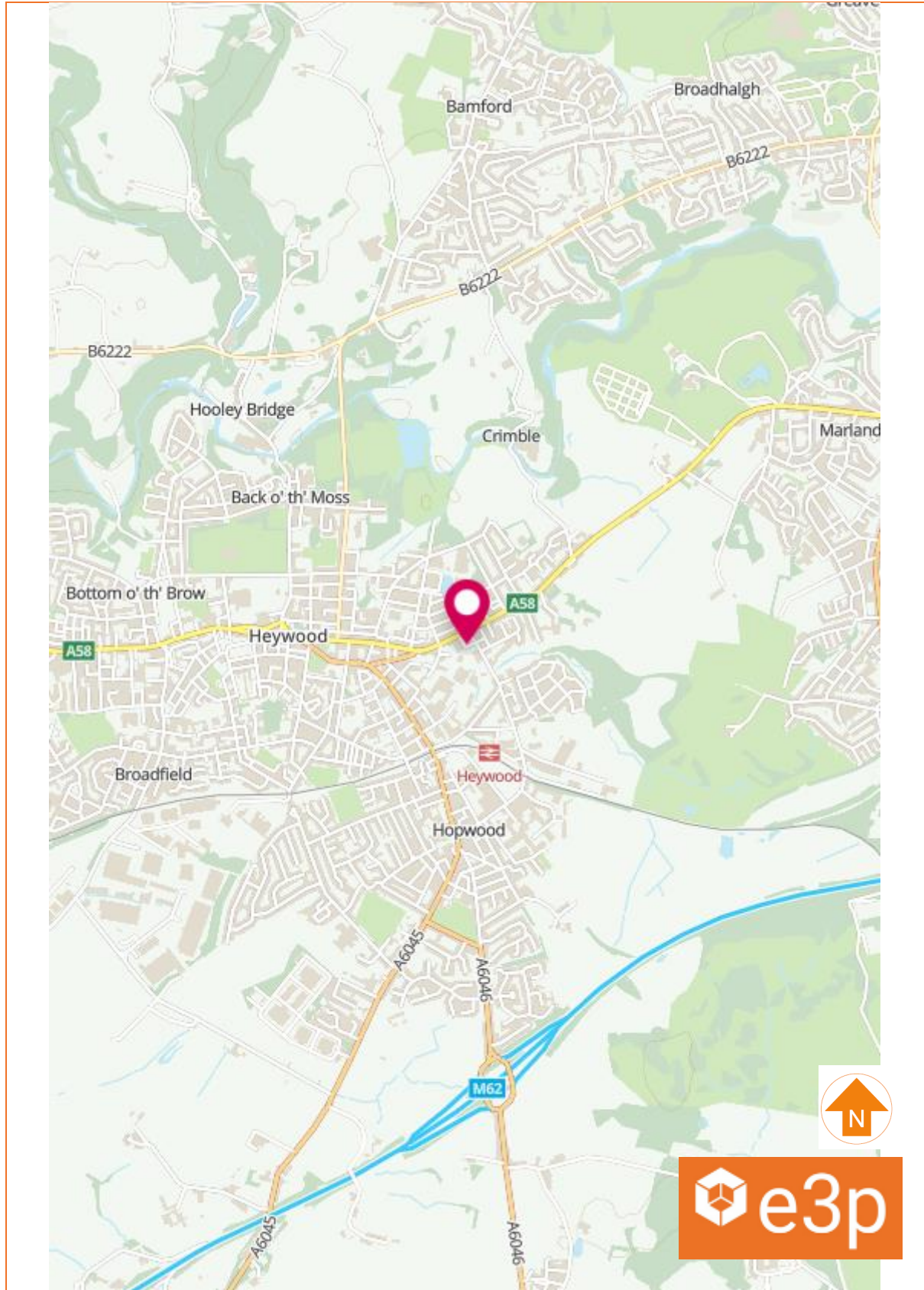
LEL	Lower explosive limit	VRSC	Vibro-replacement stone columns
LMRL	Lower method reporting limit	VSC	Vibro-stone columns
LNAPL	Light non-aqueous phase liquid (petrol, diesel, kerosene)	WHO	World Health Organisation
MCV	Moisture condition value	WRAP	Waste and Resources Action Programme
MIBK	Methyl isobutyl ketone	WTE	Water table elevation
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	kN/m²	Kilonewtons per metre squared
ppb	Parts per billion	µm	Micrometre
mg/kg	Milligrams per kilogram (parts per million)	SSRT	Site Specific Remediation Target
PSD	Particle Size Distribution	DD	Dry Density
CL:AIRE	Contaminated Land: Applications in Real Environments	Mc	Moisture Content
ρ	Bulk Density	GPR	Ground Penetrating Radar
NDP	Nuclear Density Probe	FFL	Finished Floor Level
LEL	Lower Explosive Limit	UKWIR	UK Water Industry Research
CIRIA	Construction Industry Research and Information Association	LOD	Limit of Detection

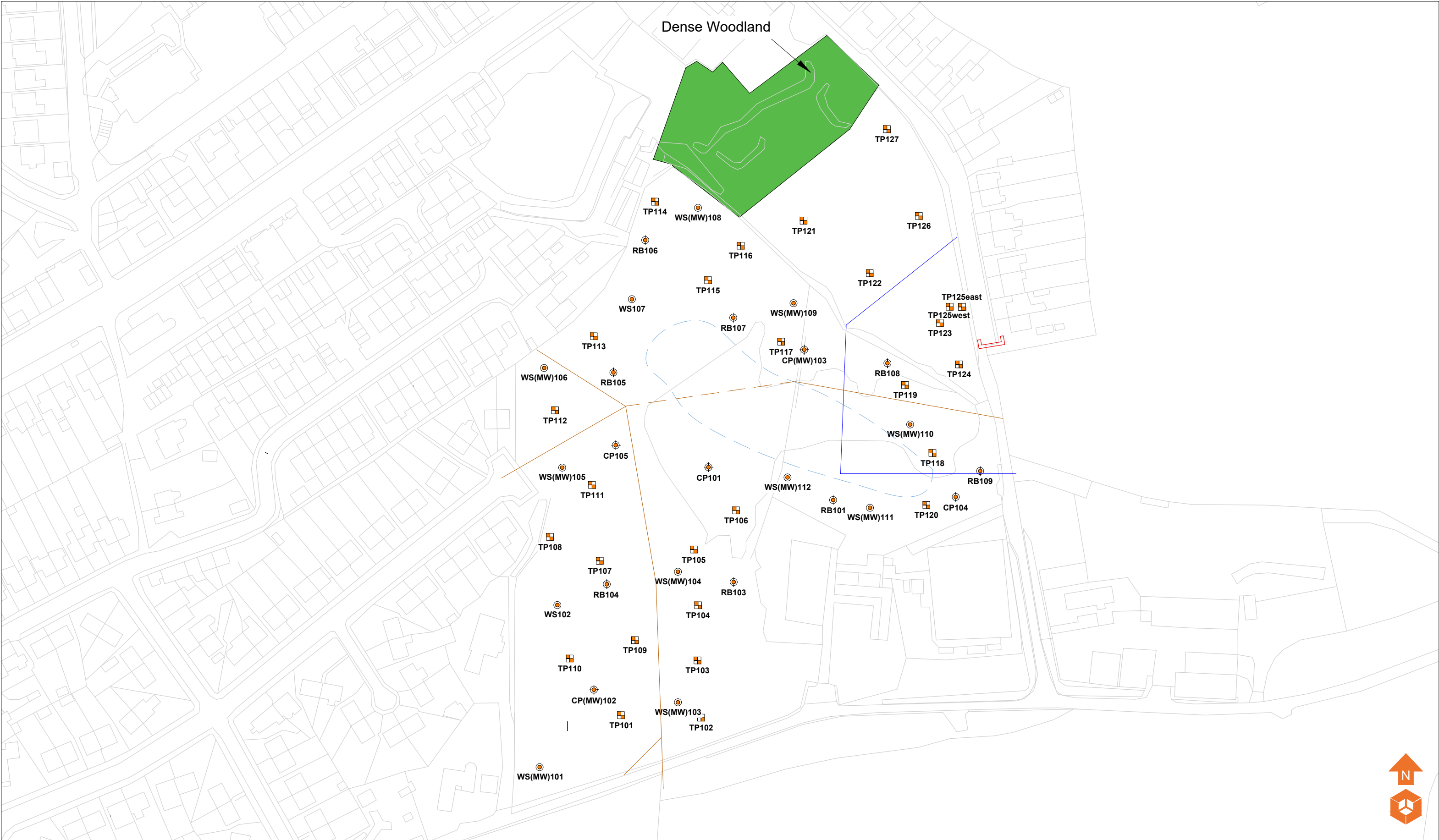


APPENDIX III

DRAWINGS

DRAWING 16-218-001 – SITE LOCATION PLAN





Location Symbols Approximate Window Sample Probehole Location Approximate Trial Pit Location Approximate Cable Percussive Borehole Location Approximate Rotary Borehole Location BT/Telecoms Drains <td> Notes: </td> <td> Client: Russell Homes </td> <td> Job No: 15-075 </td> <td> Date: 03.03.2023 </td> <td rowspan="4"> Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk </td>	Notes:	Client: Russell Homes	Job No: 15-075	Date: 03.03.2023	Environmental Engineering Partnership Ltd Taylor Road, Trafford Park Urmston, Manchester, M41 7JQ Tel: 0161 707 9612 E-mail: info@e3p.co.uk Website: www.e3p.co.uk																													
			Drawing No: 005	Scale: NTS@ A3																														
			Job Title: Land to the West of New Street	Drawing Title: Exploratory Hole Location Plan		The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.																												
	<table><tr><td>P1</td><td>REVE</td><td>03.03.2023</td><td>LM</td><td>AS</td></tr><tr><td>P1</td><td>REVD</td><td>12.12.2022</td><td>OW</td><td>AR</td></tr><tr><td>P1</td><td>REVC</td><td>16.11.2022</td><td>OW</td><td>AR</td></tr><tr><td>P1</td><td>REVB</td><td>03.11.2022</td><td>OW</td><td>EF</td></tr><tr><td>P1</td><td>REVA</td><td>29.09.2022</td><td>EB</td><td>MD</td></tr><tr><td>Phase</td><td>Issue</td><td>Date</td><td>Drawn</td><td>Checked</td></tr></table>	P1	REVE	03.03.2023			LM	AS	P1	REVD	12.12.2022	OW	AR	P1	REVC	16.11.2022	OW	AR	P1	REVB	03.11.2022	OW	EF	P1	REVA	29.09.2022	EB	MD	Phase	Issue	Date	Drawn	Checked	
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P1	REVB	03.11.2022	OW	EF																														
P1	REVA	29.09.2022	EB	MD																														
Phase	Issue	Date	Drawn	Checked																														



Location Symbols		Development Constraints	
	Approximate Window Sample Probehole Location		Made Ground
	Approximate Trial Pit Location		Peat
	Approximate Cable Percussive Borehole Location		Soft Clay
	Approximate Rotary Borehole Location		Loose Gravel/Sand
	BT/Telecoms		Soft Silt
	Drains		

Notes:				
P1	REVA	12.12.2022	OW	AR
Phase	Issue	Date	Drawn	Checked

Client:	
Russell Homes	
Job Title:	
Land to the West of New Street	

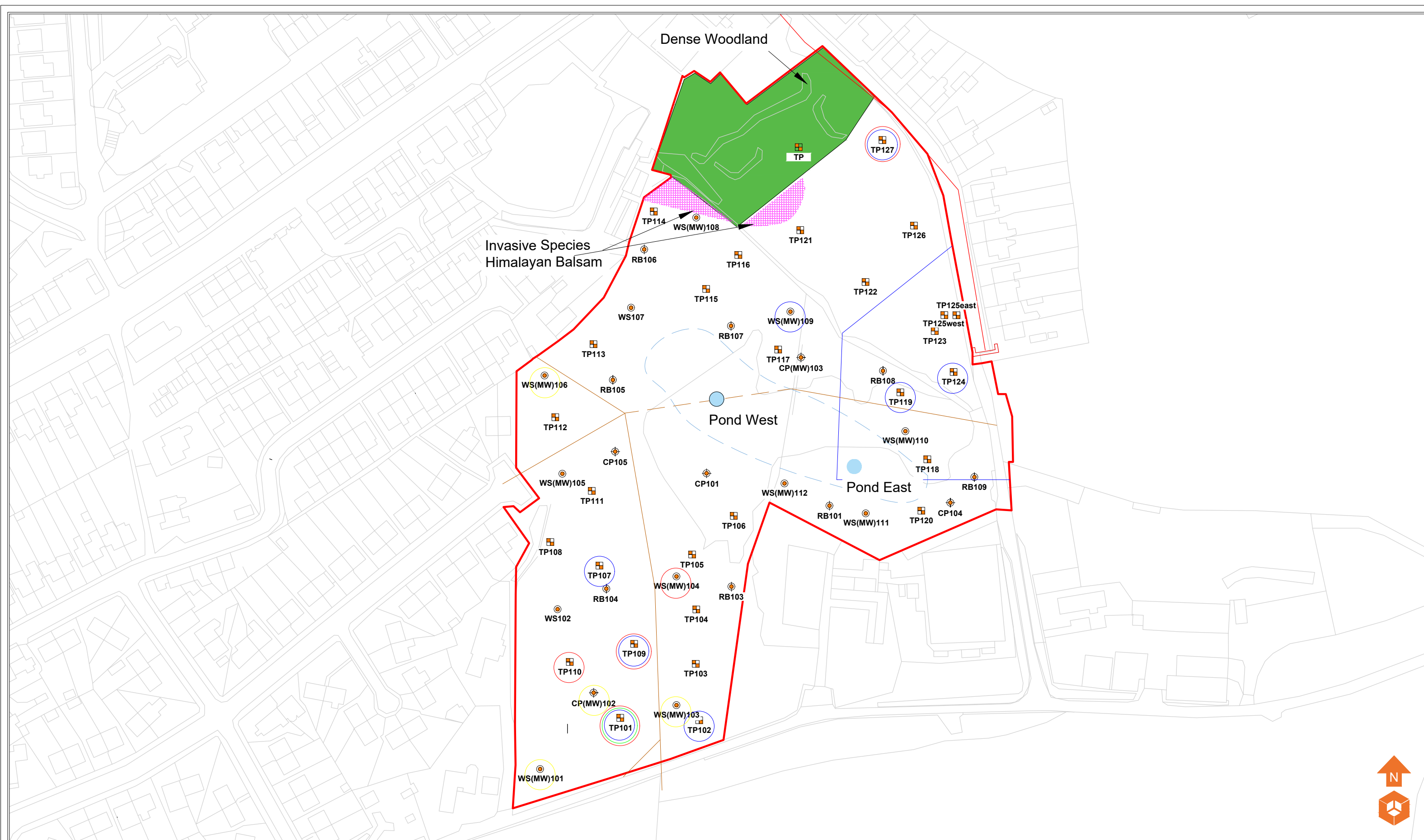
Job No:	
15-075	
Drawing No:	
015	

Date:	
12.12.2022	
Scale:	
NTS@ A3	



Environmental Engineering Partnership Ltd
Taylor Road, Trafford Park
Urmston, Manchester, M41 7JQ
Tel: 0161 707 9612
E-mail: info@e3p.co.uk
Website: www.e3p.co.uk

The client must not amend any drawing, design or other intellectual property produced by E3P Ltd without permission in writing from E3P Ltd in advance of any amendments being made. In the event that such written permission is not obtained in advance of the amendments being made, E3P Ltd shall not be liable for any damage and/or losses occurring as a result of the amended drawing, design or intellectual property.



Location Symbols		Soil	
	Approximate Window Sample Probehole Location		Elevated PAHs
	Approximate Trial Pit Location		Elevated TPHs
	Approximate Cable Percussive Borehole Location		Asbestos (<0.001%)
	Approximate Rotary Borehole Location	Leachate	
	BT/Telecoms		Elevated Heavy Metals
	Drains	Groundwater	
			Elevated Heavy Metals
		Surface Water-Pond	
			Elevated Heavy Metals

Notes:				
P1	REVA	12.12.2022	OW	AR
Phase	Issue	Date	Drawn	Checked

Client:
Russell Homes
Job Title:
Land to the West of New Street

Job No:
15-075
Drawing No:
018

Date:
12.12.2022
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APPENDIX IV E3P REMEDIATION/ VALIDATION CRITERIA

HUMAN HEALTH REMEDIATION TARGETS – LOW-RISE RESIDENTIAL END USE

DETERMINAND	UNITS	WITHIN 600 mm COVER SYSTEM (GARDEN)	HARD STANDING AND >600 mm OF COVER	PUBLIC OPEN SPACE 300 mm COVER	PUBLIC OPEN SPACE > 300 mm	PATH- WAY
Arsenic	mg/kg	37 ⁽ⁱ⁾	40 ⁽ⁱⁱ⁾	79 ⁽ⁱⁱⁱ⁾	170 ^(iv)	1
Cadmium	mg/kg	11 ⁽ⁱ⁾	85 ⁽ⁱⁱ⁾	120 ⁽ⁱⁱⁱ⁾	532 ^(iv)	1
Chromium (Hexavalent)	mg/kg	6 ⁽ⁱ⁾	6 ⁽ⁱⁱ⁾	7.7 ⁽ⁱⁱⁱ⁾	220 ^(iv)	1
Lead	mg/kg	200 ^(vi)	310 ^(vii)	630 ^(viii)	1300 ^(viii)	1
Elemental Mercury	mg/kg	1.2 ⁽ⁱ⁾	1.2 ⁽ⁱⁱ⁾	16 ⁽ⁱⁱⁱ⁾	30 ^(iv)	2
Nickel	mg/kg	130 ⁽ⁱ⁾	180 ⁽ⁱⁱ⁾	230 ⁽ⁱⁱⁱ⁾	800 ^(iv)	1
Selenium	mg/kg	250 ⁽ⁱ⁾	430 ⁽ⁱⁱ⁾	1100 ⁽ⁱⁱⁱ⁾	1800 ^(iv)	1
Copper	mg/kg	2400 ⁽ⁱ⁾	7100 ⁽ⁱⁱ⁾	12,000 ⁽ⁱⁱⁱ⁾	44,000 ^(iv)	1
Zinc	mg/kg	3700 ⁽ⁱ⁾	40,000 ⁽ⁱⁱ⁾	81,000 ⁽ⁱⁱⁱ⁾	170,000 ^(iv)	1
Phenol	mg/kg	120 ^{(i)(xi)}	440 ^{(xiv)(xi)}	440 ^{(iii)(xi)}	440 ^{(iv)(xi)}	2
Naphthalene	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)	15,000 ^{(iii)(xi)}	29,000 ^{(iv)(xi)}	3
Acenaphthene	mg/kg	210 ^{(i)(xi)}	500 ^(v)	15,000 ^{(iii)(xi)}	29,000 ^{(iv)(xi)}	1
Fluorene	mg/kg	170 ^{(i)(xi)}	500 ^(v)	9900 ^{(iii)(xi)}	20,000 ^{(iv)(xi)}	1
Phenanthrene	mg/kg	95 ^{(i)(xi)}	500 ^(v)	3100 ^{(iii)(xi)}	6200 ^{(iv)(xi)}	3
Anthracene	mg/kg	500 ^{(i)(xi)}	500 ^(v)	74,000 ^{(iii)(xi)}	150,000 ^{(iv)(xi)}	3
Fluoranthene	mg/kg	280 ^{(i)(xi)}	500 ^(v)	3100 ^{(iii)(xi)}	6300 ^{(iv)(xi)}	3
Pyrene	mg/kg	500 ^{(i)(xi)}	500 ^(v)	7400 ^{(iii)(xi)}	15,000 ^{(iv)(xi)}	3
Benzo(a)Anthracene	mg/kg	7.2 ^{(i)(xi)}	11 ^{(ii)(xi)}	29 ^{(iii)(xi)}	49 ^{(iv)(xi)}	3
Chrysene	mg/kg	15 ^{(i)(xi)}	30 ^{(ii)(xi)}	57 ^{(iii)(xi)}	93 ^{(iv)(xi)}	3
Benzo(b)Fluoranthene	mg/kg	2.6 ^{(i)(xi)}	3.9 ^{(ii)(xi)}	7.1 ^{(iii)(xi)}	13 ^{(iv)(xi)}	3
Benzo(k)Fluoranthene	mg/kg	77 ^{(i)(xi)}	110 ^{(ii)(xi)}	190 ^{(iii)(xi)}	370 ^{(iv)(xi)}	3
Benzo(a)Pyrene	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)}	45 ^{(ii)(xi)}	82 ^{(iii)(xi)}	150 ^{(iv)(xi)}	3
Dibenzo(a,h)Anthracene	mg/kg	0.24 ^{(i)(xi)}	0.31 ^{(ii)(xi)}	0.57 ^{(iii)(xi)}	1.1 ^{(iv)(xi)}	3
Benzo(ghi)Perylene	mg/kg	320 ^{(i)(xi)}	360 ^{(ii)(xi)}	640 ^{(iii)(xi)}	1400 ^{(iv)(xi)}	3
TPH C ₅ -C ₆ (aliphatic)	mg/kg	42 ^{(i)(xi)}	42 ^{(ii)(xi)}	42 ^{(iii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₆ -C ₈ (aliphatic)	mg/kg	100 ^{(i)(xi)}	100 ^{(ii)(xi)}	100 ^{(iii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₈ -C ₁₀ (aliphatic)	mg/kg	27 ^{(i)(xi)}	27 ^{(ii)(xi)}	27 ^{(iii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₀ -C ₁₂ (aliphatic)	mg/kg	130 ^{(i)(xi)}	130 ^{(ii)(xi)}	130 ^{(iii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₂ -C ₁₆ (aliphatic)	mg/kg	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	10,000 ^{(xiv)(xi)}	2



New Street, Littleborough (Phase 3)
Remediation and Enabling Works Strategy
March 2023

TPH C₁₆-C₂₁ (aliphatic)	mg/kg	1000 ^(xiv) (xi)	1000 ^(xiv) (xi)	1000 ^(xiv) (xi)	10,000 ^(xiv) (xi)	1
TPH C₂₁-C₃₅ (aliphatic)	mg/kg					1
TPH C₅-C₇ (aromatic)	mg/kg	70 ⁽ⁱ⁾ (xi)	370 ⁽ⁱⁱ⁾ (xi)	370 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	2
TPH C₇-C₈ (aromatic)	mg/kg	130 ⁽ⁱ⁾ (xi)	860 ⁽ⁱⁱ⁾ (xi)	860 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	2
TPH C₈-C₁₀ (aromatic)	mg/kg	34 ⁽ⁱ⁾ (xi)	47 ⁽ⁱⁱ⁾ (xi)	47 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	2
TPH C₁₀-C₁₂ (aromatic)	mg/kg	74 ⁽ⁱ⁾ (xi)	250 ⁽ⁱⁱ⁾ (xi)	250 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	2
TPH C₁₂-C₁₆ (aromatic)	mg/kg	140 ⁽ⁱ⁾ (xi)	1800 ⁽ⁱⁱ⁾ (xi)	1800 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	1
TPH C₁₆-C₂₁ (aromatic)	mg/kg	260 ⁽ⁱ⁾ (xi)	1900 ⁽ⁱⁱ⁾ (xi)	1900 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	1
TPH C₂₁-C₃₅ (aromatic)	mg/kg	1000 ^(xiv) (xi)	1900 ⁽ⁱⁱ⁾ (xi)	1900 ⁽ⁱⁱ⁾ (xi)	10,000 ^(xiv) (xi)	1
Asbestos	Fibres Volume Weight (%)	NFD	0.001%	NFD	0.001	4

Notes 1

NFD = No Fibres Detected

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).

Notes 2

Excludes matrices where free product is observed.

No viable exposure pathway beneath hardstanding and cover system.

Notes 3

Main exposure pathways: 1 = soil ingestion, 2 = vapour inhalation (indoor), 3 = dermal contact and ingestion, 4 = dust inhalation.

Abbreviations: GAC = general assessment criteria, n = number of samples, MC = maximum concentration, N/A = Not Applicable (no exceedance of assessment criteria), Loc of MC = location of exceedances.

- i. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use with plant uptake.
- ii. Value derived from LQM Sutable 4 Use Levels (S4ULs) for residential end use without plant uptake – these levels used below 600 mm 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 Sutable 4 Use Levels (S4ULs) for public open space (POS) residential.
- iv. Value derived from LQM Sutable 4 Use Levels (S4ULs) for public open space (POS) park – these levels used below 300 mm 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 Sutable 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 2600 mg/kg, m-xylene 3500 mg/kg) and is capped by its solubility.
- xiii. Value derived from LQM Sutable 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 GROUNDWATER / LEACHATE ANALYSIS WITH TIER 1 SCREENING LEVELS

DETERMINAND	UNIT	EQS SCREENING VALUE ^{1, 2, 3}		DWS ^{3,4,5}
		AA	MAC	
Arsenic	µg/l	50	–	10
Cadmium	µg/l	0.08-0.25	0.45-1.5	5
Chromium (VI)	µg/l	3.4	–	–
Chromium (III)	µg/l	4.7	–	50
Copper	µg/l	1	–	2000
Total Cyanide	µg/l	1	–	50
Lead	µg/l	1.2	14	10
Mercury	µg/l	–	0.07	1.0
Nickel	µg/l	4	34	20
Selenium	µg/l	–	–	10
Zinc	µg/l	10.9	–	–
pH		6–9		
Naphthalene	µg/l	2	130	10*
Anthracene	µg/l	0.1	0.1	
Benzo[b]fluoranthene	µg/l	0.00017*	0.017	
Benzo[k]fluoranthene	µg/l	0.00017*	0.017	
Benzo(a)pyrene	µg/l	0.00017*	0.27	
Indeno(123-cd)pyrene	µg/l	0.00017*	5*	
Benzo(ghi)pyrene	µg/l	0.00017*	5*	
Fluoranthene	µg/l	0.0063	0.12	
Benzo(ghi)perylene	µg/l	1.7–4	8.2–3	1
TPH C5-C6 (benzene)	µg/l	10	50	
TPH C6-C8 (toluene)	µg/l	74	–	
TPH C8-C10 (ethyl benzene)	µg/l	20	–	
TPH C10-C12 (xylene)	µg/l	30	–	
TPH C12-C16	µg/l	2	130	
TPH C16-C35	µg/l	50#	50#	
TPH C5-C6	µg/l	–	–	
TPH C6-C8	µg/l	–	–	
TPH C8-C10	µg/l	–	–	300
TPH C10-C12	µg/l	–	–	300



New Street, Littleborough (Phase 3)
Remediation and Enabling Works Strategy
March 2023

DETERMINAND	UNIT	EQS SCREENING VALUE ^{1, 2, 3}		DWS ^{3,4,5}
		AA	MAC	
TPH C12-C16	µg/l	–	–	300
TPH C16 – C21	µg/l	–	–	300**
TPH C21-C35	µg/l	–	–	300**

Notes

Solubility <0.01µg/l

AA – Annual Average

MAC- Maximum Admissible Concentration

* Polyaromatic hydrocarbons (PAH) - Benzo(a)pyrene (BaP), Benzo(b)fluoranthene, Benzo(k)fluoranthene, Benzo(g,h,i)-perylene and Indeno(1,2,3-cd)-pyrene. Benzo(a)pyrene can be considered as a marker for the other PAHs, hence only benzo(a)pyrene needs to be monitored for comparison with the biota EQS or the corresponding AA-EQS in water

** There are no WHO Guideline Values for aliphatic fractions C16-C21 and C21-C35, therefore the guideline value for aliphatic fractions inclusive of C8-C16 (300µg/l) has been applied.

1. The Water Environment (Water Framework Directive) (England and Wales) (Amendment) Regulations (2015)
2. Directive establishing a framework for Community action in the field of water policy (Water Framework Directive)
3. Council Directive on pollution caused by certain dangerous substances discharged into the aquatic environment of the Community (Dangerous Substances Directive) - List II substances
4. Council Directive on the quality of water intended for human consumption (Drinking Water Directive)
5. WHO Guidelines for Drinking Water Quality. Third edition (2004)



APPENDIX V

E3P MATERIAL IMPORT CRITERIA

SITE OF IMPORTATION ADDRESS		E3P +44 (0) 161 707 9612 info@e3p.co.uk 
Client		
Main Contractor		
Earthworks Contractor		
Haulier		
Date of Planned Import		
Overview of Planned Material Import		
Material Source (Site of Origin) and Postcode		
Site Investigation Report	Report Title and Reference: Date: Information Supplied By:	
Reason for Generation of Excess Material at Site of Origin		
Chemical Test Results for Stockpile at Site of Origin	Date: Laboratory Certificate Ref: Organisation Responsible for Stockpile Sampling:	
Geotechnical Material Classification and Testing	Delete as Appropriate: Class 1 / Class 2 / Class 6 / Topsoil	
Pictures of Material Stockpile Pending Transportation	Delete as Appropriate: Yes / No	
Person or Organisation Responsible for Ensuring Quality Control at Site of Origin		
Quantity of Material to Be Imported (m³)		
Proposed Area of Deposition (Site of Reuse)		
Waste Exemption/Permit or CL:AIRE MMP		Delete as Appropriate: U1 Standard Rules / CL:AIRE MMP (Direct Transfer) / Bespoke



APPENDIX VI CONTRACTOR PRE- COMMENCEMENT CHECK SHEET

GEOTECHNICAL ENABLING WORKS PRE-START FORM

Prior to the commencement of any site remediation or enabling works, this form will be completed by E3P, in the presence of the appointed contractor, to ensure that all pertinent remediation and enabling works activities are fully discussed and understood.

Activity	Testing Responsibility	Contractors Method Statement Required (Y/N)	Comment/Action
Deployment of Environmental Permit			Ref No:
Deployment of LAPC Part B – Mobile Plant Permit			Ref No:
CL:AIRE MMP and Qualified Person Declaration			Ref No:
Identification of All Invasive Plant Species and Production of Eradication Plan with Appropriate Supervision by Specialist			Appointed specialist:
Removal of All Vegetation			Note disposal location:
Removal of All Root Bulbs and Root Networks			Note disposal location:
Identification of Contamination Hotspots, Removal of Material and Stockpile			Rationale:
Legislatively Compliant Procedure to Deal with Contamination Excavated from Hotspot			Rationale:
Processing and Recycling of Aggregate with Geotechnical and Chemical Validation Testing			Note stockpile location and anticipated volume:
Stockpiling of Subsoil and Certification of Suitability for Reuse			Stockpile location:
Decommission of All Redundant Drainage Infrastructure			
Decommission of All Former Interceptors			
Decommission of All Former Above- and Below-Ground Tanks			
Removal of All Asbestos to a Licensed Facility			
Engineering of Plots for Shallow Spread Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers



Activity	Testing Responsibility	Contractors Method Statement Required (Y/N)	Comment/Action
Engineering of Plots for VSC in Accordance with E3P Geotechnical Specification			Plot Numbers.
Engineering of Plots for Pile Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers
Engineering of Plots for Raft Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers
Stockpiling of Topsoil and Certification of Suitability for Reuse			Stockpile location
Engineering of Highways Bulk Upfill in Accordance with E3P Specification with Compliant Validation Testing			Upfill specification
Engineering of Highways Subgrade in Accordance with E3P Specification with Compliant Validation Testing			Upfill specification
Engineering of Highways Capping in Accordance with E3P Specification with Compliant Validation Testing			Upfill specification
Cut-and-Fill the Development Site to Clients' Required Elevation with As-Built Survey			Required formation elevations



APPENDIX VII CONTRACTOR COMPLETION CHECK SHEET

GEOTECHNICAL ENABLING WORKS COMPLETION FORM

Upon completion of all site remediation and enabling works, this form will be completed by E3P, in the presence of the appointed contractor, to ensure that all pertinent geotechnical enabling works activities are complete or, where a deviation from the specification has occurred, all future limitations and issues are documented for the client's records.

Activity	Complete			Signature
	Yes	No	N/A	(initial)
Eradication of all invasive plant species				
Removal of all vegetation				
Removal of all root bulbs and root networks				
Stockpiling of topsoil and certification of suitability for reuse				
Stockpiling of subsoil and certification of suitability for reuse				
Stockpile all recycled aggregate with geotechnical and chemical validation testing				
Removal of all relict foundations and infrastructure in their entirety				
Decommission of all redundant drainage infrastructure				
Decommission of all former interceptors				
Decommission of all former above- and below-ground tanks				
Removal of all waste materials to a licensed facility				
Removal of all asbestos to a licensed facility				
Engineering of all plots for shallow spread foundation in accordance with E3P Geotechnical Specification				
Engineering of all plots for VSC in accordance with E3P Geotechnical Specification				
Engineering of all plots for pile foundation in accordance with E3P Geotechnical Specification				
Engineering of all plots for raft foundation in accordance with E3P Geotechnical Specification				
Engineering of highways bulk upfill in accordance with E3P Specification with compliant validation testing				
Engineering of highways subgrade in accordance with E3P Specification with compliant validation testing				
Engineering of highways capping in accordance with E3P Specification with compliant validation testing				
Cut-and-fill the development site to client's required elevation with as-built survey				



POST-REMEDIATION AND ENABLING LIMITATIONS

All and every deviation from the approved specification for works should be documented by the remediation and enabling works contractor below.



¹ Only required where processed materials are placed within 500mm of concrete/cement bound/other cementitious material or permanent metallic structures.