



e3p

Remediation and Enabling Works Strategy
Cherryfield Drive, Kirkby

Reference: 15-280-R2-3
Date: October 2024



REMEDIATION AND ENABLING WORKS STRATEGY

Cherryfield Drive
Kirkby
Liverpool
L32 8RX

Prepared for:
Barratt and David Wilson Homes

Report Ref: 15-280-R2-4
Date Issued: October 2024



E3P

Taylor Road
Trafford Park
Urmston
Manchester
M41 7JQ

+ 44 (0) 161 707 9612
<https://e3p.co.uk>

Registered in England
CRN: 08725262

QUALITY ASSURANCE

PROJECT NUMBER		15-280		
VERSION	Version 1	Version 2	Version 3	Version 4
REMARKS	Final	Updated proposed layout.	Updated with supplementary site investigation in North Western parcel	EHO Comments dated September 2024
DATE	26 April 2022	December 2022	May 2024	October 2024
PREPARED BY	R. Hodnett	R. Hodnett	I.Diack	P Winstanley
QUALIFICATIONS	BSc (Hons), FGS, MEnvSc	BSc (Hons), FGS, MEnvSc	BSc (Hons), FGS.	MGeol (Hons), FGS, MEnvSc
CHECKED BY	M. Dyer	M. Dyer	R. Hodnett	R. Walker
QUALIFICATIONS	BSc, FGS, AIEMA, AMIES CEnv	BSc, FGS, AIEMA, AMIES CEnv	BSc (Hons), FGS, MEnvSc, CEnv	BSc(Hons), FGS, AIEMA, AMICE, MEnvSc, CEnv
AUTHORISED BY	M. Dyer	M. Dyer	M. Dyer	R. Walker
QUALIFICATIONS	BSc, FGS, AIEMA, AMIES CEnv	BSc, FGS, AIEMA, AMIES CEnv	BSc, FGS, AIEMA, AMIES CEnv	BSc(Hons), FGS, AIEMA, AMICE, MEnvSc, CEnv



EXECUTIVE SUMMARY

Site Address	Cherryfield Drive, Kirkby, Liverpool, L32 8RX
National Grid Reference	E 341100 N 398150
Site Area	22.51 Ha
Background	E3P has been instructed by Barrett and David Wilson Homes to develop a remediation and enabling works strategy for the proposed residential development at the site located south of Cherryfield Drive, Kirkby. 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 on behalf of Barrett and David Wilson Homes.

CONTAMINATED LAND RISK ASSESSMENT

Human Health Risk Assessment	Elevated concentrations of heavy metals, mercury, non-volatile PAHs, naphthalene, asbestos and SVOCs have been identified within the soil analysis completed to date. Heavy metals and non-volatile PAHs are considered to pose a risk to future end-users through dermal contact and ingestion. The risk can be mitigated through the installation of a cover system within garden and landscaping areas. Mercury, naphthalene and Dibutyl phthalate have been noted to be elevated in isolated locations across the site, and present a vapour risk to future end-users. It is recommended that a hotspot removal is completed and the materials either placed in an area of low sensitivity or removed from the site. Within the soil analysis, no elevated concentrations of TPH or BTEX in the area of the former petrol filling station were identified to date. A hydrocarbon odour was identified within WS142 in this vicinity within SAND deposits underlying Made Ground. The tanks are understood to still be in-situ and the presence of contamination cannot be ruled out at this stage. An exceedance of Total Petroleum Hydrocarbons C21 – C35 Aromatic hydrocarbons, in conjunction with visual and olfactory observations relating to hydrocarbon impact, have been encountered within the Made Ground deposits in TP202 and surrounding exploratory locations in the northwestern parcel of the site. It is recommended that a watching brief is completed during earthworks in this location, with delineation and further sampling to determine the extent of impact present at this location. Asbestos, quantified between <0.001% and 0.009%, has been identified within locations at the site. ACM-impacted soils and Made Ground will need to be placed in accordance with the asbestos conceptual site model with a suitable cover system placed in all garden and landscaped areas to prevent exposure to future site users. A hotspot removal should be completed in areas in which asbestos quantification is greater than 0.001%.
-------------------------------------	--



Controlled Waters Risk Assessment	The assessment prepared in consideration of the developed CSM has not identified any potentially complete pollutant linkage or risk to controlled waters. Elevated TPHs against EQS screening values were identified in groundwater samples from WS142 in close proximity to the former petrol filling station, however, concentrations did not exceed the DWS screening value in relation to the underlying principal aquifer which is considered to be the primary receptor in this instance. Elevated TPHs (C12-C16) were also found within WS202, exceeding the EQS threshold, but similarly, they did not exceed the DWS threshold. Therefore, the overall risk posed is reduced.
Ground Gas	Ground gas monitoring has characterised the majority of the site as CS1, with areas of deep Made Ground and noted areas adjacent to the landfill adhering to a CS2 classification. Migration from the adjacent landfill has been identified, however a minimal flow has been recorded in the monitoring wells surrounding it, and therefore it is likely that the lateral migration of ground gases from the landfill is limited. As the landfill is uncapped, the majority of gases encapsulated within the landfill will be released to the atmosphere, however lows in barometric pressure may cause a swelling of the ground gas encroaching onto the site. It is recommended that CS2 measures are included within all plots within 75 m of the adjacent landfill. High methane concentrations have been identified within WS201 to the northwest of site, likely associated with a combination of encountered hydrocarbons in this area as well as the adjacent landfill to the south. Following suggested further investigation of the area, precautions may be increased or reduced based upon findings. It is considered that a ground gas zoning plan is created for the site based on the sources identified, where precautionary CS2 protection measures are to be included within all of these areas. Ground gas mitigation design report required to define construction and verification requirements.
Coal Mining and Historical Workings	The site is not considered to be at risk from mining or quarrying-related issues.
Invasive Plants	Invasive species have not been identified on-site to date.
Potable Water Supply	The site investigation and contaminant risk assessment identified elevated concentrations of potentially volatile hydrocarbon compounds, which could permeate into the potable supply infrastructure. It will therefore be necessary to undertake appropriate remediation works with robust validation tests or PE Barrier Pipe will be required for the proposed development.



GEOTECHNICAL ASSESSMENT

Relict Sub-Structures	Extensive relict substructures, infrastructure and materials deemed geotechnically deleterious are identified. 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. A defined area of historical deposition of incinerated materials from the late 1950s and early 1960s is present across the central and northern sectors of the site. The materials will need to be lifted, sorted and replaced in accordance with the specified engineering methodology to ensure unsuitable anthropogenic elements are removed in their entirety.
Proposed Foundations	A site wide process of remediation and enabling works will be required, to lift, sort and process the Made Ground in order to remove unacceptable material (timber, glass, plastic wood and organic materials) and process relict obstructions within the former development areas to create a suitable redevelopment platform. Within the historical deposition areas, pockets of Made Ground which are found to contain any putrescible content which will degrade and induce consolidation and potential subsidence at the surface will be unsuitable for retention and reuse within the context of a residential development and will therefore require removal as it is not possible to model or predict the potential for future consolidation, therefore such material cannot remain beneath areas of adopted highway, drives, garden or service infrastructure. It is likely that due to the gas generation potential of this material it will not be suitable beneath plots in the event a plot structure was piled. It is anticipated that on completion of the proposed site remediation the ground will generally comprise circa 0.50 to <5.00m of Made Ground overlying CLAY or Granular soils or weathered bedrock. Therefore, upon completion of these enabling works, it is likely that the most cost effective option for the majority of the site would be a combination of shallow strip foundations, mass trench foundations and to re-engineer the Made Ground using vibro stone columns (VSCs) to support a doubly reinforced shallow strip spread foundation. Localised areas of the site have been noted to have soft low strength CLAYs: TP116, TP129, TP131, TP133, TP141, TP146, TP157, TP163, TP171, TP185, TP197, TP1103, TP1116, TP1123, WS103 and WS105. Where the Cu is <30kPa, the use of VSC will not be permitted as the materials would provide limited lateral support for the construction of VSC. As such, there will be a requirement to utilise a driven piled foundation; alternatively, the materials may be removed and replaced with suitable granular fill to allow the use of VSC. Driven piled foundations may be required in areas of infilled ponds should these remain. Foundation depths should take account of the presence of existing and proposed trees, with foundations deepened locally to mitigate the potential for volumetric instability attributed to fluctuations in moisture content, in accordance with the requirements of NHBC standards.



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.
------------------------------------	--

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 of 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 if identified) in accordance with a specialist contractor method statement, validation and independent certification. ✿ Further analysis of soils for PCBs in the vicinity of Electricity Substation when access is safe to do so. ✿ Segregation of organic topsoil deemed unsuitable for use within a residential garden and placement in an area of no sensitivity or removal from the site in accordance with UK waste management legislation. ✿ Decommission of all tanks and active drainage infrastructure in accordance with the contractor method statement and ensuring no environmental impact. ✿ Removal of materials locally impacted by TPH compounds within the immediate vicinity of the USTs filling infrastructure associated with the former garage/ fuel station. ✿ Delineation of TPH impacted materials in the northwestern sector of the site. ✿ Management of all anthropogenic material impacted by trace asbestos fibre in a controlled and legislatively compliant manner. ✿ Mercury speciation to determine if elevated concentrations are deemed to be a volatile risk. ✿ Delineation and hotspot removal of naphthalene and Dibutyl phthalate impacted soils. ✿ Identification, delineation and removal of organic materials within infilled ponds.



Remediation and Enabling Works Cont.	✦ Identification, delineation, and removal of organic materials within present pond (north west). ✦ Reassurance asbestos air testing in accordance with the requirements of HSG248. ✦ Removal of all structures, relict foundations and buried features in their entirety. ✦ Removal of all materials considered geotechnically deleterious. ✦ Excavation and processing of Made Ground in a controlled manner with the sorting, processing and segregation of identified deleterious materials to geotechnical specification specifically the lifting, processing and sorting of Made Ground within the area of historically deposited materials (ash / incinerated materials). ✦ Validation sampling and leachate testing to confirm material retained on-site poses no unacceptable risk to the residential end-users controlled waters or the wider environment. ✦ 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 for the specific end use.
--	---

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 garden areas, 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 areas of public open space and soft landscaping. ✦ Construction of dwellings with appropriate gas mitigation to be compliant with CS2 pending completion of ground gas monitoring. A Ground gas mitigation design report is required to define the construction and verification requirements. ✦ Construction of appropriate potable water supply infrastructure.
--	--



TABLE OF CONTENTS

EXECUTIVE SUMMARY	2
1. INTRODUCTION	9
1.1. Background	9
1.2. Report Objectives	9
1.3. Scope of Works	9
1.4. Previous Works	10
1.5. Redevelopment Plan	11
1.6. Summary of Parties Involved	12
1.7. Regulatory Correspondence	12
1.8. Site Details	12
1.9. Site Summary	13
1.10. Summary of Reported Ground Conditions	14
2. E3P CONTAMINATION RISK ASSESSMENT	16
2.1. Background	16
2.2. Human Health Risk Summary	16
2.3. Controlled Waters Contamination Risk Summary	19
2.4. Ground Gas	19
2.5. Potable Water Supply Infrastructure	22
3. SITE REMEDIATION AND ENABLING WORKS	23
3.1. Remediation Options Appraisal	23
3.2. Determination Of Sufficiency Of Information	23
3.3. Requirement For Regulatory Control	23
3.4. Historically Deposited Materials	24
3.5. Contaminants of Concern (CoC)	24
3.5.1. Metals and PAH Compounds	24
3.5.2. Total Petroleum Hydrocarbons (C21 – C35 aromatic)	24
3.5.3. Asbestos	25
3.5.4. Volatile Mercury, Naphthalene and SVOC	25
3.5.5. Discussion of volatile Contaminants	26
3.6. IDENTIFICATION OF FEASIBLE REMEDIATION OPTIONS	26
3.6.1. Objectives	26
3.7. Summary Of Preferred Remediation Options	26
3.8. Overview of Works	27
3.9. Validation Sampling Protocol	39
3.10. Remediation Contractors Site Management and Responsibility	41
4. MATERIALS MANAGEMENT AND LEGISLATIVE COMPLIANCE	42
5. ENVIRONMENTAL MONITORING AND VALIDATION	43
5.1. Site Management	43
5.2. Completion	43
5.3. Mitigation of Risk from Soils with Asbestos Fibres	44
5.3.1. Pre-Commencement Works	44
5.3.2. Control, Monitoring and Reporting of General Aerial Emissions from Dust and Particulates	44
6. GEOTECHNICAL ENGINEERING SPECIFICATION	47
6.1. E3P Geotechnical Engineering Specification	47
6.2. Locally-Won Fill Material	47
6.3. General Overview of Fill Requirements	48
6.4. Classification of Fill Material	48
6.4.1. General Classification	48



6.4.2.	Pre-Commencement Earthworks Testing Frequency / Performance.....	49
6.4.3.	Use of Fill Materials	52
6.5.	General Requirements.....	52
6.5.1.	Construction of Fills – Highways & External Infrastructure	55
6.5.2.	Construction of Fills – Adopted Highways, Estate Roads and Car Park	56
6.5.3.	Unacceptable Material.....	56
6.6.	Earthworks Material Tests	58
6.7.	Specification for Ground Improvement by Vibro-Stone Column	58
6.8.	Current and Proposed Site Topography and Slope Interaction	60
7.	RECORD-KEEPING AND VERIFICATION.....	61
7.1.	Record-Keeping	61
7.2.	Verification.....	61
8.	CONTINGENCY PLAN	62
8.1.	Previously Unidentified Contaminants	62
9.	SECOND PHASE MITIGATION AND MANAGEMENT – BUILD PHASE.....	63
9.1.	Placement Of Cover System	63
9.1.1.	Procedure for Placement of Chemically Suitable Cover System	64
9.2.	Potable Water Supply – Contaminant Assessment Criteria	67
	APPENDIX I LIMITATIONS.....	68
	APPENDIX II GLOSSARY	70
	APPENDIX III DRAWINGS	73
	APPENDIX IV E3P REMEDIATION/ VALIDATION CRITERIA.....	75
	APPENDIX V E3P MATERIAL IMPORT CRITERIA	80
	APPENDIX VI CONTRACTOR PRE-COMMENCEMENT CHECK SHEET	82
	APPENDIX VII CONTRACTOR COMPLETION CHECK SHEET	85



1. INTRODUCTION

1.1. BACKGROUND

E3P has been instructed by Barratt and David Wilson Homes to develop a remediation and enabling works strategy for the proposed residential development at the site south of Cherryfield Drive, in Kirkby.

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

E3P has been provided with previous reports prepared for the site:

Author	Title	Reference	Client	Date
Clancy Consulting	Preliminary Geoenvironmental Appraisal Report for Phase 2 Site, Cherryfield Drive, Knowsley	Ref: 10/1519/001	Knowsley Metropolitan Borough Council	May 2020
	Geo-Environmental Appraisal Report for Knowsley Community College, Liverpool	Ref: 10/1533/001	Knowsley Metropolitan Borough Council	July 2020
Resource & Environmental Consultants Ltd	Geoenvironmental Site Assessment	Ref: 45759Fp1r0	Knowsley Metropolitan Borough Council	September 2014
ALM Consult Limited	Interpretative Report	Ref: 30090/11	Knowsley Metropolitan Borough Council	September 2015
	Hazardous Gas Risk Assessment	Ref: 30090/11/2	Knowsley Metropolitan Borough Council	December 2015
ESG	Factual Report on Ground Investigation	Ref: F5013-15	2020 Knowsley Limited	February 2016
Ian Farmer Associates	Factual Report on Ground Investigation	Ref: 41989	St Modwen Developments Limited	March 2017
RPS	Due Diligence Information for Land Development	-	St Modwen Developments Limited	June 2017
Atkins	Phase 1 Geo-Environmental Desk Study	Ref: 5145660	St. Modwen (Kirkby 2) Development Ltd	December 2016
Buro Happold	Ground Engineering Site Appraisal	Ref: 021706	-	December 2006
	Geoenvironmental and Geotechnical Interpretative Report: Phase 1 Ground Investigation (GDO 205 Landfill)	Ref: 021706	-	November 2007
Cundall	Geotechnical Due Diligence Brief	Ref: 1028732.SPC.GL.001	Barratt Developments Plc	June 2021

In addition to the above, E3P have completed the following phases of geoenvironmental investigation at the site:

- ✳ **E3P – Phase I & II Geoenvironmental Site Assessment.** Ref: Report 15-280-R1-4, dated May 2024, Prepared for Barratt and David Wilson Homes.

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 E3P Geo-Environmental Site Investigation Report should be read both as a precursor to and in conjunction with this document.



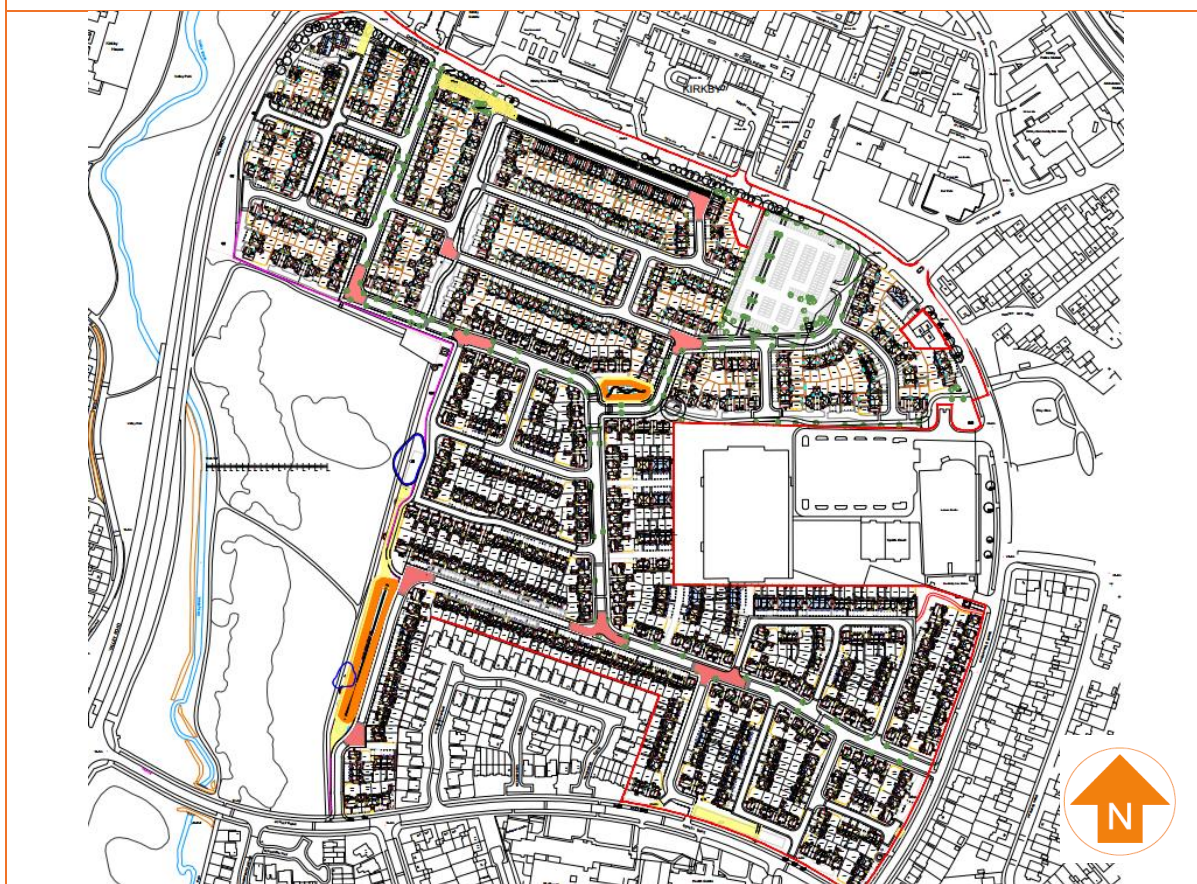
A series of historical site investigations have been completed on the subject site, and are summarised within the E3P Phase I & II Geoenvironmental Site Assessment and are referenced where necessary however this strategy is based upon the E3P report as it is considered the most up to date assessment of the site and E3P are of the understanding that the client does not have reliance on the previous reports.

1.5. REDEVELOPMENT PLAN

Barratt and David Wilson Homes propose to construct low-rise residential dwellings with associated access roads, parking, landscaping and adopted drainage infrastructure.

E3P has been provided with a draft planning layout a snapshot of which is indicated in Figure 1.1.

FIGURE 1.1 SNAPSHOT OF PROPOSED DEVELOPMENT



1.6. SUMMARY OF PARTIES INVOLVED

Function/interest	Name of Party
Local Planning Authority	Knowsley Council
Developer	Barrett and David Wilson Homes
Geoenvironmental Consultant	E3P
Main Contractor	Barrett and David Wilson Homes
Remediation/Enabling Works Contractor	TBC
Human Health Regulator	Knowsley Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Knowsley Council

1.7. REGULATORY CORRESPONDENCE

Barratt and David Wilson Homes 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); and,
- ✳ Environment Agency planning liaison.

1.8. SITE DETAILS

Site Address	Cherryfield Drive, Kirkby, Liverpool, L32 8RX
National Grid Reference	E 341100 N 398150
Site Area	22.51 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 15-280-001.



1.9. SITE SUMMARY

TABLE 1.1 SITE DESCRIPTION AND SETTING

Occupancy/Use	The subject site is an irregular shaped parcel of land located to the south of Cherryfield Drive in Kirkby. The southern sector of the site comprises maintained grassland with an area in the south east of the site having recently undergone the felling of semi-mature and mature trees. The central sector of the site is current unmaintained vacant grassland. Within the north of the site, is an area of active car park and former roadways and hardstanding associated with former development. Within the north-west of the site is Knowsley community College. There is an additional area of vacant land with areas of hardstanding associate with former development, with a small building against Cherryfield Drive.	
Environmental Setting	Drift Geology	None recorded in North-West of the site Glacial Till across majority of the site Shirley Hill Sand Formation – Northern boundary
	Bedrock Geology	Chester Sandstone Formation – SANDSTONE.
	Hydrogeology	Secondary Undifferentiated Aquifer (drift) across the majority of the site with a Secondary A drift aquifer within the north and north-west of the site. Bedrock comprises a Principal Aquifer (solid). No groundwater abstractions have been identified within a 1 km radius.
	Hydrology	The Kirkby Brook is located 52m west to the site.
	Flood Risk	Unaffected by flooding from rivers.
	Subsidence Hazard	No hazard to low risk identified in data searches.
Site History	Historical mapping indicates that the site was undeveloped until the 1960s, with the subsequent construction of the college campus in the north western sector and a school in the south-eastern sector. Circa 1961, historical mapping shows earthworks associated with the adjacent landfill site, by 1976 the landfill is no longer shown. There is evidence of level changes in the 1950s and 1960s in the central sector of the site from historical mapping showing changes in contours, likely attributed to the levelling of the site for use as playing fields. Residential dwellings and retail buildings, including a fuel station and electrical substations, are shown at the northern site boundary pre-1961. Aerial imagery indicates the south-eastern sector of the site was cleared pre-2011; the hotel pre-2012; the residential housing pre-2015, the college in the north-west pre-2016; with the remainder of buildings in the north of the site demolished by pre-2019 and pre-2021. There is currently no evidence of the petrol filling station above ground however it is understood the underground storage tanks are still present. At present, the site is largely vacant, with the former roads and hardstanding at the north of the site and areas of car parking associated with the now demolished school and college. A building associated with the former college remains in the north-western sector.	



Landfill Sites and Ground Gases	A historical landfill site is located adjacent to the southwestern boundary of the site. Three further historical landfills have been identified between 271m and 810m of the site. The site has two infilled ponds, with areas of historical deposition taken place across the site.
Radon	Unaffected – no special precautions required.

1.10. SUMMARY OF REPORTED GROUND CONDITIONS

E3P has prepared a detailed Site Investigation Report (Ref: 15-280-R1-2, dated December 2022). The summary of reported ground conditions is given in Table 1.2.

TABLE 1.2 SUMMARY OF GROUND CONDITIONS

MADE GROUND	Made Ground deposits were encountered within the majority of exploratory hole locations to depths of between 0.00 m and 5.50 mbgl. The depth of Made Ground was not proven in 20 locations due to either underground obstructions, the collapse of the trial pit, or the ingress of water. Made Ground deposits generally comprised reworked topsoil of dark grey slightly gravelly clayey fine to coarse SAND or gravelly sandy to very sandy CLAY with frequent rootlets with gravel of brick, mudstone, sandstone and ceramic. TP164 was overlain by asphalt and concrete associated with the former garage/petrol station, with TP168 overlain by ceramic tiles overlying concrete indicative of the former residential dwellings in this area of the site. Furthermore, WS150, TP188 and TP196 in the north-east of the site was overlain by asphalt, with WS144, WS146, WS148, TP190, TP192 and TP194 overlain by concrete with rebar. TP197 and WS147 in the north-west of the site was overlain by asphalt and concrete. Underlying the reworked topsoil or hardstanding, deeper Made Ground deposits comprised of reworked brown very sandy gravelly clays or gravelly sands. Within TP160 the exploratory hole location was dug down the side of a former foundation which showed the slab to be 1.10 m thick and the foundation going down to 2.80 mbgl. Made Ground deposits across the central and northern sector of the site comprised a clayey very gravelly fine to coarse ashy sand with gravel of ash, glass, ceramic, textiles, clinker, wood, timber, brick, metal, mudstone and cardboard. This material was considered to be incinerated materials utilised to create the level platform currently on site. Within the north-western sector of the site, typically, the deposits within the hardstanding areas comprise 200mm of asphalt, underlain by circa 300mm of sandy gravel with gravel of limestone, concrete, and rare asphalt (sub-base). Made Ground deposits underlying this comprised sandy gravel with cobbles, with gravel of brick, concrete, sandstone and mudstone with rare fragments of plastic, timber, metal, and cobbles of rebar and brick.
Topsoil	No topsoil that would be deemed suitable for reuse has been identified within any of the exploratory hole locations.
Drift	Drift deposits were encountered within the majority of exploratory locations with the exception of locations where the full depth of Made Ground could not be proven. The drift deposits are varied, generally comprising a soft to very stiff, medium to very high strength, slightly gravelly sandy brown CLAY with gravel of sandstone and mudstone or a slightly gravelly to gravelly, slightly clayey to very clayey fine to medium SAND with gravel of sandstone and mudstone.



Bedrock	The solid bedrock geology was first encountered between 4.70 mbgl and 6.10 mbgl. and comprised of SANDSTONE. A number of window sample probeholes terminated on or within weathered sandstone bedrock which was recovered as gravelly SANDs from 1.20 mbgl to in excess of 5.45 mbgl.
Groundwater	Groundwater was encountered as perched water, strikes and seepages at depths of between 0.40 mbgl. and 4.00 mbgl. True groundwater is considered to be between 1.40 m and 4.00 mbgl within the natural drift deposits.



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 2 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:

-  Arsenic
-  Cadmium
-  Lead
-  Mercury
-  Nickel
-  Zinc
-  Naphthalene
-  Benzo(a)Anthracene
-  Chrysene
-  Benzo(b)Fluoranthene;
-  Benzo(a)Pyrene
-  Dibenzo(a,h)Anthracene
-  Asbestos (Chrysotile, Crocidolite and Amosite)
-  Dibutyl phthalate
-  TPH C21 – C35

In the case of heavy metals and non-volatile PAH compounds, the viable exposure pathway is associated direct contact, inhalation of particulates, consumption of homegrown vegetables and ingestion of soil. The proposed development of the site will include hard cover and the importation of certified subsoil and topsoil in areas of private gardens and landscaping, thus removing this pathway.



Elevated mercury has been identified within TP118 at 0.50 mbgl and TP141 1.00 mbgl within Made Ground deposits. This presents a potential volatilisation to indoor air risk and are considered to be localised hotspots within this Made Ground strata. Speciation testing should be completed to confirm the type of mercury present and whether it presents a vapour risk. Should it be volatile a hotspot removal should be undertaken to delineate the extent of impact and soils should be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity.

Naphthalene has been noted to be elevated within TP1101 at 0.90m with elevated concentrations identified of dibutyl phthalate within WS111 at 2.50m. During remediation and enabling works the areas should undergo a hotspot removal with the area delineated with the impacted materials either removed from site or placed in an area of low sensitivity.

Exceedances of Total Petroleum Hydrocarbons C21 – C35 total hydrocarbons have been encountered within the Made Ground deposits in TP202 at 1.00 mbgl, to the south of the supplementary site investigation in the northwestern parcel of the site. This area is historically noted as a college, with several former buildings and car parking areas, however no direct link to hydrocarbon contamination can be drawn. In addition to the exceedance noted, the borehole logs in this location indicated a very strong hydrocarbon odour throughout the Made Ground in this area. The compounds are noted to only indicate exceedances in heavy-end TPHs, therefore the mobility is likely to be low. It is recommended that a watching brief is completed during earthworks in this location, with delineation and further sampling to determine the extent of contamination present. This will be confirmed within a detailed remediation strategy.

Asbestos in the form of chrysotile, crocidolite and amosite has been identified within shallow Made Ground deposits. Out of 62 samples tested, five samples had a positive identification for asbestos where quantification has confirmed soils to contain between <0.001% and 0.009% by hand picking weight. It is considered that asbestos loose fibres will be present throughout the Made Ground across the site due to the nature of the fill materials on-site. However, levels of asbestos identified above <0.001% are considered to be localised and should undergo a hotspot removal.

Visual signs of ACM were encountered within various exploratory hole locations, likely to be associated with the historical deposition Made Ground materials. During the remediation and enabling works these should be removed from site by a licensed asbestos removal contractor. Impacted soils should be managed according to the asbestos risk mitigation conceptual site model shown in Figure 2.1.

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



FIGURE 2.1 ASBESTOS CONCEPTUAL SITE MODEL



Within the soils analysis no elevated concentrations of TPH or BTEX in the area of the former petrol filling station were identified to date. A hydrocarbon odour was identified within WS142 in this vicinity within SAND deposits underlying Made Ground. The tanks are understood to still be in-situ and the presence of contamination cannot be ruled out as this stage.

Historical site investigation identified hydrocarbon odours and staining in the vicinity of the petrol filling station with TPHs within soil analysis and BTEX, MTBE, TPHs and Phenols identified within groundwater analysis. The area will be fully remediated with the tanks removed and validated to ensure that no impact poses a risk to future end users or the wider environ.

All proposed garden and landscaped areas within the development are to be installed with a 600 mm chemically suitable cover system, which will ensure that future site users will be at no unacceptable risk from the identified contaminant exceedances.

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

- 🔧 Supplementary sampling upon removal of the substation to demonstrate absence of any unacceptable risk from PCB impact.
- 🔧 Watching brief and further sampling beneath the current buildings in the north west of the site following demolition.
- 🔧 Speciation of Mercury to confirm the requirement for hotspot removal.
- 🔧 Hotspot removal and delineation of naphthalene and Dibutyl phthalate hotspots.



- ✳ UST along with associated pipework and any impacted materials to be removed.
- ✳ Delineation and further analysis of hydrocarbon impacted soils in the vicinity of TP202.
- ✳ Management of soils to ensure that all materials impacted by asbestos fibres are placed in areas of low sensitivity during the site enabling works.
- ✳ Use of potable water supply infrastructure that will be compliant with United Kingdom Water Infrastructure Risk (UKWIR) assessment criteria.
- ✳ Construction of selected dwellings with ground gas mitigation measures that conform to CS2 requirements of BS 8485.
- ✳ Construction of a 600 mm clean cover system to all areas of private garden in accordance with the detailed methodologies herein.

2.3. CONTROLLED WATERS CONTAMINATION RISK SUMMARY

A Tier 1 Controlled Water Risk Assessment was completed by E3P as part of the E3P Geo-Environmental Site Assessment, the findings of which are summarised as follows:

- ✳ The direct comparison of groundwater samples recovered from dedicated monitoring wells identified elevated concentrations of heavy metals and TPH Aromatic C10-C12, and TPH Aromatic C12-C16 against EQS screening values.
- ✳ Nickel was noted to be elevated against DWS screening values from groundwater samples.
- ✳ Leachate analysis identified elevated heavy metals against EQS and DWS screening values however the test is considered to overstate the risk and reliance should be upon groundwater samples.
- ✳ The Made Ground and former garage with associated underground fuel tanks are considered to be the sources of on-site potential contamination.
- ✳ The primary receptor is considered to be the underlying principal aquifer however there is not considered to be a complete pollutant linkage given the absence of a groundwater abstraction point within 1 km of the subject site.
- ✳ The closest surface water feature is located 56m west of the site, and is considered to not be a significant receptor given its distance from the site, and presence of a road between the site and the brook which would intercept any potential run-off from the site.
- ✳ There is considered to be a low risk to controlled waters.

2.4. GROUND GAS

Ground gas has been assessed by E3P as part of the E3P Geoenvironmental Site Assessment. Ground gas monitoring is currently on-going within the northwestern sector of the site. The assessment to date was completed in accordance with the methodology outlined with the BS8485, utilising the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV). The GSVs for the monitoring positions are summarised in Table 2.1.



TABLE 2.1 GAS RISK PROFILE AND LOCATION

LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CHARACTERISTIC SITUATION
WS101	6.8	0.0068	8.5	0.0085	CS2*
WS102	3.7	0.0037	10.8	0.0108	CS2*
WS105	0.1	0.0001	6.9	0.0069	CS2*
WS106	0.4	0.0004	7.7	0.0077	CS2*
WS108	46.1	0.0461	10.3	0.0103	CS2*
WS110	0.1	0.0001	1.5	0.0015	CS1
WS111	6.2	0.0062	5.3	0.0053	CS2*
WS113	0.1	0.0164	3.1	0.1984	CS2
WS115	0.1	0.0001	0.1	0.0001	CS1
WS117	0.1	0.0001	4.7	0.0047	CS1
WS118	0.1	0.0001	0.3	0.0003	CS1
WS119	0.1	0.0001	2.1	0.0021	CS1
WS120	0.1	0.0001	0.2	0.0002	CS1
WS121	0.1	0.0001	2.2	0.0022	CS1
WS123	0.1	0.0001	0.1	0.0001	CS1
WS124	13.7	0.0137	5.4	0.0054	CS2*
WS125	0.1	0.0001	2.1	0.0021	CS1
WS126	0.4	0.0016	1.0	0.0010	CS1
WS128	0.1	0.0001	1.5	0.0015	CS1
WS130	0.1	0.0001	0.1	0.0001	CS1
WS132	0.1	0.0001	0.4	0.0004	CS1
WS133	0.1	0.0001	2.3	0.0023	CS1
WS135	0.1	0.0001	0.1	0.0001	CS1
WS136	0.1	0.0001	0.8	0.0008	CS1
WS137	0.1	0.0001	1.6	0.0016	CS1
WS138	0.1	0.0253	1.4	0.3542	CS2
WS140	0.1	-0.0003	0.8	0.0008	CS1
WS141	0.1	0.0001	2.4	0.0024	CS1
WS142	0.1	0.0001	1.1	0.0011	CS1
WS144	0.1	0.0001	0.8	0.0008	CS1
WS147	0.1	0.0033	0.1	0.0033	CS1
WS149A	0.1	0.0001	0.8	0.0008	CS1
WS151	0.1	0.0001	0.8	0.0008	CS1
WS152	0.8	0.0008	4.8	0.0048	CS1
WS153A	0.1	0.0001	0.7	0.0007	CS1



LOCATION	MAX CH ₄ (% v/v)	GSV (l/hr)	MAX CO ₂ (% v/v)	GSV (l/hr)	CHARACTERISTIC SITUATION
WS157	0.1	0.0001	0.2	0.0002	CS1
WS161	0.1	0.0001	0.5	0.0005	CS1
WS169	0.1	0.0001	0.1	0.0001	CS1
WS171	0.1	0.0001	1.3	0.0013	CS1
CP/RB101	4.4	0.0044	9.5	0.0095	CS2*
CP/RB102	0.1	0.0001	4.1	0.0041	CS1
CP/RB103	0.3	0.0003	6.0	0.0060	CS2*
WS201	69.30	0.0693	22.0	0.022	CS2*
WS202	0.10	0.002	0.50	0.0006	CS1
WS204	0.10	0.0001	0.4	0.0004	CS1
WS206	0.10	0.0001	0.10	0.0001	CS1

* Classified as precautionary CS2 based on high concentrations observed. GSV however noted to fall under CS2 threshold.

E3P has assessed the previous variables and come to the following conclusions based on preliminary ground gas monitoring:

- ✳ Ground gas monitoring thus far suggests that the site can be predominantly classified as CS1, and in these areas it is considered that gas protection measures will not be required.
- ✳ However, localised areas of the site, including WS113 along the western boundary of the site and WS138 to the north of the site and have been classified as CS2.
- ✳ The key sources of ground gas identified within the conceptual site model are the adjacent landfill at Bewley Road (Ref: EAHLD06985), which is noted to include household waste and was active from the 1950s to circa 1974. In addition, deep Made Ground has been encountered across the site, with deeper deposits within the southern half of the site associated with former infilling. The supplementary site investigation to the northwest of the site has also identified areas of volatile hydrocarbon contamination.
- ✳ High concentrations in WS113 are likely associated with the known landfill located directly adjacent to the western boundary, however, across a total of 30 visits completed, only one visit noted any indication of gas flow, with the majority of visits encountering carbon dioxide and methane at the limit of detection.
- ✳ The monitoring well in WS138 was installed within natural sand deposits, and the high GSV noted is more likely in reference to moving groundwater creating pressure at the top of the well creating a piston effect for collected air, as no source of gas has been identified in this part of the site.
- ✳ The site is predominantly underlain by glacial till of SANDS and CLAY at depths of 0.10m bgl to 6.10 mbgl.
- ✳ A number of monitoring wells across the site have identified elevated concentrations of methane and/or carbon dioxide, however with GSV thresholds noted to be below the CS2 criteria. These wells include: WS101, WS102, WS105, WS106, WS108, WS111, WS124, CP/RB101, CP/RB103 and WS201. In general, all of the above noted locations can be associated with the infilling of ground in the southern parts of the site, adjacent to the known landfill and noted hydrocarbons. It is therefore considered that a ground gas zoning plan is created for the site based on the sources identified, where precautionary CS2 protection measures are to be included within all of these areas. It is recommended that CS2 measures are included within all plots within 75 m of the



adjacent landfill.

- ✳ High methane concentrations have been identified within WS201 to the northwest of site, likely associated with a combination of encountered hydrocarbons in this area as well as the adjacent landfill to the south. Following suggested further investigation of the area, precautions may be increased or reduced based upon findings.
- ✳ Migration from the adjacent landfill has been identified, however a minimal flow has been recorded in the monitoring wells surrounding it, and therefore it is likely that the lateral migration of ground gases from the landfill is limited. As the landfill is uncapped, the majority of gases encapsulated within the landfill will be released to the atmosphere, however lows in barometric pressure may cause a swelling of the ground gas encroaching onto the site.
- ✳ Completion of the ground gas monitoring regime is suggested for all monitoring wells within the northwestern parcel (WS201 – WS206) to fully assess the potential hazardous ground gas risk posed to subsequently classify the characteristic situation suitable.
- ✳ Within the area of the pond identified towards the northwest of the site, precautionary CS2 protections are suggested within the vicinity. Following suggested further investigation of the area, precautions may be increased or reduced based upon organic content noted.

It is recommended that the full ground gas assessment and recommended protection measures (if applicable) are agreed with the local authority prior to their adoption on site. Furthermore, all protection measures adopted should be validated by a suitably qualified engineer.

A site-specific ground gas mitigation design report will be required to define the construction and verification requirements.

2.5. POTABLE WATER SUPPLY INFRASTRUCTURE

A contaminant risk assessment completed in accordance with the UKWIR assessment framework has been completed for the majority of the site except for the north western sector, the assessment will require updating to include this sector.

Soil analysis completed to date identified elevated concentrations of potentially volatile/soluble hydrocarbon compounds and as such current site conditions infer that barrier pipe will be required at the proposed development.

In order for the development to be constructed with PE pipe it will be necessary to delineate the impacted soils were present at locations that could potentially impact the potable water infrastructure.

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 OPTIONS APPRAISAL

A remediation options appraisal has been completed in accordance with the principals as set out within Environment Agency publication Land Contamination: Risk Management (LC:RM)(updated July 2023).

The LC:RM requires that the following tiered assessments are followed to ensure sufficiently detailed and robust appraisal of remediation options to inform the selection of the preferred approach and utilisation of the correct technologies to promote safe and sustainable land remediation:

- ✚ Identification of feasible remediation technologies;
- ✚ Detailed evaluation of viable options; and,
- ✚ Selection of appropriate remediation option.

3.2. DETERMINATION OF SUFFICIENCY OF INFORMATION

Prior to the commencement of the tiered assessment of remediation options, it is a requirement to assess the sufficiency of available information and validity of the risk based assessment on which the remediation options appraisal is based.

Intrusive ground investigation works completed to date is considered sufficient across the site in order to fully understand the risks to future end users, controlled waters and the wider environ.

Access was not possible beneath the current buildings in the north west of the site however it is determined during the remediation and enabling works a watching brief and further sampling is completed in this area to ensure no unforeseen contamination is present.

In this instance it is considered that there is sufficient information to inform the detailed site characterisation which has determined that the primary pollution risk is associated with the presence of Made Ground and a former garage / petrol station. Further works will also be required following demolition of the electricity substation on-site.

3.3. REQUIREMENT FOR REGULATORY CONTROL

The LC:RM requires that due consideration be given to the following key issues which will impact the appropriate selection of suitable remediation options.

- ✚ Requirement for regulatory permits.

The proposed remediation works may be covered by a specific Environmental Permit, it is considered that the processes outlined below will be applicable to the project.

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 a 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.

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 the 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. 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 V of this report.

3.4. HISTORICALLY DEPOSITED MATERIALS

Historically deposited wastes have been identified across the site, which previous reports inferred as being associated with the historical landfill adjacent to the south-western boundary of the site.

The historical landfill was filled pre COPA 1974 due to the possibility of filling of a former clay pit and then raising to present levels.

The materials on-site should be referred to as Made Ground deposits that were historically deposited and are not classified as landfill. As such these materials should be treated as Made Ground as per other Made Ground deposits across the site and will not be subject to any specific Environmental Permits in the processing and re-use other than under a CL:AIRE Materials Management Plan.

3.5. CONTAMINANTS OF CONCERN (COC)

3.5.1. METALS AND PAH COMPOUNDS

The human health risk drivers for the carcinogenic PAHs and heavy metal CoC are:

- ☛ Direct contact with the soil source by future on-site residents; and,
- ☛ Ingestion of impacted soils by future on-site residents.

Therefore, a cover system is considered to be an appropriate remediation technique to address these impacts, as the installation of a cover system to unsurfaced areas of the site will sever the pathway of contact for human health receptors. A cover system is not considered to be required in future hardstanding areas or beneath buildings, as it can reasonably be assumed that the presence of a hardstanding will prevent direct contact.

3.5.2. TOTAL PETROLEUM HYDROCARBONS (C21 – C35 AROMATIC)

Heavy-end Total Petroleum Hydrocarbons (C21 – C35) have been identified at concentrations exceeding the GAC within TP202 at 1.00m bgl towards the south west of the north western parcel, following the supplementary site investigation.

The human health risk drivers for TPH C21 – C35 are related to direct contact with soil source and ingestion of by future on-site residents due to the low mobility and extremely high vapour point, therefore classifying them as a non-volatile TPH.

It is recommended that a watching brief is completed during earthworks in this location, with delineation and further sampling to determine the extent of impact present at this location.



As the contaminants were found within the Made Ground at a depth of 1.00m bgl, a cover system is considered to be an appropriate remediation technique to address these impacts, as the installation of a cover system to unsurfaced areas of the site will sever the pathway of contact for human health receptors. A cover system is not considered to be required in future hardstanding areas or beneath buildings, as it can reasonably be assumed that the presence of a hardstanding will prevent direct contact.

3.5.3. ASBESTOS

Asbestos has been identified in five locations. Asbestos in the form of loose chrysotile and crocidolite fibres have been identified in the granular Made Ground in TP132 at 0.20 bgl; Chrysotile loose fibrous debris, loose fibres and bitumen have been identified in the reworked topsoil in TP140 at 0.10m bgl; and in the Made Ground within TP202 at 1.00m bgl and WS206 at 0.90m bgl. Loose amosite fibres have been identified in the granular Made Ground in TP118 at 0.50m.

It should be assumed that asbestos fibres are present throughout the Made Ground on site. The risk to chronic human health associated with the elevated concentrations of loose chrysotile and fibres (<0.001%) can be mitigated through the installation of a suitable cover system in all proposed landscaping and hardstanding to remove any potential for direct exposure to impacted soils.

Where asbestos is identified at concentrations above <0.001%, a hotspot excavation will be required and the impacted Made Ground will require placement >1.00m beneath an area of low sensitivity such as a public open space in accordance with the E3P conceptual site model (Figure 2.1).

All ACM-impacted soils must be managed so as to ensure no airborne fibre release during construction or placement of impacted material in such a manner as to ensure no future exposure risk. Soils will be placed in areas of no unacceptable future risk in accordance with the E3P validation method.

Visual signs of ACM were encountered within various exploratory hole locations; where visible pieces of asbestos-containing material are identified during the site remediation and enabling work, this material must be dealt with in strict accordance with the Control of Asbestos Regulations (CAR) 2012, UK Waste Management Legislation and the Environmental Protection Act 1994. Due to the close proximity of residential dwellings, asbestos in air monitoring in accordance with HSG248 may be required to confirm that no asbestos fibres have been generated from the enabling works activities.

Should off-site disposal be required, then additional asbestos quantification and waste classification testing should be undertaken to ensure that it is classified correctly and disposed at a suitably licensed facility.

3.5.4. VOLATILE MERCURY, NAPHTHALENE AND SVOC

Volatile naphthalene, mercury and Dibutyl phthalate have been identified which present potential volatilisation to indoor air risk; the locations are summarised below:

-  TP118 at 0.50m – Mercury
-  TP141 at 1.00m – Mercury
-  TP1101 at 0.90m – Naphthalene
-  WS111 at 2.50 m - Dibutyl phthalate



3.5.5. DISCUSSION OF VOLATILE CONTAMINANTS

Mercury, naphthalene, and Dibutyl phthalate present a potential volatilisation to indoor air risk. All elevated concentrations are considered to be isolated hotspots.

During a process of cut & fill enabling works, a hotspot removal should be undertaken where these soils may be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity or for further treatment / off-site disposal if required.

In addition to the above, in regard to the elevated concentrations of Mercury identified, it is also recommended that speciation is completed in order to determine the type of mercury and if it does indeed present a vapour risk. Further risk assessment should be completed to determine its placement on site, and should it be volatile a hotspot removal should be undertaken to delineate the extent of impact and soils should be chemically validated to assess chemical suitability for retention on-site in an area of no future sensitivity.

Within the vicinity of the petrol fuel station in the north of the site, a hydrocarbon odour was identified within WS142 within SAND deposits underlying Made Ground. Historical site investigation identified hydrocarbon odours and staining in the vicinity of the petrol filling station with TPHs within soil analysis and BTEX, MTBE, TPHs and Phenols identified within groundwater analysis. During the removal of the USTs and associated infrastructure, confirmation of no further elevated TPH compounds will be required and any impacted materials will be removed.

Due to the historical site use, there is a potential for further elevated concentrations of volatile contaminants to be identified. Where a potentially unacceptable degree of risk is identified, the impacted soils should either be remediated or alternatively the proposed dwellings should be designed with appropriate mitigation measures to remove the potential pollution linkage and agreed in advance with the Local Authority.

3.6. IDENTIFICATION OF FEASIBLE REMEDIATION OPTIONS

3.6.1. OBJECTIVES

The remediation works must be completed in a safe and sustainable manner that ensures that the post-remediation condition of the site poses no unacceptable risk to controlled waters or the wider environs. The developed Conceptual Site Model must ensure no complete pollutant linkage to ensure successful implementation.

The remediation works must be completed in a manner that promotes sustainable re-use of material in a manner that minimises waste and maximises retention of material on-site.

The works should be designed and implemented in a manner that ensures no risk to an identified receptor during the works in terms of odour, air quality or noise impact.

Works should be designed, planned and implemented in a manner that ensures full compliance with all pertinent waste management and environmental permit legislation.

3.7. SUMMARY OF PREFERRED REMEDIATION OPTIONS

Based on the options appraisal, 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:



- ✳ **Capping** of site with a suitable certified clean cover system comprising 150mm topsoil and 450mm subsoil will remove any future direct exposure pathways to future end users.
- ✳ **Excavation and off site removal** of hazardous materials which cannot be treated will be required, this operation needs to be limited to materials that cannot be treated on-site to promote sustainability and ensure viable regeneration.
- ✳ **Excavation of hotspot materials** for placement in areas of low sensitivity or removal off-site.
- ✳ **Removal of impacted materials surrounding petrol filling station off-site.**

3.8. 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 – Watching Brief Beneath Current Buildings On-Site

When access is available in the north-west of the site, following demolition of existing buildings, a watching brief is recommended.

It is recommended a series mechanically excavated trial pits will be advanced with additional chemical analysis of the soils completed to confirm no unacceptable risk to human health and controlled waters.

If any as yet unidentified contamination 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 by the placement of clean cover systems to break the pathway or delineation and source removal where required.

RE-2 – Pre-commencement Regulatory Compliance

Prior to the 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.

The proposed remediation and enabling works for the re-use of the materials on site will require a CL:AIRE Materials Management Plan (MMP)-qualified declaration to be made by the contractor, having obtained full written approval for the remediation strategy from the LPA and Environment Agency.



It is not anticipated that there will be any requirement to treat any materials on site (such as hydrocarbon-impacted soil or groundwater); however, 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/treatment trials operation or arrange for the deployment of the appropriate environmental permit for the specified operation.

RE-3 – 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-4 – Risk to Infrastructure

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

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

Invasive plant species have not been identified on site to date. However, the remediation contractor must satisfy themselves with respect to the extent of all species deemed invasive, if present, 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. Once all invasive plant species are identified, 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 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 – Site Clearance Operations

Post-demolition general site clearance and provision of welfare, offices and site security are to be determined as per the contract requirements.

The site is currently overgrown with self-seeded vegetation with extensive below-ground structures within the north and south-east of the site; this material should be removed in a controlled manner with full compliance with any ecological mitigation measures that are required for the works. Any such measures are outside the scope of this report.

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

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

RE-7 – Recovery of Natural Topsoil

The site investigation report and subsequent surveys identifies limited areas of the subject site where natural organic soils (topsoil) are present at the near surface. The contractor should seek to maximise the recovery of this material to promote sustainable construction through careful segregation and subsequent stockpiling of the natural soils.

All recovered topsoil should be covered with a suitable geotextile to limit cross-contamination from anthropogenic elements during remediation, enabling and construction. This will significantly contribute to maximising the recovery and reuse of material.

All material will be subject to validation testing by the supervising consultant in accordance with the testing specification set out herein.

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

Detectable asbestos fibres have been identified in discreet locations; however, due to the nature and age of the filled material, it must be assumed that trace fibres are present throughout the Made Ground. The E3P Developed Conceptual Site Model demonstrates a suitable method for management of soils to negate any future risk.

Within the vicinity of TP1180 at 0.50m, TP140 at 0.10m, and TP202 at 1.00m quantification identified asbestos at 0.002% , 0.005%, and 0.009% respectively, and as such these locations should undergo a hotspot removal to delineate and excavate the impacted materials, with 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.

Suspected asbestos sheeting was identified within WS141 and this will require hand picking and removal by a licenced waste contractor.



In addition to the above, previous investigations completed by ALM Consult have identified asbestos loose fibres (including Amosite, Chrysotile and Tremolite) noted extensively across the eastern part of the site and in the southwest of the site in Cohesive and Granular fills. Previous site investigations from Buro Happold also notes visual evidence of cement bound asbestos site wide. No asbestos was detected within the Clancy Consulting investigation, however asbestos fibres were encountered within 5 samples of the Ian Farmers report. Based on the above, it is not possible to determine specific sources of asbestos across the site and it must be assumed that asbestos fibres are present in the Made Ground site wide.

The contractor must therefore 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 samples will be collected at 10 linear metre centres from the side and base of the excavation.

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.

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.

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 – Delineation, Excavation, Treatment and Disposal of Naphthalene and Dibutyl phthalate

Elevated Naphthalene has been identified within TP1101 at 0.90m and elevated Dibutyl phthalate within WS111 at 2.50 m.

It is considered that this material represents an unacceptable risk associated with volatilisation to indoor air.

Furthermore, when considering the prior land use, as yet unidentified potentially volatile/soluble phase compounds cannot be discounted. The proposed remediation works will include the full depth turnover of all made ground under the supervision of an independent geoenvironmental consultant from E3P.

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.

It is recommended by E3P to carry out a watching brief throughout earthworks in the vicinity of TP1101 to confirm if there is a specific source of contamination in this area, as laboratory analysis indicated elevated PAHs not identified elsewhere on site.



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. This material will then be subject to detailed laboratory analysis to determine the suitability for reuse or the requirements for off-site disposal.

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.

Validation samples will be collected at 10 linear metre centres from the side and base of the excavation.

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.

RE-10 – Excavation, Delineation & Validation of Mercury Hotspots

Elevated concentrations of mercury have been identified within TP118 0.50 m and TP141 1.00 m.

This presents a potential volatilisation to indoor air risk and are considered to be localised hotspots within this Made Ground strata.

Further speciation testing should be completed to confirm the type of mercury present and whether it presents a vapour risk. Should it be volatile a hotspot removal should be undertaken to delineate the extent of impact and soils should be chemically validated to assess chemical suitability for retention on site in an area of no future sensitivity.

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.

Validation samples will be collected at 10 linear metre centres from the side and base of the excavation.

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.

RE-11 – Delineation & Validation of TPH Impacted Soils

Elevated concentrations of heavy-end Total Petroleum Hydrocarbons (C21 – C35) have been identified at concentrations exceeding the GAC within TP202 at 1.00m bgl towards the south west of the north western parcel,

It is recommended that a watching brief is completed during earthworks in this location, with delineation and further sampling to determine the extent of impact present at this location.



RE-12 – 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.

Artificially hard materials should be broken out and crushed. Stockpiles will be made, validation testing undertaken, and site-won material reused on site where required. Materials will be processed as per the specifications provided in Section 6 using licensed plant.

The E3P drawings denote the extent of known historic features with obstructions; however, it will be the contractor's responsibility to remove all obstructions.

Obstructions encountered within the near-surface soils will be chased to their full depth and removed; if not possible, the obstruction must be surveyed with the location communicated to E3P, the client and the developer.

Where natural soils are present at a relatively shallow depth, 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-13 – Delineation, Excavation and Treatment of Infilled Historical & Present Ponds

Prior to the commencement of the main earthworks (where possible), all known former infilled ponds and a pond identified at the northwest should be clearly identified and demarked and investigated to assess the nature of materials and the extent of any deleterious elements.

The location of known historic infilled ponds are identified within the E3P Historical Features Plan (Drawing 15-280-003 in Appendix III). Additionally, during the supplementary site investigation, a further pond was identified towards the northwest of the site, illustrated within Drawing 15-280-004 Site Features plan.

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-14 – Removal of Deleterious Material

The E3P Ground Investigation identified plastic, timber and other potentially deleterious materials within Made Ground across the site. 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.

RE-15 – Investigation and Removal of Historic USTs

During the remediation and enabling works, further investigation within the areas of historically mapped tanks will be required to confirm the presence and the exact location of any underground storage tanks (USTs). It is understood one tank has been filled with concrete with six filled with RG22 hard foam.

It is proposed to break out all hardstanding around the tanks and inspect their integrity. If the tank is found to be intact, hydraulic shears should be utilised to open the tank along the top and peel back the steel, thus rendering the tank an open vessel and no longer a tank form. The tanks should be checked for vapours using a lower explosive limit (LEL) meter. If they are deemed to be free of vapours, a 24-hour certificate will be issued, during which time the tanks should be rendered unusable (by cold cutting). Should the tanks contain any residual liquids, they should then be uplifted by the vacuum tanker or a surface-mounted pump (peristaltic or double-diaphragm).

Any tank backfill material will be broken up and removed from the tank structure by the excavator until the tank is sufficiently light to be lifted and emptied. All oversize materials will be stockpiled and checked for hydrocarbon impact pending chemical validation analysis. It is likely the material present inside the tanks will require disposal off-site, in accordance with UK waste management legislation. Any surrounding locally impacted materials will be excavated, removed and validated.

The sides and bases of excavations will need to be chemically validated to ensure that soils are below the site-specific remedial validation criteria for the protection of human health and controlled waters. All waste transfer certificates will be required to be retained and included within the remediation validation report.

RE-16 – Electricity Substation

Following the demolition of the current Electricity Substations and when access allows, soils in the vicinity of the electricity substations should undergo chemical analysis for PCBs. Should PCBs be identified, the Local Authority will be notified, and a remedial plan will be agreed prior to any works carried out in this area.



RE-17 – Historically Deposited Ash Fill

The review of desk study information and site investigation has identified an area of the central and northern sectors of the site to have been backfilled in the 1950s and 1960s with incinerated ash deposits.

This material needs to be lifted and sorted with unsuitable and deleterious elements to be segregated and removed.

The material will be subject to analysis and testing to confirm the engineering type in accordance with the geotechnical specification.

We need to have this as a specific and detailed operation so it is understood that this material will all be processed and engineered.

E3P have noted an EA comment from October 2024:

"The ashy waste materials deposited on the site have originated from a source unknown. This gives EA cause for concern that, specific to this area, there is the possibility of deposits of Radioactive Slag. As the materials are to be sorted for possible reuse and/or disposal, EA asks that the developer also consider observations for Radioactive slag being included in the ashy materials. Although EA appreciate that this would be contingency, could also report a methodology for dealing with this type of waste should it be present."

E3P can confirm that there are no sites within 1 km of the site that fall within the EA's radioactive substance register, and therefore deposition of this kind of waste is considered unlikely. If there is any further cause for concern, works will be halted immediately, and a mitigation plan will be agreed with the local authority prior to any further disturbance or reuse.

RE-18 – Cut-And-Filling of Made Ground to Development Levels

The Made Ground is noted to be present to substantial depth in some areas of the site (> 2 m). It is considered that it will be possible to utilise vibro stone columns (VSC) within areas of segregated and placed granular Made Ground to treat the currently unknown potential for differential settlement and ensure a uniform safe allowable bearing pressure (ABP) in the order of 125 kN/m².

Where the proposed enabling works levels require the current landform to be cut, extreme care should be taken so as not to disturb the underlying stratum prior to the placement of the appropriate platform, in compliance with the E3P Geotechnical Specification.

Where the development levels require material to be filled, site-derived Made Ground must be sorted in a controlled manner prior to replacement, in accordance with the requirements of this specification for the intended land use.

The maximum dry density must be determined in laboratory conditions utilising UKAS-accredited testing prior to the commencement of filling and compaction works. In-situ density testing is required to demonstrate compliance with the E3P Geotechnical Performance Specification.



RE-19 – Placement and Compaction of Upfill Material to Facilitate Ground Improvement by VSC

Where plots are to be prepared in a manner that will facilitate ground improvement by Vibro-stone column, materials must be either compliant with the specified grading requirements for a nominally placed and tracked granular aggregate, or alternatively, they should be engineered to a defined geotechnical standard.

Materials compliant with VSC grading for granular backfill: granular matrices are to be graded with all particles < 125 mm with no more than 10% fines (0.063mm).

Non-compliant material requiring engineering to geotechnical design: material is to be placed and engineered in accordance with the correct method for the Series 600 classification (1, 2 or 6) with moisture contents to be controlled within acceptable design limits. In-situ density to be confirmed to be > 95% of the laboratory determined maximum (2.5 kg) with < 5% air void ratio.

RE-20 – Construction of Temporary Working Platform

Where plots are to be prepared in a manner that will facilitate ground improvement by Vibro-stone column or a driven pile, 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
- ✳ Placement of 300 mm of certified 6F2 to be rolled and compacted to ensure a CBR > 6%.

RE-21 – 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 foundation where the target founding stratum is identified to be present at a depth of 1.5 m below finished floor level (FFL). Consideration is to be given to the need to construct a strip foundation ~200–400 mm into the natural stratum and the contractor remediation elevations.



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 (0.063 mm). 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-22 – Preparation of Ground for Vibro-Stone Columns Within Tree Influence

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

The zone of tree influence will be indicated within the foundation zoning plan and all resultant excavations and subsequent backfilling must be inspected and approved by E3P.

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

RE-23 – Importation of Bulk Fill

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

Imported material must be certified as suitable for use in strict accordance with the E3P chemical and geotechnical performance criteria (See Section 6) and in conjunction with the required duty of care notes and waste transfer exemption.

If recycled aggregates are imported, then laboratory testing should be completed to demonstrate compliance with the Waste and Resources Action Programme (WRAP) protocol.



Where inert soils are imported, laboratory testing should be completed in accordance with the requirements of the pertinent environmental permit (i.e. U1 Standard Rules) or CL:AIRE MMP for the reuse of clean, naturally occurring soils.

RE-24 – Preparation of Garden for Cover System

As part of the land remediation works, garden areas will be prepared in a manner that will facilitate the placement of the clean cover system during the development phase of the 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 deemed unsuitable for retention in a garden, the area will be subject to a reduced-level dig to remove unsuitable material to a minimum depth of 600 mm below finished garden level or verified natural stratum (whichever is the shallower).

Excavated soil will be stockpiled pending the results of the appropriate validation testing (to be completed in accordance with this specification) prior to reuse in an area of no sensitivity or, where necessary, this material will be removed from the 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 garden areas where a cover system is required will be subject to plot-specific independent validation.

RE-25 – Provision of Subsoil

The shallow natural drift deposits (predominantly granular and cohesive soils) are deemed 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 (regulated by an MMP) to generate the required volumes of material.

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-26 – Provision of Topsoil

No material that would be deemed suitable for use as topsoil is present on site and as such there will 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 3.9 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-27 – 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.

Particular attention will be taken during works in the area of the former petrol station, and a mitigation plan shall be put in place should any further contamination be identified in this area.

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-28 – 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-29 – Validation of Materials for 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 that necessitate the use of protected water supply pipe-work.

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 and, where necessary, chlorinated/halogenated compounds.



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

RE-30 – 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.

3.9. 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.

Upon removal of the hotspot of unsuitable Made Ground associated with elevated concentrations of contaminants of concern, 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 IV), E3P will undertake further assessment and recommendations on the appropriate use for the material in question, which may involve the disposal of such materials off site to a suitable waste management facility.

The sampling frequency for materials to be managed under the remediation strategy is presented within Table 3.2.



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. Lechate 2:1 Speciated PAH and Banded TPH.
- I. Leachate Analysis of Inorganic Heavy Metals, TPH, Sulphate and PAH.

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



3.10. 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 a 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 the 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 the reuse of materials on the site.

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



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.



5.3. MITIGATION OF RISK FROM SOILS WITH ASBESTOS FIBRES

5.3.1. PRE-COMMENCEMENT WORKS

Prior to the commencement of works the following requirements must be satisfied:

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

5.3.2. CONTROL, MONITORING AND REPORTING OF GENERAL AERIAL EMISSIONS FROM DUST AND PARTICULATES

DAMPING DOWN OF SOILS – MITIGATE PARTICULATE (DUST) EMISSION

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

If any previously unidentified asbestos-containing materials are identified, these should be dealt with in strict accordance with the *Control of Asbestos Regulations* (2012) and industry best practice as detailed in CIRIA 733.

GENERAL CONTROL OF DUST

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

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



PERSONAL PROTECTIVE EQUIPMENT (PPE)

In accordance with the HSE *Guidance Note em6: Asbestos Essentials, Personal protective equipment (including RPE)*, E3P recommend that all site operatives present within the work area where potential asbestos-impacted soils are being excavated are supplied with the following personal protective equipment:

Overalls:

- ✳ Disposable overalls.
 - Type 5 (BS EN ISO 13982-1) are suitable.
 - Cotton overalls hold dust and need specialist laundering.
- ✳ Waterproof overalls for outdoor work.
- ✳ Use oversized overalls - this will help to prevent ripping at the seams.
- ✳ If the cuffs are loose, seal them with tape.
- ✳ Avoid wearing a long-sleeved shirt as these are difficult to cover properly.
- ✳ Wear the overall legs over footwear as tucking them in lets dust into footwear.
- ✳ Wear the hood over the RPE straps.

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

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

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

- ✳ *Health & Safety at Work Act 1974;*
- ✳ *The Control of Asbestos Regulations 2012;*
- ✳ CL:AIRE, 2016. *Control of Asbestos Regulations 2012 - Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance;*
- ✳ *Approved Code of Practice L143 Work with materials containing asbestos;*
- ✳ *Management of Health and Safety at Work Regulations 1999;*
- ✳ *HSE Guidance Note HSG248 Asbestos, the analysts guide to sampling and analysis;*
- ✳ *HSE Guidance Note HSG247 Asbestos: The licensed contractors' guide; and*
- ✳ *CIRIA 733 Asbestos in soil and made ground: a guide to understanding and managing risks.*



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

Once any monitoring has been analysed by the on-site UKAS-accredited laboratory, the results will be delivered to the resident engineer who will then follow the correct site procedure. The results will then be included in the verification report.



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:

- ✚ Preparation of plot footprint (+ 2 m on all elevations) to be suitable for ground improvement by vibro-stone column or driven piled foundations, where depth of stiff clay/medium-dense sands exceeds 2.50 m from proposed finished floor level (FFL).
- ✚ Preparation of plot footprint (+ 2 m on all elevations) to be suitable for driven piled foundations, where soft CLAYs have been identified.
- ✚ Preparation of plots to be suitable for construction with a shallow spread foundation where firm to stiff clay and medium-dense sands are present at a depth < 1.5 m from proposed FFL across the complete plot.
- ✚ Preparation of plots to be suitable for construction with mass trench where firm to stiff clay and medium dense sands are present at a depth of between 1.50m and 2.50mbgl. from proposed FFL across the complete plot or in areas of tree influence
- ✚ 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 upfill and level the site with material won from the development area. From the site-specific investigations undertaken to date, it is expected that the majority of the soils won from the processing of demolition material will be granular and cohesive soil matrices.

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. GENERAL OVERVIEW OF FILL REQUIREMENTS

Method Compaction – Fill to Infrastructure & External Areas: Material to be classified by Type (i.e. Class 1 or 2, etc.) using the prescribed pre-commencement testing, the correct compaction method to be selected from MCHW Series 600. Materials are to be placed in accordance with the prescribed method, with moisture content and particle size distribution to be within the defined control limits. Upfilling and compaction works are to be in accordance with NHBC Chapter 4.6 which requires fill <5.00m to be engineered and validated to ensure the Maximum Dry Density is >90% with <10% air voids.

End Product Compaction – Fill to Structures: Material to be classified by Type (i.e. Class 6I or 7, etc.) using the prescribed pre-commencement testing, which will include determination of the laboratory defined Maximum Dry Density and Optimum Moisture Content (DD/OMC). Material will be placed and engineered with in-situ validation testing to demonstrate that the performance requirements for the fill material have been achieved to the satisfaction of the supervising engineer. It is understood that fill to structures will not be completed on the subject site, with foundations bearing onto the underlying natural drift deposits.

E3P has provided a generalised synopsis of typical engineering requirements for differing residential development sectors and the likely geotechnical engineering performance requirements.

6.4. 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.

6.4.1. 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;
-  Selected granular fill (Class 6); and,
-  Selected cohesive fill (Class 7).

6.4.2. 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 as defined herein to ensure that the geotechnical properties and method for placement and engineering can be determined prior to the commencement of works on-site.

The Main Contractor will instigate, arrange and manage the completion of the requisite pre-commencement testing prior to the start of any earthworks.



TABLE 6.1 E3P EARTHWORKS – GENERALISED PRECOMMENCEMENT TESTING SPECIFICATION

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY	PERFORMANCE REQUIREMENT
Method Compaction Fill to infrastructure, external areas and beneath proposed plot areas Engineered Up-Fill (To be completed prior to upfilling)	All bulk fill - Class 1 and Class 2 – Site-generated screened natural sand & gravel or clay materials.	Particle Size Distribution (PSD) and Natural Moisture Content	1 per 1000 m3	Grading to Class 1 or 2
		Compaction Tests using 4.5 kg rammer for granular (Class 1) and 2.5 kg for cohesive (Class 2) – Optimum Moisture Content and Maximum Dry Density	1 per 2000 m3	Moisture content to be within 2% (+/-) of the laboratory-determined optimum.



TABLE 6.2 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



6.4.3. 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.

6.5. 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 earthworks specification assigned to individual areas.



TABLE 6.3 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- Stone Column (VSC)	Materials to be placed in a controlled manner to facilitate the construction of vibro-replacement stone columns (VSC). 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. The material must be 90% granular in composition with less than 10% fines (which are classified as materials < 0.6 mm 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 the 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). 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 on 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 footprints (+ 2 m) must be free of any deleterious elements, tree roots and obstructions > 150 mm. Where upfill is proposed, the material is to be placed using method compaction specification to achieve a CBR as required by the developer for piling mat construction. The 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 the 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 a 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 and will be responsible for ensuring that all relevant permits and consents are in place if 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.

6.5.1. CONSTRUCTION OF FILLS – HIGHWAYS & EXTERNAL INFRASTRUCTURE

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.

6.5.2. 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.

6.5.3. 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.



6.6. 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 6.4.

TABLE 6.4 COMPACTION/BACKFILL REQUIREMENTS

TABLE 3.1: COMPACTION/BACKFILL REQUIREMENTS		COMPACTION METHODOLOGY and GENERAL PERFORMANCE CRITERIA
LAND USE		
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:		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

6.7. SPECIFICATION FOR GROUND IMPROVEMENT BY VIBRO-STONE COLUMN

The over-arching method and specification for the placement and compaction of non-compliant material where the fine constituent (< 0.63 micron) exceeds the standard requirements for ground improvement by VSC is given in Table 6.5 & 6.6.



TABLE 6.5 OVERVIEW OF WORKS OPERATIONS

Step 1	Carefully segregate materials excavated during civil engineering works (on-site and import) into the following soil types: ☒ Sand/granular soils; ☒ Dry sandy clay; ☒ Wet clay soil; and ☒ Silt. Ensure all stockpiles are sealed to minimise water ingress in approved locations.
Step 2	Analyse bulk sample from each (site-won or imported) soil matrix as per the requirements of the E3P specification for: ☒ Dry density/optimum moisture content (Procter); and ☒ Particle size grading coefficient.
Step 3	On-site observations in conjunction with particle size distribution (PSD) grading will confirm the classification of material and thus the corresponding method for compaction.
Step 4	The dry density/moisture content testing should be used to ensure that the material is within $\pm 3\%$ of the optimum to ensure compaction can be achieved.
Step 5	The classified material should be placed and compacted in accordance with the corresponding method for the material under conditions where the moisture content is within the tolerable limits.
Step 6	Once placed and compacted, the required validation testing should be completed at formation to demonstrate compliance. The testing will include: ☒ In-situ density and air void ratio; ☒ Moisture condition value; and ☒ Undrained shear strength.



TABLE 6.6 COMPACTION AND VALIDATION OF NON-STANDARD MATERIAL BACKFILL TO VSC

REQUIRED PARAMETERS		THE COMPACTION MUST ACHIEVE THE FOLLOWING MATERIAL PARAMETERS:	
Verification Testing and Report	Bulk Density (ρ)	95% of the maximum dry density and must be within 3% of the optimum moisture content.	
	All materials used for upfilling must be durable and inert.		
	In order to verify that the aforementioned material parameters have been attained, representative sampling and testing must be undertaken. All testing will be in accordance with BS EN ISO 17892-1:2014 and BS EN ISO 17892-2:2014. All testing is to be undertaken by a laboratory with the relevant UKAS accreditation. The following tests are required:		
	In-situ Density (ρ)	Approved methods of in-situ testing (i.e. calibrated nuclear density probe (NDP), sand replacement test).	
	Moisture Content	Moisture content test.	
	In-situ density testing on every 500 m ³ and in each layer of upfill well-spread over site within and around the proposed structures' footprint.		
	Testing must be from a range of depths throughout the treated fill. A minimum of six samples must be taken and tested.		
	A drawing depicting the location of each sample and test point must be provided along with a list of each point and the relevant test/sample depth. A list of all geotechnical testing results for each sample and test must be provided along with the relevant test certificates.		
	If the soils are not suitable, due to the moisture content being higher than the optimum moisture content, then lime modification may also be required.		
	The above is given strictly on the basis that it does not conflict with other elements of the project-specific requirements.		

6.8. CURRENT AND PROPOSED SITE TOPOGRAPHY AND SLOPE INTERACTION

The current and proposed site topography, changes in elevation and any existing or new slopes are beyond the scope of this specification. Where any earth slopes exceed a design gradient of 1(v) in 3(h) either on site or within the conjectured zone of structural influence, extreme care should be taken with a full and detailed geotechnical slope analysis to inform the retained design solution.



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 topsoil;
- ✿ Chemical validation of any additional subsoil imported for use within gardens;
- ✿ Placement and validation of sub-soil (clean material) in a 450mm layer within any plots where the material was not placed during the Remediation & Enabling works;
- ✿ Placement and chemical validation of imported topsoil within all gardens; and,
- ✿ Installation and validation of ground gas protection measures.

This document does not cover the build phase validation items such as ground gas mitigation, which will be addressed under a separate report cover detailing the mitigation measures required in the construction of new dwellings at the subject site. A site-specific ground gas mitigation design report will be required to define the construction and verification requirements.

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:

- ✿ 450mm subsoil; and,
- ✿ 150mm topsoil.
- ✿ Break layer (where required)

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.

It is recommended that in the areas of known infilled ground across the site, a break layer is included to limit any cross contamination with any observed Made Ground. Where earthworks provide a cut of material into natural deposits, a break layer can be omitted.

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 sub-soil to classify its re-use on site has been completed as part of the remediation works undertaken. Therefore, further analysis of sub-soil 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 top-soil and sub-soil are presented in Table 9.1.



TABLE 9.1 SPECIFICATION FOR SOIL TESTING

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
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.

9.1.1. PROCEDURE FOR PLACEMENT OF CHEMICALLY SUITABLE COVER SYSTEM

Garden and landscaped areas need to be backfilled with 450mm chemically validated subsoil, with 150mm topsoil overlaying this. Topsoil is required to be confirmed as chemically suitable prior to placement. Where sub-soil is not placed during Remediation & Enabling works, E3P will be required to return to site and undertake independent validation of the correct placement of sub-soil.

The placement of 600mm of clean material will be undertaken during the build phase works of the project.

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

If proposed utilities are to be placed within the cover system, the clean cover should be placed prior to installation of these utilities.

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 garden systems. E3P will issue an email to the appropriate party with an assessment of the chemical suitability of both sub soils and top soils. 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 given that the 600mm cover system will need to be placed on each plot during the build phase.
Validation	Photographic evidence will be taken by E3P of the topsoil placement demonstrating the depth of topsoil and practical completion of works are required for each and every plot. For plots where sub-soil depths require validation by E3P during the build phase, photographs will be taken and collated by E3P.
Validation Certificate	Once the photographs of the placement of topsoil (over the clean material) have been provided, E3P will issue a plot specific validation certificate to demonstrate that the required subsoil and topsoil has been placed in the required garden plots along with the chemical analysis.
Completion Report	Upon completion of all 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: 70		
Depth of Strata (m bgl)	0.00-0.15	Validated TOPSOIL
	0.15-0.60	Validated SUBSOIL
Depth of Cover System Materials		Depth of Cover System Materials
		
Depth of Cover System at Ground Level		Depth of Cover System in Relation to Plot
		



9.2. POTABLE WATER SUPPLY – CONTAMINANT ASSESSMENT CRITERIA

Table 9.3 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 9.3 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



Cherryfield Drive

Remediation and Enabling Works Strategy

October 2024

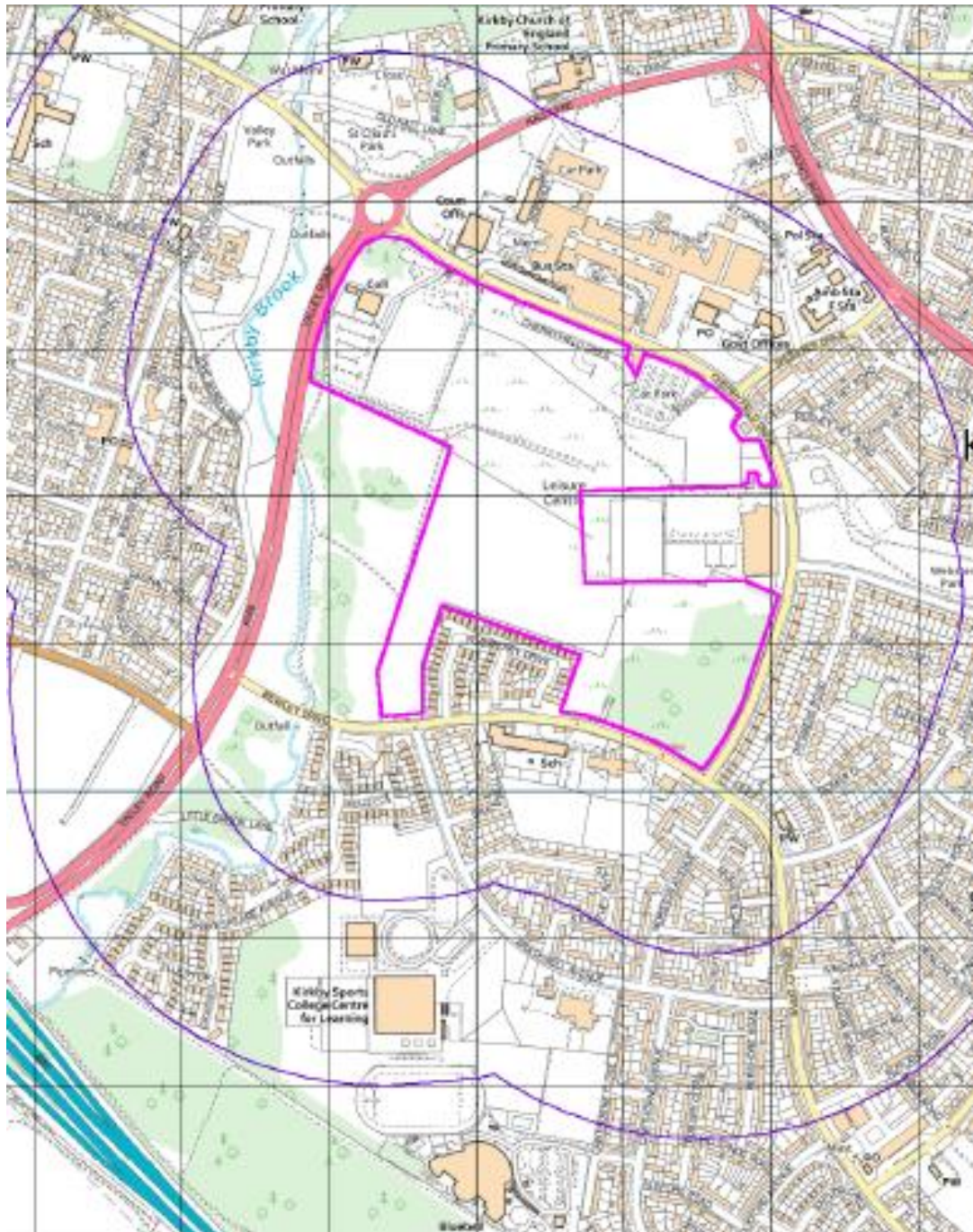
m	Metres	ppm	Parts per million
km	Kilometres	mg/m³	Milligram per metre cubed
% v/v	Percent volume in air	m bgl bgl	Metres below ground level
mb	Millibars (atmospheric pressure)	m bcl	Metre below cover level
l/hr	Litres per hour	mAOD	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts 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 15-280-001 – SITE LOCATION PLAN





Historical Features

	Former Residential Buildings		Former Garage / Petrol Filling Station
	Former School / College Buildings		Substations
	Former Buildings		Former Track
	Former Tennis Courts		Former Embankment
	Former Running Track		Former Tennis Courts
	Former Footpath		Former Gravel Pit
	Former Car Park		
	Former Woodland		
	Former Pond		

Notes:

P1	REVD	25.04.2022	LM	RH
P1	REVC	22.04.2022	LM	RH
P1	REVB	07.12.2021	LM	RH
P1	REVA	02.12.2021	LM	JB
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

003

Date:

25.04.2022

Scale:

1:1000 @ A3

Drawing Title:

Historical Features Plan



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.



Historical Features

Overgrown Vegetation	Seven Underground Storage Tanks	Pallisade Fencing
Short grass	Covid-19 walkthrough testing site	Footpath
Trees	Gas Substation Buildings	Metal Fencing
Dense Trees (Recently Removed)	Bollards	Gate
Dense Trees	Electrical Substations	Locked Gate
Road	Fly Tipped Material	Slope
Car Parks	Brambles	Pond
Hardstanding	Former Housing Slabs	
Knowsley Community College	Wooden Fence	

Notes:

P1	REVD	13.05.2024	OW	BH
P1	REVC	25.04.2022	LM	BH
P1	REVB	21.04.2022	LM	BH
P1	REVA	20.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

004

Date:

13.05.2024

Scale:

1:1000 @ A3

Drawing Title:

Site Features Plan



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

- WS101 Approximate Window Sample Probehole Location (E3P January 2022)
- TP101 Approximate Trial Pit Location (E3P January 2022)
- RH101 Approximate Rotary Borehole Location (E3P January 2022)
- WS201 Approximate Window Sample Probehole Location (E3P November 2023)
- WS201(MW) Approximate Window Sample Probehole Location with Install (E3P November 2023)
- TP201 Approximate Trial Pit Location (E3P November 2023)

Notes:

P1	REVO	15.05.2024	EB	BH
P1	REVN	13.03.2024	EB	PW
P1	REVM	30.01.2024	EB	ID
P1	REVL	08.01.2024	OW	ID
P1	REVK	25.04.2022	LM	RH
P1	REVJ	22.04.2022	LM	RH
P1	REVI	20.04.2022	LM	JB
P1	REVI	04.03.2022	LM	NG
P1	REVG	24.02.2022	LM	NG
P1	REVF	03.02.2022	LM	JB
P1	REVE	28.01.2022	LM	NG
P1	REVD	26.01.2022	LM	NG
P1	REVC	19.01.2022	LM	NG
P1	REVB	07.01.2022	EB	EB
P1	REVA	07.12.2021	LM	JB

Phase	Issue	Date	Drawn	Checked
-------	-------	------	-------	---------

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

005

Drawing Title:

Exploratory Hole
Location Plan

Date:

15.05.2024

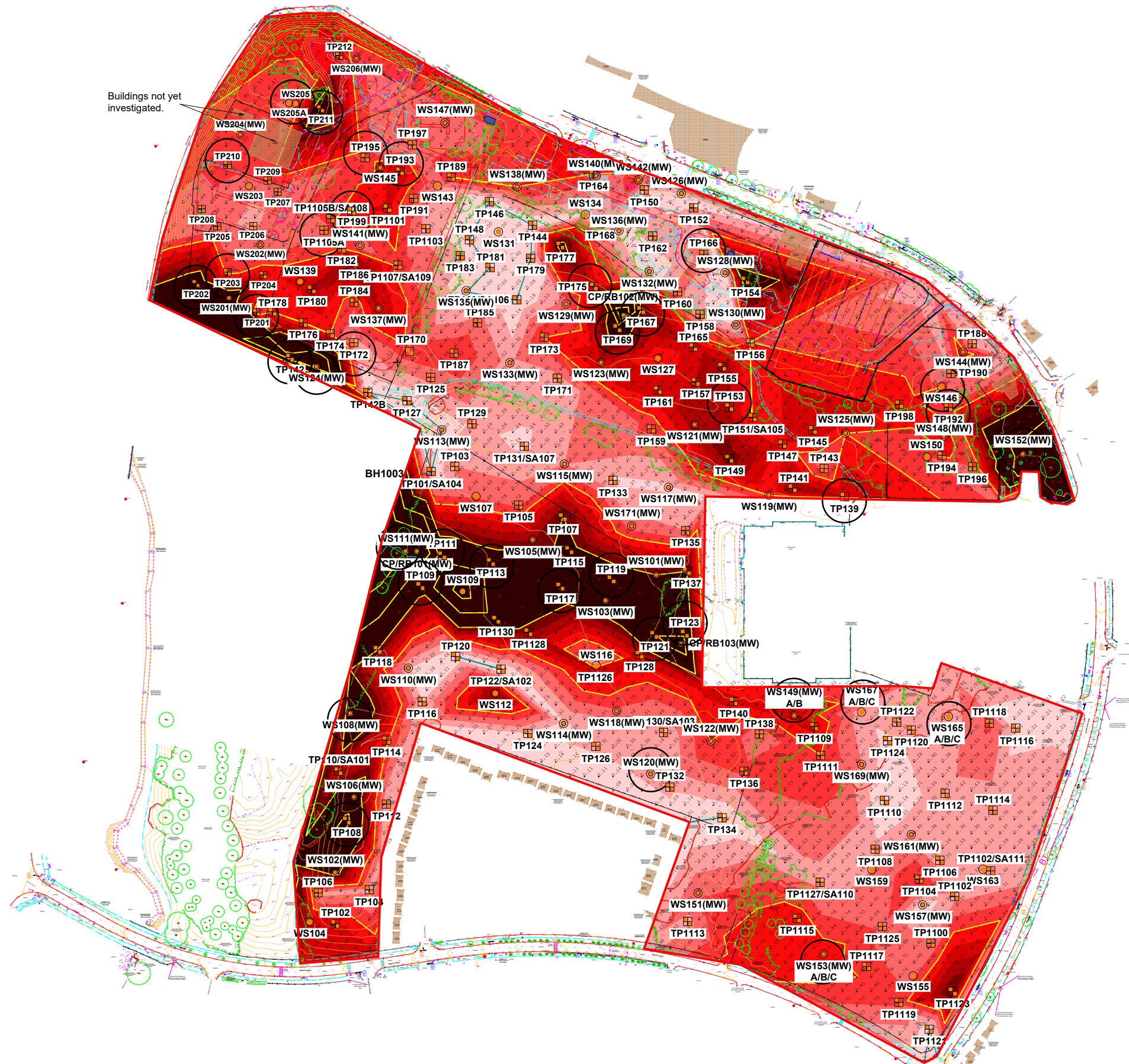
Scale:

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
- Approximate Window Sample Probehole Location
 - Approximate Trial Pit Location
 - Approximate Rotary Borehole Location
 - Full Extent of Made Ground Not Encountered

- Made Ground Depth (m)
- Depth of Made Ground 0.00
 - Depth of Made Ground 0.01 - 0.49m
 - Depth of Made Ground 0.50 - 0.99m
 - Depth of Made Ground 1.00 - 1.49m
 - Depth of Made Ground 1.50 - 1.99m
 - Depth of Made Ground 2.00 - 2.49m
 - Depth of Made Ground 2.50 - 2.99m
 - Depth of Made Ground 3.00 - 3.49m
 - Depth of Made Ground 3.50 - 3.99m
 - Depth of Made Ground 4.00 - 4.49m
 - Depth of Made Ground 4.50 - 4.99m
 - Depth of Made Ground >5.00m

Notes:

P1	REVF	16.05.2024	EB	BH
P1	REVE	28.02.2024	EB	PW
P1	REVD	30.01.2024	EB	ID
P1	REVC	09.01.2024	OW	ID
P1	REVB	25.04.2022	LM	BH
P1	REVA	27.01.2022	LM	NG
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

006

Drawing Title:

Depth of Made Ground Plan

Date:

16.05.2024

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

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Rotary Borehole Location

Natural Topsoil Depth (m)

- Depth of Natural Topsoil 0.00
- Depth of Natural Topsoil 0.01 - 0.09m
- Depth of Natural Topsoil 0.10 - 0.19m
- Depth of Natural Topsoil 0.20 - 0.29m
- Depth of Natural Topsoil 0.30 - 0.39m
- Depth of Natural Topsoil >0.40

Notes:				
P1	REVF	15.05.2024	EB	BH
P1	REVE	01.03.2024	EB	PW
P1	REVD	28.02.2024	EB	PW
P1	REVC	30.01.2024	EB	ID
P1	REVB	25.04.2022	LM	JB
P1	REVA	31.01.2022	LM	NG
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

007

Date:

15.05.2024

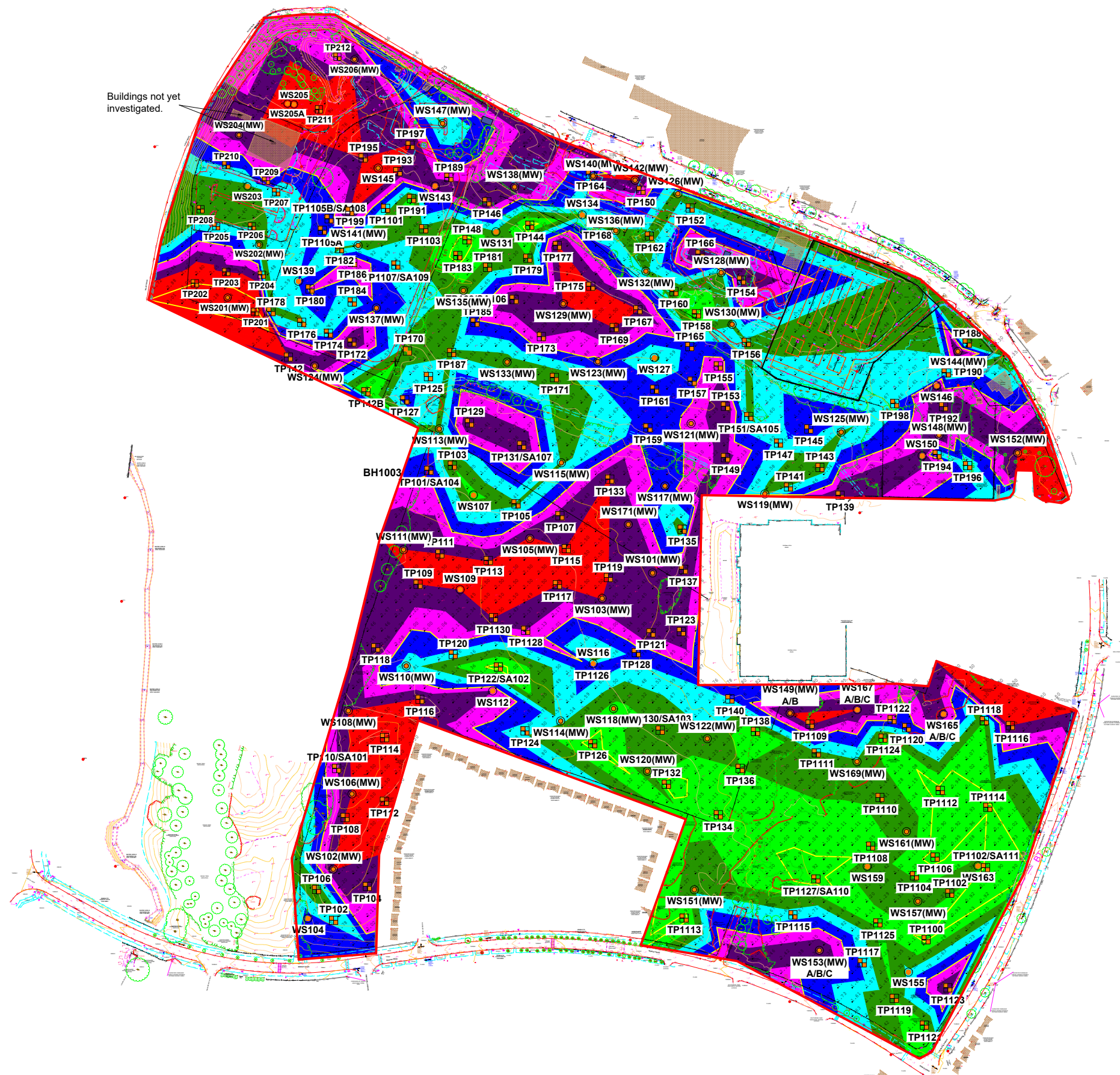
Scale:

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

- Approximate Window Sample Probehole Location
- Approximate Trial Pit Location
- Approximate Rotary Borehole Location

Shallow Spread Footings

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

Mass Trench Fill Footings

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

Engineered Footings

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

Notes:					
P1	REVF	15.05.2024	EB	BH	
P1	REVE	28.02.2024	EB	PW	
P1	REVD	30.01.2024	EB	ID	
P1	REVC	09.01.2024	OW	ID	
P1	REVB	25.04.2022	LM	BH	
P1	REVA	21.04.2022	LM	BH	
Phase	Issue	Date	Drawn	Checked	

Client:

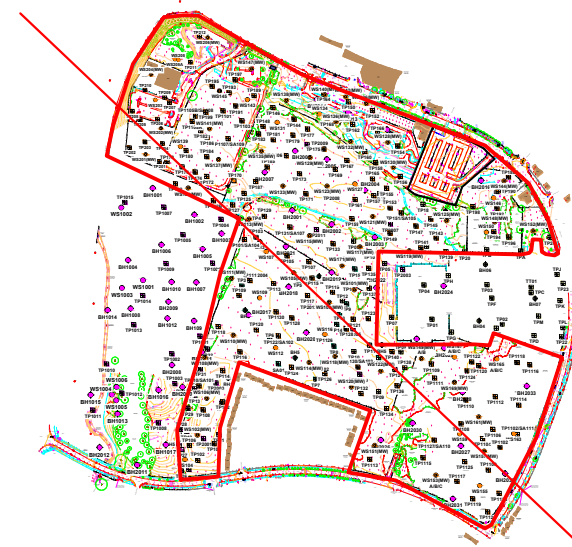
DWH

Cherryfield Drive, Kirkby

Job No:	15-280	Date:	15.05.2024
Drawing No:	008	Scale:	NTS @ A3
Drawing Title:		Depth to Founding Strata Plan	

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.



Geology Key Made Ground Clay Interbedded Clay & Sand Bedrock Groundwater	Sources 1 Heavy Metals, Non volatile PAH 2 Napathalene 3 TPH 4 Mercury 5 Asbestos 6 Ground Gases (Methane / CO2)	Receptors 1 Future End Users 2 Construction Works 3 Construction Materials 4 Groundwater (Bedrock) 5 Groundwater (Drift) 6 Water Pipelines 7 Flora / Fauna	Pathways Inhalation / Accumulation Dermal Contact / Ingestion Plant Uptake Tainted Water Supply Vertical Migration Horizontal Migration Sulphate Attack on Concrete	Site Features Proposed Residential Development	Notes:					Client: DWH		Job No: 15-280		Date: 13.05.2024		e3p 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
					P1 REVE 13.05.2024 OW BH P1 REVD 11.03.2024 EB PW P1 REVC 28.02.2024 EB PW P1 REVB 25.04.2022 LM JB P1 REVA 16.03.2022 EB NG Phase Issue Date Drawn Checked					Job Title: Cherryfield Drive, Kirkby		Drawing No: 010		Scale: NTS@ A3		
										Drawing Title: Conceptual Site Model		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

Approximate Window Sample Probehole Location

Approximate Trial Pit Location

Approximate Rotary Borehole Location

Contamination Exceedances

Heavy Metals

Mercury

Asbestos

Naphthalene

PAHs

Dibutyl phthalate

Notes:					
P1	REVD	15.05.2024	EB	BH	
P1	REVC	13.05.2024	OW	BH	
P1	REVB	30.01.2024	EB	ID	
P1	REVA	20.04.2022	LM	BH	
Phase	Issue	Date	Drawn	Checked	

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

018

Date:

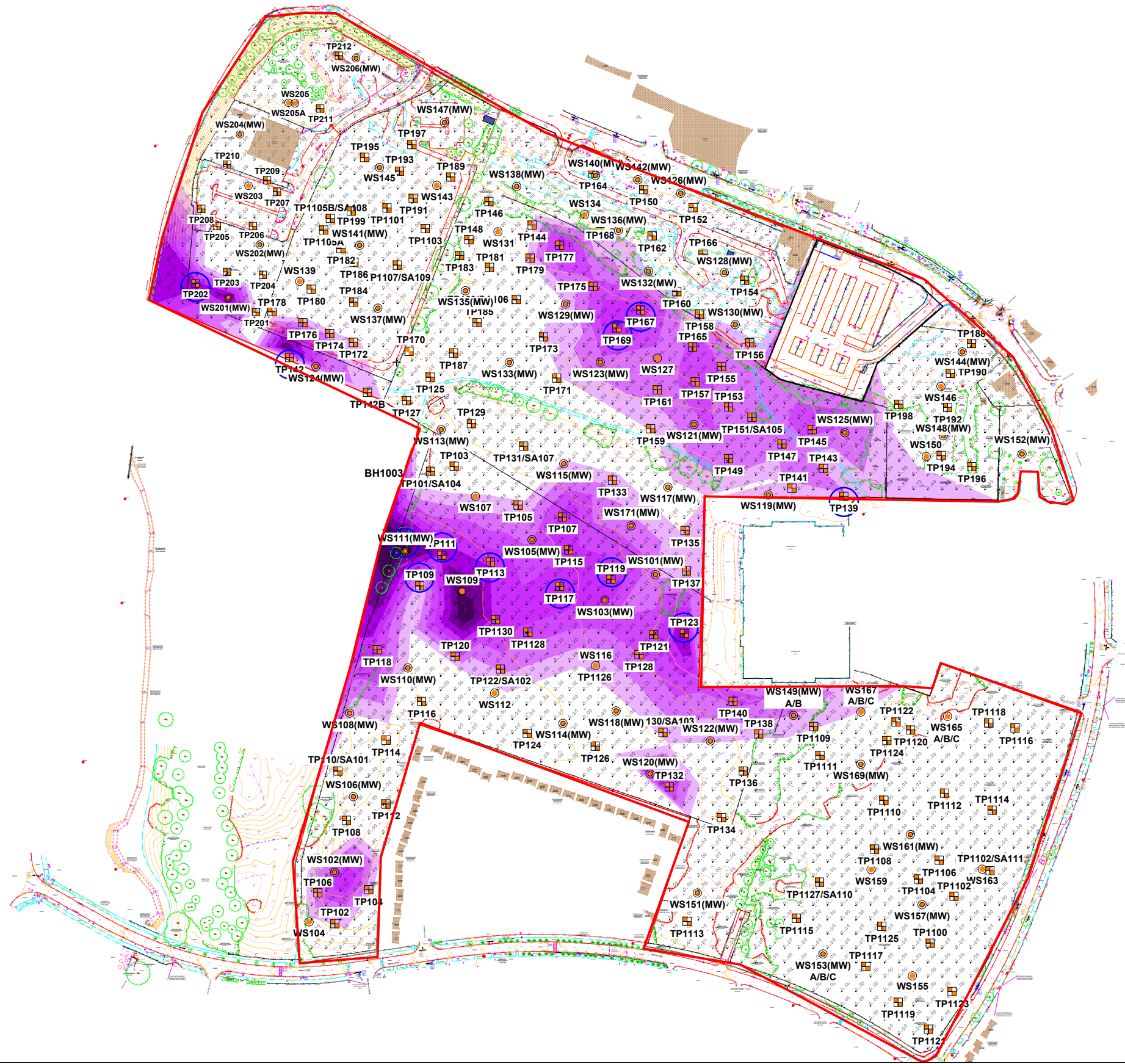
15.05.2024

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

Approximate Window Sample Probehole Location

Approximate Trial Pit Location

Approximate Rotary Borehole Location

Landfill Thickness (m)

Thickness of Landfill 0.00

Thickness of Landfill 0.01 - 0.49m

Thickness of Landfill 0.50 - 0.99m

Thickness of Landfill 1.00 - 1.49m

Thickness of Landfill 1.50 - 1.99m

Thickness of Landfill 2.00 - 2.49m

Thickness of Landfill 2.50 - 2.99m

Thickness of Landfill >3.00

Base of Landfill Not Proven

Landfill Depth (m)

Depth of Landfill

Notes:

P1	REVF	15.05.2024	EB	BH
P1	REVE	02.04.2024	EB	PW
P1	REVD	25.04.2022	LM	BH
P1	REVC	03.02.2022	LM	JB
P1	REVB	31.01.2022	LM	NG
P1	REVA	28.01.2022	LM	NG
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job No:
15-280

Date:
15.05.2024

Drawing No:
023

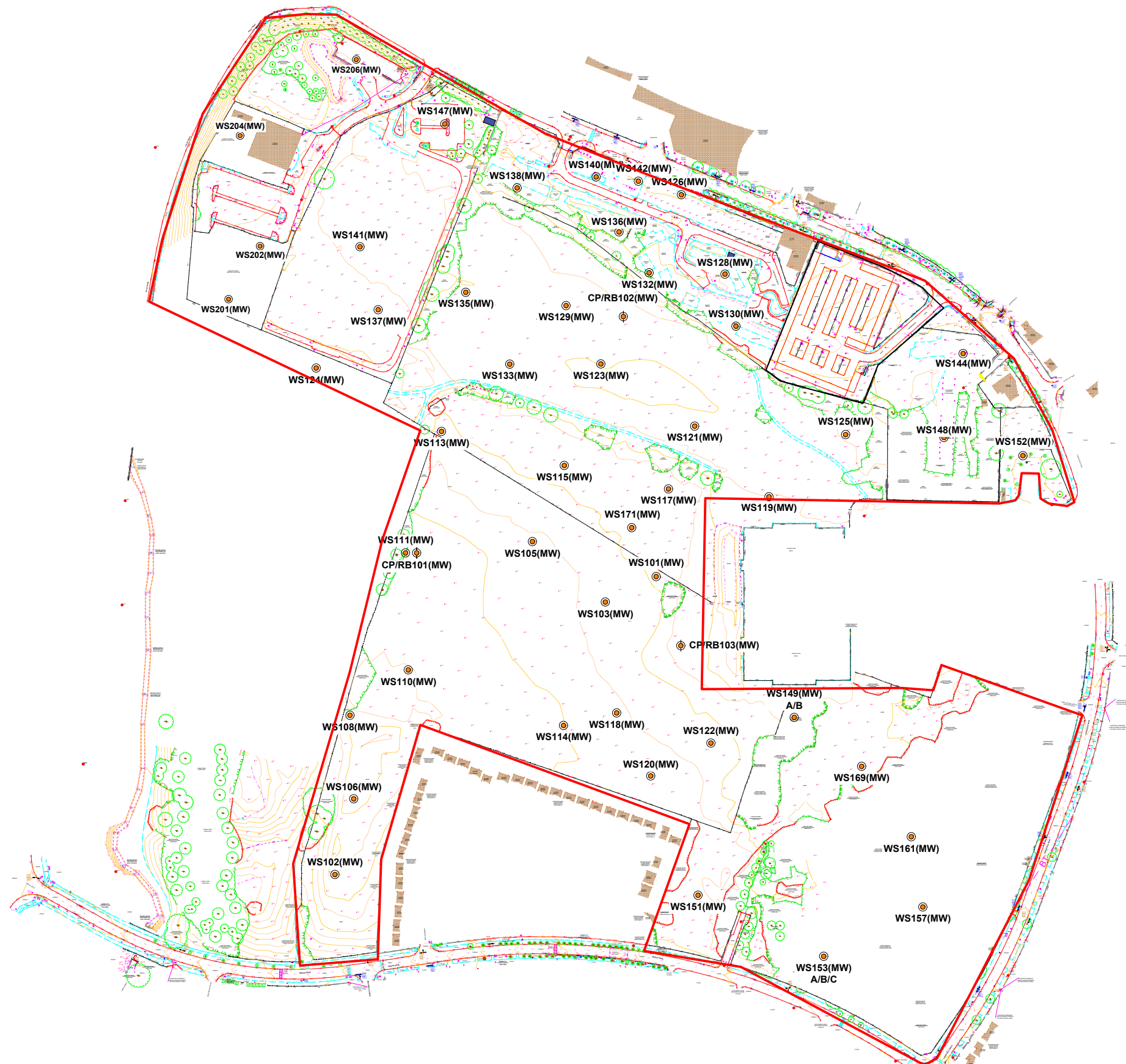
Scale:
NTS@ A3

Job Title:
Cherryfield Drive, Kirkby

Drawing Title:
Depth and Thickness of
Historically Deposited Made
Ground Materials Plan

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

Window Sample with Monitoring Well

Cable Percussive / Rotary Boreholes Location

Notes:

P1	REVF	15.05.2024	EB	BH
P1	REVE	02.04.2024	EB	PW
P1	REVD	18.08.2022	EB	BH
P1	REVC	04.03.2022	LM	BH
P1	REVB	09.02.2022	LM	BH
P1	REVA	08.02.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

027

Date:

15.05.2024

Scale:

NTS@ A3

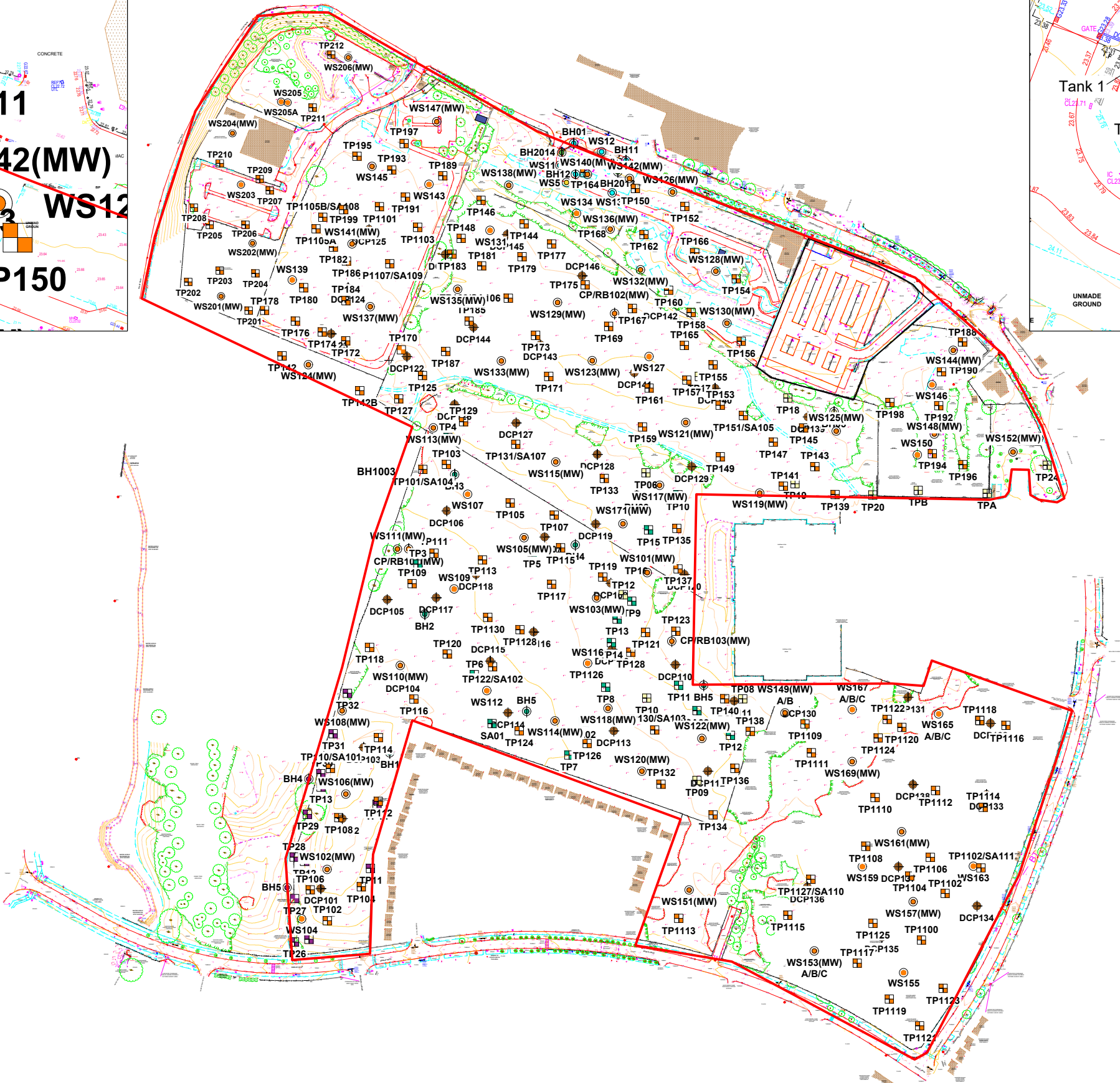
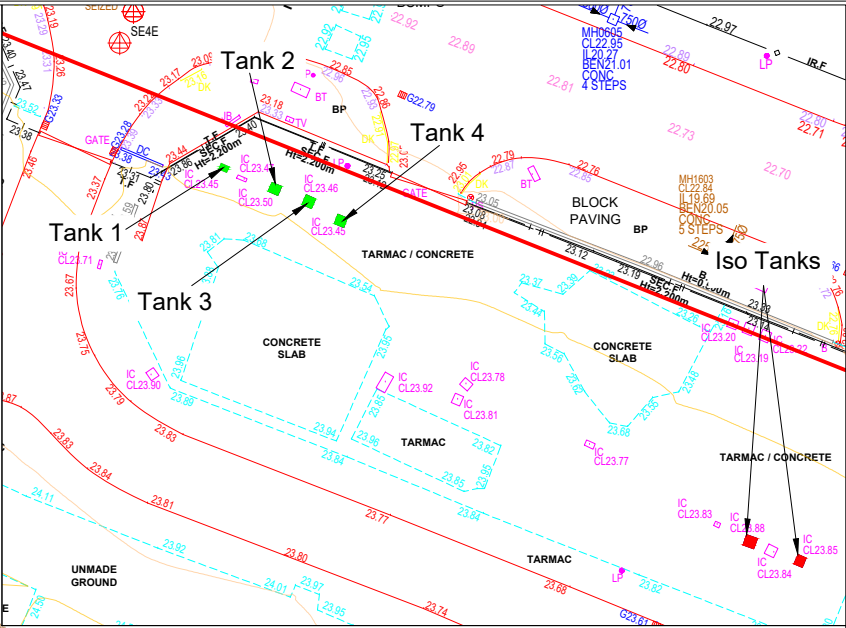
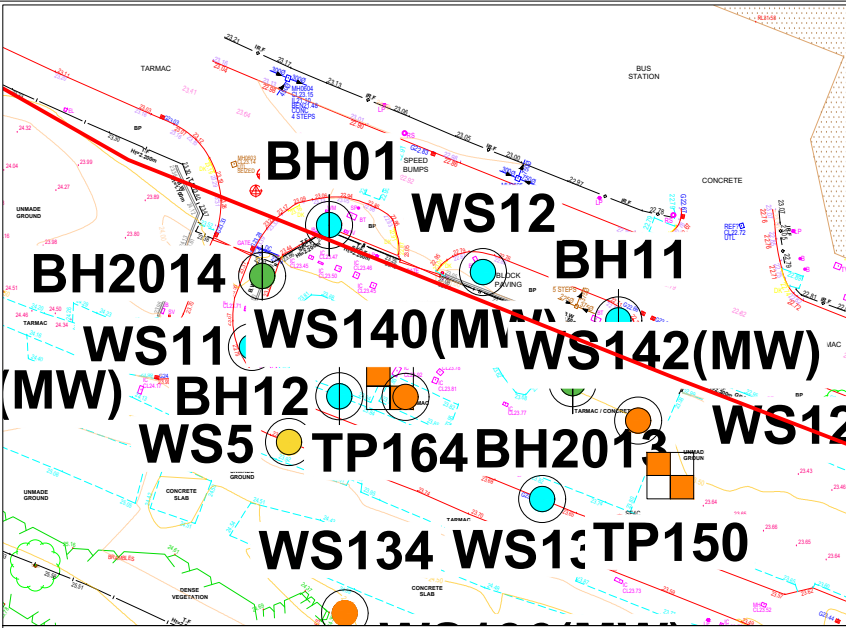
Drawing Title:

Window Sample with
Monitoring Well Location Plan



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**
- WS101 Approximate Window Sample Probehole Location
 - TP101 Approximate Trial Pit Location
 - BH101 Approximate Rotary Borehole Location
 - WS101 Approximate Window Sample Probehole Location (Clancy Consulting)
 - BH101 Approximate Rotary Borehole Location (Baro Happold Boreholes)
 - TP101 Approximate Trial Pit Location (Abatec 2006)
 - BH101 Approximate Rotary Borehole Location (Atkins Rotary holes)
 - WS101 Approximate Window Sample Probehole Location (Atkins Rotary holes)

- Tanks**
- Tanks
 - Iso Tank

Notes:

P1	REVD	15.05.2024	EB	BH
P1	REVC	13.05.2024	OW	BH
P1	REVB	02.04.2024	EB	PW
P1	REVA	25.04.2022	LM	BH
Phase	Issue	Date	Drawn	Checked

Client:

DWH

Job Title:

Cherryfield Drive, Kirkby

Job No:

15-280

Drawing No:

031

Date:

15.05.2024

Scale:

NTS@ A3

Drawing Title:

Garage and Petrol Filling
Station Area Plan



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.

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 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₆ -C ₈ (aliphatic)	mg/kg	100 ^{(i)(xi)}	100 ^{(ii)(xi)}	100 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₈ -C ₁₀ (aliphatic)	mg/kg	27 ^{(i)(xi)}	27 ^{(ii)(xi)}	27 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₀ -C ₁₂ (aliphatic)	mg/kg	130 ^{(i)(xi)}	130 ^{(ii)(xi)}	130 ^{(ii)(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)}	1
TPH C ₁₆ -C ₂₁ (aliphatic)	mg/kg	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	1000 ^{(xiv)(xi)}	10,000 ^{(xiv)(xi)}	1
TPH C ₂₁ -C ₃₅ (aliphatic)	mg/kg					1
TPH C ₅ -C ₇ (aromatic)	mg/kg	70 ^{(i)(xi)}	370 ^{(ii)(xi)}	370 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₇ -C ₈ (aromatic)	mg/kg	130 ^{(i)(xi)}	860 ^{(ii)(xi)}	860 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₈ -C ₁₀ (aromatic)	mg/kg	34 ^{(i)(xi)}	47 ^{(ii)(xi)}	47 ^{(ii)(xi)}	10,000 ^{(xiv)(xi)}	2
TPH C ₁₀ -C ₁₂ (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	
TPH C5-C6 (benzene)	µg/l	10	50	1
TPH C6-C8 (toluene)	µg/l	74	–	700
TPH C8-C10 (ethyl benzene)	µg/l	20	–	300
TPH C10-C12 (xylene)	µg/l	30	–	500
TPH C12-C16	µg/l	2	130	90 ⁵
TPH C16-C35	µg/l	50#	50#	90 ⁵
TPH C5-C6	µg/l	–	–	15000
TPH C6-C8	µg/l	–	–	15000
TPH C8-C10	µg/l	–	–	300
TPH C10-C12	µg/l	–	–	300
TPH C12-C16	µg/l	–	–	300



Cherryfield Drive

Remediation and Enabling Works Strategy

October 2024

DETERMINAND	UNIT	EQS SCREENING VALUE ^{1, 2, 3}		DWS ^{3,4,5}
		AA	MAC	
TPH C16 – C21	µg/l	–	–	300**
TPH C21-C35	µg/l	–	–	300**
Tetrachloroethylene	µg/l	0.4	–	10
Trichloroethylene	µg/l	10	–	10
Trichlorobenzene	µg/l	0.4	–	–
Trichloromethane	µg/l	2.5	–	–
Dichloromethane	µg/l	20	–	200
Carbon Tetrachloride	µg/l	12	–	3
Vinyl Chloride	µg/l	–	–	0.3

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



Cherryfield Drive

Remediation and Enabling Works Strategy

October 2024

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-REMEDATION AND ENABLING LIMITATIONS

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



