Remediation and Enabling Works Strategy

Site: Riverpark Road, Manchester
Reference: 17-246-R3-8
Date: March 26



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15-974-R1-001 - Site Location Plan
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15-974-R1-004 - Site Features Plan
15-974-R1-005 - Exploratory Hole Location Plan
15-974-R1-006 - Depth of Made Ground Plan
15-974-R1-008 - Depth to Founding Strata Plan
15-974-R1-009 - Conceptual Foundation Zoning Plan
15-974-R1-010 - Controlled Waters Conceptual Site Model
15-974-R1-012 - Depth to Bedrock Plan
15-974-R1-015 - Development Constraints Plan
15-974-R1-018 - Contamination Issues Plan
15-974-R1-027 - Human Health Conceptual Site Model (Current/Historic Uses)
15-974-R1-028 - Human Health Conceptual Site Model (Residential End Uses)
Section Line 1 - East-West Cross Section
Section Line 2 - South-North Cross Section
Kellen Homes Drawing KH012-Q

1. INTRODUCTION

1.1. BACKGROUND

E3P has been instructed by Kellen Homes to develop a remediation and enabling works strategy for the proposed residential development at Riverpark Road, Manchester.

Kellen Homes is in the process of submitting a detailed planning application to the local planning authority for the proposed redevelopment of the site for residential housing and multistorey apartments with associated adopted estate roads and infrastructure.

As part of the planning approval process, the planning authority will require the submission of a remediation strategy. This report is intended for submission to the regulatory bodies to outline the necessary remediation and enabling works required to render the site suitable for future residential development.

This report has additionally been prepared to highlight the contractor's requirements.

1.2. SITE DETAILS

Site Address	Riverpark Road, Manchester, M40 2XP
National Grid Reference	E 387308, N 399470
Site Area	7.43 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 17-246-001.

1.3. REPORT OBJECTIVES

This report aims to present a remediation and enabling works strategy to discharge relevant aspects of a standard contamination planning condition.

To achieve this, the report presents details of the remedial objectives, presents the findings of a remedial options appraisal, describes how the remediation of the site will be undertaken and specifies how the works will be validated. In addition, the strategy explains how the works will be permitted under the current regulatory regime.

This document, therefore, describes the steps that need to be taken during the enabling works and construction phases to prepare the site for residential end use.

Depending on the conditions encountered, this working document may need to be updated in agreement with the relevant regulatory authorities at any stage during development.

1.4. SCOPE OF WORKS

This report has been written in general accordance with Land Contamination: Risk Management (LCRM) (Environment Agency, July 2023). The scope of this Remediation Strategy and Remedial Options Appraisal comprises:

- A summary of background information and the conceptual model;
- An overview of the results of risk assessment undertaken at the site;

- Identification of geotechnical constraints;
- A remediation options assessment including a selection of final remediation options; and,
- A methodology and verification requirement for remediation works.
- Geotechnical earthworks specification.

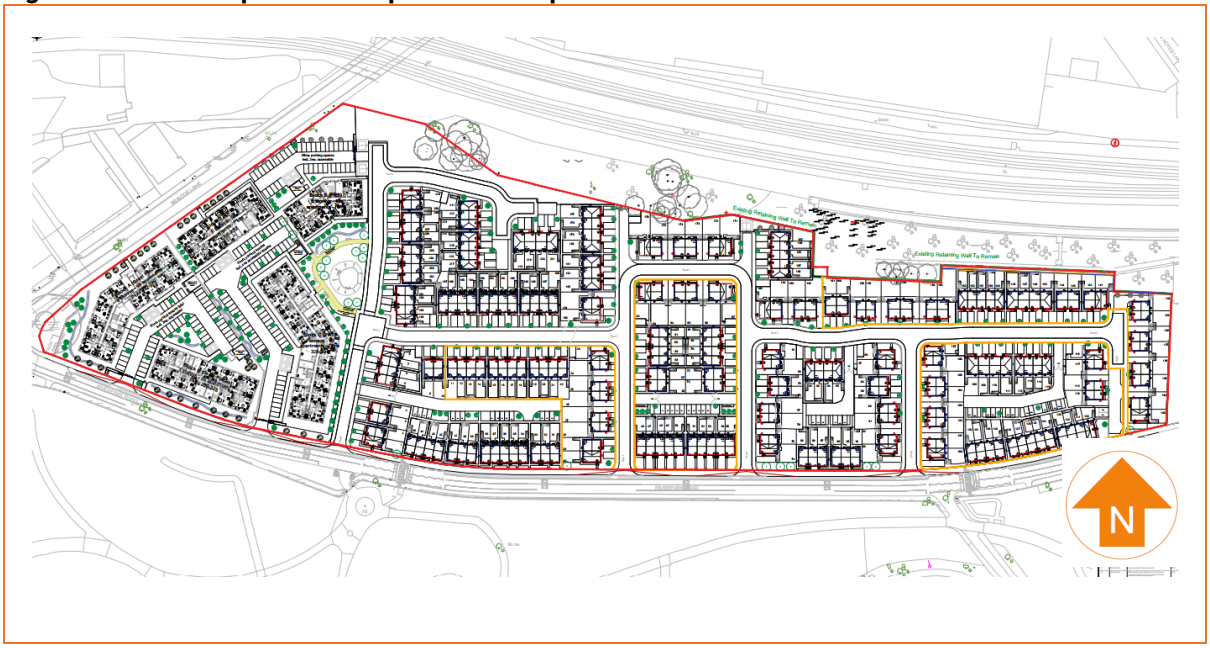
1.5. REDEVELOPMENT PLAN

Kellen Homes intends to create a new community on a sustainably located site in East Manchester, delivering new family housing and affordable homes. The proposed residential development will comprise a total of 221 low rise residential dwellings and 277 apartments across five buildings ranging from 4 to 6 storeys in height with associated gardens, estate roads and infrastructure.

Kellen Homes Drawing KH012-Q (APPENDIX IV) identifies the proposed development layout.

A snapshot of the proposed development layout is indicated in Figure 1.

Figure 1 Snapshot of Proposed Development



1.6. SUMMARY OF PARTIES INVOLVED

FUNCTION/INTEREST	NAME OF PARTY
Local Planning Authority	Manchester City Council
Developer	Kellen Homes
Geoenvironmental Consultant	E3P
Main Contractor	Kellen Homes
Remediation/Enabling Works Contractor	TBC
Human Health Regulator	Manchester City Council
Controlled Waters and Waste Regulator	Environment Agency
Highways Adoption Authority	Manchester City Council

1.7. REGULATORY STATUS

Kellen 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 assumed that as part of the planning approval process, the planning authority will undertake consultation with the pertinent statutory consultees, which will include:

- Environmental health/contaminated land officer at the local authority (or external adviser);
- Environment Agency planning liaison; and
- The Coal Authority.

E3P and Kellen homes have had correspondence with Manchester City Council EHO in regards to the removal of volatile hotspots recorded on site in order to remove the requirement of a vapour risk assessment on site.

2. SITE SYNOPSIS

2.1. SUMMARY OF PREVIOUS WORKS

Table 1 summarises the phases of Geoenvironmental Assessments that have previously been carried out at the site.

Table 1 Summary of Previous Works

ORGANISATION	TITLE	DATE	REFERENCE	PREPARED FOR
E3P	Phase 1 Geoenvironmental Site Assessment	February 2025	17-246-R1-4	Kellen Homes
E3P	Phase 2 Geoenvironmental Site Assessment	February 2025	17-246-R2-3	Kellen Homes

The assessment of the potential risk of contaminated land within the context of the proposed residential development is included in the documents listed in Table 1. To inform the preparation of the remediation strategy, the pertinent points from the above reports are summarised within Section 2.

To avoid doubt, the above reports should be read as a precursor to and in conjunction with this document.

2.2. SITE SETTING

Table 2 Site Description and Setting

Current Occupancy/Use	The subject site is an irregularly shaped parcel of land located to the northeast of Manchester city centre. The site is currently undergoing demolition; however, in February 2024 during the initial site investigation the site was occupied by a large meat processing and wholesale ring and industrial/commercial warehouse units. Various occupancies and site uses were noted during the walkover, including HGV parking facility, butchery, drain clearance, self-storage facility, mechanical and electrical warehouse(s) and an outdoor furniture warehouse.

	Prior to demolition six structures were present, including an office block in the west, a former butchery building and warehouses in the east. Western structures and MODA furniture buildings in the east were brick and concrete. The central self-store warehouse and eastern warehouse were steel-clad, portal frame structures. A communication tower is present atop a concrete pillar located immediately adjacent to the centre of the self-storage building. It would appear that the ground level of the former livestock building (building in the east) was historically partially open to allow ventilation. However, observations suggest that since the cessation of livestock processing, concrete block have been used to infill and form a completely enclosed building. This building had two levels, the top level being accessed on the eastern side via a ramp beneath the building. A cutting is present east of the structure to facilitate access to the central outdoor area. A retaining wall and slope are present along the northern boundary of the railway embankment, supporting active Network Rail infrastructure. A further retaining wall is present separating the warehouses in the east from the western area, placing the eastern sector at circa 1.00m lower level than the west. A gentle slope is present in the central area, sloping down from the north and south and leading to a cutting in the centre that allows access to the former abattoir building. The surrounding areas in the west and east are generally topographically flat. The Site is predominantly covered in concrete or asphalt hardstands that is to be removed as part of enabling works. The retaining wall and slope present along the northern boundary are densely vegetated with multiple semi-mature and mature trees and scrub vegetation. A further area of rough scrub vegetation is present in the very east. There are also areas of landscaped grass along the southern boundary and outside the eastern entrance of the central building. A former livestock delivery ramp connects to the railway, which is located on the crest of the embankment (higher elevation). Japanese knotweed has also been identified within the vegetation along the northern boundary and localised on the western boundary.
Environmental Setting	**Drift Geology**	Glacial Till- CLAY, SAND, GRAVEL
	Bedrock Geology	East- Chester Formation- SANDSTONE Centre and west- Pennine Middle Coal Measures Formation- SANDSTONE, SILTSONE, MUDSTONE South west corner- Pennine Upper Coal Measures Formation- SANDSTONE, SILTSONE, MUDSTONE
	Hydrogeology	A Secondary (undifferentiated) Aquifer has been recorded on site in the drift with a Principal Aquifer and a Secondary A Aquifer in the bedrock geology. No groundwater abstractions have been identified within a 500m radius; the closest being 555m west for construction use (Hansen Quarry products).

	Surface waters	No surface water features have been identified within 50 m of the subject site. The closest surface water feature is the River Medlock located 56 m south east of the site boundary, with a cemetery located between the site and watercourse.
Site History	Examination of the relevant Ordnance Survey maps shows that the site originally consisted of agricultural land pre 1843 with several footpaths and field boundaries. A cutting is also marked on this mapping series along the western boundary. From 1890, cuttings named clay pits were marked in the centre and south, with a pond also indicated in the centre west boundary. Further cutting continued into the 1900s along the western and southern boundary, with some structures marked southwest of the site boundary. A brickwork is marked in the west from circa 1923, with kilns and a chimney at the centre of the works. A tramway was present through the centre of the site, connecting the clay pit and brickworks, which later extended to the east circa 1933. Aerial imagery (courtesy of Britain From Above) from 1936 and 1939 shows the cutting/excavation in the south east with the northern embankment/batter visible along the northern boundary. Circa 1966, the brickworks and tramway were demolished, and the clay pits are no longer marked. It is likely that the clay pits were nominally infilled with incinerated wastes, as was common at the time of the early to mid-20th century, to aid the construction of the development platform of the abattoir. The depth of filling is unknown, however, aerial imagery (from 1939) and review of topography and historic contours on historic mapping suggest that the site was lowered with shallow excavations over time, with the development platform (circa 1966) constructed at the base of the former excavations. Three structures marked on Site from circa 1966 utilised as an abattoir. A large slope is marked along the northern boundary with cattle pens and cattle walk located in the north east. Along the southern boundary, cattle grids are marked with a ramp leading to a platform. A footbridge connects the eastern structure to the circular structure in the centre, with a cutting forming a ramp for access in the centre. From 1966 until approximately 2000, when the abattoir closed, it stayed in this formation until being marked as Riverpark Trading Estate in 2010. During this time, the footbridge is demolished, connecting the buildings in the east to the centre. The Site remains in this configuration until 2025 when demolition of the on-site structures occurred.	
Invasive Plant Species	Japanese Knotweed has been identified in areas along the northern slope and western site boundary.	

2.3. SUMMARY OF REPORTED GROUND CONDITIONS

E3P has prepared a detailed Site investigation report (Ref: 17-246-R2-2, dated March 2024). The summary of reported ground conditions is given in Table 3.

Table 3 Summary of Ground Conditions

Made Ground	Made Ground deposits were encountered within all exploratory hole locations to depths of between from ground level to an unproven depth of 5.45 m bgl (WS112) although, in general, Made Ground was encountered to a depth of less than 1.00 m bgl Generally, the Made Ground deposits on site comprised of asphalt across the majority of the site with concrete identified in the east within the warehouse and surrounding the building to a depth of 0.15m bgl. This was underlain by a black gravelly fine to medium sand with gravel of sandstone, mudstone and brick with fragments of concrete, clinker and ash inclusions. In eastern areas, a subbase MOT gravel was encountered underlying the asphalt and concrete which comprised of a yellowish grey sandy gravel of sandstone, mudstone and brick to a depth of 0.60m bgl. Below this, a brown reworked clay was encountered at a maximum unproven depth of 5.45 m bgl (WS112). More generally, this reworked clay is encountered to depths between 1.00 m and 2.00 m bgl. The reworked clay comprised a soft to firm, slightly gravelly sandy clay, with gravel of sandstone, mudstone, brick, timber fragments, and clinker. Deeper Made Ground deposits were encountered within the south west where the site is currently used as a lorry park. Made Ground within this area comprised of a reworked clay of soft to firm light grey mottled brown slightly sandy gravelly clay of sandstone, mudstone, coal and brick with fragments of timber and clinker, to a proven depth of 4.30m bgl within CP202 and unproven depth of 5.45 m bgl within WS112. Made Ground across the site was noted to contain ash and occasional clinker, which is indicative of incinerated waste backfill, which was common at the time of the early to mid-20th century.
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 generally uniform across the site, comprising a stiff to very stiff, high to very high strength, brown, slightly gravelly sandy CLAY with gravel of sandstone, mudstone and rare coal. During the 2019 investigation, localised sand bands were encountered within TP109, CP103 and CP105 as dense brown medium SAND, generally overlying the bedrock with occasional gravel of sandstone.
Bedrock	Generally, the solid geology comprised a light / dark grey weathered MUDSTONE with SANDSTONE bands. Red brown SANDSTONE was also encountered at CP104 and CP105. Top of bedrock varied from 5.50 m bgl in the east of the site (CP105) to 17.20 m bgl in the north of the site (RB202). Generally top of bedrock was encountered between 9.00 m bgl and 13.00 m bgl across the majority of the site, with localised areas of deeper drift cover noted in the southwest and central northern sectors. The varying depth of bedrock across the site is likely due to the Bradford Fault present across the centre of the site, which has a downthrow to the northeast. A thin (discontinuous) band of coal was encountered as intact at RB102 between 12.70m and 13.00m bgl.
Groundwater	Groundwater strikes were varied across the site, encountered between 0.40 m bgl to 2.10 m bgl. A consistent groundwater table was not encountered during either phase of intrusive works.

The glacial clay is stiff high strength with no effective permeability and is therefore not considered to be capable of representing a viable aquifer. The clay also inhibits vertical migration, resulting in localised perched groundwater. There is little infiltration of the site due to the extensive hardstanding.

3. E3P CONTAMINATION RISK ASSESSMENT

3.1. BACKGROUND

E3P has completed a Tier 2 Qualitative Contaminated Land Risk Assessment to determine the potential risk to human health, controlled waters, and the wider environment. 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.

3.2. 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:

- Lead;
- Arsenic;
- Asbestos;
- Benzo(a)Anthracene;
- Benzo(b)Fluoranthene;
- Benzo(a)Pyrene; and
- Dibenzo(a,h)Anthracene.
- TPH C12-C16; and
- TPH C16-21; and
- TPH C21-C35.

In the case of heavy metals, non-volatile PAH and long-chain TPH compounds (TPH C16-35), the viable exposure pathway is associated with direct contact, inhalation of particulates, consumption of homegrown vegetables and ingestion of soil.

Short-chain TPH compounds (TPH C12-C16) have a primary exposure pathway associated with vapour inhalation (indoor). Minor short short-chain TPH exceedances have been identified in two isolated locations (WS109 at 0.5 m bgl and WS118 at 0.90m bgl) associated with historical HGV parking. Isolated TPH hotspots will be delineated and removed for placement in an area of no future sensitivity as part of the remedial works.

Asbestos in the form of loose amosite fibres has been identified in the granular Made Ground in TP205 at 0.50m bgl and in the previous site investigation in 2019 trace asbestos (loose chrysotile and amosite fibres) were identified within shallow Made Ground soils within WS101 and WS114 at 0.50m and 0.60m bgl. Quantification confirms asbestos to be present at trace amounts (<0.001%) in all locations. No visual signs of asbestos-containing material (ACM) were encountered during the ground investigation; therefore, it is likely that only trace fibres are present within these localised soils.

The soil in TP115 was tested for PCBs due to the proximity to a current and a former electrical substation; no PCB exceeding the general assessment criteria (GAC) screening values were recorded.

Following multiple phases of investigation, the site has been suitably characterised in terms of human health.

3.3. CONTROLLED WATERS CONTAMINATION RISK SUMMARY

The ICSM developed within the context of the site setting has only identified a single viable pollutant pathway, which would be the downward migration of potentially mobile phase-soluble contaminants towards the underlying principal aquifer in the east of the site. As such, a comparison of leachate and groundwater results against DWS exceedances has been made.

Five groundwater samples and four leachate samples taken across both phases of investigation from varying depths within the Made Ground, were compared to the Tier 2 screening levels.

The Tier 2 controlled water risk assessment identified marginally elevated concentrations of inorganic heavy metals (arsenic, total cyanide, and selenium) above drinking water standards (DWS) within the groundwater samples submitted for analysis. Lead and arsenic were identified above DWS in leachate samples. With the exception of lead, which was not identified within groundwater samples, all of the aforementioned heavy metals are considered to be associated with perched water confined within the Made Ground. The elevated concentrations of inorganic heavy metals are deemed to be associated with the historical site use as a brickworks and the limited infilling of clay pits with incinerated (ashy) Made Ground to create a development platform.

The presence of >3.00 m (more widely >10.00 m) of low permeability clay cover will inhibit/impede the lateral and vertical migration of perched waters with potential dissolved phase impact, therefore offering protection to the underlying aquifer. Where granular deposits have been encountered (CP103 and CP105), granular high permeability deposits were encountered directly overlying the top of bedrock below sufficient clay cover.

Given the lack of active groundwater abstraction recorded within 500m of the site, low permeability of the overlying drift limiting vertical migration and low solubilities and concentrations of heavy metals recorded, there is considered to be no unacceptable risk to controlled waters.

Based on the above, there is considered to be no significant level of risk to the controlled water receptors.

3.4. HAZARDOUS GROUND GAS

Ground gas has been assessed by E3P as part of the E3P Geoenvironmental Site Assessment. The assessment was completed in accordance with the methodology outlined in the CIRIA publication C665, utilising the results of the ground gas monitoring surveys to calculate a tentative gas screening value (GSV).

The GSV has been compared to the criteria outlined with CIRIA C665 to determine the level of risk to the proposed development and to ensure the appropriate remedial options are incorporated into any future building design in this area.

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

3.4.1. RADON

A BGS report was obtained for the Site and confirmed the Site falls within Radon Class 1 - less than 1% of homes are estimated to be at or above the Action Level. No radon protection measures required to new structures.

3.5. BIOLOGICAL PATHOGENS (ANTHRAX)

Anthrax is an infectious disease caused by Bacillus anthracis, a spore-forming bacterium that can survive in soil under specific conditions for extended periods. However, for anthrax spores to be present at a site, a number of conditions must be met. These include the historical processing or burial of animals infected with anthrax, suitable environmental conditions for long-term spore persistence, and undisturbed soils capable of hosting viable spores. Importantly, there is no evidence to suggest that such conditions apply at this site.

The abattoir is understood to have been operational in the 1950s and was subject to the prevailing legislative controls of the time, including the Anthrax Order 1938, which required the reporting and appropriate handling of any suspected cases of anthrax in livestock. There are no known records or anecdotal reports to suggest that animals infected with anthrax were ever processed at the site. Furthermore, there is no evidence that animal waste, hides, or carcasses were buried on-site.

Environmental conditions on the site, including soil type and historic land use, are not considered conducive to the long-term survival of anthrax spores. In addition, proposed remedial works, including excavation, capping, placement of clean cover layers, and installation of hardstanding and residential infrastructure, will significantly reduce any hypothetical risk. These works will remove and/or brake any viable exposure pathways, further mitigating any potential health risk.

There have been no reported cases of anthrax in humans or animals associated with the site, either during its operational history or during recent remediation and redevelopment activities. Taken together, these lines of evidence confirm that there is no realistic pathway for human exposure to anthrax, and no indication that anthrax spores are present on site.

In conclusion, the risk to human health from anthrax on the former abattoir site is considered to be negligible. No further assessment or specific mitigation measures are required in relation to anthrax, and the site is suitable for its proposed residential end use.

Standard good practice in soil handling and hygiene should continue to be followed during any future groundworks, in line with general site health and safety procedures.

3.6. POTABLE WATER SUPPLY INFRASTRUCTURE

A contaminant risk assessment completed in accordance with the UKWIR assessment framework should be completed and will be addressed under separate cover.

4. PHASE 3 REMEDIATION OPTIONS APPRAISAL

4.1. OVERVIEW

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

LCRM 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.

4.2. 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.

Two phases of intrusive ground investigation works have been completed to date, which have formed a detailed conceptual site model. As such, investigative works are considered sufficient in order to fully understand the risks to future end users, controlled waters and the wider environment.

4.3. CONTAMINANTS OF CONCERN (COC)

Following the completion of the intrusive investigation, assessment and the completion of a developed conceptual site model, Table 4 below summarises the contaminants of concern for which a Remediation Options Appraisal has been developed.

Table 4 Summary of Contaminants of Concern

CONTAMINANT OF CONCERN	LOCATION	DEPTH (M BGL)	MATERIAL TYPE	EXPOSURE PATHWAY
Heavy Metals (Arsenic and Lead)	TP105 WS102 WS109 WS122 WS208	0.30 0.40 0.50 0.70 0.80	Made Ground	Direct contact of soil by future residents Direct ingestion by future residents
Heavy Metals (Arsenic, total cyanide, lead and selenium)	WS101 DBH207 DBH209 CP202 WS209	N/A	Perched Groundwater	
Non-volatile PAHs (Benzo(a)Anthracene, Benzo(b)Fluoranthene, Benzo(a)Pyrene, Dibenzo(a,h)Anthracene)	WS112 WS117 TP216	2.10 0.80 2.00	Made Ground	
Long Chain TPH	WS109 WS118 WS122	0.50 0.90 2.00	Made Ground	
Semi Volatile TPH	WS109 WS118	0.50 0.90	Made Ground	Vapour inhalation by future residents Vapour dispersion to proposed dwellings
Asbestos (Chrysotile and Amosite)	WS101 WS114 TP205	0.20 0.50 0.50	Made Ground	Inhalation of dust/fibres by future residents

4.4. IDENTIFICATION OF FEASIBLE REMEDIATION OPTIONS

4.4.1. 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 environment. 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.

4.4.2. AVAILABLE TECHNOLOGIES

Potential remedial technologies that can be applied to remediate the identified contaminants of concern (Table 4) are summarised in Table 5, overleaf. The remedial techniques considered would potentially break any source-pathway-receptor linkages, thereby reducing the risk to human health and controlled waters.

Table 5 Soil Remediation Technologies

REMEDIAL TECHNOLOGY	CLASSIFICATION	APPLICATION	MEDIUM	LINKAGE ELEMENT AFFECTED
Cover system	Containment	In situ	Soil	Pathway interruption
Ex-situ bioremediation	Biological	Ex situ	Soil	Removes source
Stabilisation / Solidification	Chemical	In situ/ex Situ	Soil	Pathway Interruption
Excavation and offsite disposal	Civil Engineering	Ex situ	Soil/groundwater	Removes source
Pathway Interruption – Specialist Mitigation by ventilation and impermeable barriers	Physical Pathway Interruption	Design of buildings with passive ventilation and specialist membranes	Hazardous gasses and vapour.	Source / Pathway interruption

4.4.3. SELECTION OF REMEDIATION TECHNOLOGY OPTIONS

Several remedial technologies have been considered in addressing the contaminant linkages of concern identified at the site as summarised in Table 6, overleaf.

In order to assess which of these technologies are most viable for this particular project, each technology has been reviewed on the basis of applicability, permissibility, cost, timescale and acceptability (including sustainability).

Limited contamination issues have been noted on site, however, it is likely a combination of remediation solutions and technologies will be utilised to address these.

Aspects of sustainable remediation are also included within the review element of applicability.

Sustainable remediation is, 'the practice of demonstrating, in terms of environmental, economic and social indicators, that the benefit of undertaking remediation is greater than its impact and that the optimum remediation solution is selected through the use of a balanced decision-making process', (as defined within 'A Framework for Assessing the Sustainability of Soils and Groundwater Remediation', produced by Sustainable Remediation Forum UK, dated March 2010).

Table 6 Assessment of Remediation Technologies Applicability

REMEDIAL TECHNOLOGY	APPLICABILITY	REGULATORY APPROVAL / PERMITS	COST	TIME-FRAME	SCORE	SUITABILITY COMMENT
Cover system	5	5	5	5	20	Essential remediation solution to remove direct exposure pathways associated with non-volatile PAH, heavy metal and long chain TPH impact in isolated areas of Made Ground.
Ex-situ bioremediation	4	3	2	1	10	Considered viable to treat soils impacted by semi volatile TPH to ensure residual concentrations pose reduced risk in terms of vapour inhalation and migration in dissolved phase to controlled waters. Given that only limited volatile TPH has been recorded (two isolated areas), increased time scale and relatively high cost the viability is reduced in comparison to other technologies.
Stabilisation / Solidification	4	4	4	4	16	The addition of stabilisation and binding agents will limit volatilisation of TPH impacted soils and impede migration of heavy metal and PAH contaminates within the Made Ground. Considered viable.
Excavation and offsite disposal	5	5	1	5	16	Limited by the cost being prohibitive. Small quantities of material that cannot be treated and are unsuitable for retention on site will be removed. Likely to form one aspect of the remediation approach.
Pathway Interruption – Specialist Mitigation by ventilation and impermeable barriers	5	5	3	5	18	Likely to form part of the remediation to remove direct exposure pathways where ground gas is recorded on site. Potential to form part of the remediation to remove direct exposure pathways where volatile soils are retained on site. However, if volatile impacted soils are placed in area of future low sensitivity, then this aspect of remedial works may not be required.

Note for Table 6 The scoring methodology is presented below

SCORE	APPLICABILITY	PERMISSIBILITY	COST	TIMEFRAME	ACCEPTABILITY (INCLUDING SUSTAINABILITY)
0	Not applicable, available or implementable	No chance of obtaining a permit			N/A
1	Not widely used and probably not applicable	Permitting will probably be difficult	Very High	Treatment time does not meet the client's requirements	N/A
2	Widely used but probably not applicable or not widely used and may not be applicable	Permitting may be difficult	High	Treatment time almost meets the client's requirements	N/A
3	Widely used but may not be applicable or not widely used but probably applicable	No permitting problems	Moderate	Treatment time meets the client's requirements	N/A
4	Widely used and probably applicable or not widely used but proven and applicable		Low		N/A
5	Widely used, proven and applicable		Very Low		N/A
Considerations	Contaminant type; Soil conditions; Groundwater considerations; Availability; Proven track record; Requirements for additional treatment; Whether technology is implementable at the site; Ability to attain remediation goals.	Emissions; Discharges; Noise; Planning; Mobile Treatment License; Environment Agency.	Indicative costs data from professional experience.	Site requirement for treatment within 12 months.	Client acceptance; Regulatory acceptance; Site acceptance; Other potential stakeholders' acceptance.

4.5. 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 economical solutions that will ultimately result in the successful remediation of the site:

- The construction of a designed and validated clean **cover system** ensures no direct exposure pathway to future receptors;
- **Solidification and stabilisation** to bind compounds within the soil matrix to reduce volatilisation and migration into the dissolved phase. If required, works to be completed by a specialist contractor in accordance with a Mobile Treatment License/Environmental Permits; and
- Removal of defined **contaminant hotspots** for off-site treatment with subsequent validation to demonstrate effective implementation; 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.

4.5.1. CL: AIRE DOW COP MATERIALS MANAGEMENT PLAN

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 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 within APPENDIX V of this report.

5. REMEDIATION AND SITE-ENABLING WORKS

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.

For clarity, turnover will be completed to the top of natural or three metre below the original ground level (whichever is shallower). Where removal and processing of obstructions are referred to throughout this document ('in the entirety' etc.) removal and processing will be required to a maximum depth of three metres.

5.1. REMEDIATION AND ENABLING WORKS

5.1.1. RE 1: PRE-COMMENCEMENT REMEDIATION CONTRACTOR REQUIREMENTS

Multiple phases of intrusive ground investigation have been undertaken to adequately characterise the site, as such, no additional investigation is deemed to be required.

No sources of contamination have been recorded within the current buildings; this should be confirmed by a watching brief undertaken during the demolition of the existing buildings.

Following the demolition of structures on site, samples will be obtained from the shallow Made Ground soils in areas where 'data gaps' exist to confirm the wider ground model. 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 operation or arrange for the deployment of the appropriate environmental permit for the specified operation.

5.1.2. RE 2: PRE-COMMENCEMENT REGULATORY COMPLIANCE

Prior to commencement of any works on site, all reports relating to the assessment of risk to contaminated land should be submitted to the regulatory authorities to gain written approval.

All relevant Standard Rules Permits should be registered with the Environment Agency by the contractor.

The LAPC Part B Notification for deployment of mobile crushing plant should be implemented prior to the establishment of equipment on site.

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

It is not anticipated that there will be any requirement to treat any materials on-site; 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 operation or arrange for the deployment of the appropriate environmental permit for the specified operation.

5.1.3. RE 3: INDEPENDENT VALIDATION AND SITE SUPERVISION

The site-wide remediation and enabling works should be undertaken with advice from a suitably qualified and independent specialist that is familiar with this report. The specialist is required to attend the site on a part-time basis in order to record ground conditions and to monitor the progress and quality of works completed by the contractor.

Frequencies of site attendance may vary depending on specific operations that are being completed.

5.1.4. RE 4: ENVIRONMENT AND NUISANCE 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.

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

Temporary works are to be implemented as necessary to support excavations throughout the works.

In the event that a complaint is made with respect to dust emissions, noise, or vibration levels, remedial measures and an ongoing monitoring programme should be agreed upon with the local authority and implemented on-site.

5.1.5. RE 5: RISK TO INFRASTRUCTURE

All works are to be completed in a manner so as not to create any structural risk or disturbance to the adjacent highways, rail and telecommunication infrastructure.

5.1.6. RE 6: SITE CLEARANCE OPERATIONS

Several above and below-ground slabs/foundations are present in areas of historical development; these structures and building 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.

Any above-ground waste/fly tipping – contractor should visit site and determine waste materials and responsible.

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

5.1.7. RE 7: IDENTIFICATION, ISOLATION AND TREATMENT OF INVASIVE PLANTS

Invasive plant species have been identified on-site. The remediation contractor must satisfy themselves concerning the extent of all species deemed invasive prior to the commencement of works on site. The contractor shall employ a suitably qualified expert to investigate the presence of invasive plant species on or adjacent to the site. 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 before 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.

5.1.8. RE 8: DELINEATION, EXCAVATION AND TREATMENT OF IDENTIFIED ASBESTOS IMPACT

Detectable asbestos fibres have been identified in discrete locations (WS101 at 0.20 m, WS114 at 0.50 m and TP205 at 0.50m) within the shallow Made Ground with <0.0001% asbestos recorded in all 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 (APPENDIX III) demonstrates a suitable method for the management of soils to negate any future risk.

The contractor must ensure that all personnel working on site are trained in the identification of Asbestos Containing Materials (ACM) and the risks associated with impacted soils.

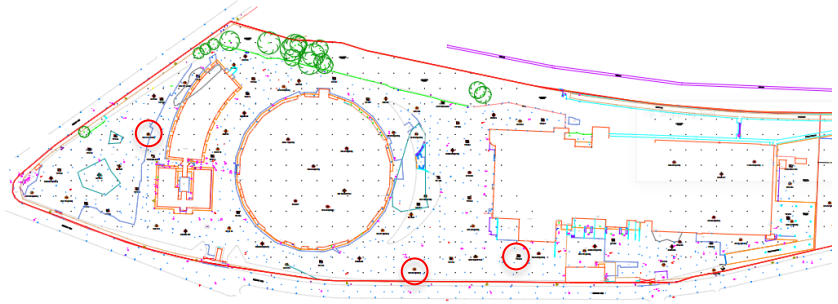
Where any visual evidence of ACM is identified, these materials should be carefully segregated and removed from the soil matrices (if/where possible).

Validation sampling of the processed Made Ground should be completed to demonstrate compliance with the developed conceptual site model (included in APPENDIX III).

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 the ambient air.

If necessary, reassurance air testing in accordance with the requirements of HSG248 should be completed during the operation to move the soils to demonstrate the deployment of the required control procedures and safe working methods.

Location of identified trace asbestos highlighted in red on the below.



5.1.9. RE 9: DELINEATION, EXCAVATION, TREATMENT AND DISPOSAL OF HYDROCARBON-IMPACTED MATERIAL

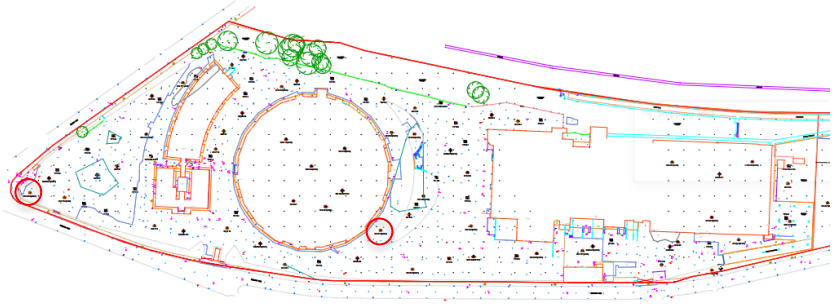
Two discrete areas of volatile hydrocarbon impact have been identified (WS109 0.50 m and WS118 0.90 m) associated with historic HGV parking/storage. Within both locations semi-volatile TPH impact was recorded in a black sandy gravel Made Ground, recorded from 0.30 m – 1.10 m bgl at WS109 and 0.30 – 0.80 m bgl at WS118. It is considered that this material represents an unacceptable risk associated with volatilisation to indoor air, migration towards controlled waters receptor and odour nuisance that cannot be mitigated through the construction of a clean cover system.

Hydrocarbon impacted soils within WS109 (0.30m – 1.10 m bgl) and WS118 (0.30 m - 0.80 m bgl) should be subject to delineation, excavation and removal from site. 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 ten 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.

At the time of writing, it is understood that the client intends to remove volatile and hydrocarbon impacted soils from site. The removal of these materials will eliminate the primary source of vapour generation and, consequently, mitigate potential risks to future site users. On the basis that the vapour source is effectively removed and remediation is appropriately validated, no further vapour risk assessment is anticipated to be required.

Location of identified volatile hydrocarbon impacted are highlighted in red on the below.



Any as yet unidentified potentially volatile/soluble phase compounds cannot be discounted. The proposed remediation works will include the turnover of made ground under the supervision of an independent Geoenvironmental consultant from E3P. During turnover of the Made Ground across the wider site PID monitoring should be undertaken. 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 soil leaching and dispersal of any odours and/or vapours. This material will then be subject to detailed laboratory analysis for off-site disposal.

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.

5.1.10. RE 10: BIOLOGICAL PATHOGENS BENEATH FORMER ABATTOIR

The risk of anthrax has been discussed in Section 3.5, given the abattoir was operational following the legislative controls of the Anthrax Order (1938), which required the reporting and appropriate handling of any suspected cases of anthrax in livestock, and that no livestock was buried on the site, with bodily fluids (blood, fat etc) washed into the drainage infrastructure and not into the soils – the risk is considered negligible.

The former abattoir and meat wholesalers that operated within the central buildings is a potential source of biological pathogens associated with the former slaughter of livestock and removal of animal wastes. The risk of encountering pathogens associated with the former animal processing land use will lessen over time, therefore given the elapsed time period since the cessation of abattoir operations the risk is considered significantly reduced.

During the demolition of the former abattoir and meat wholesaler buildings, a watching brief should be implanted during the removal of any tanks or pipework to identify any potentially blood or animal fat.

5.1.11. RE 11: 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, including plot footprints, rear gardens, private driveways, adopted highway and utility 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 the E3P geotechnical design report using licensed plant. Where it is not feasible to remove to artificially hard materials to their full depth, an assessment with regard to the foundation option and proposed layout should be undertaken.

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.

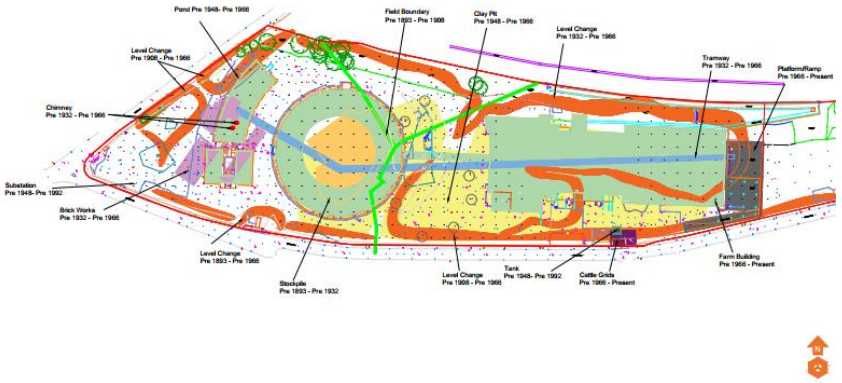
5.1.12. RE 12: DELINEATION, EXCAVATION AND TREATMENT OF INFILLED HISTORICAL PONDS

Prior to the commencement of the main earthworks (where possible), all known former infilled ponds should be 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 11-096-003 in APPENDIX III). Additionally, along the western boundary a cutting is present (circa 3m deep) that appears to have been utilised as a historic surface water management feature – this feature should be investigated during remedial works.

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.



5.1.13. RE 13: IMPORTATION OF MATERIALS FOR USE IN CONSTRUCTION

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 set out in the E3P geotechnical design report.

Imported material must be certified as suitable for use in strict accordance with the E3P chemical and geotechnical performance criteria (E3P geotechnical design report) 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.

5.1.14. RE 14: PREPARATION OF COVER SYSTEM

Where the remediation technology has been identified for soft-standing cover systems, it will be the contractor's responsibility to prepare the area to 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 level that would allow the placement of the cover system 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 following 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 by E3P.

The DEFRA / Environment Agency guidance states *'that conflicts of interest in verification should be avoided. A contractor certifying their own work is considered to be a conflict of interest and is not good practice. If verification is carried out by the same company (or related company) that carried out the work, then the process, results and report will need to be audited by an independent consultant'* (Environment Agency, 2010a).

5.1.15. RE 15: STOCKPILE ARRANGEMENT

Whenever it is envisaged that the use of the materials will occur in excess of one year from being stockpiled/stored, a time limit has to be agreed with the Environment Agency. The decision relating to the length of storage will be made within the context of the extant planning permission or agreed programme of works. Supporting information may be requested by the Environment Agency in the form of the Soil Resource Plan.

The proposed location of any stockpiles must be pre-agreed with the developer and remediation engineer prior to stockpiling commencing.

Soil will be stripped or excavated during the construction process. In order to enable its reuse on-site at a later stage, soil needs to be stored in temporary stockpiles to minimise the surface area occupied, and to prevent damage from the weather and other enabling works/construction activities.

Stockpiled soil must not be vulnerable to compaction or erosion; must not cause pollution to surrounding watercourses; and must not increase flood risk to the surrounding area.

Stockpiles must be appropriately marked out and clearly signed to ensure that they are easily identifiable for reinstatement.

Soil should be stored in an area of the site where it can be left undisturbed and will not interfere with site operations. Ground to be used for storing the topsoil should be cleared of vegetation and any waste arising from the development.

The locations and footprints of each stockpile will be accurately recorded on a plan of appropriate scale. Marker posts will be provided in locations which have been surveyed and recorded to provide volumes for each stockpile type. Photographic records of stockpiles will be provided at the point of handover to the developer

Stockpiling should follow the guidance set out in Defra's Construction Code of Practice for the Sustainable Use of Soils on Construction Sites with the appropriate method adopted based on the soil type for the creation of stockpiles (method 1 or 2).

Stockpiled material that may pose a risk to the environment will be required to be stored within an impermeable bunded area that is adequately sealed with a membrane sufficient to prevent rainfall from entering the bund or stockpile. Typically sheeting is laid to lap over the extent of the bund sidewalls and sealed with soil around the periphery.

Stockpiled soils will require chemical analysis at the frequency defined within Table based on the soil type and use.

5.1.16. RE 16: PROVISION OF SUBSOIL

The shallow natural drift deposits (predominantly cohesive soils) are deemed suitable for use within the clean cover system to areas of soft landscaping. It is therefore deemed viable to reuse materials that are cut as part of the wider earthworks or through a soil inversion (regulated by an MMP) to generate the required volumes of material.

Materials generated from the 'site strip' operation can be subdivided into topsoil and sub-soil, with sand and clay loam soils within the lower 50% of the site strip likely to be classified as a sub-soil material. These soils can be sustainably segregated, tested, and stockpiled for re-use as sub-soil.

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.

Sub-soil stockpiles should be placed in areas that will ensure no 'cross contamination' from materials with significant anthropogenic influence on-site.

5.1.17. RE 17: 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 removed from the 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 the 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*.

5.1.18. RE 18: GENERAL VALIDATION OF STOCKPILED MATERIALS AND TURNOVER REQUIREMENTS

The site has been characterised with respect to the potential pollution risks to all known receptors defined and understood; furthermore, the appropriate remediation actions have been defined within this strategy to ensure that the site will be suitable for the intended use.

Where soils are nominally turned over or subject to a direct cut / fill as part of the enabling earthworks, there is no requirement for further testing of either Made Ground or natural soils. However, where materials are subject to specific stockpiling (Made Ground or Natural), such materials will be subject to the geo-chemical validation requirements for the re-use of stockpiled materials in line with Table 7.

Turnover will be completed to the top of natural or three metre below the original ground level (whichever is shallower).

5.1.19. RE 19: VALIDATION OF MATERIALS FOR POTABLE WATER SUPPLY INFRASTRUCTURE

A contaminant risk assessment in line with the UKWIR assessment framework should be undertaken prior to the installation of potable water supply infrastructure. Given the presence of Made Ground elevated concentrations of potentially volatile/soluble hydrocarbon compounds cannot be discounted, as such, at this stage an allowance should be made for 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 has been 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, 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. Failure to meet the required specification may necessitate further remedial works.

5.1.20. RE 20: REMEDIAL VERIFICATION REPORT

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

Complete remedial validation is to be reported in line with regulatory guidance. This will include a detailed risk assessment. The report will be submitted to the local authority for approval following completion.

The Verification Report will conclude the site remediation and enabling works with the Build Phase validation to be produced separately.

5.1.21. RE 21: REMEDIATION PROJECT CHANGE, ADJUSTMENT AND UPDATES TO REQUIRED WORKS

LCRM states the following with respect to the completion of remediation works:

- Ensure remediation is done in line with the remediation strategy and regulatory controls
- React to testing results or monitoring data promptly
- Manage unexpected contamination
- Allow time to get and interpret the data without delaying progress
- Use a different solution or contingency measure if the data shows that the remediation is not working
- Ensure any method statements are correct and kept up to date

Remediation work is an iterative process, and as such, it will be managed by the specialist contractor on site, the supervising engineer, the professional project team and the client.

Where possible, regulatory authorities will be informed of ongoing changes to the project and specific remediation requirements; however, works must be allowed to proceed under professional judgment without the requirement to revise the formal remediation strategy.

All project adjustments will be fully documented and detailed within the validation report. For absolute clarity, professional judgement will be made by Chartered professionals supervising the remediation works. It is considered that there is no requirement for any revision to a Remediation Strategy on the basis that adjustments are made due to unforeseen circumstances, which are reviewed and approved by a Chartered professional within the project team. The approved remediation strategy is an iterative document that allows flexibility and changes based on specific circumstances.

5.2. VERIFICATION PLAN

5.2.1. 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.

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 or 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 to remove the risk of cross-contamination.

The sampling frequency for materials to be managed under the remediation strategy is presented in Table 7. The validation sampling protocol has been developed utilising guidance from the Manchester City Council Planning and Contaminated Land Technical Guidance document, dated February 2021.

Table 7 Specification of Chemical Validation Laboratory Analysis

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Site-Generated		
Site-Generated 6F2	1 Sample per 500 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	F
Stockpiled Made Ground General Backfill	1 Sample per 1000 m^3	A/B/C/D
Stockpiled Made Ground General Backfill	1 Sample per 2000 m^3	G
Stockpiled Natural Backfill	1 Sample per 2000 m^3	A/B/C/D
Site-Generated Subsoil (Cover system)	1 Sample per 100 m^3	A/B/C/D
Site-Generated Topsoil Cover (Cover system)	1 Sample per 100 m^3	A/B/C/D
Hotspot Validation Samples (naphthalene)	1 Sample per 10 m of linear excavation to base and sidewall	B
Imported		
Recycled Aggregate	1 Sample per 500 m^3	A/B/C/D
Virgin Quarried Aggregate	2 samples per source	D
Subsoil/Topsoil Greenfield Source (Residential Garden Cover system)	1 Sample per 200 m^3 (minimum 3 from source)	A/B/C/D
Subsoil/Topsoil Brownfield Source (Residential Garden Cover System)	1 Sample per 50 m^3 (minimum 6 from source)	A/B/C/D
Subsoil/Topsoil Greenfield Source (Soft Landscaping/POS Cover System)	1 Sample per 200 m^3 (minimum 3 from source)	A/B/C/D
Subsoil/Topsoil Brownfield Source (Soft Landscaping/POS Cover System)	1 Sample per 150 m^3 (minimum 6 from source)	A/B/C/D
General Engineering Fill (Class 1 and 2 Soil)	1 Sample per 200 m^3	A/B/C/D

***Table 7 Notes**:*
Suites of Analysis:
A. Speciated PAH.
B. Speciated TPH (C5-C35, BTEX, MTBE).
C. Asbestos (ID).
D. CLEA Inorganic Heavy Metals.
E. SVOC/VOCs
F. On-Site Screening for VOC Using Calibrated PID.
G. Leachate Analysis of Inorganic Heavy Metals, TPH, Sulphate and PAH.
H. Asbestos Quantification

5.2.2. IMPLEMENTATION OF THE VERIFICATION PLAN

Implementing the verification plan is an iterative process, with the process only complete when you have ended monitoring or sampling and produced the verification report.

In accordance with LCRM, all relevant data as set out in the verification plan will be collected to ensure verification reporting accurately reflects all works carried out.

Performance against all remediation criteria will be assessed to ensure that the remediation objectives are being achieved. This may be a complex operation where criteria relate to several remediation activities, phases or timescales, and a phased approach may be taken if prior agreement has been sought from the relevant regulatory authorities.

5.2.3. RISK-BASED ASSESSMENT FOR NON CONFORMANCE

Where the 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.

5.2.4. REMEDIATION OBJECTIVE REVIEW

A contingency plan is provided in Section 8 of this report to identify what action to take if results fall outside of the acceptable limits. It is possible that remediation objectives and criteria may need to be reviewed to modify the remedial process or consider other options.

Data that may lead to a further review include:

- A change in conditions such as temperature or pH.
- A decline in contaminant concentrations not as predicted.
- A contaminant plume that does not shrink or stabilise as predicted during monitored natural attenuation (MNA) or in situ treatment.
- A diminishing return in efficiency for example, in soil vapour extraction, air sparging or pump and treat.
- A change in groundwater flow or head-up gradient of a slurry wall or permeable reactive barrier.
- A failure to prevent the migration of ground gases for example, by passive venting, containment or active abstraction.

Any changes to the original remediation objectives will be justified, recorded and agreed with the details provided in the verification report upon completion of the remediation works.

5.3. REMEDIATION CONTRACTOR'S 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 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.

6. MATERIALS MANAGEMENT & LEGISLATIVE COMPLIANCE

The processing of recycled aggregates will be completed using LAPC Part B licenced plan with the appropriate deployment notification to the local authority prior to commencement of works. All materials that are recovered as recycled aggregate will be compliant with the E3P validation testing requirements and as such would not be deemed to be a waste material where there is a certainty for their reuse on site.

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

A T5 Exemption, allowing for the screening and recovery of up to 5000 T of permissible material for subsequent reuse in construction, will also be registered.

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

The relevant LAPC, U1, T5 and WRAP licenses, exemptions and protocols provide the legislative framework for material compliance during the site remediation and enabling works to be completed by the specialist contractor and validated by 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)*.

Under the Waste Framework Director, certain waste materials, even once processed under exemptions, continue to be classified as waste until they have fully recovered or are no longer a waste for other reasons. To facilitate the reuse or recovery of these waste materials, it is essential the correct framework is in place, including appropriate exemptions, permits or quality protocols.

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.

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.

7. GEOTECHNICAL ENGINEERING SPECIFICATION

7.1. E3P GEOTECHNICAL ENGINEERING SPECIFICATION

The geotechnical specification provides a set of performance specifications for the placement and engineering of materials to facilitate the construction of a development platform that will be suitable for the intended end use.

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

- Removal of all subterranean geotechnical hazards.
- Placement of fill materials to ensure compliance with the design end use for the structural foundation solution;
- Preparation of plots to be suitable for construction with shallow spread foundation where firm to stiff clay are present at a depth < 1.5 m from proposed FFL across the complete plot.
- Preparation of plot footprint (+ 2 m on all elevations) to be suitable for ground improvement by vibro-stone column, where the depth of stiff clay/medium-dense sands exceeds 1.5 m from the proposed finished floor level (FFL).
- Preparation of plots to ensure suitability for the construction of CFA and driven piled foundations within the locations denoted on the geotechnical foundation key plan.
- Engineer all areas of proposed infrastructure, adopted highway and private drives to be compliant with the E3P Geotechnical Specification.
- Where deep upfill is proposed (>2.50m), surcharge settlement analysis is required to ensure that the imposed loads do not induce unacceptable long-term total or differential settlement to infrastructure.

If it is not possible to prepare the site to 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 are undertaken in accordance with this specification and to ensure that any unforeseen circumstances, such as adverse weather, do not compromise the earthwork process.

Works should be halted during periods of intermittent or prolonged rainfall to ensure the materials are not placed in a manner that would soften either the formation or the newly placed material. The contractor will be responsible for determining appropriate weather conditions and the suitability of the works.

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

Settlement analysis may be required within areas of compressible material and or significant earthworks, and this is a specialist geotechnical matter outside the scope of this report.

7.2. 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. The earthworks contractor will complete pre-commencement geotechnical testing of all as-dug materials prior to engineering or any site-derived soil materials.

Due to climatic weather conditions and variance in long-term differential settlement associated with even well-compacted granular and cohesive soils and the need to ensure materials are engineered to ensure suitability for the proposed structural / infrastructure construction design, 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 that they achieve the required geotechnical specification as defined for specific areas of the site.

7.3. GENERAL OVERVIEW OF FILL REQUIREMENTS

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. Material to be compacted to ensure the in-situ density is >90% of the maximum dry density with an air void ratio <10% (for fill <5.0m) (NHBC Chapter 4.6 compliant).

End Product Compaction – Fill to Structures & VSC Ground Improvement: 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, which will be >95% of the maximum dry density with <5% air voids.

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

7.4. CLASSIFICATION OF FILL MATERIAL

This specification should be read in conjunction with the following:

- The Manual of Contract Documents for Highway Works (MCHW), 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

7.4.1. 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).

Other materials, as defined within MCHW, may be suitable for use; however, their selection, testing and use must be approved by the supervising engineer prior to the commencement of any works on-site.

7.4.2. PRE-COMMENCEMENT EARTHWORKS TESTING FREQUENCY

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 8 E3P Earthworks – Generalised Pre-commencement & Performance Testing Specification

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY	PERFORMANCE REQUIREMENT
Method Compaction **Fill to Infrastructure & External 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. >90% Max DD & <10% air void.
End Product Compaction / VSC **Fill To Structures** **Engineered Up-Fill** **(To be completed prior to upfilling)**	Class 6 (selected Granular) or Class 7 (selected Cohesive)	Particle Size Distribution (PSD) and Natural Moisture Content	1 per 1000 m3	Grading to Class 6 or 7
		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 1500 m3	Moisture content to be within 2% (+/-) of the laboratory-determined optimum. Materials to be engineered to ensure the in-situ density exceeds 95% of max DD & <5% air void.

Table 9 E3P Generalised Earthworks Geotechnical Compaction Separation

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

7.4.3. 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.

7.5. GENERAL FILL PERFORMANCE 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 10 Compaction/Backfill Requirements

LAND USE REQUIREMENT	COMPACTION METHODOLOGY AND GENERAL PERFORMANCE CRITERIA
Traditional Spread Foundation	Ensure no disturbance of natural soil at shallow depths.
Re-Engineering of Soils Using Vibro-Replacement Stone Column (VRSC)	Materials to be placed in a controlled manner to facilitate the construction of vibro-replacement stone columns (VRSC). to limit differential settlement and increase Allowable Bearing Capacity (ABC) **These works are to be completed within the building structure footprint and +2 m of all elevations.** The material grading must be >90% granular in composition with less than 10% fines (which are classified as materials < 63 microns in size). No material greater than 125 mm in size is permitted, with 90% of the soils placed conforming to grading < 90 mm. In addition, there shall be less than 20% material finer than 2mm. Material is to be placed when actual moisture content is within tolerable limits of the optimum, with specific attention to soils that are notably wetter than the optimum. Material to be placed in a manner so as to ensure a minimum CBR of 3% at formation to facilitate machine movement and piling mat construction.

LAND USE REQUIREMENT	COMPACTION METHODOLOGY AND GENERAL PERFORMANCE CRITERIA
	Where materials that do not conform to the standard backfill requirements for VSC (i.e >10% <63 microns), materials 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) with an air void of <5%. Where CBRs exceed 7%, the pile contractor should be consulted to discuss the potential requirement for pre-boring locations. Where rock is present at a shallow depth, the remediation contractor will ensure the substratum is prepared to ensure that a minimum of 1000 mm of appropriately graded granular material is present to the underside of the proposed doubly reinforced concrete strip foundation. The substratum must be prepared to ensure a vibro-stone column treatment depth is not less than 80% of the immediate adjacent profile.
Piled Foundation	All plot footprint (+ 2 m) must be free of any deleterious elements, tree roots and obstructions > 150 mm. Where upfill is proposed, 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 the Back of Footpath)	*Method Compaction – MCHW Specification For Highway Works Series 600* is to be followed, with in-situ validation testing to meet requirement of the adoptions authority. A CBR > 5 % is required at subgrade formation (prior to placement of capping). >90% of MDD and <10% air void.
All areas of external/Infrastructure	*Method Compaction – MCHW Specification For Highway Works Series 600* is to be followed to achieve a CBR > 5%. >90% of MDD and <10% air void.
Gardens, POS	Material is to be placed in layers not exceeding 300 mm and must be rolled using a dedicated plant (no earth moving equipment) and comply with the requirements of a Method Compaction *MCHW Specification For Highway Works Series 600.*

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.

7.5.1. CONSTRUCTION OF FILLS – HIGHWAYS & ALL 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.
- In accordance with Chapter NHBC Chapter 4.6

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.

Where fill material is placed on a soil matrix, the contractor and client shall ensure the future settlement associated by consolidation of compressible materials is considered by a geotechnical engineer. For soils with the potential to consolidate by surcharge, live and dynamic loading ground improvement works may be required.

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.

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.

Materials will be engineered and compacted to ensure that the in-situ density is equal to or grater than 90% of the maximum dry density with an air void of <10%.

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 the failure of the contractor to comply with the 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.

7.5.2. 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.

7.6. 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.

Table 11 Compaction/Backfill Requirements

LAND USE	COMPACTION METHODOLOGY and GENERAL PERFORMANCE CRITERIA
Liquid and Plastic Limits	BS 1377: Part 2
Grading	BS 1377: Part 2
Uniformity Coefficient	Calculated from grading curve
Moisture Content Multi-point moisture condition value (MCV) (to assess optimum moisture content).	BS 1377: Part 2
Organic Matter (Maximum 2.5% Total Organic Content)	BS 1377: Part 3
Water Soluble Sulphate	TRL Report 447 Test No 1
Total Sulphate Content	TRL Report 447 Test No 4
Earthwork In-situ Tests Subsequent to the filling and compaction of the material, a series of in-situ tests shall be undertaken to confirm the success of the compaction process. This testing shall include, but necessarily be limited to, the following:	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

Table 12 **Material Performance Requirements**

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY	PERFORMANCE REQUIREMENT
Method Compaction **Fill to Infrastructure & External 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
		Proctor 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. Materials to be engineered to ensure the in-situ density exceeds 90% of the laboratory defined maximum with an air void of <10%.
End Product Compaction **Fill To Structures** **Engineered Up-Fill (To be completed prior to upfilling)**	Class 6 (selected Granular) or Class 7 (selected Cohesive)	Particle Size Distribution (PSD) and Natural Moisture Content	1 per 1000 m3	Grading to Class 6 or 7
		Proctor 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 1500 m3	Moisture content to be within 2% (+/-) of the laboratory-determined optimum. Materials to be engineered to ensure the in-situ density exceeds 95% of the laboratory defined maximum.
		Max Deformation & CBR by Plate Load	1 every 1.00m of upfill, 1 test per 25 lenear metres,	>3%

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY	PERFORMANCE REQUIREMENT
Capping & Sub-Base	Recycled 6F2 / Imported 6F5	Max Deformation & CBR by Plate Load	1 test per 400 m2 of engineered stratum (~20 linear metres).	>15% at top of the formation (capping or sub-base). <6mm settlement 150 kN/m2 – to be confirmed based off working platform design.
Underside of Piling Mat (Sub-formation)	Granular or Cohesive	Max Deformation & CBR by Plate Load	1 test per 625 m2	<10mm settlement 100 kN/m2

7.7. SPECIFICATION FOR EARTHWORKS PREPARATION 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 (<63 microns) exceeds the 10% by volume generally considered as the standard requirements for ground improvement by VSC is given in Table 13 & Table 14.

Table 13 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 samples from each (site-won or imported) soil matrix as per the requirements of the E3P specification for: • Dry density/optimum moisture content (4.5kg Class 2 or 2.5kg Class 1); 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 ± 2% 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 14 Compaction and Validation of Non-standard Material Backfill to VSC

REQUIRED PARAMETERS	**THE COMPACTION MUST ACHIEVE THE FOLLOWING MATERIAL PARAMETERS:**	
	Bulk Density (ρ)	95% of the maximum dry density and must be within 2% of the optimum moisture content and <5% air void.
	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.
Verification Testing and Report	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 by the contractor. 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.	

7.8. PREPARATION OF VIBRO STONE COLUMNS IN TREE INFLUENCE

Where trees are present or are to remain within their total zone of influence, the contractor must ensure that all cohesive soils are removed to the required depth with the subsequent replacement using 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.

Where trees are fully removed, potentially desiccated material will be removed to its full extent, as defined within NHBC Chapter 4.2.

Where the tree influence depth exceeds 2.5m, specialist assessment and desiccation assessment will be required to determine the full depth of removal of cohesive materials within the conjectured zone of tree influence.

The depth of the granular blanket required will be determined prior to the commencement of the works in accordance with the parameters specified by the NHBC and LABC.

The supervising engineer will supervise and validate the removal of all potentially desiccated material.

7.9. 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.

7.10. DEFINED GEOTECHNICAL ENGINEERING WORKS AND VALIDATION

In accordance with the geotechnical specification and requirements as documented herein, the following schedule of Ground Engineering (GE) works will be implemented and validated by the specialist contractor with validation by a suitably qualified geotechnical engineer.

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7.10.1. GE 1: PRE-COMMENCEMENT REMEDIATION CONTRACTOR REQUIREMENTS

Complete all materials testing in accordance with the required frequencies prior to the commencement of earthworks.

The contractor is to prepare an Implementation Testing Plan (ITP) for submission to the supervising engineer for approval prior to the commencement of earthworks.

7.10.2. GE 2: 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 E3P Geotechnical Specification using licensed plant.

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.

7.10.3. GE 3: 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 capacity (ABC) in the order of 125 kN/m^2.

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 before 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 before the commencement of filling and compaction works. In-situ density testing is required to demonstrate compliance with the E3P Geotechnical Performance Specification.

7.10.4. GE 4: 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 (0.63 microns).

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 is to be confirmed to be > 95% of the laboratory determined maximum (2.5 kg) with < 5% air void ratio.

7.10.5. GE 5: CONSTRUCTION OF TEMPORARY WORKING PLATFORM

Where plots are to be prepared in a manner that will facilitate ground improvement by vibro-stone column, 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%.

7.10.6. GE 6: 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 7.1 of this report, which generally requires the reinstatement and compaction criteria presented in Table 9.

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.

7.10.7. GE 7: 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 before 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.

7.10.8. GE 8: DEEP FILL ASSESSMENT

An underpass/tunnel is present in the central western section of the site, along the eastern boundary of the former butchers building. During turnover works the tunnel is to be grubbed out, temporary slopes associated with the side walls of this feature shall be formed at gradients that ensure stability (no greater than 45 degrees). The surface shall be benched immediately prior to deposition of the fill in order to achieve horizontal basal surfaces in accordance with Section 7.5.1 of this report.

Where material upfill is proposed on compressible materials, predictive settlement modelling is required to determine the long-term potential for surcharge to induce consolidation within the underlying stratum.

Where settlement exceeds the prescribed limits, Ground Engineering works are required to be designed by a specialist to ensure no long-term risk of subsidence to structures and infrastructure.

Table 15 E3P Validation Testing Criteria

CONSTRUCTION DETAIL	MATERIAL	TEST TYPE	FREQUENCY	PERFORMANCE REQUIREMENT
In-situ Validation Engineered Upfill to Structures & VSC	Engineered Granular or Cohesive	Max deformation and CBR by plate load	5 every 900 mm upfill. Circa 1 test per 20 linear metres.	> 3%.
		In-situ density	1 test per 1225 m^2 (35 m grid) or (551 m^3) every second layer (450 mm) upfill.	In-situ density > 95% of the laboratory determined maximum for material type. < 5% air voids (cohesive).
	Cohesive	Undrained Shear Strength by HSV	1 test per 625 m^2.	Cu > 40 kN/m^2.
In-situ Validation Engineered Upfill External Areas & Infrastructure.	Engineered Granular or Cohesive	Max deformation and CBR by plate load	Every 900 mm upfill. Circa 1 test per 20 linear metres.	> 3%.
		In-situ density	1 test per 1225 m^2 (35 m grid) or (551 m^3) every second layer (450 mm) upfill.	In-situ density > 90% of the laboratory determined maximum for material type. < 10% air voids (cohesive).
	Cohesive	Undrained Shear Strength by HSV	1 test per 625 m^2.	Cu > 40 kN/m^2.

8. RECORD KEEPING AND VERIFICATION

8.1. RECORD-KEEPING

During the remediation and site enabling works, the contractor will undertake the following record-keeping protocols:

- Detailed site diary including material movements;
- Sampling register, testing results, photographs, details of locations of contaminated 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 remediation and site enabling works.

8.2. VERIFICATION REPORT

Following the completion of the remediation works and the provision of site records from the contractor, to demonstrate that all of the remediation works have been undertaken in accordance with the Remediation and Enabling Works Strategy, E3P will provide a Verification Report.

The report will provide a summary of the key elements of work and will be referenced to the agreed redevelopment strategy and planning requirements with supporting information presented within appendices.

The Verification Report will be based upon LCRM (July 2023) and will incorporate a summary and commentary of, where applicable:

- Background information on the site;
- Statutory and regulatory requirements;
- Details of the remediation required;
- Decision records covering agreements with regulators;
- Records of works undertaken and associated validation and monitoring records obtained from the contractor (chemical and geotechnical testing data, import sources, consignment notes etc);
- E3P's supervision records;
- Detailed drawings showing all sampling locations for chemical and geotechnical validation sampling;
- Specialist contractor's validation reports for particular elements of work;
- Detailed surveys of all excavations and production of as-built drawings;

- Final status of remediation and achievement of remedial objectives to satisfy planning conditions; and,
- Additional risk assessments/non-scheduled reactive works undertaken or details of any unexpected contamination.

On completion of the verification works, the appropriate documentation will be forwarded to the client and the regulatory authorities.

In most cases, a Verification Report will be produced once the remediation works have been completed, however, there may be instances where the remediation is phased and separate Verification Reports may be required.

E3P considers that with the adoption of the above best practices, the site can be safely redeveloped. The site enabling works process and the 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.

9. CONTINGENCY PLAN

9.1. PREVIOUSLY UNIDENTIFIED CONTAMINANTS

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

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

Any amendments to the original remediation objectives will be justified, recorded and included in the Verification Report.

10. SECOND PHASE, MITIGATION AND MANAGEMENT

10.1. OVERVIEW OF FULL PROJECT REQUIREMENTS

Build phase mitigation requirements are provided under a separate cover. The below 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 site won and/or imported topsoil for use in cover systems;
- Laboratory testing of the site won and/or imported subsoil for use in cover systems;
- Placement and depth validation of cover systems;
- Installation of suitable potable water infrastructure; and
- Installation and validation of ground gas protection measures.

The validation protocols are presented within the E3P Remediation and Enabling Works Strategy and are presented below.

10.2. PLACEMENT OF COVER SYSTEM

The remediation and enabling works strategy for the site, concerning the health of the future site users, includes the provision of a chemically suitable clean material to be installed in all soft landscaped areas. The construction of the clean cover/placement of clean material shall be in accordance with Table 16.

Table 16 Construction and Validation of Cover System

SOFTSCAPE TYPE	DEPTH		BREAK LAYER Y/N/TYPE	VALIDATION FREQUENCY	TESTING SUITE	VALIDATION DOCUMENTATION
	TOPSOIL	SUBSOIL				
Back garden	150	450	N	1 per plot	A/B/C/D	Cover System Validation Certificate
Front garden	150	300	N	1 per 10 plots	A/B/C/D	
LEAP (parkland)	Minimum 300mm clean cover		N	1 per 625 m^2	A/B/C/D	
Functional POS	Minimum 300mm clean cover		N	1 per 2000 m^2	A/B/C/D	
None Functional POS	N/A		N/A	N/A	A/B/C/D	N/A

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 (Table 7).

Subsoil and topsoil shall be free of any deleterious materials, such as building 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 the importation of additional material during construction.

Testing requirements for top-soil and sub-soil are presented in Table 17.

Table 17 Specification for Soil Testing

MATERIAL USE	TESTING FREQUENCY	SUITE OF ANALYSIS
Subsoil Greenfield Source	1 Sample per 100 m^3 (minimum 3 from source)	A/B/C/D
Subsoil Brownfield Source	1 Sample per 50 m^3 (minimum 6 from source)	A/B/C/D
Topsoil Greenfield Source	1 Sample per 100 m^3 (minimum 3 from source)	A/B/C/D
Topsoil Brownfield Source	1 Sample per 50 m^3 (minimum 6 from source)	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.

10.2.1. PROCEDURE FOR PLACEMENT OF CHEMICALLY SUITABLE COVER SYSTEM

Garden and landscaped areas need to be backfilled with validated subsoil, and topsoil overlaying this in line with Table 10.3. Topsoil is required to be confirmed as chemically suitable prior to placement. Where sub-soil is not placed during remediation and enabling works, E3P will be required to return to the site and undertake independent validation of the correct placement of sub-soil.

The placement of clean material in soft landscaping 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 certified topsoil and 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 18.

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Table 18 Garden Validation Procedure

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 topsoils. 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 and must be advanced at random.
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. It should be noted that cover systems should be installed as late as possible in the build programme to reduce the risk of cross-contamination.
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 have 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.

Figure 2 provides an example of a garden validation certificate that will be required for each plot.

Figure 2 Example of Plot Cover System Validation

Plot Validation

20 / 20 (100%)

Plot Validation 1

5 / 5 (100%)

Plot Number	117
Is Plot Ready	Yes
Installation Standard	Pass
Depth of Cover System Materials (record the depth and support with Photo down the hole)	1000



Photo 1



Photo 2

Depth of Topsoil (mm)	150
Depth of Subsoil (mm)	850
Depth of Cover System at Ground Level (Photo)	☒



Photo 3

Depth of Cover System in Relation to Plot (Ensure the whole plot can be seen in the photo) ☒



Photo 4

Soil suitable	Yes
Geotextile membrane present	N/A

10.3. POTABLE WATER SUPPLY – CONTAMINANT ASSESSMENT CRITERIA

Table 19 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 19 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



GENERAL

1. This report and any associated works (together comprising the "Services") were compiled and carried out by E3P for the client (as present in Section 1) under the E3P “Terms of Business” or with those parties with whom a warranty agreement has been executed, or with whom an assignment has been agreed and outlined in the body of the report.

2. Unless explicitly agreed otherwise, in writing, this report has been prepared under E3P Standard Terms and Business as included within our proposal to the Client.

3. Project-specific appointment documents may be agreed upon at our discretion and a charge may be levied for both the time to review and finalise appointment documents and also for associated changes to the appointment terms. E3P reserves the right to amend the fee should any changes to the appointment terms create an increased risk to E3P.

4. The report needs to be considered in light of the proposal and associated limitations of scope. The report needs to be read in full and isolated sections cannot be used without full reference to other elements of the report and any previous works referenced within the report.

PHASE 1 GEOENVIRONMENTAL AND PRELIMINARY RISK ASSESSMENTS

5. Coverage: This section covers reports with the following titles or combination of titles: Phase 1; Desktop Study; Geoenvironmental Assessment; Development Appraisal; Preliminary Environmental Risk Assessment; Constraints Report; Due Diligence Report; Geotechnical Development Review; Environmental Statement; Environmental Chapter; Baseline Environmental Assessment; Project Scope Summary Report (PSSR), Program Environmental Impact Report (PEIR), Geotechnical Development Risk Register; Agricultural Land Assessment; Mineral Safeguarding Assessment; Desk Top Coal Mining Risk Assessment; Hydrogeological Appraisal; Construction Environmental Management Plan; and Site Water Management Plan.

6. The works undertaken to prepare this report comprised a study of available and easily documented information from a variety of sources (including the Client), together with (where appropriate) a brief walkover inspection of the Site and correspondence with relevant authorities and other interested parties. Due to the short timescales associated with these projects responses may not have been received from all parties. E3P cannot be held responsible for any disclosures that are provided post-production of our report and will not automatically update our report.

7. The opinions given in this report have been dictated by the finite data on which they are based and are relevant only for the purpose for which the report was commissioned. The information reviewed should not be considered exhaustive and has been accepted in good faith as providing true and representative data pertaining to site conditions. Should additional information become available which may affect the opinions expressed in this report, E3P reserves the right to review such information and, if warranted, to modify the opinions accordingly.

8. It should be noted that any risks identified in this report are perceived risks based on the information reviewed. Actual risks can only be assessed following intrusive investigations of the site.

9. 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 does not constitute or replace full and proper surveys completed by suitably qualified and experienced specialists in these fields.

10. E3P does not warrant work/data undertaken/provided by others.

INTRUSIVE INVESTIGATION REPORTS

11. Coverage: The following report titles (or combination) may cover this category of work: Geoenvironmental Site Investigation; Geotechnical Assessment; GIR (Ground Investigation Reports); Preliminary Environmental And Geotechnical Risk Assessment; Preliminary Summary; Coal Mining Risk Assessment, Ground Gas Addendum; and, Geotechnical Risk Register.

12. The investigation has been undertaken to provide information concerning either:

    I. The type and degree of contamination present at the site in order to allow a generic quantitative risk assessment to be undertaken; or

    II. Information on the soil properties present at the site to allow for geotechnical development constraints to be considered.

13. The scope of the investigation was selected on the basis of the specific development and land use scenario proposed by the Client and may be inappropriate to another form of development or scheme. If the development layout was not known at the time of the investigation the report findings may need revisiting once the development layout is confirmed.

14. Unless otherwise specified in the scope of works, any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

15. For contamination purposes, the objectives of the investigation are limited to establishing the risks associated with potential contamination sources with the potential to cause harm to human health, building materials, the environment (including adjacent land), or controlled waters.

16. For geotechnical investigations, the purpose is to broadly consider potential development constraints associated with the physical property of the soils underlying the site within the context of the proposed future or continued use of the site, as stated within the report.

17. The amount of exploratory work, soil property testing and chemical testing undertaken has necessarily been restricted by various factors which may include accessibility, the presence of services; existing buildings; current site usage or short timescales. The exploratory holes completed assess only a small percentage of the area in relation to the overall size of the Site, and as such can only provide a general indication of conditions.

18. The number of sampling points and the methods of sampling and testing do not preclude the possible existence of contamination where concentrations may be significantly higher than those actually encountered or ground conditions that vary from those identified. In addition, there may be exceptional ground conditions elsewhere on the site which have not been disclosed by this investigation and which have therefore not been taken into account in this report.

19. The inspection, testing and monitoring records relate specifically to the investigation points and the timeframe that the works were undertaken. They will also be limited by the techniques employed. As part of this assessment, E3P has used reasonable skill and care to extrapolate conditions between these points based on assumptions to develop our interpretation and conclusions.

20. The assumption made in forming our conclusions is that the ground and groundwater conditions (both chemically and physically) are the same as have been encountered during the works undertaken at the specific points of investigation and at the time of the investigation.

21. Conditions can change between investigation points both spatially and over time and these interpretations should therefore be considered indicative. The assessment of extreme weather events and their impact on ground conditions is not within the scope of E3P's work.

22. The risk assessment and opinions provided are based on currently available guidance relating to acceptable contamination concentrations; no liability can be accepted for the retrospective effects of any future changes or amendments to these values. Specific assumptions associated with the risk assessment process have been outlined within the body or associated appendix of the report.

23. Additional investigations may be required in order to satisfy relevant planning conditions or to resolve any engineering and environmental issues.

24. Where soil contamination concentrations recorded as part of this investigation are used for commentary on the potential waste classification of soils for disposal purposes, these should be classed as indicative only. Due consideration should be given to the variability of contaminant concentrations taken from targeted samples versus bulk excavated soils and the potential variability of contaminant concentrations between sampling locations. Where major waste disposal operations are considered, targeted waste classification investigations should be designed and the waste classification and any subsequent disposal option agreed upon with licenced subcontractors and/or the relevant regulators.

25. The results of the asbestos testing are factually reported and interpretation is given as to how this relates to the previous use of the site, the types of ground encountered and site conceptualisation. This does not however constitute a formal asbestos assessment. These results should be treated cautiously and should not be relied upon to provide detailed and representative information on the delineation, type and extent of bulk ACMs and/or trace loose asbestos fibres within the soil matrix at the site.

26. If costs have been included in relation to additional site works, and/or site remediation works these must be considered as indicative only and must be confirmed by a qualified quantity surveyor.

EUROCODE 7: GEOTECHNICAL DESIGN

27. On 1st April 2010, BS EN 1997-1:2004 (Eurocode 7: Geotechnical Design – Part 1) became the mandatory baseline standard for geotechnical ground investigations.

28. In terms of geotechnical design for foundations, slopes, retaining walls and earthworks, EC7 sets guidance on design procedures including specific guidance on the numbers and spacings of boreholes for geotechnical design, there are limits to methods of ground investigation and the quality of data obtained and there are also prescriptive methods of assessing soil strengths and methods of design. Unless otherwise explicitly stated, the work has not been undertaken in accordance with EC7. A standard geotechnical interpretative report will not meet the requirements of the Geotechnical Design Report (GDR) under Eurocode 7. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. The report is likely to represent a Ground Investigation Report (GIR) under the Eurocode 7 guidance.

DETAILED QUANTITATIVE RISK ASSESSMENTS AND REMEDIATION AND ENABLING WORK STRATEGY REPORTS

29. These reports build upon previous report versions and associated notes. The scope of the investigation, further testing and monitoring and associated risk assessments were selected based on the specific development and land use scenario proposed by the Client and may not be appropriate to another form of development or scheme layout. The risk assessment and opinions provided are based on currently available approaches in the generation of Site Specific Assessment Criteria relating to contamination concentrations and are not considered to represent a risk in a specific land use scenario to a specific receptor. No liability can be accepted for the retrospective effects of any future changes or amendments to these values, associated models or associated guidance.

30. The outputs of the Detailed Quantitative Risk Assessments are based upon the manipulation of standard risk assessment models. These are our interpretation of the risk assessment criteria.

31. Before adoption on-site, assessment criteria will need to be discussed and agreed upon with the Regulatory Authorities prior to adoption on site. The regulatory discussion and engagement process may result in an alternative interpretation being determined and agreed. The process and timescales associated with the Regulatoy Authority engagement are not within the control of E3P. All costs and programmes presented as a result of this process should be validated by a quantity surveyor and should be presumed to be indicative.

32. E3P does not accept liability for any subcontract work that has not been completed in strict accordance with an approved E3P Remediation and Enabling Works Strategy.

GEOTECHNICAL DESIGN REPORT (GDR)

33. The GDR can only be prepared following confirmation of all structural loads and serviceability requirements. All the relevant information needs to be provided to allow for a GDR to be produced.

MONITORING (INCLUDING REMEDIATION MONITORING REPORTS AND BUILD PHASE MITIGATION)

34. These reports are factual and comprise monitoring, normally groundwater and ground gas and data provided by contractors as part of earthworks or remedial works.

35. The data is presented and will be compared with assessment criteria.

APPENDIX II
GLOSSARY



TERMS

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

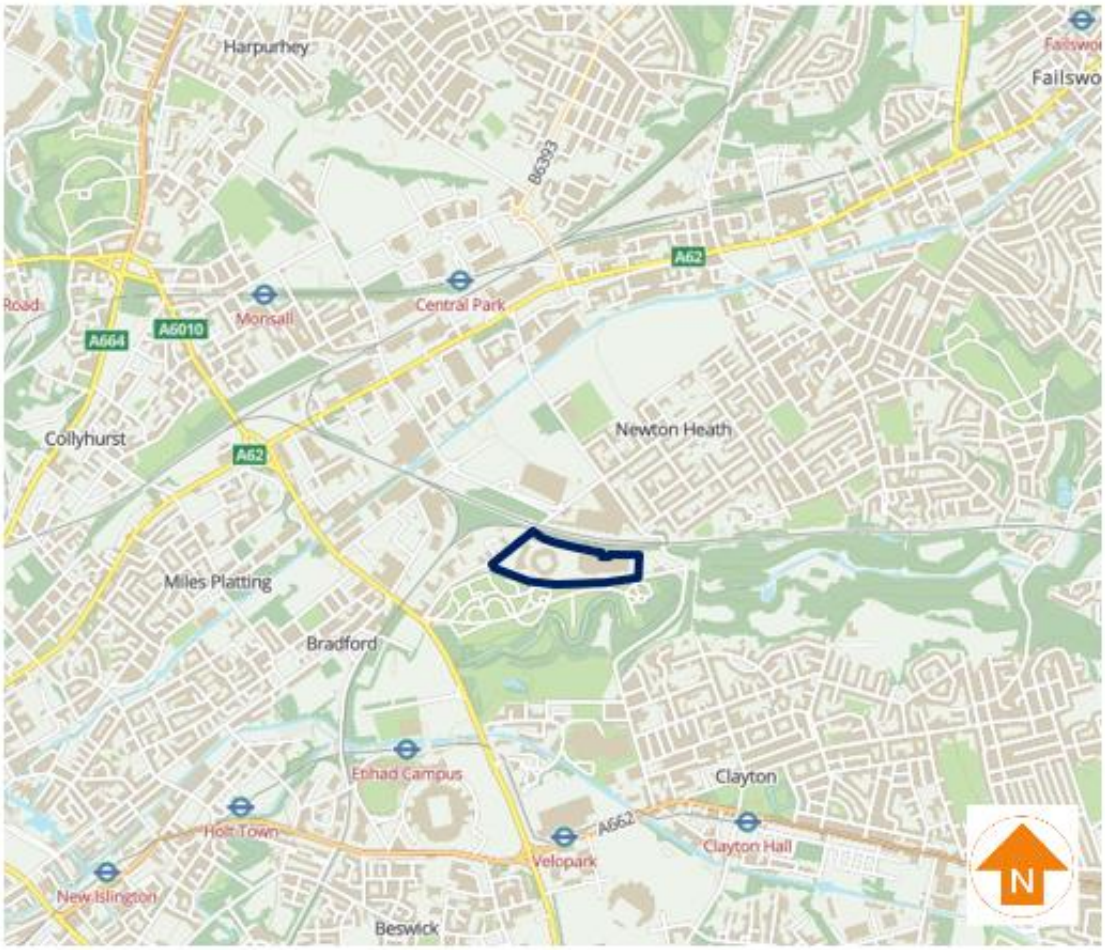
m	Metres	**ppm**	Parts per million
km	Kilometres	**mg/m^3**	Milligram per metre cubed
% v/v	Percent volume in air	**m bgl bgl**	Metres below ground level
mb	Millibars (atmospheric pressure)	**m bcl**	Metre below cover level
l/hr	Litres per hour	**mAOD**	Metres above ordnance datum (sea level)
µg/l	Micrograms per litre (parts per billion)	**kN/m^2**	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
PFAS	Per- and Polyfluoroalkyl Substances	**MTBE**	Methyl tert-Butyl Ether
EP	Environmental Permit	**WFD**	Waste Framework Directive
WML	Waste Management Licence		

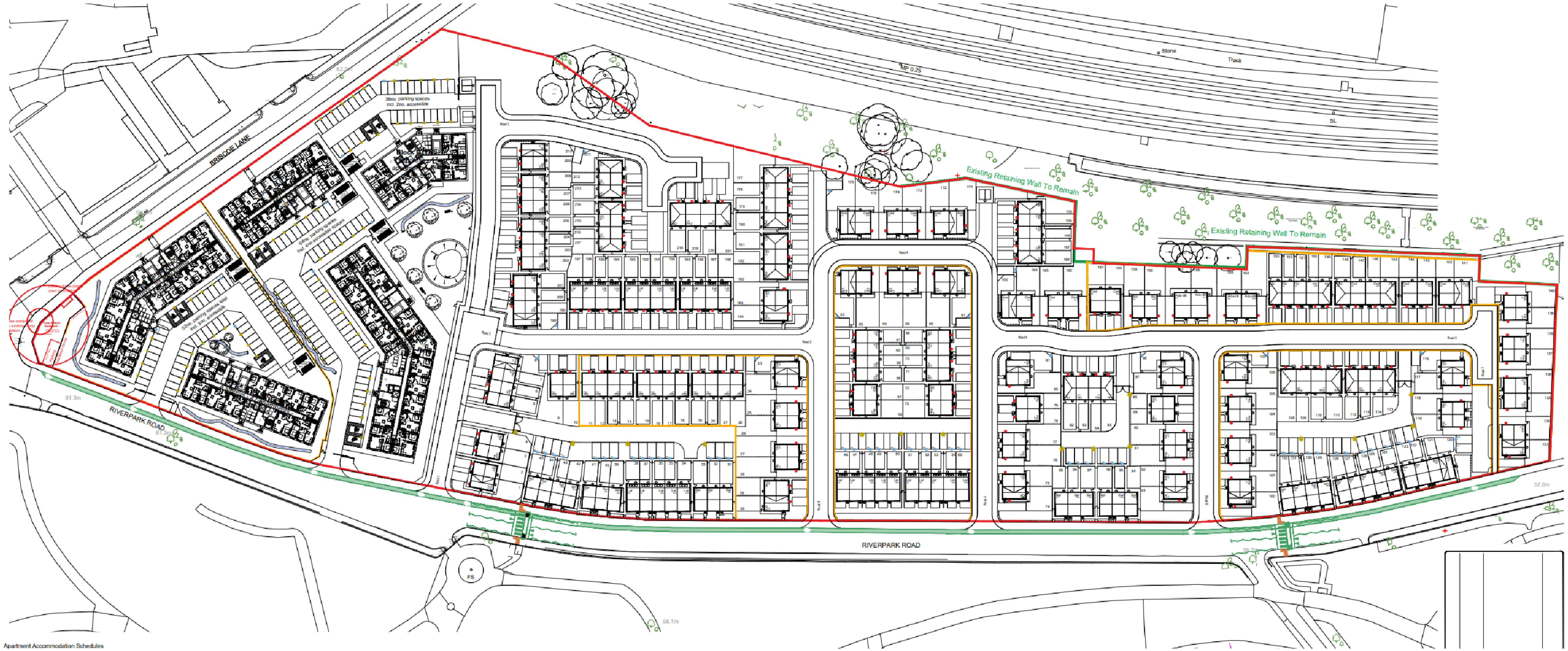
APPENDIX III
DRAWINGS



DRAWING 17-246-001 – Site Location Plan







Apartment Accommodation Schedules

N

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVC	14.03.2025	TG	MD	MD
P1	REVB	20.02.2025	TG	MD	MD
P1	REVA	07.03.2024	EB	MD	MD

Client: Kellen

Job No: 17-246

Date: 14.03.2025

Drawing No: 002

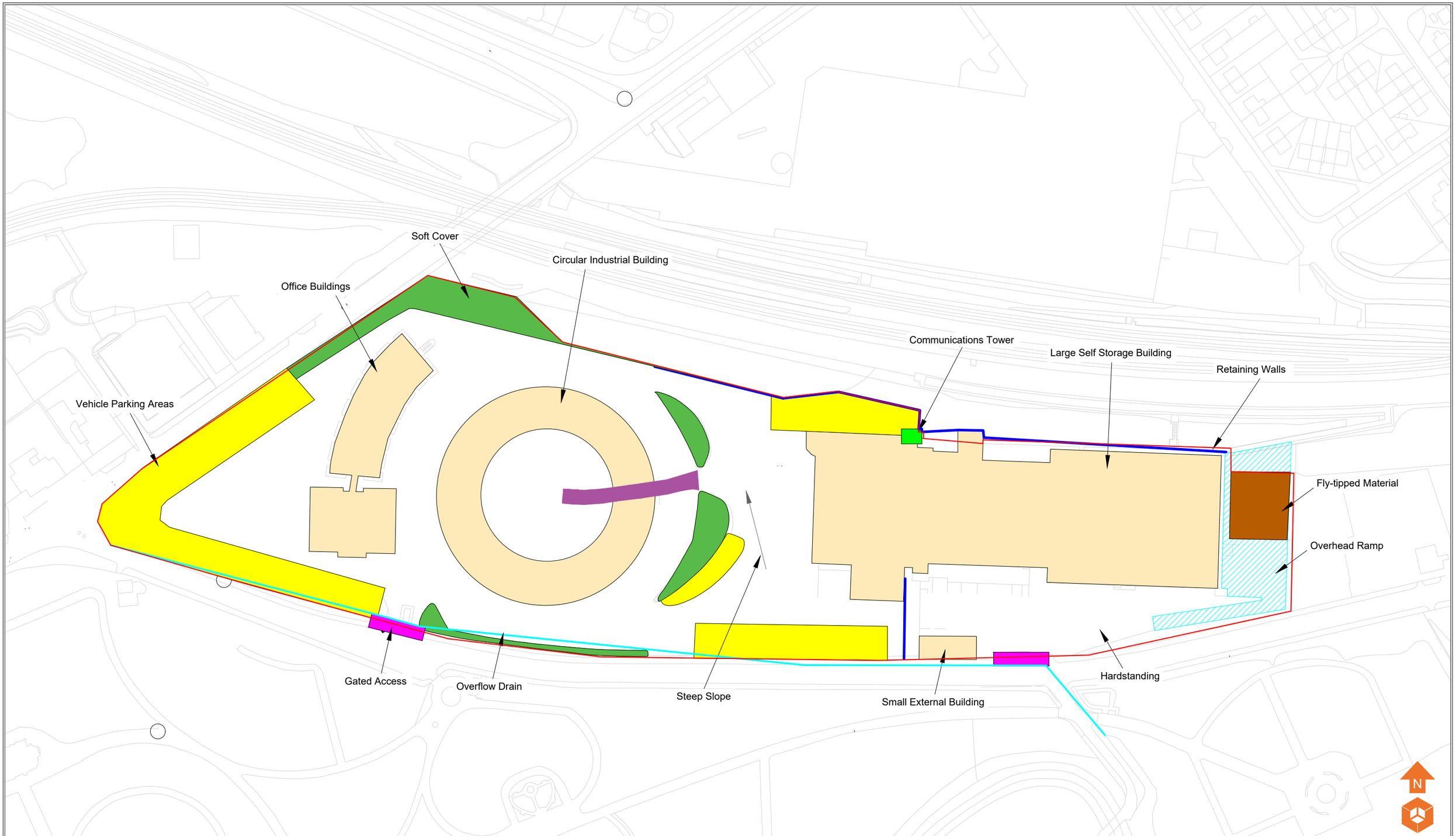
Scale: NTS @ A3

Job Title: Riverpark

Drawing Title: Proposed Development Plan

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Site Features

- Buildings
- Steep Slope
- Hardstanding
- Soft Cover
- Fly-tipped Materials
- Communications Tower
- Overhead Ramp
- Vehicle Parking Areas
- Retaining Walls
- Overflow Drain
- Underpass

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVD	21.11.2024	TG	MD	MD
P1	REVC	16.05.2024	OW	MD	MD
P1	REVB	01.03.2024	OW	LC	MD
P1	REVA	29.02.2024	OW	LC	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 004

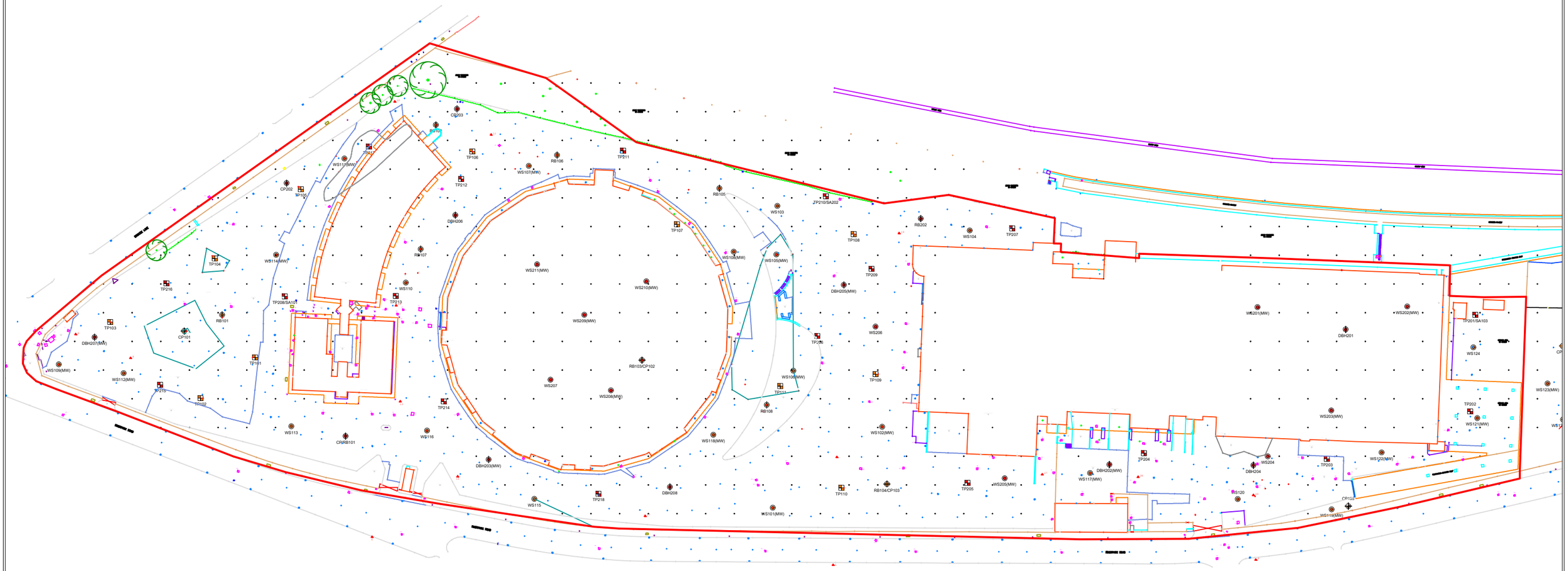
Scale: NTS @ A3

Job Title: Riverpark

Drawing Title: Site Features Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P November 2019)
- Approximate Trial Pit Location (E3P November 2019)
- Approximate Cable Percussive Borehole Location (E3P November 2019)
- Approximate Rotary Borehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P January 2024)
- Approximate Trial Pit Location (E3P January 2024)
- Approximate Soakaway Test Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Window Sample Probehole Location (E3P January 2024)

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVD	21.11.2024	TG	MD	MD
P1	REVC	19.03.2024	EB	GC	MD
P1	REVB	12.02.2024	EB	MD	MD
P1	REVA	26.01.2024	OW	LC	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 006

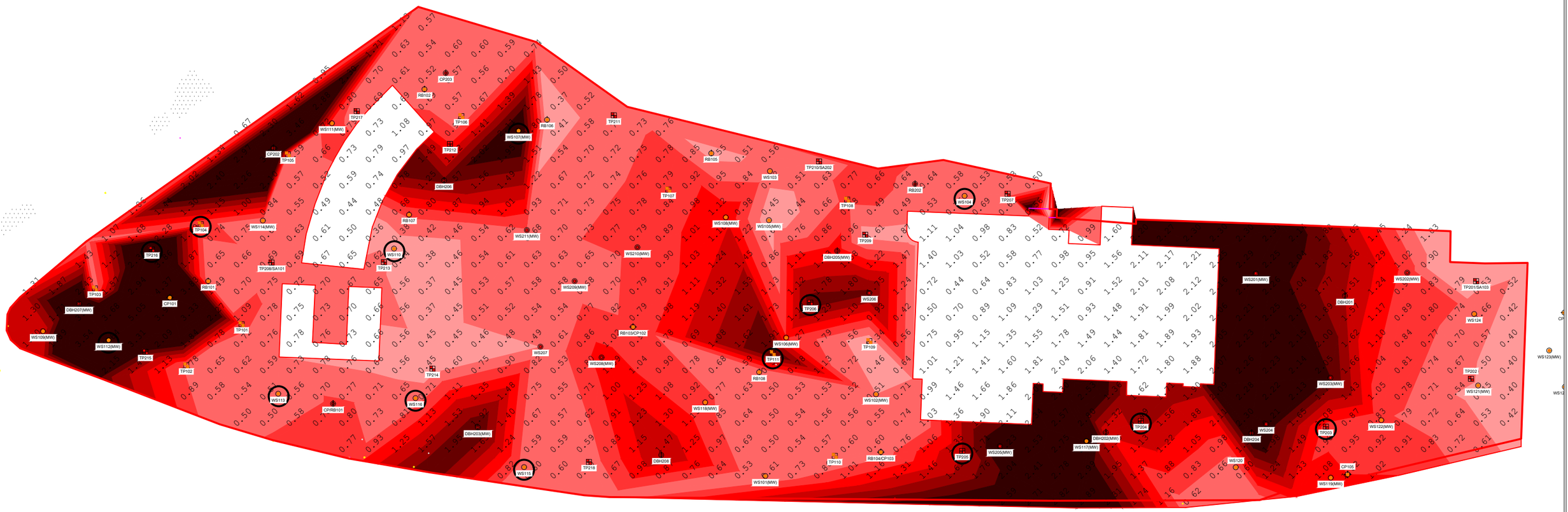
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Job Title: Riverpark

Drawing Title: Exploratory Hole Location Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P November 2019)
- Approximate Trial Pit Location (E3P November 2019)
- Approximate Cable Percussive Borehole Location (E3P November 2019)
- Approximate Rotary Borehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P January 2024)
- Approximate Trial Pit Location (E3P January 2024)
- Approximate Soakaway Test Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Window Sample Probehole Location (E3P January 2024)

Made Ground Depth (m)

- Depth of Made Ground 0.25 - 0.49m
- Depth of Made Ground 0.50 - 0.74m
- Depth of Made Ground 0.75 - 0.99m
- Depth of Made Ground 1.00 - 1.24m
- Depth of Made Ground 1.25 - 1.49m
- Depth of Made Ground 1.50 - 1.74m
- Depth of Made Ground 1.75 - 1.99m
- Depth of Made Ground >2.00m
- Base of Made Ground Not Encountered

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVD	26.02.2025	TG	MD	MD
P1	REVC	21.11.2024	TG	MD	MD
P1	REVB	14.02.2024	EB	MD	MD
P1	REVA	12.02.2024	EB	MD	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 006

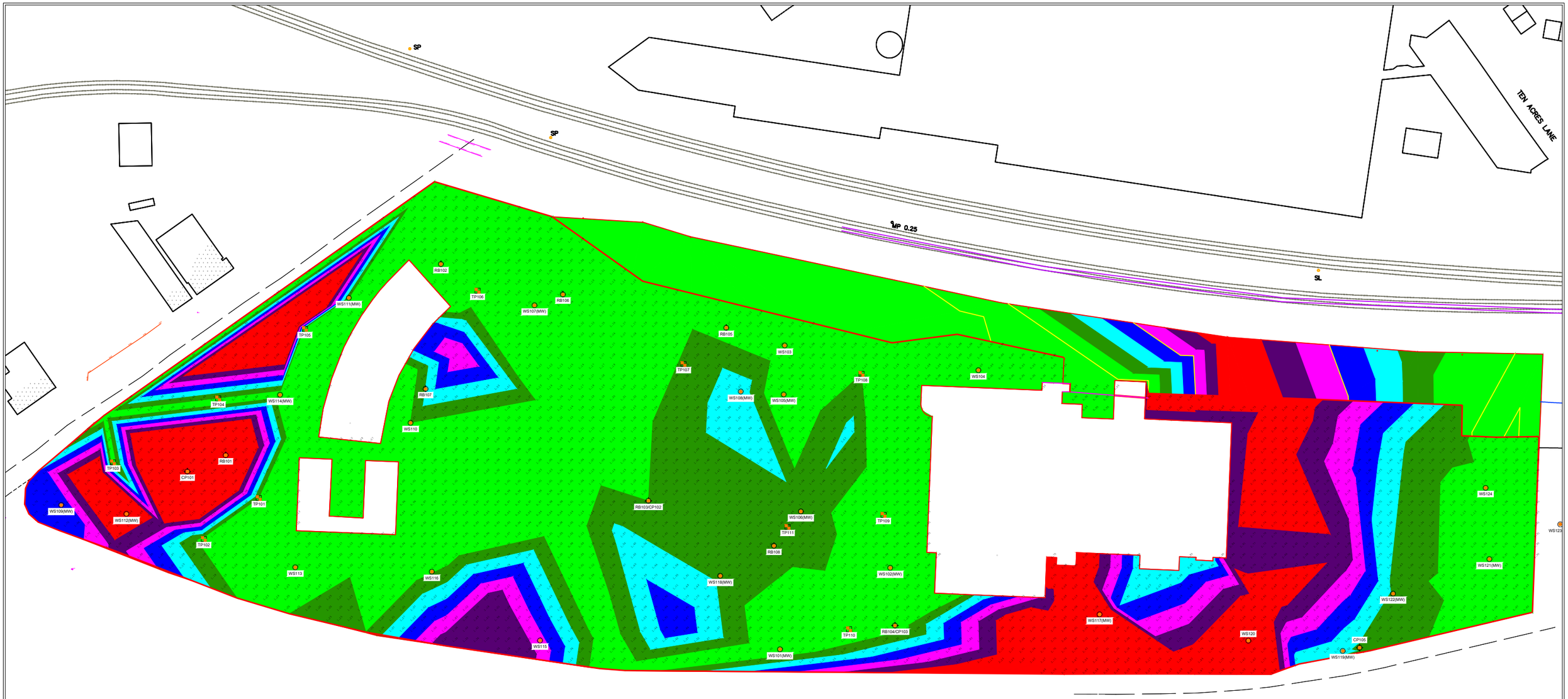
Scale: NTS @ A3

Job Title: Riverpark

Drawing Title: Depth of Made Ground Plan

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Location Symbols

- WS101 — Approximate Window Sample Probehole Location (E3P November 2019)
- WS101(MW) — Approximate Window Sample Probehole Location with Install (E3P November 2019)
- TP101 — Approximate Trial Pit Location (E3P November 2019)
- CP101 — Approximate Cable Percussive Borehole Location (E3P November 2019)
- RB101 — Approximate Rotary Borehole Location (E3P November 2019)
- WS201(DRK) — Approximate Window Sample Probehole Location with Install (E3P January 2024)
- TP201 — Approximate Trial Pit Location (E3P January 2024)
- SA201 — Approximate Soakaway Test Location (E3P January 2024)
- CP201 — Approximate Cable Percussive Borehole Location (E3P January 2024)
- DBH201 — Approximate Cable Percussive Borehole Location (E3P January 2024)
- WS201 — Approximate Window Sample Probehole Location (E3P January 2024)

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:

Depth to Founding Strata does not Consider Anthropogenic Influence or Trees and is an Indicative Assessment

Phase	Issue	Date	Drawn	Checked	PM
P1	REVD	26.02.2025	TG	MD	MD
P1	REVC	21.11.2024	TG	MD	MD
P1	REVB	14.02.2024	EB	MD	MD
P1	REVA	12.02.2024	EB	MD	MD

Client: Kellen

Job Title: Riverpark

Job No: 17-246

Drawing No: 008

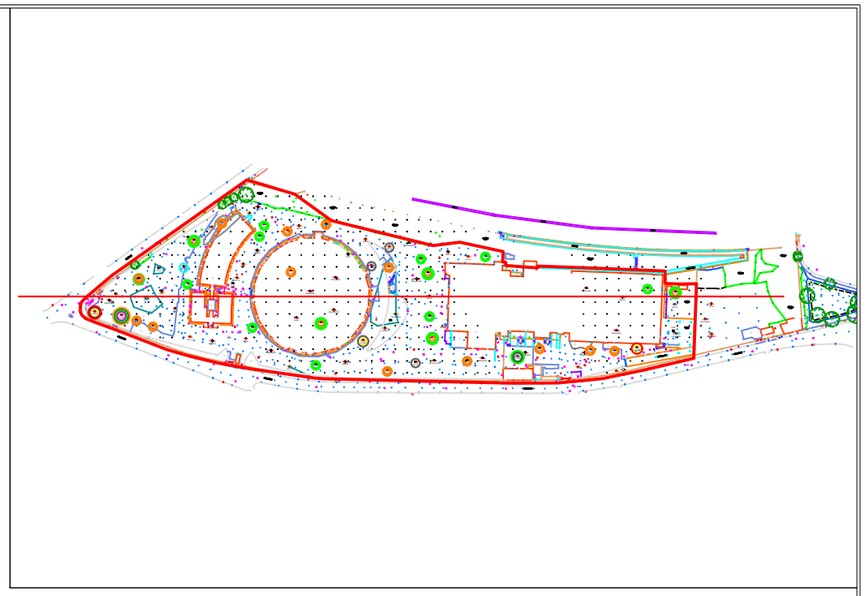
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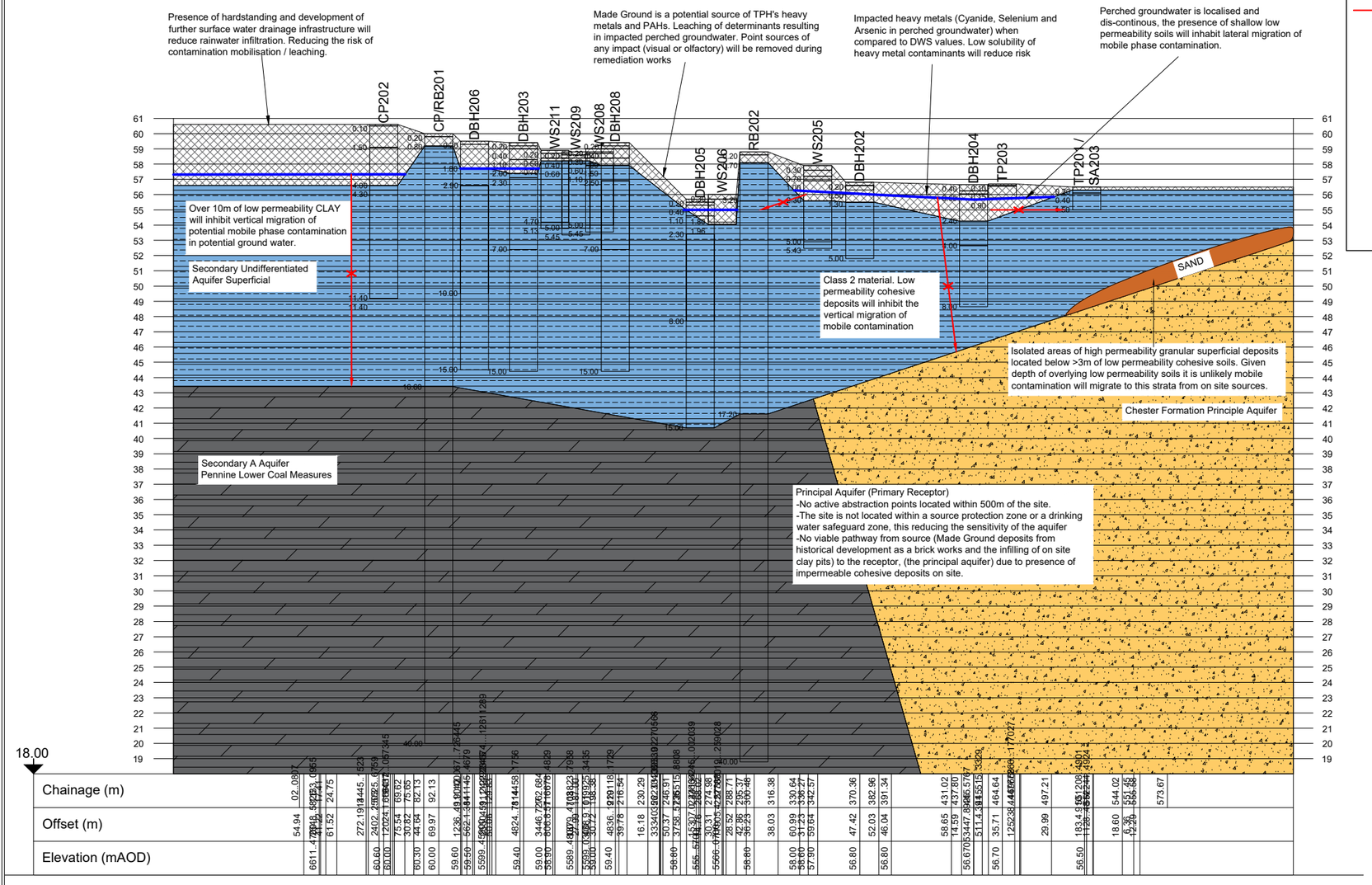
Scale: NTS A3

Drawing Title: Depth to Founding Strata Plan

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Geology Key

- Made Ground
- Superficial Deposits
- Chester Formation
- Pennie Lower Coal Measures
- Groundwater
- Pathways
- Pathway Interrupted

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVE	21.11.2024	TG	MD	MD
P1	REVD	16.05.2024	OW	MD	MD
P1	REVC	08.04.2024	OW	MD	MD
P1	REVB	19.03.2024	EB	GC	MD
P1	REVA	18.03.2024	EB	GC	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 010

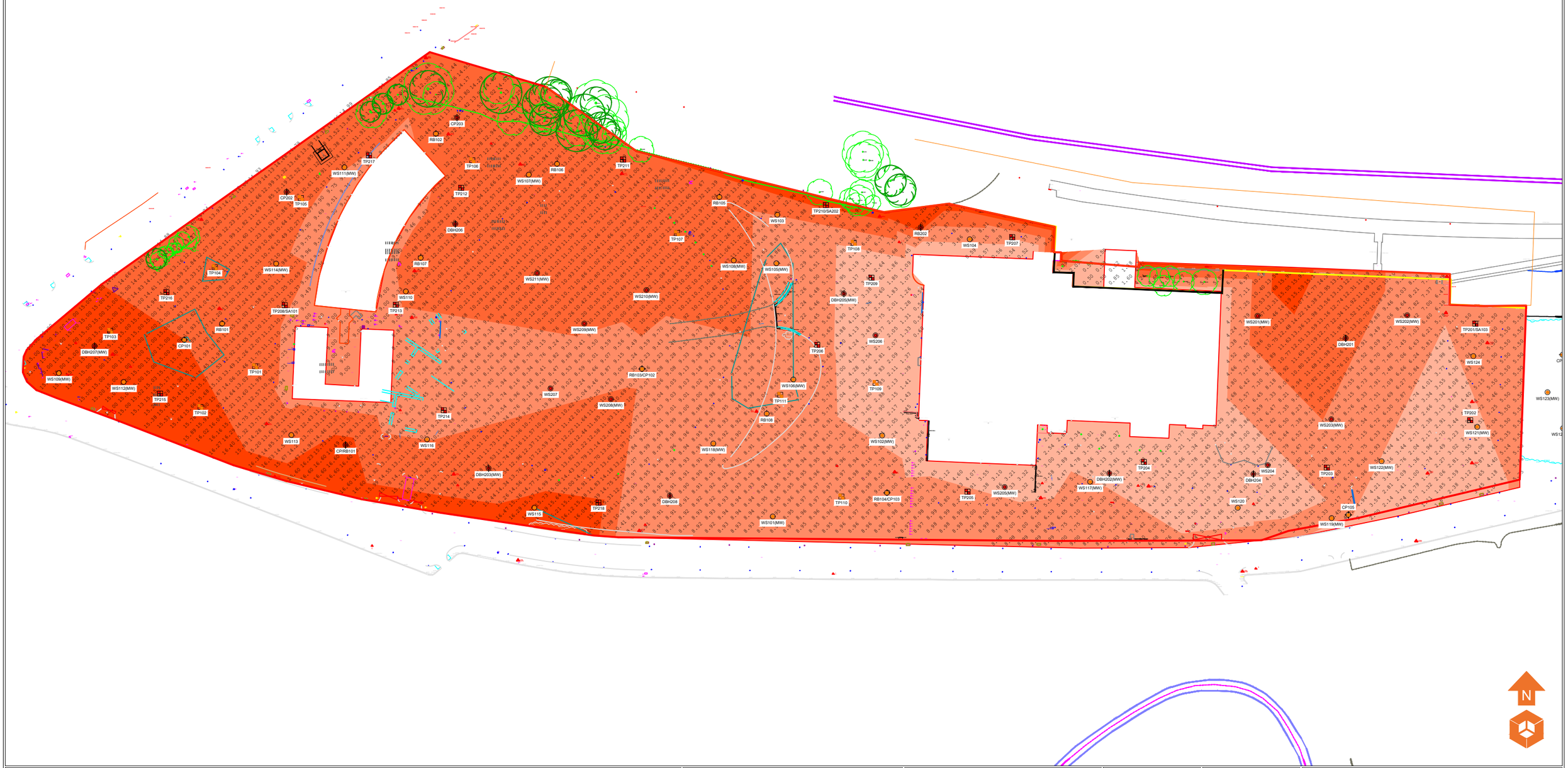
Scale: NTS

Job Title: Riverpark

Drawing Title: Controlled Waters Conceptual Site Model

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Location Symbols

- Approximate Window Sample Probehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P November 2019)
- Approximate Trial Pit Location (E3P November 2019)
- Approximate Cable Percussive Borehole Location (E3P November 2019)
- Approximate Rotary Borehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P January 2024)
- Approximate Trial Pit Location (E3P January 2024)
- Approximate Soakaway Test Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Window Sample Probehole Location (E3P January 2024)

Bedrock Depth (m)

- Depth to Bedrock 0.00 - 4.99M
- Depth to Bedrock 5.00 - 9.99M
- Depth to Bedrock 10.00 - 14.99M
- Depth to Bedrock <15.00M

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVB	23.03.2026	TG	GC	MD
P1	REVA	12.02.2024	EB	MD	MD

Client: Kellen

Job Title: Riverpark

Job No: 17-246

Drawing No: 012

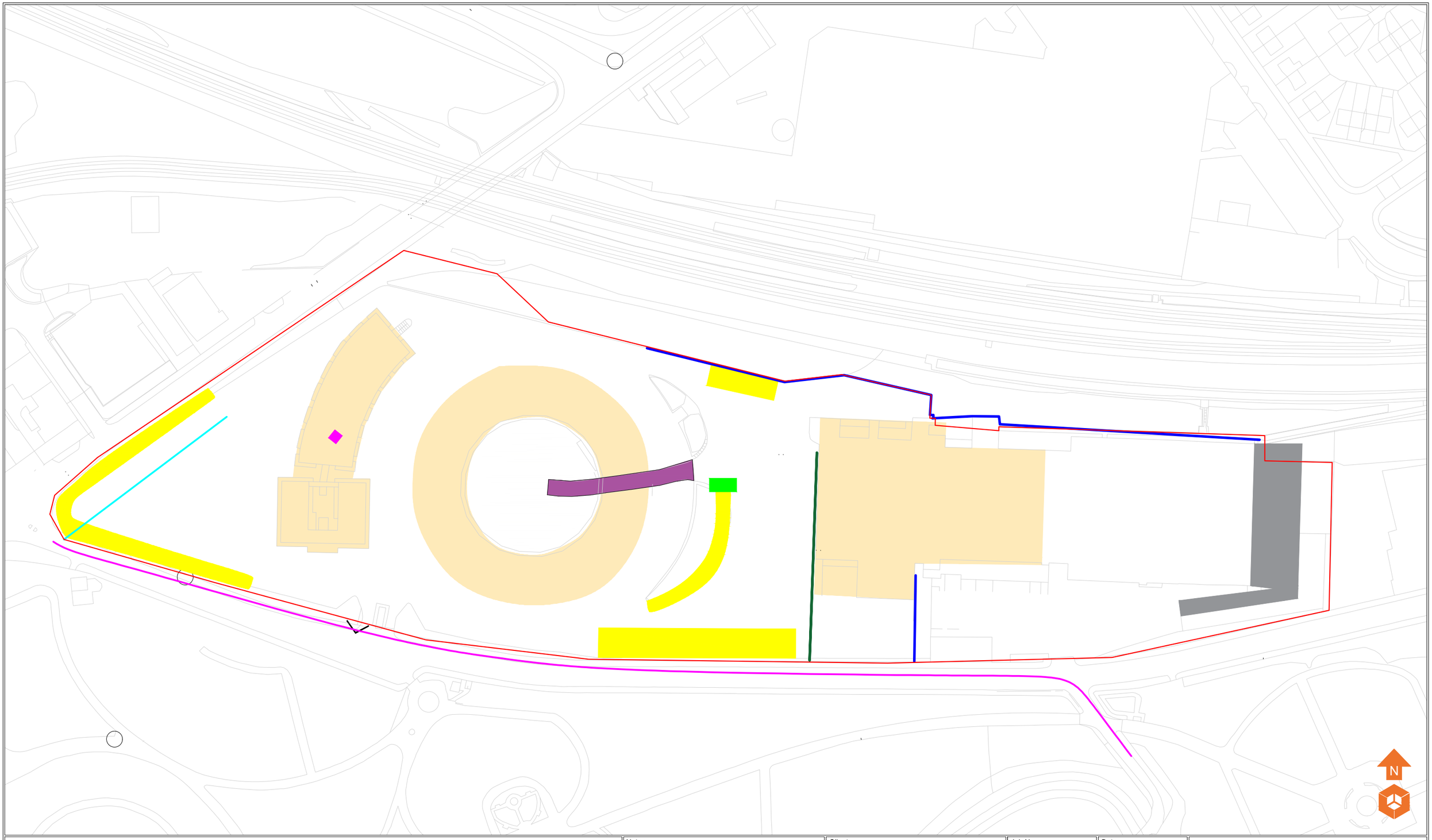
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Scale: NTS @ A3

Drawing Title: Depth to Bedrock Plan

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Development Constraints

- Public Sewer
- Inaccessible Building
- Vehicle Parking Areas
- LP Gas Main
- Overhead Ramp
- Potential Chimney Base Obstruction
- Abandoned United Utilities Head System
- Retaining Walls
- Underpass
- Japanese Knotweed

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVG	21.11.2024	TG	MD	MD
P1	REVF	09.04.2024	OW	MD	MD
P1	REVE	21.03.2024	EB	MD	MD
P1	REVD	01.03.2024	OW	LC	MD
P1	REVC	29.02.2024	OW	LC	MD
P1	REVB	27.02.2024	OW	MD	MD
P1	REVA	26.01.2024	OW	LC	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 015

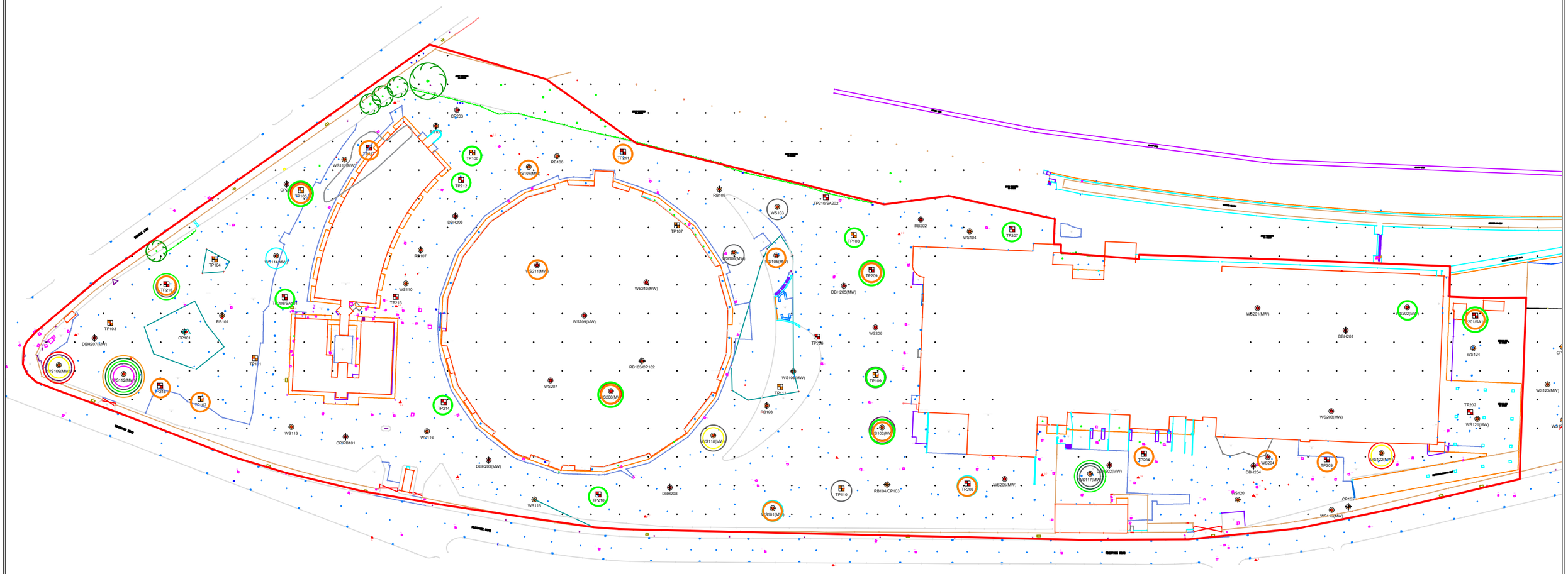
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Job Title: Riverpark

Drawing Title: Development Constraints Plan

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Location Symbols

- Approximate Window Sample Probehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P November 2019)
- Approximate Trial Pit Location (E3P November 2019)
- Approximate Cable Percussive Borehole Location (E3P November 2019)
- Approximate Rotary Borehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P January 2024)
- Approximate Trial Pit Location (E3P January 2024)
- Approximate Soakaway Test Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Window Sample Probehole Location (E3P January 2024)

Contamination Exceedances

- Arsenic
- Lead
- Asbestos
- Benzo(a) Anthracene
- Benzo(b) Flurathene
- Benzo(a) Pyrene
- Dibenzo(a,h) Anthracene
- TPH C12-C16
- TPH C16-C21
- TPH C21-C35

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVB	21.11.2024	TG	MD	MD
P1	REVA	19.03.2024	EB	GC	MD

Client: Kellen

Job Title: Riverpark

Job No: 17-246

Date: 21.11.2024

Drawing No: 018

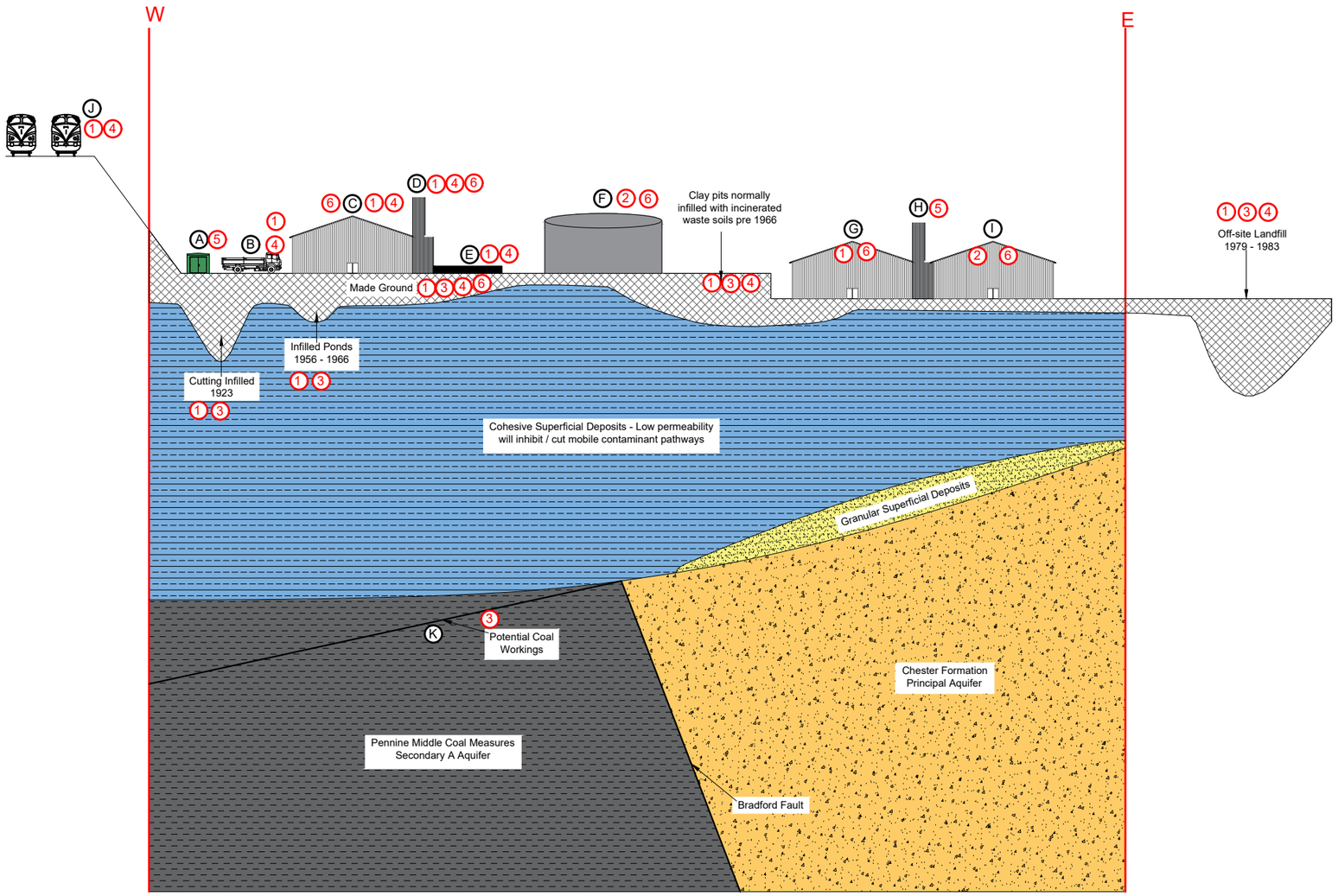
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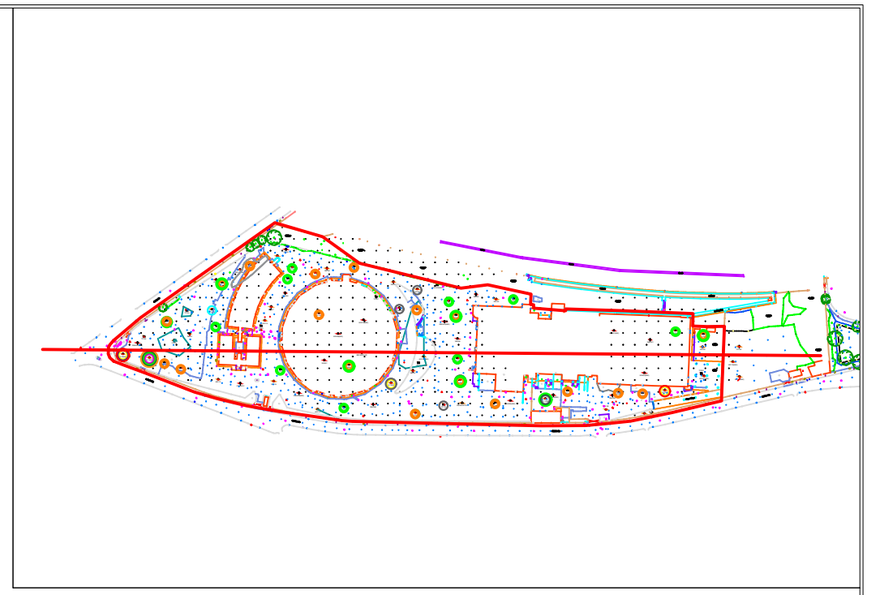
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Current / Historic Uses





Geology Key

- Made Ground
- Cohesive Superficial Deposits
- Chester Formation Principle Aquifer
- Granular Superficial Deposits
- Pennine Middle Coal Measures

Potential Contaminants

1. Heavy Metals, Non Volatile PAH's, Non Volatile TPH's
2. Biological Pathogens
3. Ground Gas
4. Volatile Contaminants (TPH C5 - C12), Napathalene, BTEX
5. PCB's
6. Asbestos

Mitigation Measures

- A Substation
- B Lorry (HGV) Park
- C Former Brickworks
- D Chimney
- E Former Tramway
- F Butchers
- G Current Commercial Activites
- H Communication Tower
- I Former Abattoir
- J Off-site Railway & Rail Infrastructure
- K Potential Coal Workings

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVE	21.11.2024	TG	MD	MD
P1	REVD	16.05.2024	OW	MD	MD
P1	REVC	20.03.2024	EB	MD	MD
P1	REVB	19.03.2024	EB	GC	MD
P1	REVA	15.03.2024	EB	GC	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 027

Scale: NTS

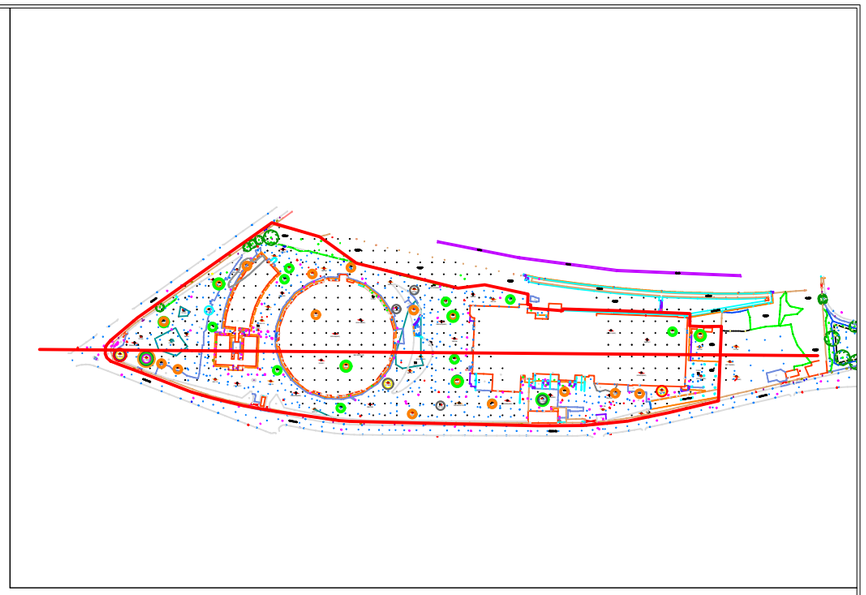
Job Title: Riverpark

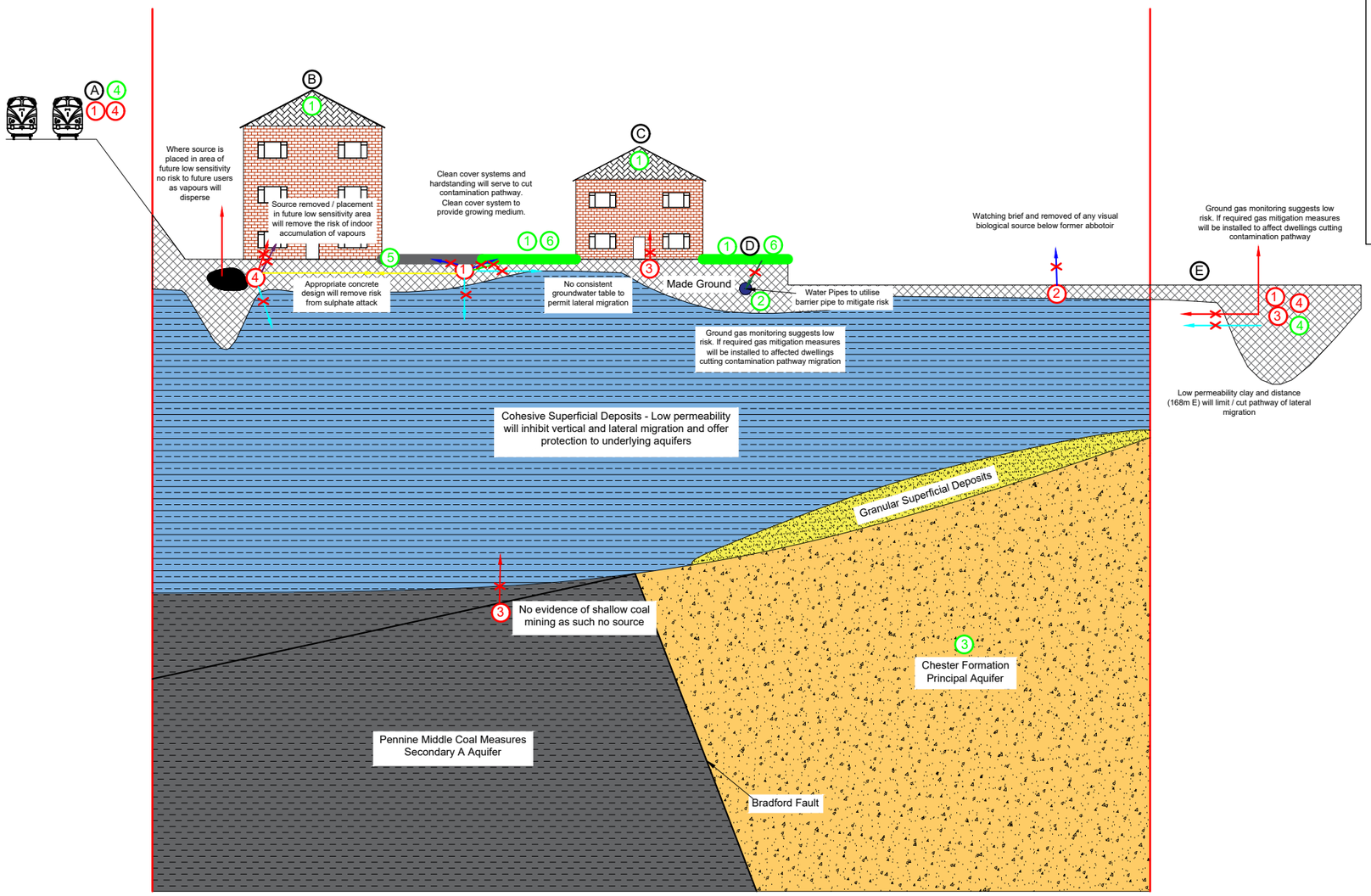
Drawing Title: Human Health Conceptual Site Model

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

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Residential End Use





Geology Key

- Made Ground
- Cohesive Superficial Deposits
- Chester Formation Principle Aquifer
- Granular Superficial Deposits
- Pennine Middle Coal Measures
- Pathway Interrupted

Potential Contaminants

1. Heavy Metals, Non Volatile PAH's, Non Volatile TPH's
2. Biological Pathogens
3. Ground Gas
4. Volatile Contaminants (TPH C5 - C12), Napathalene, BTEX
5. PCB's
6. Asbestos

Pathways

- Dermal Contact / Ingestion
- Vapour Inhalation
- Inhalation / Accumulation
- Tainting of Water Supplies
- Dust Inhalation
- Vertical / Lateral Migration
- Sulphate Attack on Concrete
- Plant Uptake

Receptors

1. Future End Users
2. Water Pipes
3. Groundwater (Principal Aquifer)
4. Off-site Receptors
5. Building Structure
6. Flora

Mitigation Measures

- A Off-site Railway & Rail Infrastructure
- B Appartment Block
- C Low Rise
- D Site Cover / Private Gardens
- E Off-site Landfill

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVD	21.11.2024	TG	MD	MD
P1	REVC	16.05.2024	OW	MD	MD
P1	REVB	19.03.2024	EB	GC	MD
P1	REVA	15.03.2024	EB	GC	MD

Client: Kellen

Job No: 17-246

Date: 21.11.2024

Drawing No: 028

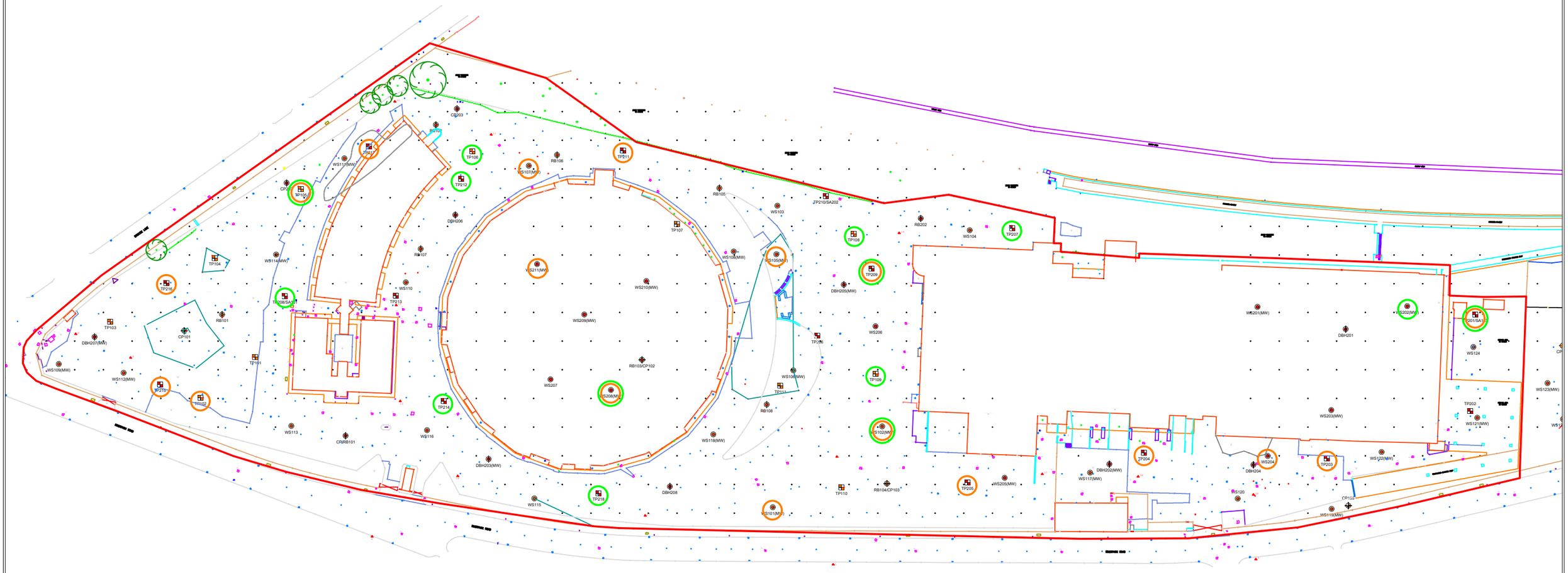
Scale: NTS

Job Title: Riverpark

Drawing Title: Human Health Conceptual Site Model

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Location Symbols

- Approximate Window Sample Probehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P November 2019)
- Approximate Trial Pit Location (E3P November 2019)
- Approximate Cable Percussive Borehole Location (E3P November 2019)
- Approximate Rotary Borehole Location (E3P November 2019)
- Approximate Window Sample Probehole Location with Install (E3P January 2024)
- Approximate Trial Pit Location (E3P January 2024)
- Approximate Soakaway Test Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Cable Percussive Borehole Location (E3P January 2024)
- Approximate Window Sample Probehole Location (E3P January 2024)
- Made Ground Sample Location
- Natural Sample Location

Notes:

Phase	Issue	Date	Drawn	Checked	PM
P1	REVB	21.11.2024	TG	MD	MD
P1	REVA	08.04.2024	OW	MD	MD

Client: Kellen

Job Title: Riverpark

Job No: 17-246

Drawing No: 029

Date: 21.11.2024

Scale: NTS @ A3

Drawing Title: Sampling Location Plan

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APPENDIX IV
E3P REMEDIATION/ VALIDATION CRITERIA



HUMAN HEALTH REMEDIATION TARGETS – LOW-RISE RESIDENTIAL END USE

DETERMINAND	UNITS	WITHIN COVER SYSTEM (GARDEN)	HARD STANDING AND BELOW COVER	PUBLIC OPEN SPACE COVER	BELOW PUBLIC OPEN SPACE COVER	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]	2
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 C_{12}-C_{16} (aromatic)	mg/kg	140[i][xi]	1800[ii][xi]	1800[ii][xi]	10,000[xiv][xi]	1

TPH C_{16}-C_{21} (aromatic)	mg/kg	260[(i)(xi)]	1900[(ii)(xi)]	1900[(ii)(xi)]	10,000[(xiv)(xi)]	1
TPH C_{21}-C_{35} (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 Suitable 4 Use Levels (S4ULs) for residential end use with plant uptake.
ii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use without plant uptake – these levels used below 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 Suitable 4 Use Levels (S4ULs) for public open space (POS) residential.
iv. Value derived from LQM Suitable 4 Use Levels (S4ULs) for public open space (POS) park – these levels used below 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 Suitable 4 Use Levels (S4ULs) alongside assessment with WM3 to ensure that materials remaining on site do not exceed the WM3 toxicity criteria for hazardous waste.
vi. Value derived from Category 4 Screening Levels (C4SL) for residential land use with homegrown produce.
vii. Value derived from Category 4 Screening Levels (C4SL) for residential land use without homegrown produce.
viii. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) residential.
ix. Value derived from Category 4 Screening Levels (C4SL) for public open space (POS) park.
x. Mercury – based on elemental mercury.
xi. PAH and TPH levels used are for 1% SOM.
xii. Xylenes based on p-xylene (o-xylene 2600 mg/kg, m-xylene 3500 mg/kg) and is capped by its solubility.
xiii. Value derived from LQM Suitable 4 Use Levels (S4ULs) for residential end use with plant uptake due to the volatilisation risk.
xiv. BTEX is not SOM-related due to inhalation pathway.

REMEDIATION TARGETS – COMPARISON OF GROUNDWATER / LEACHATE ANALYSIS WITH TIER 2 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

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 (m^3)	
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 Hotpots, Removal of Material and Stockpile			Rationale:
Legislatively Compliant Procedure to Deal with Contamination Excavated from Hotspot			Rationale:
Processing and Recycling of Aggregate with Geotechnical and Chemical Validation Testing			Note stockpile location and anticipated volume:
Stockpiling of Subsoil and Certification of Suitability for Reuse			Stockpile location:
Decommission of All Redundant Drainage Infrastructure			
Decommission of All Former Interceptors			
Decommission of All Former Above- and Below-Ground Tanks			
Removal of All Asbestos to a Licensed Facility			
Engineering of Plots for Shallow Spread Foundation in Accordance with E3P Geotechnical Specification			Plot Numbers

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

APPENDIX VII CONTRACTOR COMPLETION CHECK SHEET



GEOTECHNICAL ENABLING WORKS COMPLETION FORM

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

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

POST-REMEDIATION AND ENABLING LIMITATIONS

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