



University of Manchester, The
Relocation of the Limes, Fallowfield
Campus

Remediation Strategy & Verification Plan

For University of Manchester

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1. Introduction

1.1 Terms of reference

Hydrock Consultants Ltd. (Hydrock) has been commissioned by the University of Manchester (the Client) to prepare a Remediation Strategy and Verification Plan (RSVP) for University of Manchester - The Limes Relocation (the "site"). A Site Location Plan (Ref: LIMES-HYD-XX-XX-D-G-00001) is presented in Appendix A.

The works have been undertaken in accordance with Hydrock's proposal (by email dated 17th July 2024 worked in accordance with the Sub Consultants Agreement Reference UoMRRP) and the Client's instructions to proceed (by email dated 15th April 2025).

1.2 Background

Hydrock now Stantec completed a ground investigation between 2nd and 4th April 2024 and the risk assessment is presented in the Ground Investigation Report, reference LIMES-HYD-XX-XX-RP-G-2001_S2_P03, dated 24th August 2024.

The ground investigation found the 'General' Made Ground, present at depths between 0.1m and 1.65m bgl with an average thickness of 0.71m, contains pervasive polycyclic aromatic hydrocarbons (PAHs) and asbestos loose fibres up to <0.001% w/w. Therefore, mitigation will be required in the form of a cover system within landscaped areas.

The site currently comprises a car park, bike sheds, skip storage area, and associated soft landscaping. The site is rectangular in shape and relatively flat.

The proposed Development will combine the University's Catering Central Processing Unit (CPU), Maintenance Services Unit (MSU), Environmental Services Unit (ESU) and Residences Team to form a facility consisting of facility management stores and workshops, catering facilities, staff workspaces and storage facilities.

The proposed development layout (Butress Drawings, LIMES-BUT-M3-R3-DR-A-04101); is shown below as Figure 1.1.



Figure 1.1: Proposed Development Layout

1.3 Objectives

The objective of this Remediation Strategy and Verification Plan is to fulfil Stage 3: Remediation and Verification of the Environment Agency's (EA) Land Contamination Risk Management (LCRM), specifically the development of a remediation strategy to ensure that, on completion, the site can be shown to be suitable for its intended use, such that it will not pose an unacceptable contamination risk to the identified receptors.

This document ultimately seeks to agree the remediation concept for the proposed development with the relevant regulatory authorities. Significant departures and/or variations to this strategy will require approval from the regulators.

1.4 Scope

This Remediation Strategy and Verification Plan has been undertaken in general accordance with Environment Agency guidance Land Contamination Risk Management (LCRM), (EA, 2023) and the scope comprises:

- » Provision of background information.
- » Summarising the findings of the completed risk assessments.
- » Summarising the options appraisal process and setting out the key objectives of the remediation.
- » Presentation of the remedial measures recommended to mitigate the identified risks from contaminants at the site.
- » Detailing the appropriate verification procedures in order to demonstrate the successful implementation of the remediation.

This report provides an overview of the site development proposals and discusses the remediation measures required to ensure the site is suitable for use with respect to the identified receptors. This document does not cover the geotechnical requirements for the proposed development.

1.5 Available information

The following notable documents have been used in the preparation of this report:

- » Hydrock, May 2024. 'Ground Conditions Desk Study Report, UoM The Limes Relocation', Ref: LIMES-HYD-XX-XX-RP-G-1001 P02.
- » Hydrock, August 2024. 'Ground Investigation Report, UoM The Limes Relocation', Ref: LIMES-HYD-XX-XX-RP-G-2001 P03.

It is assumed that the reader has full knowledge of the ground conditions as detailed in the above documents.

1.6 Limitations

The report has been prepared by Hydrock on the basis of available information obtained during the study period. Although every reasonable effort has been made to gather all relevant information, all of

the potential environmental constraints or liabilities associated with the site may not have been revealed.

The report has been prepared for the exclusive benefit of the Client for the purpose of providing information on the remediation options for development of the site. The report contents should only be used in that context. Furthermore, new information, changed practices or new legislation may necessitate revised interpretation of the report after the date of its submission.

Hydrock has used reasonable skill, care and diligence in the design of the remediation of the site. The inherent variation in ground conditions allows only definition of the actual conditions at the locations and depths of exploratory locations at the time of the investigations. At intermediate locations, conditions can only be inferred.

Information provided by third parties has been used in good faith and is taken at face value. However, Hydrock cannot guarantee the accuracy or completeness of any information provided by others.

The Remediation Strategy and Verification Plan has been carried out in general accordance with Environment Agency guidance Land Contamination Risk Management (LCRM), (EA, 2023). Other relevant guidance that has been cross-referenced is indicated in the report text.

This report is subject to review and approval by the regulators in accordance with the planning condition.

2. Site description and Conceptual Site Model

2.1 Site location

The site is located on Owen Park, Fallowfield, Manchester, M14 6YZ. The site is situated between Whitworth Lane (west) and Chancellors Way (East), approximately 230m east of Platt Field Park and 4km south east of Manchester City Centre.

A site location plan (Hydrock Drawing LIMES-HYD-XX-XX-D-G-00001) is presented in Appendix A.

2.2 Site description

The site is rectangular in shape and has an area of approximately 0.56ha. The site is flat and lies at 44.35 to 44.41m AOD.

The site is currently an asphalt car park utilised by student living within the adjacent halls of residence. The site is bordered by mature and semi mature trees to the north and south, and adjacent to the access from Whitworth Lane to the west.

Visual scarring is present across the car park and various manholes and inspection chambers relating to existing services cross the site including BT, Gas, Sewers and Electricity.

A site features plan (Hydrock Drawing LIMES-HYD-XX-XX-D-G-00002) is presented in Appendix A.

2.3 Sources of contamination

The Made Ground contains significant exceedances for PAHs in 4 out of 5 samples, and as such the Made Ground is considered to contain pervasive concentrations of PAHs.

Asbestos loose fibres were present in the Made Ground in one sample taken from WS08 at 0.3m bgl, which contained loose fibres (amosite) at <0.001% w/w.

The levels of PAHs - particularly Naphthalene - within the Made Ground indicate an exceedance of organic contamination threshold values for use of PE pipe. Locally in WS09 the Made Ground and Glacial Till contain exceedances of PE organic contamination threshold values for Aliphatic and Aromatic bands EC10-16 and EC16-40. Hydrock believes barrier pipe is required, subject to completion of a United Utilities Water Pipe Risk Assessment, which is outside the scope of this report.

Ground gas monitoring of wells screened within the bedrock found elevated gas flows and elevated levels of carbon dioxide and methane, deemed to be associated with a low-risk offsite source. If the foundation solution for the building or externals involves piling, Hydrock considers the site to represent CS2 conditions and gas protection measures would be required. However, the current building design utilises pad foundations, leaving a minimum thickness of 1.5m of low permeability Glacial Till overlying the bedrock, removing the identified ground gas pathway provided all borehole monitoring wells are appropriately decommissioned in line with EA guidance¹. Therefore, the site is classified as CS1, not requiring gas protection measures.

¹ Environment Agency. October 2012. 'Good practice for decommissioning redundant boreholes and wells'.

The 'General' Made Ground which does not include the overlying type 1 or hardstanding has an average thickness of 0.7m and did not contain evidence of degradable organic content. The Total Organic Content of the Made Ground ranged from 1.5 to 2.6% which in accordance with BS8576:2013 is considered a very low ground gas source potential.

2.4 Ground model

The ground conditions as proven by ground investigations undertaken to date are summarised in Table 2.1 below.

Table 2.1: Summary of ground conditions encountered in previous GI

Stratum	Depth to top (m bgl)	Depth to base (m bgl)	Thickness (range) (m bgl)
Surface Cover – Asphalt Hardstanding	0.00 – 0.15	0.07 – 0.15	0.07 – 0.15
Non-General Made Ground	0.07 – 0.15	0.17 – 0.55	0.10 – 0.45
'General' Made Ground	0.17 – 0.55	0.40 – 1.65	0.23 – 1.40
Glacial Till	0.35 – 1.65	3.65 -4.70	2.65 – 3.80
Chester Formation	3.65 – 4.70	>5.45	Unproven

Figure 2.1 is a typical cross section from west to east below the proposed building footprint with Made Ground found to a maximum of 1.00m bgl in this area. The 'General' Made Ground comprised a blackish grey, locally gravelly silty CLAY, containing a gravel content of brick, coal, mudstone and sandstone.

The Glacial Till comprises a soft to firm silty CLAY extending to circa 1.50m bgl before transitioning into a stiff to very stiff slightly sandy slightly gravelly CLAY which extending to circa 4.10m to 4.20m bgl below the building footprint.

The weathered Chester Formation base was unproven and groundwater in the bedrock was monitored between 4.30m and 4.45m bgl (shown by the blue line).

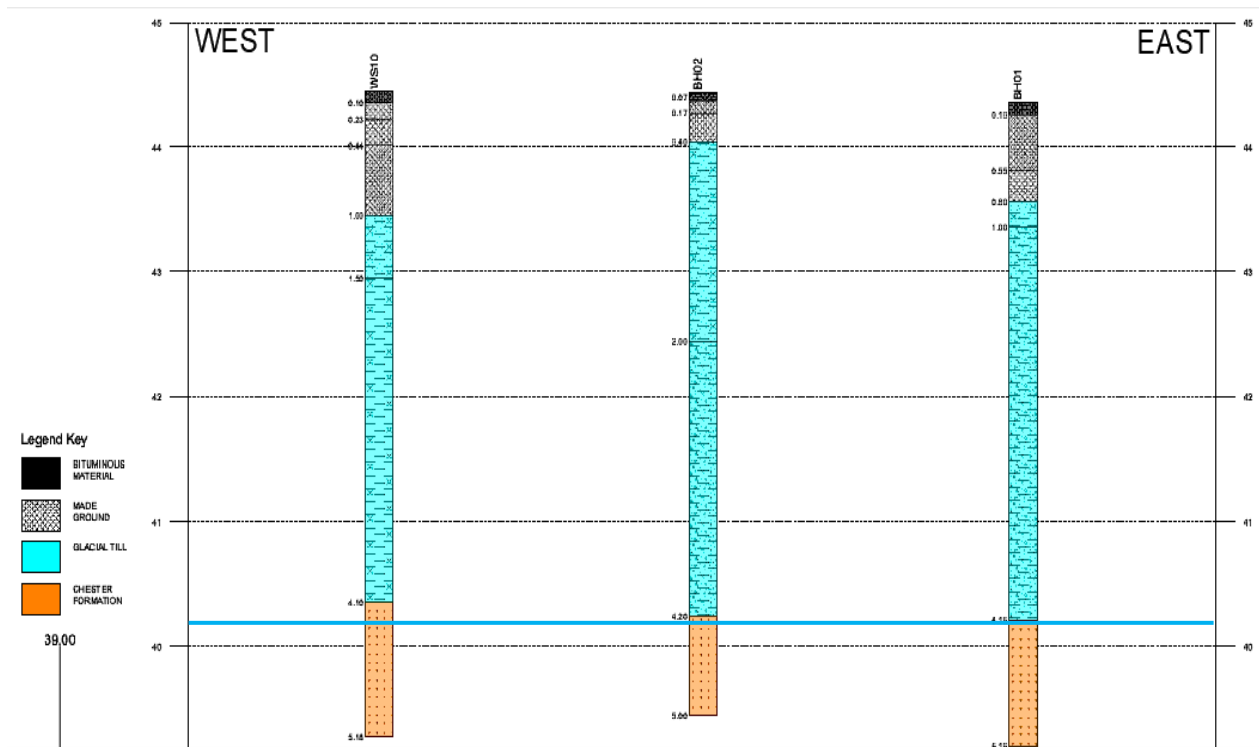


Figure 2.1: Typical Cross Section below the proposed building

2.5 Hydrology and hydrogeology

An unnamed brook is present 250m west. Given the likely discontinuous nature of the perched groundwater within the Glacial Till it is unlikely to be in direct hydraulic continuity with the brook, which feeds into Platt Lake further west.

2.5.1 Post Fieldworks Groundwater monitoring

The post fieldwork monitoring has proven that there is a perched groundwater table at the interface of the Made Ground and Glacial Till between 0.60m and 0.77m bgl (43.57 to 43.40m AOD).

The groundwater within BH01 and BH02 present between 4.30m and 4.63m bgl (40.06m to 39.81 m AOD) is representative of seepage of perched groundwater on top of the Glacial Till, migrating into the well below the bentonite seal.

Within WS08 the groundwater appears to be associated with a band of sand at 3.00m bgl which is under sub artesian pressure rising to 0.96 to 1.10m bgl (43.59 – 43.45m AOD).

2.6 Outcome of risk assessments

The contaminant linkages identified are summarised in Table 2.2 overleaf.

Table 2.2: Updated Conceptual Site Model

Contaminant linkage	Source	Pathway	Receptor	Comments
PL1	Pervasive PAHs and asbestos loose fibres in the Made Ground.	Ingestion, inhalation or direct contact.	Human health.	Requires mitigation
PL2	Elevated Naphthalene within the Made Ground.	Direct contact	Water supply pipes.	Requires mitigation
PL3	Ground gas concentrations and flow representing CS2 conditions within the bedrock.	Vertical migration via existing borehole installations.	Buildings.	The current proposals are for shallow pad foundations at 2.5m bgl which will leave 1.5m of cohesive Glacial Till below the foundation, this will remove the pathway for gas in the deeper bedrock. If the building is piled the RSVP will require updating a gas protections measure at CS2 classification will likely be required.

The ground investigation has proven up to 3.8m thickness of low permeability Glacial Till is overlying the Principal Aquifer (sandstone bedrock), protecting it from migration of leachable or mobile contaminants in the Made Ground, therefore pathways for leachable contaminants reaching the aquifer are not active.

3. Remediation Options Appraisal

3.1 Introduction

The following section of this report is intended to identify feasible remedial techniques which can be applied in order to achieve a site which is suitable for the proposed student accommodation development.

Upgraded potable water pipelines and upgraded services are not discussed in the Remediation Options Appraisal as the risks to them are mitigated by prescriptive measures identified by British Standards, BRE Guidance, water supply companies, British Plastics Federation Guidance and good practice.

Decommissioned borehole installations are not discussed in the Remediation Options Appraisal as the risks to them are mitigated by prescriptive measures identified by the aforementioned EA guidance and good practice.

In addition, amendment of the receptor (i.e. change the land use [and sensitivity] to match the risks) is not a potential option as the proposed development has already gone through the planning process and the development scheme is set.

3.1.1 Remediation objectives

The high-level objective of the remediation is to ensure that, on completion, the site can be shown to be suitable for its intended use, such that it will not pose an unacceptable contamination risk to identified receptors.

The specific objectives of the remediation works are to:

- » Break the linkage between the contamination in soils and future site users (including users of neighbouring properties);
- » Effectively contain the contaminant;
- » Minimise off-site soil disposal requirements;
- » Demonstrate that the remediation is a sustainable approach;
- » Account for reasonable climate change effects;
- » Avoid unacceptable environmental impacts, health and safety issues and minimise long term liabilities associated with the remedial approach;
- » Avoid the requirement for long term monitoring or maintenance; and
- » Complete the remediation within the programme timescale of the development.

3.1.2 Remediation Criteria

No treated material based on a set testing frequency, as agreed with the regulator, should contain more than the specific values agreed for residential public open space.

Demonstrate an appropriate thickness of a composite surface cover in all affected landscaped areas, with compliance to be measured based on agreed spatial measurements.

Specific remediation criteria (remediation targets and material reuse and importation criteria) are discussed in more detail in later sections of this report.

3.1.3 Constraints

Remediation works need to be designed and undertaken with recognition of the site constraints. Whilst the wider site is relatively open and unconstrained, the areas of impacted soils and groundwater is constrained by:

- » Student residential properties at the site boundary to the east and south;
- » Existing underground assets including gas main, fibre optics, electricity and sewer;
- » United Utilities asset cabinet in the north west;
- » Residential properties at the site boundary to the north;
- » Existing access roads including Chancellors Way to the east and Whitworth Lane to the west; and
- » Utilities connecting to the Energy Centre adjacent to the north east of the site including gas and electric situated adjacent to the east.

Remediation works will (as far as practicable) need to:

- » Minimise the impact on adjacent residents with regard to noise, dust, odour and vibration.
- » Minimise road traffic by reducing the amount of disposal and maximising reuse of excavated materials.

The site is located above Principal aquifer in the Chester Formation. The remediation works (and associated geotechnical works) will need ensure that additional risks to controlled waters are not created.

3.2 Selection of feasible remediation options (Options Appraisal Step 1)

In accordance with LCRM (EA, 2023), the first stage of an options appraisal is to select feasible remediation techniques, which may be applied in order to achieve a site which is suitable for the proposed development.

The initial screening process considers the available remedial techniques based on following key criteria:

- » **Effectiveness.** Will the remediation treatment successfully reduce, or control unacceptable risks to a defined (and appropriate) level? The strategy must work within the context of the site and be effective in the removal of contamination linkages.
- » **Durability.** Can the remediation treatment continue to reduce, or control unacceptable risks to a defined level over a period of time? Preference is given to techniques that are not reliant on ongoing maintenance to continue being effective.
- » **Environmental impact.** Will the remediation treatment affect the quality of the environment during or following remediation?
- » **(Relative) cost.** Is the strategy reasonable and affordable, given the available resources?
- » **Sustainability.** Is the option sustainable? More sustainable options are preferred.

- » **Relative Operational Time.** The strategy should work in a feasible and realistic time scale.
- » **Practicality.** The strategy has to have been successfully used in similar situations on other sites and be readily available in the UK market. Novel solutions or those still in the research stage would require additional consideration.
- » **How the strategy meets other environmental objectives.** For example, on the use of energy and other material resources.
- » **Are there any indirect benefits that the remediation would bring?** For example, will it enhance the amenity or ecological value of an area, remove blight or encourage regeneration.
- » **The legal, financial and commercial context of the site.**

The options are assessed with regard to the constraints discussed in Section 3.1.3 above, and a review of accepted remedial techniques readily available in the United Kingdom is provided in Appendix B.

The durability of each of the remediation options is assessed as either: durable (D) i.e. providing a long-term solution for the lifetime of the current or future proposed land-use; durable with maintenance requirements (D-M) e.g. gas venting trenches or a permeable reactive groundwater barrier, which may require inspections and maintaining; or temporary (T) i.e. providing a short-term solution, but not necessarily effective in the long term e.g. groundwater pump and treat without source removal. If, for example, a given technique is only effective over a period of years to decades then its overall feasibility is diminished. Durability is judged on the basis that the remediation has been effective and has been successfully validated; it does not take into account ineffective remediation (for example where a part of the source zone has been missed, or dissolved phase rebound in groundwater occurs.)

The environmental impact is assessed, based on a qualitative judgement on direct and indirect emissions to air, water and land, and material resource use, as: Low (L); Moderate (M); or High (H).

The listed techniques are assessed in terms of relative cost ranging from: low cost (£); moderately expensive (££); expensive (£££); to prohibitively expensive for the site under consideration (£££+).

Sustainability is assessed based on a relative comparison of: Sustainable (S); or Unsustainable (U). This is a qualitative judgement based primarily on the outcome of the scoring on durability, environmental impact, and cost, and additional considerations on the potential impact of the remediation on the local community (specifically disruption).

The operational timescale for the implementation of the remediation technique has been broadly assessed in units of weeks (W), months (M), or years (Y).

Previous site experience, technical literature and Hydrock's in house knowledge have been used to reject impractical and or unsuitable remediation options. The primary reasons for rejection of an option are the ongoing operational constraints, the cost and/or the inability to treat all the required contaminants. If an option is deemed impractical, it is noted in the comments.

The feasibility of each of the listed remedial options is assessed in terms of effectiveness at treating the contamination, which is broken down into: effective (Y), partially effective (P) or ineffective (N). Additional comments are provided as necessary and if other environmental objectives, indirect benefits, or legal implications are identified, these are noted in the comments.

In some instances, there may be a number of treatment options identified, and it may not be possible to determine the best practicable option at this stage. In these instances, all potential remedial options are carried forward.

Based on the applicability assessment provided in Appendix B, the following remediation techniques/technologies have been shortlisted for addressing pervasive PAHs and asbestos loose fibres based on an appraisal of applicable techniques/technologies against the following selection factors:

- » must meet legal or regulatory requirements
- » must result in a positive environmental outcome
- » must meet the objectives set out in Section 1
- » must be practicable, durable and effective
- » must be cost effective and fit wider programme timescales
- » must be sustainable
- » must not require post construction monitoring
- » must be complementary to current earthworks design
- » must be capable of being carried out in phases alongside construction phasing
- » must not lock out areas of the site for development
- » must be a technique/technology with a demonstrable track record of success for both contaminant and site-specific ground conditions
- » must avoid incompatible options for co-located contaminant groups

This assessment of applicable options is detailed in Table 3.1 and provided in Appendix B.

Table 3.1: Short-listed remediation technique

Remediation option	Rationale for consideration
Civil engineering in the form of a cover system / growing medium in landscaped areas (as required).	Does not remove the contamination but allows for the installation of a cover systems to protect site users from the contamination within Made Ground.
Civil Engineering excavation and disposal	Excavation and disposal of the Made Ground beyond the existing requirement of reduced level dig to formation level of the cover system is considered unsustainable. The risk from the remaining Made Ground would be negated via the use of a cover system.

3.3 Detailed evaluation of options (Options Appraisal Step 2)

As the feasible options identified in Step 1 above are naturally selecting there is no need to consider each option in more detail prior to finalising the recommended remedial option.

The only viable remediation option is a combination of:

- » Installation of a clean cover system in landscaped areas to protect site end users coming into contact with Made Ground that could contain loose asbestos fibres and PAHs;

- » Installation of barrier water pipes and installation of granular surround around pipes to protect against degradation from organic contamination in the Made Ground.

3.3.1 *Materials management (excavation, reprocessing and reuse of suitable materials) – with a cover system / growing medium*

Excavation and reuse of suitable materials has been widely used in the UK for managing risks associated with brownfield land. The method involves the excavation of soils, determining their suitability for reuse (both chemically and geotechnically) and replacement of suitable soils as part of an earthworks programme. The final part of the remediation (if the contaminated soils are not removed from site) would be the placement of a cover to form a barrier between the contaminants and site users, thus breaking the source-pathway-receptor linkages (see Section 2.6).

Subject to site levels being suitable for the installation of a cover, this option is technically simple and represents a low-cost strategy that can be implemented rapidly.

Materials management will need to be undertaken in accordance with 'The Definition of Waste: Development Industry Code of Practice' (Version 2) (DoWCoP), CL:AIRE, dated March 2011.

3.3.2 *Cover system/growing medium*

Cover systems have been widely used in the UK for managing risks associated with brownfield land developed for residential land uses. The technology involves the placement of a cover to form a barrier between the contaminant and site users thus breaking the source-pathway-receptor linkage.

Subject to site levels being suitable for the installation of the cover, this option is technically simple and represents a low-cost strategy that can be implemented rapidly. However, finished site levels may not allow the installation of a cover system from the existing levels across the entire site. Furthermore, the geotechnical constraints of the site require a robust solution, which will deal with both the geotechnical and contamination issues. As such, some cut to fill and management of soils is required to allow the installation of the cover system. Any cut to fill would need to be undertaken under a Materials Management Plan (MMP).

There are three principal disadvantages to this strategy:

- » because the contaminants in the soils are not removed, there remains a risk of future site users exposing the contaminated soil and therefore the potential for long term liabilities must be considered during the design process;
- » the presence of a cap across the defined area would place a constraint on the potential future land use for that area; and
- » future maintenance workers may be exposed to contaminated soils.

There are a number of measures to mitigate the risks associated with the contaminants being exposed in the future that can be implemented, for example:

- » over-excavation of service trenches to reduce the risk of contact with contaminated soils by future maintenance workers.

Whilst in some instances the presence of a cover system may place a constraint on the potential future land use for that area, Hydrock believes in this instance as long as the cover system is installed in line with BRE (2004), CIRIA SP124 (1996), and NCLOG (2024), it will be robust and the site will not pose a risk to future site users. Justification for the cover system is provided in Appendix D.

As the exercise is predominantly an earthworks exercise, the timescales are generally relatively short allowing for rapid completion of the remediation objectives.

It is anticipated that the majority of the cover system soils would be imported Topsoil and Subsoil due to the lack of suitable growing medium on the site.

3.3.3 *Disposal of excess or unsuitable soils*

Disposal involves the removal of contaminated material from site and disposal at an appropriately licensed waste management facility.

The advantages of excavation and disposal are:

- » it represents a relatively rapid remediation strategy; and
- » it provides a high degree of certainty in the suitability of the site for its intended end use.

The main disadvantages with excavation and disposal are:

- » cost of disposal, especially as the majority of the soils would be suitable for reuse on site as general fill below the cover system; and
- » it does not represent a sustainable remediation strategy, as significant vehicle movement will be required to and from the site and the contamination is not destroyed but simply relocated to a waste management facility, thus taking up valuable landfill space.

Hydrock does not believe that disposal of all impacted soils is appropriate for the site. However, partial disposal may be required, and this option is considered viable if used in conjunction with other techniques, or if material is proven to be unsuitable for reuse.

Whilst reuse is considered to be the most sustainable option, it may be necessary to dispose of excavated Made Ground to achieve cover system formation level.

4. Remediation Strategy

4.1 Introduction

The Remediation Strategy and Verification Plan detailed in the following sections is based on Stage 3: Remediation and Verification of LCRM, specifically the development of a remediation strategy (Step 1).

Following on from the remediation options appraisal in Section 3, notably the setting of the remediation objectives (Section 3.1.1) and selection of the viable remediation options (Section 3.2), the remediation strategy is generally structured as follows:

- » Summarising the key remediation criteria, including the derivation of Remedial Target Values (where applicable).
- » Summarising the remediation stages and their implementation.
- » Summarising the regulatory controls that need to be in place.
- » Detailing the monitoring requirements.
- » Detailing how the remediation will be verified.
- » Contingency planning and unexpected contamination.

The remediation options appraisal detailed in Section 3 has identified the following remediation options to form the remediation strategy:

1. A surface soil cover system in landscaped areas of the development to break the pathway between the PAHs and asbestos loose fibres identified in the Made Ground and end users. Made ground in other areas of the development to be covered by either the external hardstanding or building.
2. Provision of a suitable thickness of granular surround for service runs to prevent future maintenance workers coming into contact with the Made Ground.

4.2 Overarching strategy

The overarching strategy is to break contaminant linkages associated with human health via pathway interruption (soil cover system and barrier water pipes) or by Made Ground pathways being severed by the building or external hardstanding areas.

4.3 Remediation criteria

Remediation criteria are required to demonstrate and verify the performance of the remediation. In accordance with LCRM these can be both numerical (for example model-derived concentration values) and/or qualitative/descriptive (for example "the removal of all visually contaminated material"). The site-specific remediation criteria and RTVs, as well as the considerations that have been used during their derivation, are detailed in the following sub-sections.

4.4 Remediation criteria and testing frequency:

The soil testing frequency are outlined below in Table 4.2.

Table 4.1: Soil Testing Frequency

Material Type	Frequency of Testing	Testing Schedule
Virgin Quarried Material	Minimum of 2 tests per source of inert stone.	» Standard metals/metalloids » Asbestos
Crushed hardcore, stone, brick (excluding asphalt)	Minimum of 3 tests or 1 per 500m ³ (whichever is greater)	» Standard metals/metalloids » PAH (16 USEPA) » Total TPHs » Asbestos
Imported Topsoil/ Subsoil	Minimum of 3 tests or 1 per 150m ³ (whichever is greater)	» Standard metals/metalloids » PAH (16 USEPA) » Total TPHs » pH, TOC and SOM » Asbestos
Site won soils.	Minimum of 3 tests to be completed only if visual and olfactory evidence of contamination is present.	» Standard metals/metalloids » PAH (16 USEPA) » Total TPHs » Asbestos

As Site won soils are to be placed below the cover system or hardstanding, chemical testing will only be necessary if visual and olfactory evidence of contamination is encountered. The process for dealing with unexpected contamination is outlined in Appendix C.

4.5 Summary of remedial target values

The proposed RTVs and justifications are summarised in Table 4.2 below.

4.5.1 Chemical limits for imported topsoil and subsoil

The table below sets out the chemical criteria for imported naturally occurring soils (i.e. topsoil and subsoil). These limits are based on the principles of (1) the protection of human health and the environment, (2) the practicality of sourcing soils with chemical concentrations that are below naturally occurring regional levels, (3) not introducing new chemical hazards to the site by importing soil containing chemical concentrations significantly elevated compared to existing site and regional concentrations, and (4) balancing chemical limits with other considerations such as visual and olfactory contamination.

The criteria are subject to review and amendment should any of the values prove impractical to achieve or define soil that is otherwise unsuitable for use based on wider project suitability requirements.

Table 4.2: Proposed remedial target values for imported Topsoil and Subsoil.

CoPC	RTV- All SOM	Justification
Arsenic	79	LQM C4SL for residential public open space
Beryllium	2.2	LQM/CIEH S4UL 2015 guidance value for residential public open space.
Boron	5	Import criteria limited to phytotoxic GAC of pH 7.
Cadmium	0.93	As Background Topsoil Concentrations within the area (UK Soil Observatory).
Chromium (III)	26	Limited to existing site concentrations.
Chromium (VI)	23	LQM C4SL for residential public open space
Lead	250	Limited to existing site concentrations.
Mercury (inorganic)	0.5	Limited to existing site concentrations
Selenium	1	Background Topsoil Concentrations within the area (UK Soil Observatory).
Copper	135	Import criteria limited to phytotoxic GAC of pH 7.
Nickel	75	Import criteria limited to phytotoxic GAC of pH 7.
Vanadium	36	Limited to the site mean concentration.
Zinc	300	Import criteria limited to phytotoxic GAC of pH 7.
Cyanide (free)	1	Limited to existing site concentrations
Phenol (total)	1	
Total PAHs (USEPA 16)	6*	UKSHS 95th percentile concentration.
Dibenz (a,h) anthranace	0.57	LQM C4SL for residential public open space
Total TPHs	1000**	To avoid visual/olfactory evidence of contamination.
Asbestos	NIL	Protection of site end users.

*The UKSHS 95th percentile concentration for the sum of 16 PAHs is a reasonable value to use to define uncontaminated natural soils – 5.832mg/kg (rounded to 6mg/kg)

**A limit of 1000mg/kg has been applied to prevent odours or visually oily material being reused. The soils saturation limit has been rejected as an appropriate criterion in this case as the soil saturation limits for TPH fraction are unnecessarily low.

4.5.2 Chemical limits for imported recycled aggregates

The imported recycled aggregate should be tested and compared to public open space residential GACs and to ensure the aggregate is not hazardous a threshold for Total PAHs of 6mg/kg (0.57mg/kg on with a limit on Dibenz (a,h) anthranace), Total TPHs should be 1000mg/kg and asbestos should be NIL.

Any recycled aggregate that either exceeds public open residential GACs and contain Total PAHs , Total TPHs or asbestos above the threshold it must not be imported onto the site.

The EA/WRAP Quality Protocol for recycled aggregates from inert waste sets out the following requirements for the produced aggregate:

- » Feed material must be inert and must not contain or be contaminated with dangerous substances (as defined in the List of Waste Regulations). List of acceptable input wastes is provided in Appendix C of the Quality Protocol.
- » Inert physical contaminants such as soils, peat, clays, silts, wood, plastics, rubber, metal must be removed during the waste processing and not be present in the final aggregate.
- » The producer must develop waste acceptance criteria specific to each site/location that set out the types and source of input wastes to be used.
- » The requirements of a BS EN aggregate standard (e.g., BSEN 13242) must be met. Example standards and specifications are provided in Appendix B of the Quality Protocol and include the Highways Agency (now National Highways) Specifications for Highway Works. The recycled material must be processed in accordance with the approved standard including a Factory Production Control system.
- » To be inert it cannot contain any asbestos. Asbestos is prohibited in the Part B permits for the mobile crushers used to produce the aggregate.

In addition, all recycled aggregate must also comply with the following wider suitability criteria:

- » No visible or olfactory evidence of organic contamination, including free phase liquids.
- » No visible evidence of invasive plant species (e.g., Japanese Knotweed or Giant Hogweed).
- » No visible organic or putrescible material that could constitute a source of ground gas (e.g., wood).

The recycled aggregate must also comply with the geotechnical (physical) testing requirements set out in the relevant aggregate's standard adopted. Evidence of material conformance with these testing requirements must be provided prior to the use of the material on-site.

4.6 Implementation phases

It is envisaged that the remediation will be undertaken in the following phases as part of the wider project:

4.6.1 Pre enabling works

The following works are considered necessary pre enabling works and are discussed in more detail in Section 5.

- » Completion of a United Utilities Water Pipe Risk Assessment to confirm their approval that barrier pipes are required.

4.6.2 Enabling works

The following works are considered necessary during the enabling works phase and are discussed in more detail in Section 5.

- » Vegetation Clearance, demarcation for Tree Protection Orders (TPOs);
- » Decommissioning of existing borehole installations;
- » Reduced level excavation of Made Ground in landscaped areas;

NOTE: Where natural soils are already present at formation level a cover system will not be required subject to confirmation by a suitably qualified Geo-Environmental consultant.

- » Off-site disposal of Made Ground.

4.6.3 Construction phase

The following works are considered necessary during the construction phase and are discussed in more detail in Section 5.:

- » Installation of barrier pipe (following confirmation from United Utilities) .
- » Installation of the clean cover system where Made Ground is present at the formation level.

4.6.4 Earthworks and reinstatement of excavations

The reinstatement of excavations (with either tested and suitable site-won materials or imported soils/aggregates) is to be undertaken in accordance with an Earthworks Specification that details the methodology for placement of fill and should also detail associated geotechnical testing and earthworks specific verification requirements.

The specification should be based on the Specification for Highway Works Series 600 (Earthworks) tables to ensure that the construction works Contractor inherits a subgrade suitable for the proposed development.

4.6.5 Management of asbestos containing materials

No clearly identifiable ACM has been seen during the site walkover or during the ground investigation and the laboratory testing has identified trace concentrations of asbestos fibres (<0.001%) in the soils.

All site staff should be made aware of the possibility to encounter asbestos within the Made Ground soils anywhere on the site at any stage of the development. It is advised that the Contractor should consider supplying suitable and sufficient 'Asbestos Awareness' training (specific to asbestos in soils) to all site staff who could foreseeably encounter asbestos containing materials during the course of their work.

The Contractor for each stage of works must assess the risks in accordance with Regulation 6 of the Control of Asbestos Regulations 2012 (CAR2012) and if considered necessary compile a methodology in accordance with Regulation 7 of CAR2012.

It is the responsibility of the Contractor to ensure that mitigation measures are suitable and sufficient to prevent exposure to airborne asbestos so far as is reasonably practicable in accordance with Regulation 11 of CAR2012. However, the asbestos fibres detected at the site are at a very low concentration and within a soil matrix. As such, if the soils are kept damp and appropriate site hygiene measures are in place, this should assist in minimising the risk of the release of airborne fibres.

4.6.6 *Site boundaries*

Excavations in close proximity to the site boundaries at which 3rd party assets are present, including roads/ pavements/ student accommodation/ the energy centre, will require appropriate management to ensure collapse of excavations does not have a disproportional effect on offsite assets.

5. Implementation

The anticipated stages of work required to implement the remediation strategy are detailed below. The Contractor will be required to prepare a Detailed Remediation Implementation Plan to address, in detail, the design and working methods by which the requirements of this strategy will be implemented. The details below are therefore interim and indicative only and are subject to confirmation by the appointed Contractor. The stages of work have been split into preparatory works, enabling works phase, construction phase to indicate at what stage in the wider site programme the stages in the remediation scope are expected to be implemented.

5.1 Preparatory Works

Prior to finalising the requirement for installation of barrier pipes, the depth at which water pipes are to be installed should be established. If water pipes are to be installed in the Made Ground due to the organic contamination above the PE threshold in the Made Ground particularly related to Total VOCs (including Naphthalene at 0.68 to 19mg/kg versus the PE threshold of 5mg/kg), a United Utilities Water Pipes Risk Assessment will be required, which should be approved by United Utilities.

5.2 Enabling Works

The anticipated stages of the remediation during the enabling works phase are detailed below.

5.2.1 *Vegetation clearance*

Hydrock understand no ecological mitigation is required. During site vegetation clearance works, tree protection should be installed as required. Trees, shrubs, boundaries and other features of interest, which are to be retained, shall be clearly identified and protected by a robust fence to avoid accidental impact damage and prevent excavation within the root zone. Any necessary tree protection is to be installed by the Contractor prior to commencement. All works shall be undertaken in accordance with BS 5387: 1991 'Trees in relation to Construction'. The Contractor shall remove any trees and vegetation (including roots) which are not protected. Prior to removal of any trees, the Contractor shall confirm with the Client, during a site walkover, which trees are to be retained.

5.2.2 *Decommissioning of existing borehole installations*

All existing ground investigation borehole installations (also known as monitoring wells) require decommissioning in line with Environment Agency, October 2012, 'Good practice for decommissioning redundant boreholes and wells', in order to break the ground gas risk pathway from the sandstone.

For most purposes the ground should be restored as closely as possible to its pre-drilled condition. The pipework should be removed prior to the borehole being backfilled with clean (washed), uncontaminated materials so that the permeability of the selected materials are similar to the properties of the geological strata against which they are placed. The backfilled borehole will then mimic the surrounding natural strata and groundwater flow and quality will be protected.

Restoration will require a variety of materials to be used so that permeable aggregates (for example pea gravel and sand) are positioned adjacent to aquifer horizons, whilst low permeability materials (usually clay, bentonite cement grout, or concrete) are positioned adjacent to low permeability horizons. Alternatively, the entire borehole or well can be backfilled with low permeability

materials that will prevent significant vertical or horizontal movement of groundwater through or along the borehole.

5.2.3 *Excavation of the Made Ground*

Excavation of Made Ground present in landscaped areas, suitable stockpiling, segregation and waste classification testing prior to disposal offsite.

Following stripping of existing Made Ground in landscaped areas if natural soils are present at formation and the notable blackish grey CLAY or black ashy SAND/GRAVEL is absent then a cover system will not be required, subject to observation and confirmation and production of a site visit report by a suitably qualified Geo-Environmental Consultant.

5.2.4 *Other considerations*

5.2.4.1 *Supervision*

The Contractor is to provide appropriate supervision at all times during excavation works to ensure that materials are appropriately segregated and classified. Therefore, it may be prudent for excavation works within landscaped area to be supervised by suitably qualified and experienced Geo-environmental Engineer or Consultant, especially when Made Ground is stripped and sub soil exposed.

5.2.4.2 *Earthworks and reinstatement of excavations*

The reinstatement of excavations as part of the earthworks is to be undertaken in accordance with an Earthworks Specification that details the methodology for placement of fill and should also detail have associated geotechnical testing and verification requirements.

5.2.4.3 *Off-site disposal of unsuitable materials.*

The works should seek to reduce and control impacts upon the natural environment, therefore, the Contractor shall seek to reuse materials within the works, where appropriate.

However, where identified, any surplus (i.e., soils which cannot be reused on-site due to volumes), or unsuitable soils (i.e., soils which cannot be treated and/or reused in an appropriate location), or are geotechnically unsuitable for use in the earthworks, shall be disposed of off-site by the Contractor.

If a material does not comply with the relevant criteria for its intended use (e.g., reinstatement of excavations in line with reuse criteria, clean cover system, etc.), then, by definition, the material is not suitable for use.

All waste materials generated during the works shall be dealt with in full compliance with the statutory Duty of Care as defined by the Environmental Protection Act (1990) and all subsequent amendments. The Contractor shall be the waste producer and is responsible for the production of all documentation required under relevant legislation, ensuring this is kept up to date and is available on-site for inspection.

Further details on the disposal of unsuitable materials, and a preliminary waste classification of the soils recorded on-site, is presented in Section 7.3.

5.3 Construction phase

The anticipated stages of the remediation during the construction phase are detailed below.

5.3.1 Installation of barrier pipe

Subject to UU approval all potable water supplies are to be installed with barrier pipe as an additional precaution to ensure that the service is protected from permeation by any remaining organic contaminants that may be above Threshold Values for standard water supply pipework.

This is to be verified by the Contractor by the provision of delivery tickets showing barrier pipe has been delivered to the site and by photographic evidence that the pipework has been installed across the site. The full construction phase verification requirements are detailed in Section O.

Installation should comply with all relevant local Water company guidance.

5.3.2 Installation of granular surround around all underground services

The use of barrier pipe for water supply pipework is proposed and subject to approval from United Utilities. It's recommended that all services will need be laid within trenches with clean granular fill used as a bedding material and the trench backfilled with clean soils to surface to avoid future maintenance coming into contact with the Made Ground.

5.3.3 Installation of the cover system

A clean cover system is required for landscaped areas. The cover system should be designed and validated in accordance with NCLOG, 2024. The general principles for the cover system design are:

- » Building footprints as per the structural design (by others): the floor slab will break the linkage between the soils and potential receptors
- » Areas of hardstanding (roads, pavements, etc.) as per the design (by others): the hardstanding will break the linkage between the soils and potential receptors.
- » The installation of a simple cover system in soft landscaping to align with Manchester City Council Planning Guidance documentation (see Figure 5.1) and should include 600mm, comprising a subsoil beneath a topsoil thickness of between 150mm and 300mm.

The justification for the cover system depth and selection is presented in Appendix D.

Table 1 Growth medium rooting depths for various vegetation types

Vegetation Type	Rooting Depth (mm)
Grass	450
Plants	450
Shrubs	600
Trees	900

Figure 5.1: Rooting depth requirements from extracted from Manchester City Council Planning Guidance (2021)

A clean cover system shall be installed in all soft landscaping areas across the landscaped area in accordance with NCLOG guidance.

The clean cover system is to comprise (from base up):

- » A minimum 600mm combined thickness of topsoil and subsoil (minimum 150mm topsoil).
- » The depth of cover system within proposed tree pits is to be designed by the landscaped architect, however it is envisaged to be at least 600mm to tie into the cover system for proposed shrub planting.

The clean cover system installation should be undertaken in the following steps:

1. Check the elevation of the formation level to ensure that it is at the correct level and allows for the placement of the full required thickness of the clean cover system.
2. Place the required thickness of topsoil and subsoil as detailed above (of which a minimum 150mm is to be topsoil).

Chemical testing of the soils against the import criteria presented in Table 4.2 is to be undertaken to ensure that the clean cover is suitable for use. The soils should also comply with any additional criteria stipulated by the landscape architect. It is recommended that the Contractor also samples and analyses the materials prior to placement to avoid the requirement for abortive works and removal of such materials.

For areas of proposed trees, the depth of growing medium will be deeper and tree pits will need to be excavated as per the requirements of an arboriculturist and/or landscape architect.

Where existing trees are to be retained (e.g., trees under a Tree Protection Order, or retained in landscaping schedule) provisions for the clean cover system should be agreed with an arboriculturist and/or landscape architect. Proposals include the placement of a geogrid on the existing soils in the root protection area and capped with 100 mm of clean topsoil. Where soft landscaped areas are adjacent, it is proposed that the geogrid should overlap with the geotextile at the base of the cover system by a minimum of 2m.

The clean cover systems shall also give consideration to their permeability and the consequential impact upon surface runoff. This principally relates to their composition (e.g., granular, cohesive or composite). The capping material will also need to satisfy the end client.

Soils used as part of the clean cover system should be free of asbestos and significant quantities of anthropogenic materials (e.g., brick, concrete, etc.) or other potentially hazardous foreign material which could cause injury. In addition, all materials must be free from aggressive / invasive weeds (especially Japanese Knotweed and Giant Hogweed) and bulk vegetative growth, in order to ensure negligible risk of subsequent weed problems.

Verification of the installed thicknesses and the chemical quality of the soils should be completed in landscaped areas. The full construction phase verification requirements are detailed in Section 6.2.2.

All soils moved and placed as part of the clean cover system need to be transported and stored with care to prevent cross contamination. This is to include, but not be limited to, the following:

- » The stockpiling of soils on a geotextile separator layer.
- » Using dedicated plant to move the cover system soils or washing plant thoroughly before use to move cover system soils.
- » Minimising tracking over contaminated soils.
- » Separating clean and dirty areas of the site.
- » Placing the soils into the final position and not pushing soils across the surface.

Due to the lack of a clean growing medium on-site, it is anticipated that the topsoil and subsoil to be used within clean cover systems will require import. The clean cover soils are to comply with the import criteria presented in Table 4.2.

If clean naturally occurring site-won soils are used within the cover system, they similarly need to comply with the criteria presented in Table 4.2. For clarity, treated materials should not be used as part of clean cover systems.

6. Verification and reporting

The remediation works presented in this document need verification such that the regulating bodies can be satisfied that the strategy has been fully complied with, and ultimately, such that any associated planning conditions relating to land quality can be discharged. The verification process is also required to provide a permanent record of the remedial works undertaken at the site. The sections below summarise the various activities requiring verification and also comment upon the verification reporting process.

The following remediation works require verification:

Enabling works:

- » Decommissioning of existing borehole installations (wells) on site.
- » Off-site disposal of Made Ground excavated from landscaped areas to achieve formation level.

Construction phase:

- » Installation of barrier pipe.
- » Installation of the 600mm thick cover system

Verification visits shall be made by a suitably experienced and qualified independent Geo-environmental Engineer or Consultant who shall undertake the necessary works outlined below.

6.1 Enabling works verification

Upon completion of the enabling works, the supporting evidence demonstrating that the remediation objectives and criteria have been met is to be compiled into an Enabling Works Verification Report that meets the reporting requirements set out in LCRM (EA, 2023).

The verification report should be prepared using a multiple line of evidence approach to demonstrate the successful implementation, and should include the following information as a minimum:

- » A general description of the remediation works completed.
- » Decommissioning records of all borehole installations (wells) on site.
- » Details of all excavated material classifications, including site location, excavation extents and volumes.
- » The volumes of excavated materials sentenced for reuse (either with or without treatment).
- » Details of all imported material classifications and volumes.
- » Results of all chemical testing, including both excavated and imported materials.
- » Details of the final placement of materials.
- » Details of the materials sentenced for off-site disposal, including waste classification, volumes and final disposal location.
- » Results of all waste classification and WAC testing to support off-site disposal.
- » All waste management documentation for the materials disposed of off-site.
- » Records of stockpiled materials.

- » Details of required permits and compliance with permit conditions.
- » Details of any alterations and amendments made to the Remediation Strategy.
- » Details of any contingencies undertaken during the works, notably any unexpected contamination or identification of additional sources (e.g., unexpected underground tanks).
- » Details of correspondence with the regulatory authorities during the works.
- » Description of the final condition of the site at completion.
- » As-built drawings showing surveyed levels of base of temporary excavations, temporary sides of excavations and positions of samples and tests carried out.
- » As-built drawings showing surveyed formation levels and positions of any samples and tests carried out at formation level.

6.2 Construction phase verification

6.2.1 *Barrier Pipe*

Barrier pipe verification should be in accordance with prevailing local Water Company guidance, provided by United Utilities. The installation of barrier pipe should be verified by the Contractor by the provision of delivery tickets showing barrier pipe has been delivered to the site and by photographic evidence that the pipework has been installed.

6.2.2 *Clean cover system*

Cover system verification should be in accordance with NCLOG, 2024.

The installation of the clean cover system should be verified by site visits made by a suitably experienced and qualified independent Geo-environmental Engineer or Consultant who should undertake a visual inspection of the installation and take samples for laboratory testing. This should be carried out at a minimum rate of 1 verification trial pit for each separate landscaped area to verify thickness of clean cover (with photographs) and collect samples of both topsoil and subsoil for chemical analysis.

Verification trial pits will be excavated at random locations as designated by the nominated verifier. This will take the form of a photograph with scale marker and accompanying photographic board detailing the measured clean cover system thickness.

The topsoil and subsoil samples should not exceed the import criteria presented in Table 4.2.

It is recommended that the Contractor also samples and analyses the materials prior to placement to avoid the requirement for abortive works and removal of such materials. The soils should also comply with any criteria stipulated by the landscape architect.

If the clean cover system is deemed to be insufficient, the Contractor will be informed. In instances where the soil thicknesses are measured to be inadequate, following the addition of further soil, the verification pits will be re-excavated to confirm that a sufficient thickness of soil is now present. Verification of the clean cover system will only be carried out on areas where the cover system has been completed to finished surface level across the footprint of the landscaped area.

The cover system verification documentation should include:

- » The source of materials (topsoil and subsoil).

- » The clean cover system thicknesses, including photographs of the verification pits with a scaled marker;
- » The chemical test results for the samples of topsoil and subsoil.
- » Comparison of the topsoil and subsoil samples against the import criteria presented in Table 4.2.

Soil samples may be taken from stockpiles prior to placement in the clean cover system (this will require confirmation during verification that the placed materials are visually/physically consistent with those tested) or the samples are to be taken in situ, once the clean cover system has been placed.

6.2.3 *Construction phase verification reporting*

The installation of barrier pipe and the clean cover system will be included in a single Construction Phase Verification Report that allows sign off the works.

7. Materials management

The materials management strategy currently comprises maximising on-site reuse of excavated materials and minimising off-site disposal and import as far as reasonably practicable.

The reuse on-site of imported and site-won soils should be managed in accordance with a Materials Management Plan (MMP) that is prepared in accordance with 'The Definition of Waste: Development Industry Code of Practice', Version 2 (CL:AIRE, 2011) (the 'DoWCoP'). The Materials Management Plan will need to be signed off and Declared with CL:AIRE by a Qualified Person prior to commencing the earthworks. It should be noted that Version 3 of the DoWCoP is undergoing preliminary consultation, and recommendations within this report with regard to waste and re-use of soils will require review when the DoWCoP Version 3 is adopted. It is unknown at this stage whether MMPs for which a declaration has been accepted under version 2 will be impacted by changes in version 3.

7.1 Sourcing of imported materials

Due to the lack of a clean growing medium on-site, it is anticipated that the topsoil and subsoil used within the soft landscaping area clean cover systems will require import. The clean cover soils are to comply with the criteria presented in Table 4.2.

Every effort should be made to ensure soils to be imported are accompanied by proof of provenance to demonstrate that there is no potential for the soils to have been contaminated as a result of past land uses or in the process of their creation, if a manufactured material. This information should be obtained in advance of the import on to site.

The requirements set out in the DoWCoP for importing materials under the 'Direct Transfer' scenario are clear. For clarity, the DoWCoP requirements for direct transfer of materials from one development site to another are:

- » Material must be clean naturally occurring soils and mineral materials.
- » 'Clean' is defined as devoid of anthropogenic contamination to a degree or level that is considered harmful to living organisms (i.e. harmful is not a site-specific definition).
- » Naturally occurring materials are defined as:
 - » Soil, both topsoil and subsoil;
 - » Parent material;
 - » Clays, silts, sands and gravels;
 - » Underlying geology; and
 - » Made Ground consisting of the above materials only.

The following protocol applies to all imported soils.

- » The soil is from an identified site, which is clean and has no history of potentially contaminative uses. This should be supported by appropriate reporting, such as a Phase 1 Desk Study.
- » A map and site plan showing the location of the site and area that the soils are from (with an approximate grid reference). When checking the source site, accurate details of where on the site the soil was derived are required, not just where they were stockpiled or screened.

7.2 Stockpiling

Any materials that are proposed for reuse shall be stockpiled separately by material type. Similarly, any materials being imported to site, for example clean topsoil or construction aggregates, or material awaiting disposal off-site, shall be stockpiled separately. Stockpile management shall be undertaken in accordance with the following protocol:

- » Separate stockpiles shall be created for each material type, whether site-won or imported materials, and shall be appropriately labelled / identified on-site.
- » The Contractor shall identify all stockpiles with clear signage.
- » Stockpiles shall not be cross-contaminated, double handling shall be avoided, and stockpiles shall remain quarantined until ready for use.
- » Topsoil shall not be placed during or after heavy or prolonged periods of rainfall.
- » For imported materials, copies of the carrier's Consignment Notes shall be retained on-site and made available for inspection and as part of verification reporting.
- » A record of all imported materials shall be maintained by the Contractor recording details of material type, source of the imported material and Consignment Note reference numbers. In addition, the Contractor shall record the status of each stockpile, in terms of material type, source site, volume and intended use on-site.
- » Stockpiles of significantly contaminated materials (either generated during remediation of previously identified impacts or due to encountering unexpected finds) are to be placed in lined above-ground treatment areas comprised of impermeable membranes to prevent leaching and run off of the potential contaminant(s).

7.3 Disposal of materials

The Waste Framework Directive (WFD) (2009/98/EC) defines waste as '*any substance which the holder discards or intends to discard*'. In a geo-environmental context, the waste is most often 'soil' and the two main scenarios are offsite disposal of the material as a waste and/or reuse of the material on-site. For cost and sustainability reasons, reuse is preferred to off-site disposal.

The site is brownfield and based on the site history and previously reported HazWasteOnline™ assessment, if suitable segregation of different types of waste is put in place, it is considered that:

- » The 'General' Made Ground is likely to be classified as non-hazardous waste.
- » The Glacial Till is likely to be classified as non-hazardous waste.
- » Made Ground in WS09 underneath the proposed landscaping area between 1.00m and 1.10m bgl is locally classified as hazardous (under HP7 carcinogenic and HP11 mutagenic) due to the concentrations of petroleum hydrocarbon bandings.
- » Any soils containing > 0.1% asbestos or visible asbestos containing materials would be considered as hazardous.

It should be noted that:

- » The above preliminary assessment has been made on the basis of the soils tested as part of the ground investigations undertaken to date and is only intended to provide an indication of potential waste classification. Prior to disposal, the characteristics of the actual soils to be disposed of will need testing and classification in consultation with landfill sites and waste

disposal Contractors. The receiving landfill will make the final decision on the classification and acceptability of the waste.

- » Non-hazardous soils require pre-treatment (separation, sorting and screening) prior to disposal.
- » The costs for disposal of non-hazardous and hazardous soils are significant compared to disposal of inert material. Waste segregation (and especially hazardous waste) should always be undertaken where practicable.

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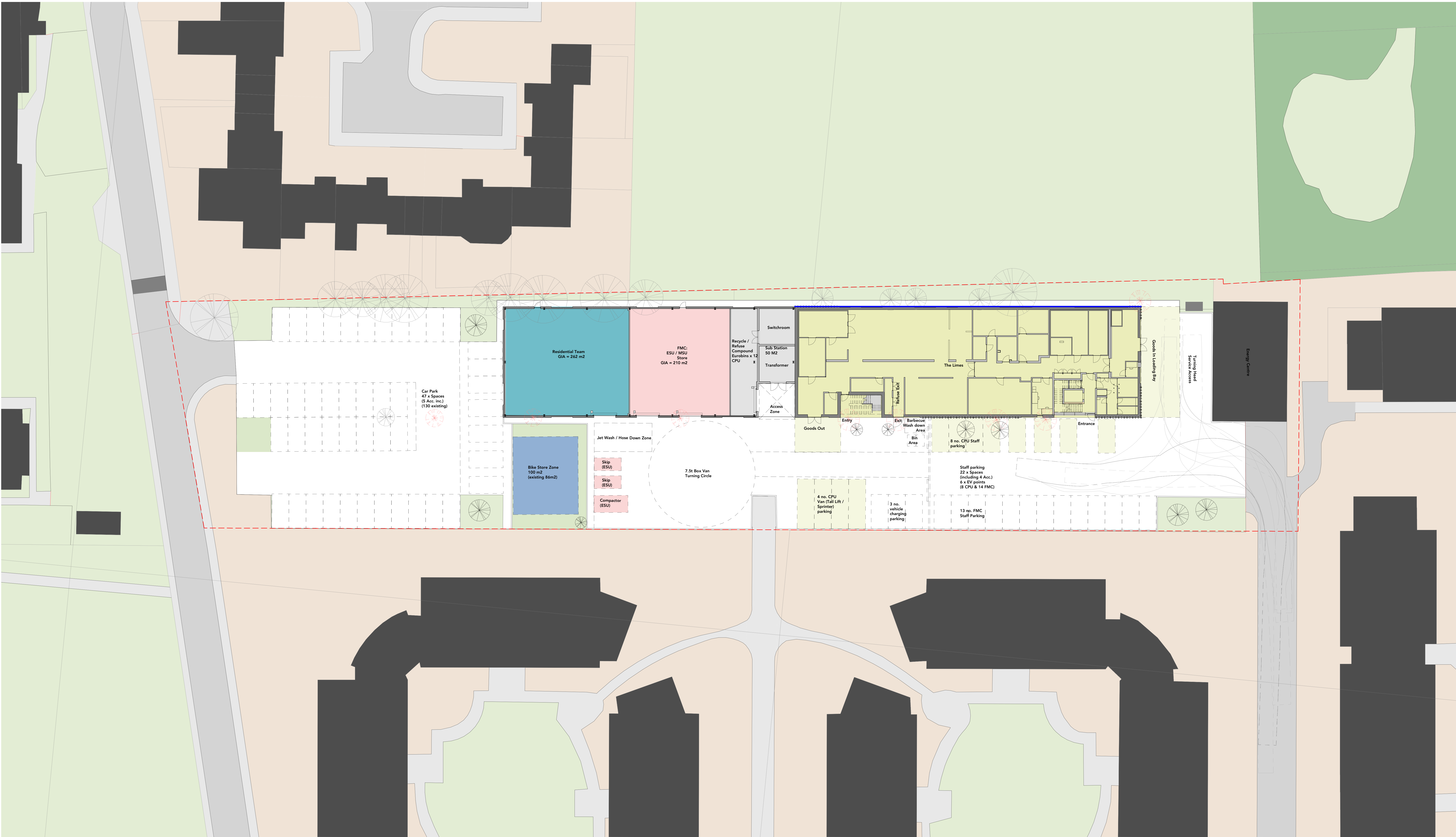
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Appendix A Drawings



NOTE:

All information is based on external survey information.

Further information required in terms of existing and extent of retained car parking spaces, bike shelter trees, planters, gas governor/ meter enclosure TBC.

Extent of red line boundary may need to be adjusted to suit proposed road access, turning heads and radius.

N

20246810m

SCALE 1:200

Project Boundary

Key :

Existing Tree Removed TBC by Arboriculture report

Existing Tree

Indicative Replacement Trees TBC by Arboriculture report

P0215/04/24

P0105/04/24

Revision

Details

41 Bengal Street
Manchester
M4 6AF
0161 256 3303
www.buttress.net

Clockwise, Yorkshire House
Grook Street, Leeds
LS1 5SH
0113 269 7965

Project Title

The Limes Relocation

Client

Rider Levett Bucknall

Location

Fallowfield Campus, Manchester

Drawing ref

Proposed Site Plan (Whole)

Date

16/04/2024 16:25:30

Checker

Checker

Job No:

9774

Project

Origin

Volume

Level

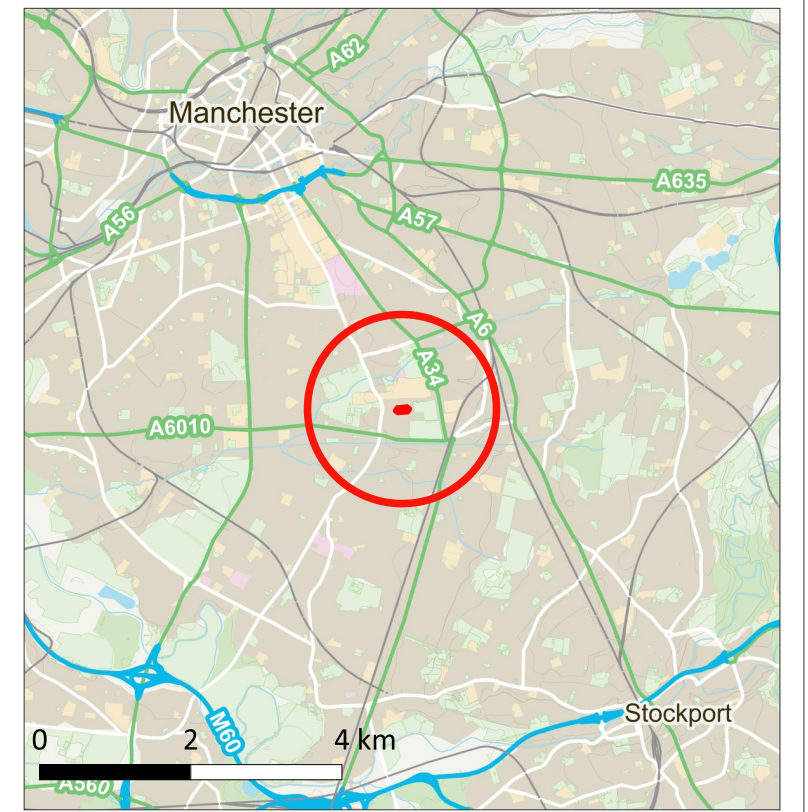
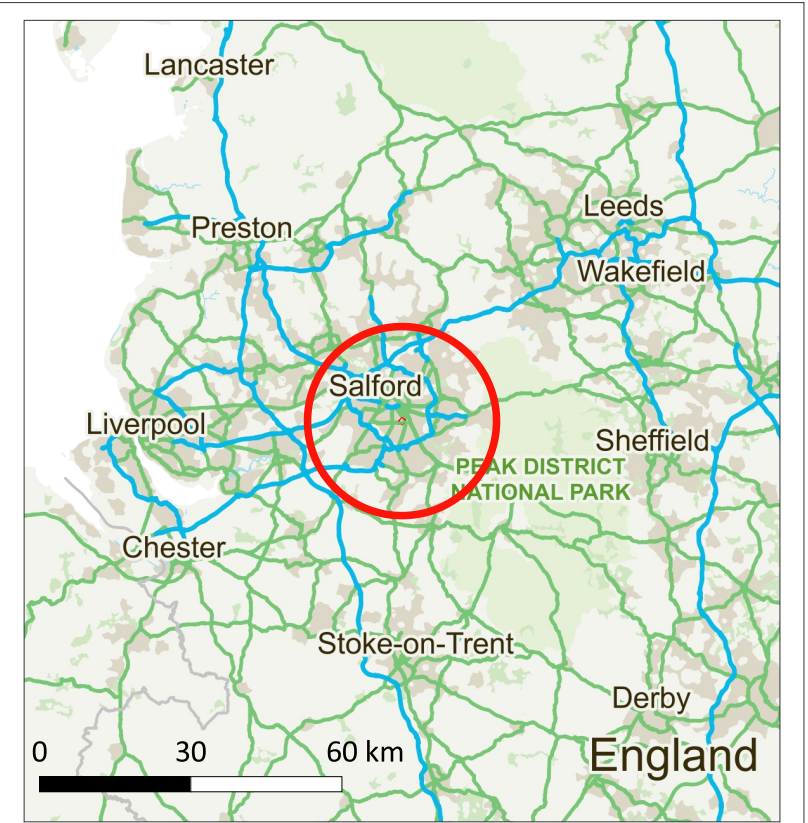
Type

Rate

Number

Rev

LIMES-BUT-MS-R3-DR-A-04101-P02



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KEY PLAN Site Boundary	NOTES 1. Contains OS data © Crown copyright and database right (2022)	REVISIONS <table><tr><th>REV.</th><th>DRAWN BY INITIALS</th><th>CHECKED BY INITIALS</th><th>DATE</th><th>REVISION NOTES/COMMENTS</th></tr><tr><td>P01</td><td>RS</td><td>LM</td><td>18.03.24</td><td>First issue</td></tr></table>				REV.	DRAWN BY INITIALS	CHECKED BY INITIALS	DATE	REVISION NOTES/COMMENTS	P01	RS	LM	18.03.24	First issue	Hydrock		TITLE SITE LOCATION PLAN	
		REV.	DRAWN BY INITIALS	CHECKED BY INITIALS	DATE	REVISION NOTES/COMMENTS													
		P01	RS	LM	18.03.24	First issue													
		HYDROCK PROJECT NO. 33445		SCALE @ A3 1:850															
CLIENT University of Manchester		PURPOSE OF ISSUE SUITABLE FOR INFORMATION		STATUS S2															
PROJECT The Limes Relocation		DRAWING NO. LIMES-HYD-XX-XX-D-G-00001		REVISION P01															



KEY PLAN

Site Boundary [1]

Current Site Features (Polygons)

Mature/Semi Mature Trees/Inclu Crown

Scarring Suspected Service

Existing Site Compound

Landscaping

Gas Meter and United Utilities

Bike Sheds

Street Lighting

Existing Building

Permeable Area

NOTES

1. Contains OS data © Crown copyright and database right (2022)

REVISIONS

REV.	DRAWN BY INITIALS	CHECKED BY INITIALS	DATE	REVISION NOTES/COMMENTS
P01	RS	LM	19/03/24	First issue

TITLE

Site Features Plan

HYDROCK PROJECT NO.

33445

SCALE @ A3

1:550

CLIENT

University of Manchester

PURPOSE OF ISSUE

SUITABLE FOR INFORMATION

STATUS

S2

PROJECT

The Limes Relocation

DRAWING NO.

LIMES-HYD-XX-XX-D-G-00002

REVISION

P01

Appendix B Applicability of remediation options and initial assessment

Table B.1: Technology review as per remediation applicability matrix (EA, 2019 and CL:AIRE, 2010)

Method	Remediation options	Durability	Environmental impact	Relative cost	Relative sustainability	Treatment duration	Site feasibility	Site applicability
Civil engineering	Containment - cover systems	D	L	£-££	S	W	This would reduce risk to human health by removing potential contact with the Made Ground.	Yes
	Containment - hydraulic barriers	T	L	££-£££	U	Y	No risk from leachable contaminants due to underlying clays.	No
	Containment - in-ground barriers	D-M	L	££	S	W		
	Excavation and disposal	D	L	£££+	U	W	Would lead to excessive disposal costs and un-sustainable.	Yes

Method	Remediation options	Durability	Environmental impact	Relative cost	Relative sustainability	Treatment duration	Site feasibility	Site applicability
Biological	Natural attenuation	D	L	£	S	M-Y	No risk from volatile, leachable contamination or mobile contamination impacting the groundwater. The Glacial Till offers the principal aquifer in the sandstone suitable protection from leachable contamination.	No
	Enhanced natural attenuation	D	L-M	£-££	S	M-Y		
	Biopiles	D	L	£	S	M		
	Bioventing	D	L	££	S	M-Y		
	Biosparging	D	L	£	S	M-Y		
	Landfarming	D	L	£	S	M		
	Slurry phase biotreatment	D	L	££	S	M		
	Windrow turning	D	L	£	S	M		
Chemical	Chemical oxidation	D	L-M	££-£££	S	W-M	N/A	No
	Chemical dehalogenation	D	L-M	££-£££	S	W-M	N/A	
	Solvent extraction	D	L-M	££-£££	S	M	Although may reduce PAH	No

Method	Remediation options	Durability	Environmental impact	Relative cost	Relative sustainability	Treatment duration	Site feasibility	Site applicability
	Soil flushing	D	L-M	££-£££	S	M-Y	concentration, the site size is a constraint for the use of such methods.	
Physical	Soil vapour extraction	D	L	££	S	M	N/A	No
	Dual- (/ multi-) phase extraction	D	L	££	S	M	N/A	
	Pump and treat	T	L	£-££	S	Y	N/A	
	Air sparging	D	L	££	S	M-Y	N/A	
	Permeable reactive barrier	D-M	L	££-£££	S	W-Y	There are considered to be no source of offsite of leachable or mobile contaminants which could impact the site.	No

Method	Remediation options	Durability	Environmental impact	Relative cost	Relative sustainability	Treatment duration	Site feasibility	Site applicability
	Soil washing	D	L	£££+	S	W-M	May reduce concentrations of pervasive PAHs but unlikely feasible given the timescales of the project and limitation with site size.	No
Stabilisation and solidification	Hydraulic binders	D	L	££-£££	S	W	Site size constrains use of such methods.	No
	Vitrification	D	H	£££+	U	W		
Thermal	Incineration	D	H	£££+	U	W	Excessive cost for amount of soils to remediate.	No
	Thermal desorption	D	H	£££+	U	W		

Table codes:

D = durable, D-M = Durable (with maintenance), T = temporary (effectiveness stops when treatment ends)

L = low, M = moderate, H = high

S = sustainable, U = unsustainable

£ = comparatively low cost, £££+ = comparatively high cost

W = weeks, M = months, Y = years

Appendix C Unexpected and unforeseen contamination protocol

The site previous use has including local buildings, sports stands and earthworks associated with the athletics stadium, and the potential exists for encountering materials that were not recorded during the original ground investigations. Outside of the known areas of contamination, any significant quantities of suspected oily or odorous material, significant ashy soils and/or unusual brightly coloured or asbestos containing materials should be considered as possibly contaminated.

All relic underground structures and services will require appropriate management and decommissioning to reduce the potential for additional contamination of soils and groundwater during the works. Furthermore, given the potential presence of unidentified sources of contamination existing within discrete areas across the site it is recommended that a watching brief be adopted by a suitably qualified Geo-environmental Engineer or Consultant for all excavation activities and during the removal of relic underground structures.

Should any previously unidentified material suspected of being contaminated be encountered during the development of the site (by visual or olfactory means), then the following protocol should be implemented.

- » Site activities in the immediate vicinity shall cease and an independent Geo-environmental Engineer or Consultant should be contacted (if not on-site already) and provided with a summary of the observations made.
- » The Local Authority should be contacted.
- » Should there be a perceived risk to Controlled Waters, the EA should also be contacted.
- » The Geo-environmental Engineer or Consultant should undertake appropriate investigations to establish the extent of the materials in question. Depending upon the extent and volume of material present, the materials may be removed and temporarily stockpiled (on heavy grade polythene sheeting to prevent leaching/runoff) to enable activities to continue.
- » The Geo-environmental Engineer or Consultant should identify an appropriate suite of chemical testing and agree this with the relevant regulator(s).
- » The resultant chemical analyses shall be compared with the appropriate criteria for the land use in question. The findings and recommendations shall be discussed and agreed with the relevant regulator(s).
- » Updates will be made to this Remediation Strategy and Verification Plan, if required. In the majority of cases, it would be proposed that unexpected contamination is dealt with via independent correspondence, but on occasion it may be necessary to revisit and update this document.
- » Prior to implementing any amendments to the Remediation Strategy and Verification Plan, the relevant regulator(s) shall be consulted and the amendments agreed in writing.

Appendix D Cover system justification

Introduction

There are two broad categories of cover system available for use in the remediation of contaminated land²:

- » simple cover systems/growing medium: designed to provide a reduction of risk to human health and to provide a suitable medium for plant growth; and
- » engineered cover systems: designed to provide complete separation of the receptor from the source and to perform a number of functions including limiting upward migration of contaminants due to capillary rise and controlling the downward infiltration of water.

An assessment of the suitability of an engineered cover system as per Hollingsworth, 2004 (BRE 465) and CIRIA SP124 (1996), has been undertaken. This indicates that

The cover system in landscaping areas is to comprise:

- » A minimum thickness of 600mm subsoil and topsoil cover within proposed soft landscaping areas.
- » Deepening locally to accommodate the root-ball of trees or shrubs.

Beneath building footprints backfilling is required to create a level layer with a void being left in accordance with BS 8485:2007 and NHBC requirements.

In addition, beneath areas of hard standing (roads, drives, pathways etc.), replacement with suitable construction thickness as per road design and capping requirements is required.

The cover system will need to be verified by the Consultant once final installation has been undertaken.

An assessment of the design limitations and considerations regarding the proposed cover system has been undertaken and is detailed in Table D.1 in accordance with BRE 465.

Table D.1: Design considerations for a cover system

Factor affecting suitability of a cover system	Design limitation	Site-specific consideration
Presence of soil gases and vapours	A cover system will not inhibit the movement of soil gases or vapours.	No vapour risk onsite. Gas risk mitigated by underlying Glacial Till thickness.
Location and mobility of water table and solubility of contaminants	Liquid or soluble contaminants may be brought to the surface by rising water table.	There will be no groundwater present at the formation level of the cover system.

² BRE 465 'Cover Systems for Land Regeneration, Thickness of Cover Systems for Contaminated Land' 2004 is a useful discussion document, but as noted in the publication, the principle aim of the research is focussed on a reduction in risk rather than the prevention of exposure.

Factor affecting suitability of a cover system	Design limitation	Site-specific consideration
Risk to Controlled Waters	If mobile elements are in continuity with the Controlled Waters a cover system would provide no additional increased protection to the groundwater.	The site poses a low risk to controlled waters.
Significant contamination	If the concentrations of contaminants are significantly elevated the short-term exposure risk due to any excavation is likely to be unacceptable along with other potential risks associated with the cover system being compromised.	PAHs are present in the Made Ground at pervasive concentrations. Asbestos fibres may still be present at very low concentrations, and these are not considered a significant risk to future site users. It is anticipated that services will be constructed within the cover system/development platform. If not, service trenches will be over-excavated and backfilled with clean soils. The Cover System is designed to mitigate this risk.
Deep excavation	Exposing the contaminated material below the cover.	The deep excavations will be carried out prior to the emplacement of the cover system.
Excavations for buried services	Exposing the contaminated material below the cover. Contamination of water services.	Barrier pipework is recommended for the site, dependent on confirmation from the water supply company. Site workers will be made aware of the hygiene requirements regarding the material below the cover system.
Slopes	The combined effects of gravity and seeping waters on a slope could lead to the failure of the cover system.	The site is flat.
Areas where mole, badger, rabbit and fox populations are significant	Contaminated material can be brought to the surface.	The cover system/development platform construction will be thick enough that burrowing creatures will create burrows within it, rather than below it.

In addition to the considerations covered in Table D.1 above, additional considerations with respect to the cover system are: the growing of vegetables, and the future planting of trees in gardens.

Growing of Vegetables in Gardens

With regard to the thickness of the soil cover in the landscaped areas. Hydrock is proposing a 600mm thickness of Topsoil and Subsoil (of which a minimum 150mm has to be Topsoil).

In proposing the 600mm soil cover, Hydrock have considered (with reference to BRE 465) the following points, to determine if 600mm of soil is sufficient as a soil cover, specifically with regard to the potential future growing of vegetables:

- » depth of earthworm activity;
- » depth of burrows from burrowing animals;
- » effects from plant/tree roots; and
- » gardening activities.

Depth of Earthworm Activity

Worms can cause intermixing of the soils, including bringing soils from depth to the surface. However, the research also indicates that the main worm activity within the soil profile is within the upper 150mm, reducing rapidly with depth. The temporary shallow sub-horizontal burrows, which are more likely to lead to soil intermixing (due to their regular collapse) are generally to depths of 300mm to 350mm, with more permanent near vertical burrows to greater depths.

It can be concluded that a depth of 600mm Topsoil/Subsoil will not have a significant impact from worm activity.

Depth of Burrows from Burrowing Animals

The main burrowing animals that are likely to affect soil cover in gardens are rats, mice, moles, rabbits, badgers and foxes. Given the activity on the subject site including students and site users during the day and evening, animals including foxes and badgers are unlikely to inhabit the site and form dens/setts.

As the site is a proposed residential area the presence of moles, rabbits, badgers and foxes will not present an obstacle to the implementation of the cover system (as they will be actively discouraged by the residents or prefer alternative locations in the fields surrounding the site).

Rats live in burrows often near a food source such as houses, farms or near rubbish bins. The burrows are generally to depths of around 500mm, and they frequently occupy disused rabbit burrows. As there are not going to be disused rabbit burrows in the engineering cover system, a depth of 450mm Topsoil/Subsoil will not have a significant impact on rats. In addition, rats will be actively discouraged by residents as a pest.

The burrowing animals that are likely to be present on site may cause the greatest disturbance is rats which may dig to 500mm. However, rats are not seen as a desirable animal to encourage in a residential area and will have many alternative locations and it can be concluded that a depth of 600mm Topsoil/Subsoil will not have a significant impact on burrowing animal activity.

Wood mice also live in burrows to depths of 70mm to 180mm.

Effects from Plant/Tree Roots

Plants tend to have a shallow root mat influenced by: soil density; availability of nutrients; and availability of moisture. Ranges of the minimum soil layer thickness required for various plants include: 150mm for grass; 200mm to 300mm for garden crops and up to 500mm for shrubs. However, it is considered that significant root penetration can be reduced if shallow soils have suitable nutrients and moisture.

Deeper pits are required for trees. However, tree pits will be dug for trees planned for installation during construction. As the site will be underlain at depth by either a granular, or more likely concrete it is considered that trees planted by the residents should not affect the integrity of the overall remedial scheme for the protection of human health.

It can be concluded that a depth of 600mm Topsoil/Subsoil will be suitable for plants in the landscaped area.

Gardening Activities

Whilst double digging (approximately 600mm) is undertaken by landscapers planting shrubs, it is recognised that this comprises digging out the soil to one spade depth (or to the depth of the Topsoil if less than this) and then loosening the soil to another spade depth using a fork moved backwards and forwards. However, it is considered that mixing below the first spade depth will be minimal.

Roots will preferentially grow laterally, not vertically and not penetrate the capillary break layer. The combination of geotextile and granular capillary break layer/no dig layer, will make it difficult for excavation below the capillary break layer using hand tools.

Uptake of contaminants by crops is not a concern as the crops will root in the validated (uncontaminated) cover system soils.

Hydrock has concluded that a depth of 600mm Topsoil/Subsoil will be suitable for planting of shrubs or laying off grasses.