

MMU Science & Engineering, Manchester

Interim Remediation Strategy

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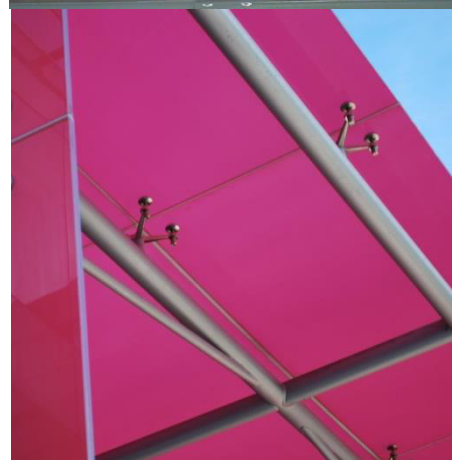
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1.0 Introduction

This Interim Remediation Strategy has been prepared by Curtins for Bowmer & Kirkland (the Client) to provide guidance with respect to land remediation requirements for a site at Manchester Metropolitan University's campus in Manchester to be developed for a Science & Engineering building. The site is located off Chester Street, approximately centred on national grid reference 384130, 397240.

Development proposals comprise demolition of existing buildings within the site, and construction of the new 7 storey Science and Engineering Building with vehicular access from Chester Street, landscaping and public realm works, and servicing facilities.

The site location plan and current development plans for which can be referred to within Appendix A.

This report has been compiled following various stages of pre demolition intrusive investigations undertaken across the site in February 2019 and December 2019. At the time of investigation, the John Dalton West building occupied a significant portion of the site, recommendations for a post-demolition ground investigation beneath the footprint of existing John Dalton West Building have therefore been made to characterise the soils in this area. Following the post-demolition investigation of these areas, this report will be updated accordingly.

1.1 Particular Requirements of the Remediation Strategy

The Remediation Strategy is to account for the following;

- A description of the materials likely to be encountered by the developer and their sub-contractors;
- Proposals for excavations with respect to the materials likely to be encountered;
- Any action required to reduce the risk from contaminants on the development site (soil, liquid and gas);
- Any action required to reduce the risk from contaminants entering water supply pipes;
- Advice on the thickness and quality of any cover to soft landscaped areas of the development; and
- Advice on the verification and validation of the cover layer including a regime for sampling and chemical analysis of sub-soil material.

Reference should also be made to Curtins previous reports Phase 1 Preliminary Site Assessment & Phase 2 Site Investigation Reports (Ref. 1 & 2).

1.2 Definitions

In this document the following definitions apply,

Contractor Refers to the appointed contractor responsible for undertaking the remediation works.

Site Manager Refers to a representative of the appointed contractor resident on site.

Engineer Refers to a suitably qualified representative from Curtins, who would not normally be resident on site.

2.0 Ground Conditions

Ground conditions have been summarised based on the findings from the following reports:

- Curtins (2018) Phase 1 Preliminary Risk Assessment, MMU Science and Engineering, report no. 1338B-CUR-ZZ-RP-C-000001); and
- Curtins (2020) Phase 2 Ground Investigation Report, report no. 069656-CUR-00-XX-RP-GE-002-P05.

Borehole and trial pit locations are shown on Curtins drawings ref. 069656-CUR-00-XX-DR-GE-002-V02 and 069656-CUR-00-XX-DR-GE-003-V02 contained within *Appendix A*. The investigations were undertaken during two phases of works, the first in February 2019 and second in December 2019 and generally revealed the following:

2.1 Made Ground

Made Ground was encountered from ground levels to depths of 0.20m to 3.20m bgl. It typically comprised Asphalt overlying Made Ground of Sand overlying Made Ground of Clay.

The granular Made Ground was encountered within all the exploratory holes at 0.10 – 2.75m bgl; typically comprising reddish brown to black clayey gravelly Sand, brown to black slightly clayey slightly sandy fine to coarse Gravel and brown to black fine to coarse Sand and Gravel. Gravel is angular to surrounded, fine to coarse of various lithologies including coal, ash/clinker, brick, concrete, asphalt, ash, sandstone and mudstone.

The underlying cohesive Made Ground was encountered within WS02, WS03, WS04, BH01, BH04 and BH05 at 0.45m – 3.20m bgl, comprising soft to stiff greyish brown very sandy, slightly to very gravelly Clay with a low to medium cobble content of brick. Gravel is angular to subrounded, fine to coarse of various lithologies including brick, concrete, slate, tile, ceramic, coal, sandstone and mudstone.

WS01 was terminated at 0.80m bgl due to a brick obstruction and BH03 was terminated at 1.80m bgl due to obstructions, likely brick or concrete. WS102, WS103 and WS103A were terminated due to a concrete slab, encountered from depths of 0.20 – 0.70m bgl.

2.2 Superficial Deposits

Natural superficial strata deposits comprised Glacial Till encountered from depths of 0.80m to 3.20m to a proven depth of 12.00m to 17.00m bgl and consisted of Clay underlain by Sands and Gravels.

The cohesive deposits generally comprised firm to very stiff brown to greyish brown, slightly to very sandy, slightly gravelly Clay. Gravel is subangular to subrounded, fine to coarse of various lithologies including sandstone, mudstone, coal and quartzite and cobbles of sandstone. The Clay was typically recorded to depths up to 12.00m bgl.

The granular deposits encountered within the majority of exploratory holes generally comprised loose to very dense, brown to grey clayey, slightly to very gravelly fine to coarse Sand and reddish brown to brown medium dense to very dense fine to coarse Sand & Gravel. Gravel is subangular to sub rounded fine to medium of various lithologies including sandstone, mudstone and quartzite. Granular material was encountered from 10.80m and 12.00m bgl to a maximum depth of 12.00m to 17.00 mbgl.

2.3 Bedrock Deposits

Sandstone bedrock was encountered within Cable Percussive (with Rotary cored follow on) Boreholes from depths of 12.50m to 17.00m bgl to borehole completion depth (22.00 – 31.50m bgl).

The bedrock was recorded as extremely weak to weak, moderate reddish-brown slightly silty fine to medium grained Sandstone. Occasional to rare fine to medium grained gravel of sandstone, siltstone, quartzite and dark reddish-brown mudstone. Fractures (0 – 25 degrees) are extremely closely to medium spaced, open to incipient, smooth planar and sand coated. Some assumed zones of core loss were recorded, and non-intact zones recovered as very sandy gravel.

In BH102, mudstone was encountered from 18.78m to 20.85m and from 21.49m to 25.36m, generally described as extremely weak to very weak reddish brown thinly laminated Mudstone with occasional widely spaced thin laminations of fine-grained sandstone. Discontinuities identified are incipient fractures, extremely closely spaced to closely spaced, 0 – 10 degrees, planar and fractures very closely spaced to widely spaced 0 – 10 degrees, planar, smooth.

2.4 Groundwater Levels

Groundwater strikes were recorded during siteworks in BH01, BH03A at 10.00m and 9.50m bgl respectively.

During return monitoring, groundwater was encountered within the window sample boreholes at 1.60m – 2.14m bgl. Within the installed rotary boreholes groundwater was encountered at 3.84m to 10.40m bgl. This is considered likely represent perched groundwater in made ground and superficial deposits.

2.5 Contamination Concentrations

2.5.1 Soils

With respect to the proposed '*Commercial*' end-use of the site, no exceedances were noted within recovered soil samples from either site investigation (February and December 219 SI's).

Twelve soil samples from the February 2019 SI and six soil samples from the December 2019 SI were screened for asbestos as part of the general soil testing suite. No suspected asbestos containing materials (ACMs) were identified in the exploratory hole logs.

Laboratory screening confirmed that asbestos was present within two of the February SI recovered Made Ground samples, WS03 at 0.30m and BH02 at 0.30m. Both of these locations are located on the south of the site. Results are detailed within *Table 2.5.1* below.

Table 2.5.1 – Locations of positive asbestos identification, with asbestos quantification results

Borehole Ref.	Depth (m bgl)	Asbestos ID	Asbestos Quantification (%)
WS03	0.30 – 0.40	Chrysotile (Loose Fibres)	0.002
BH02	0.30 – 0.40	Chrysotile (Loose Fibres & Loose Insulation)	0.22

2.5.2 Groundwater

When compared to the UK/EU Drinking Water Standards and WHO Thresholds for TPHs, no exceedances were recorded in the two recovered groundwater samples collected which could present a risk to the underlying aquifer and Source Protection Zone (Zone III).

2.6 Water Supply Pipe Assessment

With reference to the UKWIR Report no. 10/WM/03/21 (Ref. 5) advice is given on the appropriate materials for these ground conditions. The exact requirements are to be confirmed with the relevant utility supplier.

Based on the data collected and assessed during the February and December 2019 site investigations PE and PVC pipes are unlikely to be considered suitable for use for water supply pipes at this site due to concentrations of C5-C10, C11-20 and C21-40 mineral oils and BTEX exceeding UKWIR guidelines. Therefore, it is recommended that appropriate materials for water supply pipes would likely comprise Barrier Pipes (PE/AL/PE). The exact requirements should be confirmed with the relevant utility supplier.

2.7 Ground Gas Risk Assessment

To characterise the site's ground gas regime and validate the qualitative assessment of ground gas risk standpipe installations were incorporated within boreholes on site. During the February 2019 ground investigation, an initial programme of six gas monitoring visits over three months were undertaken between 6th March and 13th May 2019. As part of the December 2019 GI a programme of six monitoring visits over three months was undertaken between 14th January and 8th April.

A maximum carbon dioxide (CO₂) concentration of 0.8% was recorded in WS03 and a maximum flow of 1.8l/hr was recorded. Concentrations of methane (CH₄) were recorded below the instruments limit of detection. Carbon monoxide (CO) and hydrogen sulphide (H₂s) were recorded at maximum concentrations of 3ppm and 6ppm respectively. The borehole Qhg of 0.0008 l/hr within WS03 was considered representative of the gassing regime of the site as a whole and particularly beneath the proposed building footprint, thus was adopted as the sites Gas Screening Value. The maximum carbon dioxide concentrations and respective gas screening values indicate a Gas Characterisation Situation 1 (CS1) gas regime, not requiring gas protection measures for the proposed new development.

2.8 Materials Management

2.8.1 Re-use of Site Soils

Based on the geochemical testing results presented as part of this investigation it is considered that there is no specific requirement to remove soils from site because of them presenting an unacceptable risk to human health or the environment.

The re-use of site-won soils may therefore be undertaken if the following principles are met:

- i) the geotechnical suitability of the material needs to be confirmed;
- ii) the re-use of the material needs to be covered as part of the planning approval, e.g. site levels maintained within agreed limits;
- iii) the volume of the material being re-used needs to be confirmed and traceable; and
- iv) regulatory approval from the relevant authorities has been sought.

These principles are outlined within the CL:AIRE Definition of Waste Code of Practice (v2) (Ref. 21) and if and where the re-use of site-won soils is proposed as part of the development works it is recommended that a Materials Management Plan is produced in line with the Definition of Waste Code of Practice to detail and document the process.

It should be noted that asbestos containing soils may not be suitable for crushing for re-use due to the risk of fibre release and cross contamination.

2.8.2 Material Classification

Where any site soils are to be disposed of offsite guidance on the disposal of contaminated soils is provided within the following document published by the Environment Agency, the Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st Edition 2015) (Ref. 6).

Guidance states that the principal contractor (or any other sub-contractor undertaking excavations) should, in conjunction with the proposed disposal facility, use where possible the

relevant environmental chemistry analyses results to classify any surplus material identified for offsite disposal. However, it should be noted that this information is for guidance only and material identified for disposal should be tested and assessed in accordance with WM3 to enable classification during the works.

An initial assessment for the waste classification of the shallow and deeper Made Ground soils encountered onsite has been carried out through a comparison of the soil testing results against the Tier 1 Thresholds and using the Waste Soils Characterisation Assessment Tool, Cat-WasteSoil, developed by McArdle and Atkins. This online tool gives a rapid assessment of contaminated soils and their classification as either hazardous or non-hazardous (stable non-reactive hazardous waste) waste, it should be noted that this tool does not classify inert waste. Persistent Organic Pollutants (POP's) were not tested for as part of the investigation, however based on the Conceptual Site Model the risk of these being present on the site is considered Low.

The initial assessment revealed that of the 22 no. soils tested, two samples have been identified as 'hazardous' with respect to Environment Agency waste classes, using the guidance given in WM3. WS02 at 1.2m was identified as having hazard property HP14 due to elevated concentrations of Copper and Lead; and BH02 at 0.30 – 0.40m due to concentrations of asbestos fibres greater than 0.1%. Asbestos Containing Material (ACM) picking may enable for disposal as non-hazardous waste.

As discussed, preliminary waste classification is undertaken to offer indicative advice with respect to disposal requirements. Landfill operators are not obliged to accept waste and, if they were to do so, may have specific requirements beyond those outlined above prior to acceptance. Landfill operators should be contacted to confirm the above classifications or otherwise.

3.0 Relevant Pollutant Linkages

A conceptual site model (CSM) for the site has been developed based on the two phases of Ground Investigations undertaken as detailed in Curtins Geo-environmental reporting (Ref.1 & 2).

The CSM details several pollutant linkages at the site, however, based on the risk assessments undertaken, the potential pollutant linkage (PPL) listed in *Table 3.0* was identified as requiring remediation to enable the safe re-development of the site. This CSM will require update following post demolition ground investigation.

Table 3.0 Potential Pollutant Linkages (Existing)

PPL	Sources	Receptor	Potential Pathway	Remediation Recommended
1	Made Ground soils containing elevated loose asbestos fibres and/or asbestos containing material	Construction Workers	Inhalation and/or ingestion with contaminants in soil and soil-derived dust from on-site Made Ground.	Appropriate PPE for construction staff and suitable asbestos management measures during construction.
2	Made Ground soils containing elevated concentrations of PAHs, lead and asbestos fibres/containing materials.	End Users	Inhalation and/or ingestion with contaminants in soil and soil-derived dust from on-site Made Ground.	Soft Landscape Areas overlying Made Ground - Provide a clean and inert growing medium of 300mm of topsoil/subsoil with underlying geotextile/break layer in soft landscaped areas. It may be possible to zone soft landscaping capping areas. Only two boreholes on the south of site have encountered asbestos to date. Subject to the findings of the post demolition investigation, the intentions for re-use of made ground soils on site and regulatory approval.
3	Made Ground soils containing elevated concentrations of TPHs & BTEX above UKWIR thresholds.	End Users	Chemical attack of potable water supply pipes and subsequent infiltration from contaminants on site, followed by ingestion.	Ensure appropriate water supply pipes are used. Exact requirements to be confirmed the relevant utility supplier through United Utilities Water Supply pipe risk assessment.

The risks to groundwater and surface waters from contamination on site and the risks from ground gas to end users were identified as Low within previous ground investigation reporting (Ref.1 & 2).

4.0 Remedial Works

With reference to the Conceptual Site Model and the potential contaminant linkages detailed in *Table 3.0* remedial actions are recommended in order for the site to be brought up to a condition that is deemed 'suitable for use';

- **Remedial Action 1:** Appropriate PPE for all construction workers and suitable asbestos management measures;
- **Remedial Action 2:** Engineered capping to serve as physical barrier between Made Ground and site surface; and
- **Remedial Action 3:** Ensure suitable water supply pipes are used on site.

It is further recommended that Curtins Engineer is contacted if any unexpected contamination/contaminative incidents are encountered during construction works or should ground conditions vary from those outlined in Section 2.0. Further advice on handling such incidents is enclosed within Section 6.0.

4.1 Remedial Action 1 – Contamination and Asbestos Management During Construction

Under current health and safety legislation, employers are required to carry out their own appropriate risk assessments and mitigation to protect themselves and their employees, other human receptors and the environment from potential contamination. Such risks must be adequately mitigated by law, specifically the Construction Design Management (CDM) Regulation, 2015 which require the potential risk to human health and the environment from construction activities are appropriately identified and all the necessary steps taken to eliminate / manage the risk.

It has been assumed that any future construction works on site will be undertaken in compliance with these requirements to address PPL 1 (Table 3.0).

CL:AIRE have published guidance to aid in the classification of remediation works on Asbestos Containing Soils (ACS) compliant with Control of Asbestos Regulations 2012 (CAR). This is detailed in CL:AIRE (2016) 'Control of Asbestos Regulations 2012 – Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry Guidance.

Any works with asbestos containing soils are required to determine their classification in accordance with Control of Asbestos Regulations 2012. The specialist groundworks contractor is therefore to designate the works based on the investigation results but utilizing their own additional testing and delineation if they deem it to be required.

Where, from the site investigations, material are known to contain asbestos fibres good practice (JIWG Car-Soil and CAR 2012) prescribes such material to be segregated to ensure materials would not cross-contaminate other soils and to reduce the risk of further fiber release to site workers.

Table 2.5b in Section 2.5 above should be consulted together with Curtins Exploratory Hole Plan Drawings in *Appendix A* (Ref. 069656-CUR-00-XX-DR-GE-002-V02) for the locations, depths and concentrations of asbestos was identified during Curtins Ground Investigations (Ref. 2).

Concentrations of chrysotile asbestos fibres encountered within the Made Ground soil in WS03 was relatively low (0.02% w/w). In BH02, where chrysotile loose fibres and chrysotile loose insulation asbestos containing material was encountered, a concentration of 0.22% w/w of asbestos was recorded.

Materials containing asbestos >0.1% w/w would be classed as hazardous waste.

Any fragments or asbestos containing materials where identified must be picked where possible and be kept separate in line with those from any soil arisings. This is typically carried out by picking visible fragments at the point of excavation.

On this basis, removal of ACM debris, during enabling works at the site is required.

The following steps should be taken;

1. Asbestos Management Plan to be developed by the contractor prior to works. This document will outline procedures to be undertaken during construction to ensure removal of ACM debris.
2. Visual inspection of all excavations is to be undertaken by suitably qualified and experienced asbestos professional;
3. All identified or suspected ACM debris should be removed from the site and submitted to the laboratory for testing;
4. The contractor is responsible for providing appropriate records of ACM identified, along with provision of disposal records;
5. Validation should be in the form of collating records of ACM findings (e.g. daily site log, photographs (if appropriate), along with laboratory testing and disposal records, to be included in a validation report.

It is the responsibility of the contractor to make all relevant risk assessments to protect site users and the public during construction. The asbestos management plan should detail the risk assessments completed, mitigation to be employed as well as an assessment of the type of work i.e. notifiable, non-notifiable etc.

Existing Made Ground should not be crushed or in any way treated due to risk of asbestos fibre release. It may be possible to use Made Ground soils as general fill subject to in situ trial tests and

where managed appropriately by the Method Statement compiled by the Asbestos Management Specialist.

4.2 Remedial Action 2 – Engineered Capping

The second PPL identified at the site relates to the direct contact, dermal uptake, soil and dust ingestion and inhalation of PAHs, lead and asbestos fibres in soils and soil derived dust (PPL 2, *Table 3.0*).

Hardstanding, including vehicular asphalt, pedestrian asphalt and concrete block paving are considered sufficient to break the potential contaminant linkage, PPL 2, detailed in *Table 3* and therefore no specific remediation measures, above activities required for construction, are considered necessary if and where these are installed at the site.

However, a risk remains in landscape areas of exposure to contaminated Made Ground. It is therefore recommended that verified clean capping, comprising a thickness of imported subsoil and topsoil where directly overlying the Made Ground.

Recommended remedial measures are detailed in *Table 4.2* below.

Table 4.2 Engineered Capping Details for Soft Landscaping Areas

Location	Further Remedial Measures Required ¹	Rationale
General Landscape Areas	Provision of a minimum 300 mm clean capping with underlying geotextile or break layer. The geotextile or break layer must be provided to provide a warning/prevent future excavation into contaminated soil below. The capping thickness should comprise a minimum of 150mm topsoil over resultant depth of subsoil.	Remove potential for exposure of on-site receptors via direct contact, dermal uptake and soil and dust ingestion and inhalation.

Given only two boreholes on the south of site have encountered asbestos to date subject to the findings of the post demolition investigation, the intentions for re-use of made ground soils on site and regulatory approval it may be possible to zone soft landscaping capping areas .

The engineered capping must meet the specification outlined in *Section 5.0*.

4.3 Remedial Action 3 – Use of Suitable Water Supply Pipes

The third PPL identified at site relates to the risk to water pipes by chemical attack from contaminants on site which will enable infiltration of contaminated material followed by potential ingestion by the receptor (PPL 3, *Table 3.0*).

UK Water Industry Research (UKWIR) published 'Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' to ensure the correct materials are selected for water pipes and components to be used below ground in brownfield sites to protection quality of drinking water. An initial review of the site comparing laboratory analysis results for soils against UKWIR thresholds indicates PE & PVC are unlikely to be considered suitable materials for water supply pipes on the site. The exact requirements should however be confirmed with the utility provider, in this case United Utilities.

United Utilities have adopted the guidance to include a Risk Assessment for Water Pipes. At a minimum a desk study shall be provided within the risk assessment in accordance with the framework in Environment Agency publication 'Model Procedures for the Management of Land Contamination' that sets out whether land which the pipes are to be laid may be affected by contamination.

United Utilities require the signatory of the risk assessment to be carried out under the direction of a suitably qualified person e.g. a chartered member of an appropriate professional body or a Specialist in Land Condition (SiLC).

5.0 Engineered Capping Specification

5.1 Sourcing of Materials

5.1.1 Off-Site Sources

It is anticipated that materials are to be imported to the site for use in constructing the growing medium in soft landscaping areas. It is strongly recommended that materials are sourced from reputable suppliers and comprise materials that have been suitably processed to produce standardised materials. It is not recommended that materials are imported directly from 'donor' development sites. Imported material will also require verification testing to ensure suitability for reuse, and it is strongly advised that the Contractor undertake their own independent verification testing if accepting material from a third party, rather than relying on supplier reports.

5.1.2 On-site Sources

Based on the findings of the Site Investigation, it is considered highly unlikely that the general shallow Made Ground could be considered 'uncontaminated' or 'clean' material for re-use as a subsoil due to the presence of asbestos fibres and other contaminants at a number of locations across the site.

5.2 Imported Topsoil

Imported Topsoil will invariably be required and should be supplied and placed in accordance with the Architects' specification but generally, all topsoil will be a minimum of 150mm thick in soft landscaped areas (as part of the 300mm overall layer thicknesses as detailed in Section 4.0).

Where topsoil is imported, it is to be 'Multipurpose' in accordance with BS 3882:2015 'Specification for Topsoil and Requirements for Use'.

The topsoil should also be confirmed to be 'suitable for use' as per the analysis outlined in *Section 5.4*.

5.3 Imported Subsoil

Where imported subsoil is required as part of the growing medium this can be cohesive or granular but should be free-draining and confirmed to be 'suitable for use' as per the analysis outlined in *Section 5.4* and compliant with the British Standard for Subsoil BS 8601:2013.

5.4 Chemical Composition of Soils

Site won and imported subsoil and topsoil should not contain concentrations of contaminants that present an unacceptable risk to the health of future site occupants.

The Contractor shall be responsible for demonstrating that both site won and imported material is 'clean' and therefore suitable for use in soft landscaping areas. This will include the recovery of samples for laboratory testing from both the material source and verification testing of material following delivery to site. The required testing frequencies for materials source types are detailed below. Other sources may be applicable, however testing frequencies shall be confirmed with the Engineer prior to acceptance.

Table 5.4a Environmental chemistry testing frequency for imported and re-used soils

Source	Testing Frequency
Imported Topsoil/Subsoil (Greenfield)	Verification: One sample every 200m ³ used (or a minimum of 3 No. samples whichever is greater) in accordance with Table 3 of Clause 5.5.3 of Planning Guidance in Relation to Ground Contamination: Guidance Note for Applicants, Developers, Land Owners and Consultants, Manchester City Council (2016). To include on site sampling not just sampling at source.
Imported Topsoil/Subsoil (Remediated/ Brownfield/Unknown)	Verification: One sample every 150m ³ used (or a minimum of 3 No. samples whichever is greater) in accordance with Table 3 of Clause 5.5.3 of Planning Guidance in Relation to Ground Contamination: Guidance Note for Applicants, Developers, Land Owners and Consultants, Manchester City Council (2016). To include on site sampling not just sampling at source.
Re-used/ Site Won Natural Soils	Verification: one sample every 150m ³ used (or a minimum of 3 No. samples whichever is greater).

The environmental chemistry testing requirements are as *Table 5.4b*. Additions to the suite and frequency of sampling maybe required based on the source of the imported materials. For example, if the imported Topsoil is not naturally sourced, e.g. recycled soil, further chemical determinants may be added to the chemical analysis suite at the discretion of the Engineer.

Table 5.4b Environmental chemistry analysis suite for imported soils.

Suite Reference	Environmental Chemistry Analysis
Greenfield or Manufactured Soils Imported to Site and Site Won Soils for Use as Clean Capping	Total metals: Arsenic, cadmium, chromium, chromium VI, lead, mercury, selenium, copper, nickel, zinc, water soluble boron; pH Soil Organic Matter Asbestos Screening Polycyclic Aromatic Hydrocarbons by GC-MS (Detection Limit 0.1mg/kg for each compound - 16 USEPA speciation)

Suite Reference	Environmental Chemistry Analysis
	Total Petrol Hydrocarbons (Full TPHCWG analysis – aromatic/aliphatic split, Detection Limit 0.01mg/kg for each banding C5 to C10 and 1mg/kg for bandings above C10)

Assessment criteria: Concentrations of the above determinants shall not exceed the '*Residential without Home Grown Produce*' screening criteria; refer to *Appendix B*.

Definition of 'clean': Where ALL concentrations are less than these values the soils shall be defined as 'clean'.

Soil organic matter (SOM): A review of the thresholds outlined may be made for specific soil sources whereby the Soil Organic Matter is proving to be routinely above 6%.

5.5 Verification and Validation of Capping/Growing Media

Confirmatory analysis outlined previously is required to verify the suitability of any imported and site won topsoil, and where required, subsoil.

Evidence that the specified depth of capping/growing media has been provided will be required including evidence of the underlying geotextile/anti-dig break layer.

Evidence should include hand excavated trial pits advanced in areas where material has been placed to prove a sufficient depth is provided and geotextile/anti-dig layer is present.

The pits shall be excavated to the base of the interface between the imported material and the geotextile/ anti dig layer.

A photographic record of the hand excavated trial pits would also be required.

6.0 Strategy for Handling Potentially Contaminated Soils and Contaminative Incidents on Site

6.1 Unexpected Contamination

In the event that material is revealed on the site of a nature that does not accord with the previously observed and recorded descriptions the following procedure is to be complied with:

- a) Cease and make safe all excavations in this location and report observations to the Site Manager.
- b) The Site Manager is to notify the Engineer.
- c) Under guidance of the Engineer take representative samples of the suspect materials and forward to a suitably accredited laboratory for analysis.
- d) Await Engineers instructions with respect to re-commencement of the works and or removal of suspect material to a suitably licensed disposal facility (following guidance outlined in *Section 6.1* above).
- e) Manchester City Council Environmental Protection Team and if relevant the Environment Agency are to be kept fully informed of any site such occurrences.

6.2 Contaminative Incidents

It is possible that some below ground features / structures exist that have not been recorded on plans and have not been encountered during the ground investigation works or demolition works. It is possible that unknown/unrecorded substructures (e.g. fuel tanks) may exist which if ruptured may release materials that could contaminate the surrounding soils and groundwater (petroleum hydrocarbons, solvents, for example). In the unlikely event that this occurs an outline strategy is detailed below.

Where such a tank/pipework is damaged during excavation and the contents are released into the surrounding soil, the tank/pipework should be immediately pumped dry into another suitable container and a trench with a low permeability base formed around the tank/pipework to prevent seepage laterally and to collect the contaminant. Where groundwater is encountered in the trench, it should be pumped into a suitable container and tested for the contaminant. All soils affected shall then be tested and removed from site as appropriate.

Where the damage is caused to the underside of a tank and seepage is vertical, the contaminants may present a risk of polluting the groundwater. In this instance and subject to the findings of a risk

assessment boreholes may be required to prove and intercept the contaminant. The contaminant will then be pumped into suitable containers.

7.0 Verification, Validation and Reporting

Verification and/or Validation visits shall be undertaken by an appropriately qualified and experienced person throughout the construction phase to ensure that the requirements of this Remediation Strategy have been implemented at the site. It is anticipated records will be taken during the work as identified below:

- During groundworks should any unexpected contamination be encountered;
- During groundworks to demonstrate suitable contamination and asbestos management measures have been put in place by the contractor;
- During and after installation of the engineered capping layer to soft landscaped areas;
- Prior to and upon installation of suitable water supply pipes on site (subject to UU Risk assessment);

All documentation pertaining to the above will be supplied to the Engineer and incorporated within a completion report.

The Completion Report will be required on completion of the works confirming that the remedial works have been completed satisfactorily.

Confirmatory analysis is required to confirm the suitability of any imported topsoil, and where required, subsoil, the results of which will be included within the Completion Report. Any additional, confirmatory testing will also be included herein.

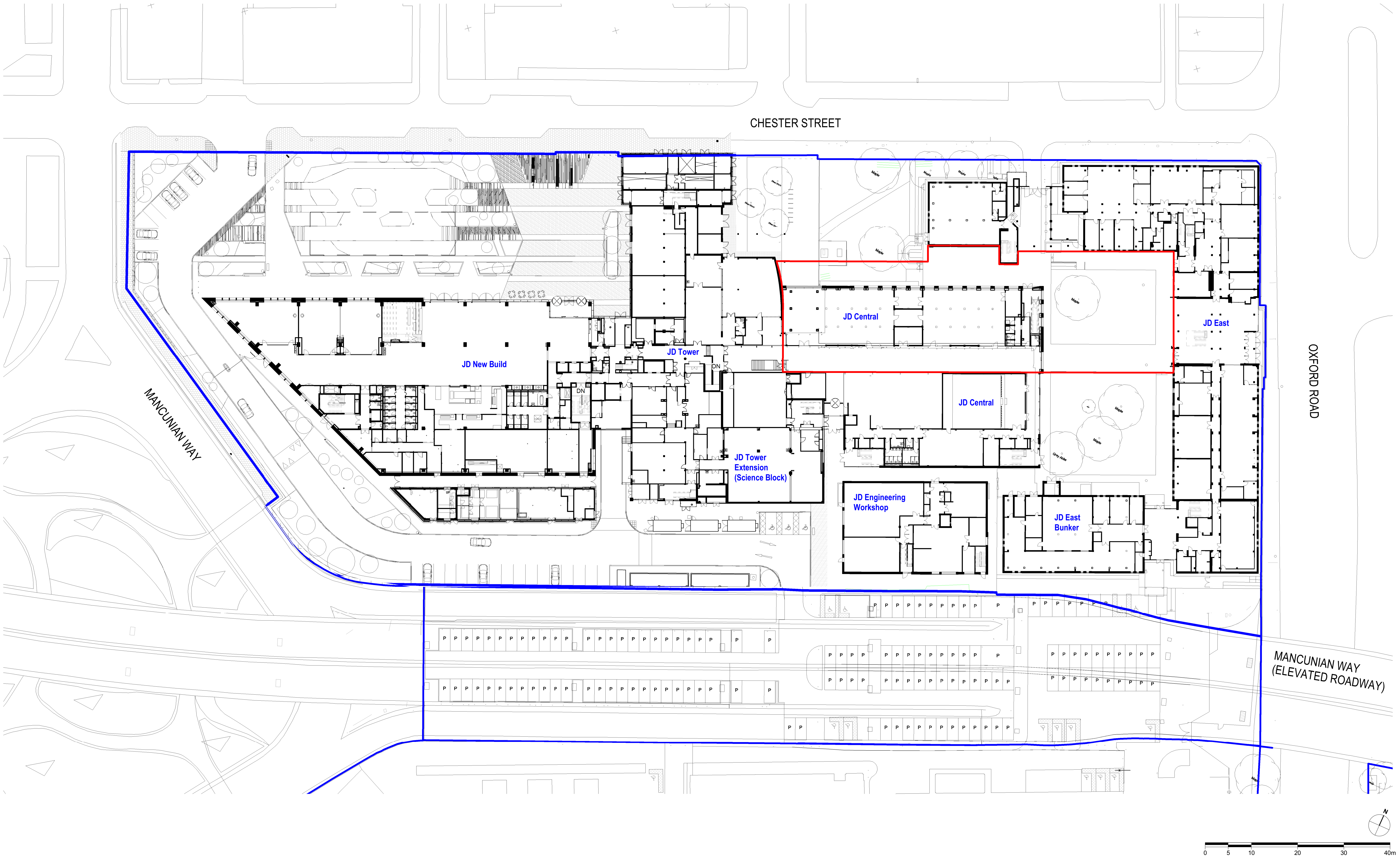
Validation through hand excavated trial pits with photographic record will all be included within the Completion Report to confirm the provision of a requisite depth of clean capping/growing media.

8.0 References

1. Curtins (2018) Phase 1 Preliminary Risk Assessment, MMU Science and Engineering (ref. 1338B-CUR-ZZ-RP-C-000001).
2. Curtins (2020) *Phase 2 Ground Investigation, MMU Science & Engineering, Manchester* – ref. 069656-CUR-00-XX-RP-GE-002-P05.
3. Contaminated Land: Applications in Real Environments (CL:AIRE) *The Definition of Waste: Development Industry Code of Practice. Version 2*; March 2011.
4. Environment Agency. *Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st Edition)*. 2015.
5. UK Water Industry Research (2010) Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (report no. 10/WM/03/21).
6. Environment Agency (2015) *Guidance on the Classification and Assessment of Waste Technical Guidance WM3 (1st edition)*.

Appendix A – Drawings

- BDP (2020) Proposed Site Plan 1-500 RIBA Stage 2 (drawing ref. 1338B-BDP-YY-00-DR-A-200005 P01)
- Curtins (2020) Exploratory Hole Location Plan West (drawing ref. 069656-CUR-00-XX-DR-GE-002-V02)
- Curtins (2020) Exploratory Hole Location Plan East (drawing ref. 069656-CUR-00-XX-DR-GE-003-V03)



BUILDING DESIGN PARTNERSHIP SHALL HAVE NO RESPONSIBILITY FOR ANY USE MADE OF THIS DOCUMENT OTHER THAN FOR THAT WHICH IT WAS PREPARED AND ISSUED.

ALL DIMENSIONS SHOULD BE CHECKED ON SITE.

DO NOT SCALE FROM THIS DRAWING.

ANY DRAWING ERRORS OR DIVERGENCIES SHOULD BE BROUGHT TO THE ATTENTION OF BUILDING DESIGN PARTNERSHIP AT THE ADDRESS SHOWN BELOW.

DRAWINGS SHALL BE READ IN CONJUNCTION WITH THE FOLLOWING BEFORE WORK COMMENCES.

- THE CDM DESIGN ISSUES REGISTER
- THE BOP RISK SERIES OF DRAWINGS
- THE PROJECT CDM RISK REGISTER

NOTES

Site Location & Ownership

— Application Site Boundary

— Adjacent Sites in Ownership of Applicant

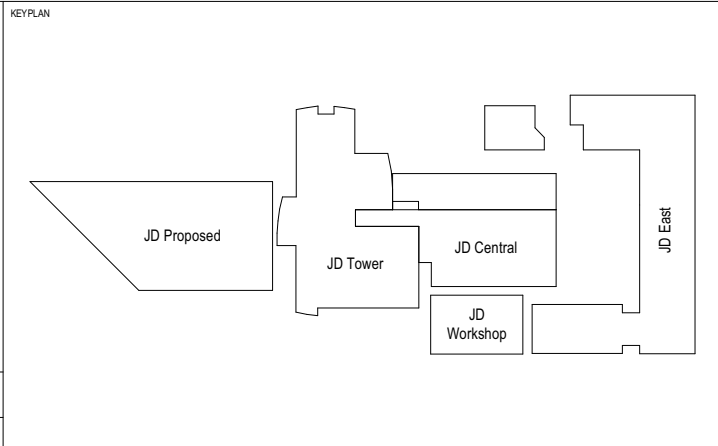
Blue lines confirming legal boundaries provided by Manchester Metropolitan University on 03/01/2019

Landscape configuration is indicative. Refer to separate Landscape Architects' Information

REVISION	DESCRIPTION	DRAWN	CHECKED	DATE
P01	Planning Issue			19.08.20

REVISION	DESCRIPTION	DRAWN	CHECKED	DATE

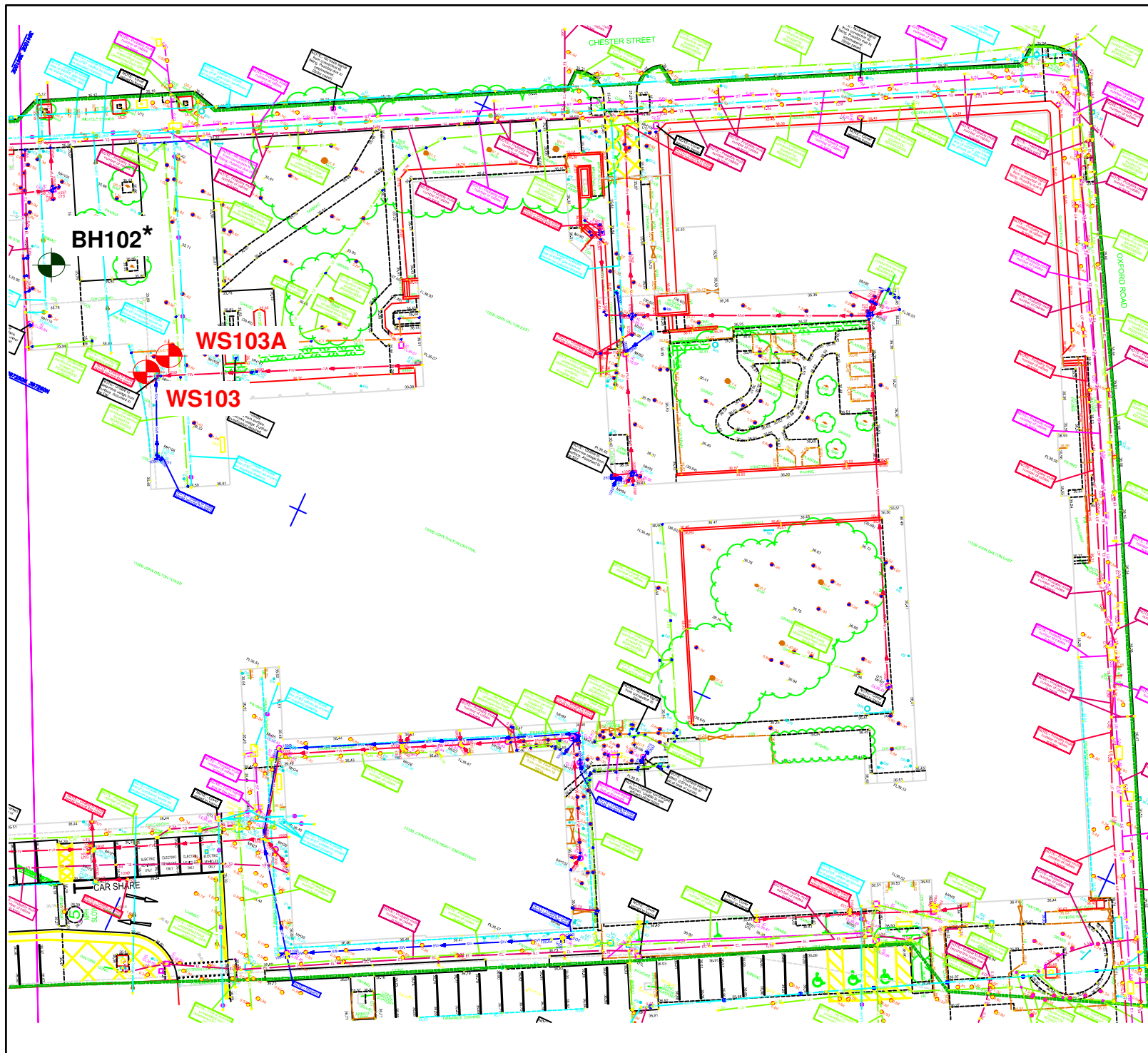
REVISION	DESCRIPTION	DRAWN	CHECKED	DATE



11 Ducie Street
PO Box 85
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PROJECT TITLE Science and Engineering Building		
BDP JOB NUMBER P2008524	PROJECT CLASSIFICATION Commercial In Confidence	SURETYPED As indicated
DRAWING TITLE Site Plan - Proposed		DATE FIRST ISSUED 19.08.20
DRAWING NO. 1338B-BDP-YY-GF-DR-A-200005		REVISION P01



Window Sample Borehole



Cable Percussive with Rotary
Core follow on Borehole

Rev:	Description:	Date:	By:	Chkd:
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Status:

INFORMATION

Project:

MMU Science and Engineering

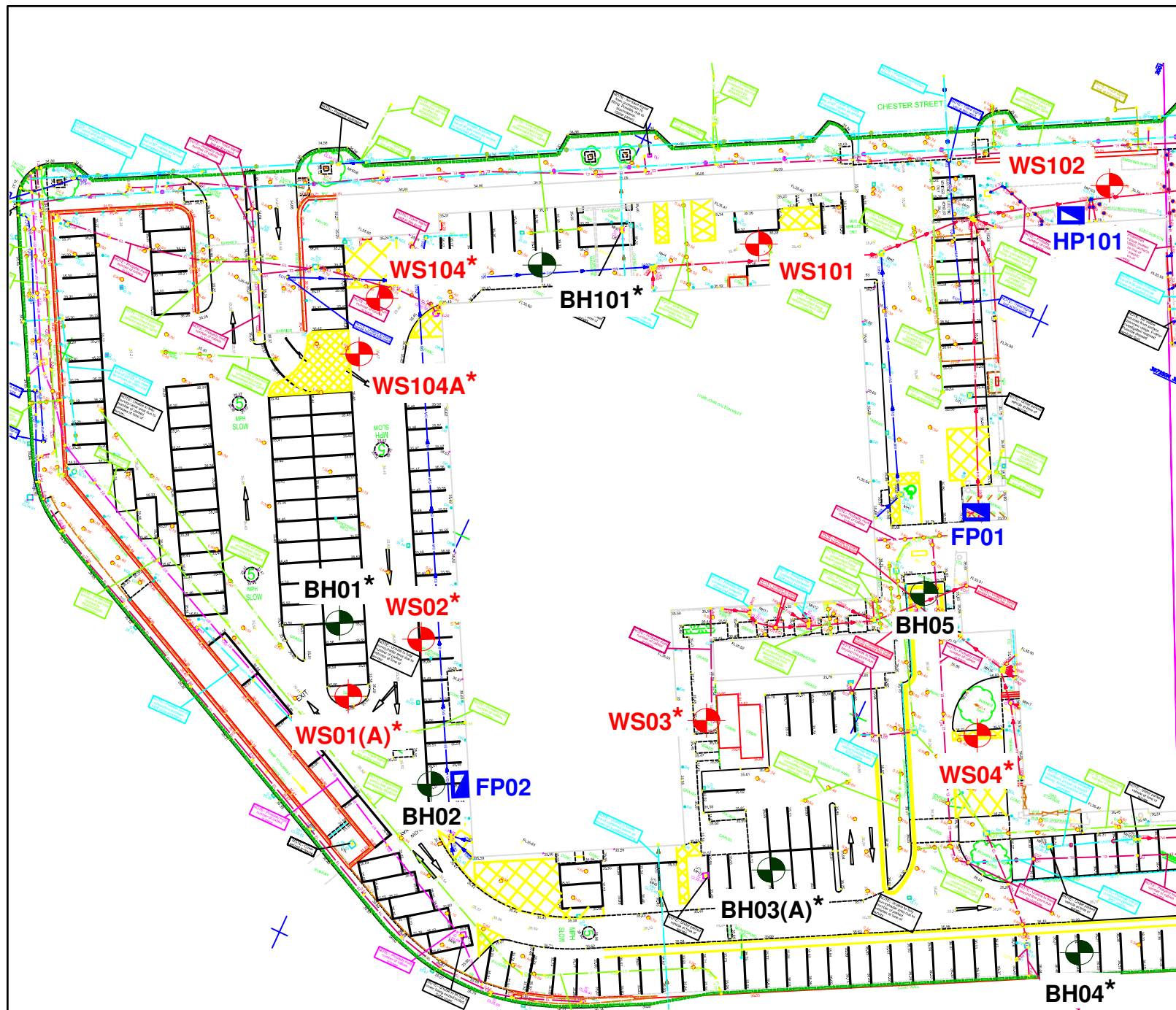
Drg Title:

Exploratory Hole Location Plan East

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	22/01/20	ZH	JJ

Drg No:	Rev:
069656-CUR-00-XX-DR-GE-003	V03

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-  Window Sample Borehole
-  Cable Percussive with Rotary Core follow on Borehole
-  Hand Excavated Foundation Pit
- * Denotes borehole installed

Rev:	Description:	Date:	By:	Chkd:
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Status:

INFORMATION

Project:

MMU Science and Engineering

Drg Title:

Exploratory Hole Location Plan West

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	22/01/20	ZH	JJ

Drg No:	Rev:
069656-CUR-00-XX-DR-GE-002	V02

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Appendix B – Chemical Acceptability Thresholds

- Residential Without Homegrown Produce

Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 21	6 21	1.8 170	33 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130⁽¹⁰⁾	180⁽¹⁰⁾	53⁽¹¹⁾	980⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 79	170 170
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₆	160	160	3900	12000	600000	180000
EC ₅₋₆ - EC ₈	530	530	13000	40000	620000	320000
EC ₅₋₈ - EC ₁₀	150	150	1700	11000	13000	21000
EC ₁₀₋₁₀ - EC ₁₂	760	770	7300	47000	13000	24000
EC ₁₂₋₁₂ - EC ₁₆	4300	4400	13000	90000	13000	26000
EC ₅₋₁₆ - EC ₃₅	110000	110000	270000	1800000	250000	490000
EC ₃₅₋₃₅ - EC ₄₄	110000	110000	270000	1800000	250000	490000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅₋₅ - EC ₇	300	1400	57	86000	56000	92000
EC ₅₋₇ - EC ₈	660	3900	120	180000	56000	100000
EC ₅₋₈ - EC ₁₀	190	270	51	17000	5000	9300
EC ₁₀₋₁₀ - EC ₁₂	380	1200	74	34000	5000	10000
EC ₁₂₋₁₂ - EC ₁₆	660	2500	130	38000	5000	10000
EC ₅₋₁₆ - EC ₂₁	930	1900	260	28000	3800	7800
EC ₂₁₋₂₁ - EC ₃₅	1700	1900	1600	28000	3800	7900
EC ₃₅₋₃₅ - EC ₄₄	1700	1900	1600	28000	3800	7900
Aliph + Arom EC >44-70	1900	1900	3000	28000	3800	7900
Aromatic						
Benzene	0.33 0.87	1.0 3.3	0.07 0.18	95 98	73 140	110 230
Ethyl benzene	350	840	90	2800⁽⁸⁾ [66000]	2800⁽⁸⁾ [25000]	2800⁽⁸⁾ [27000]
Toluene	610	2700	120	4400⁽⁸⁾ [190000]	4400⁽⁸⁾ [56000]	4400⁽⁸⁾ [100000]
Xylene ⁽⁹⁾	230	290	160	2600⁽⁸⁾ [32000]	2600⁽⁸⁾ [43000]	2600⁽⁸⁾ [31000]
Phenol	420	520	280	3200⁽¹⁴⁾ (38000)	3200⁽¹⁴⁾ (10000)	3200⁽¹⁴⁾ (9300)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	13	13	24	1100	4900	3000
Acenaphthylene	920	6000	160	100000	15000	30000
Acenaphthene	1100	6000	200	100000	15000	30000
Fluorene	860	4500	160	71000	9900	20000
Phenanthrene	440	1500	90	23000	3100	6300
Anthracene	11000	37000	2200	540000	74000	150000
Fluoranthene	890	1600	290	23000	3100	6400
Pyrene	2000	3800	620	54000	7400	15000
Benz(a)anthracene	13	15	13	180	29	62
Chrysene	27	32	19	350	57	120
Benzo(b)fluoranthene	3.7	4.0	3.9	45	7.2	16.0
Benzo(k)fluoranthene	100	110	130	1200	190	440
Benzo(a)pyrene	3.0 5.0	3.2 5.3	3.5 5.7	36 77	5.7 10	13 21
Indeno(123cd)pyrene	41	46	39	510	82	180
Dibenzo(ah)anthracene	0.3	0.32	0.43	3.6	0.58	1.4
Benzo(ghi)perylene	350	360	640	4000	640	1600
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.0014	0.0015	0.0018	0.12	3.5	5.4
Trichloroethene (TCE)	0.075	0.08	0.21	5.7	120	120
1,1,1,2 Tetrachlorethane	6.4	8.2	4.4	560	1400	2100
Tetrachlorethane (PCE)	0.90	0.92	3.6	95	1400	1500
1,1,1 Trichlorethane	39	40	240	3000	140000	100000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs**
- Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 <u>21</u>	6 <u>21</u>	1.8 <u>170</u>	33 <u>49</u>	7.7 <u>21</u>	220 <u>250</u>
Lead	<u>200</u>	<u>310</u>	<u>80</u>	<u>2,300</u>	<u>630</u>	<u>1,300</u>
Mercury (elemental)	1	1	26	26	16	26 ⁽⁸⁾ [30]
Mercury (inorganic)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 <u>79</u>	170 <u>170</u>
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
<i>Aliphatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₆	78	78	1700	5900	590000	130000
EC ₆ - EC ₈	230	230	5600	17000	610000	220000
EC ₈ - EC ₁₀	65	65	770	4800	13000	18000
EC ₁₀ - EC ₁₂	330	330	4400	23000	13000	23000
EC ₁₂ - EC ₁₆	2400	2400	13000	82000	13000	25000
EC ₁₆ - EC ₃₅	92000	92000	270000	1700000	250000	480000
EC ₃₅ - EC ₄₄	92000	92000	270000	1700000	250000	480000
<i>Aromatic risk banded hydrocarbons - TPHCWG method</i>						
EC ₅ - EC ₇	140	690	27	46000	56000	84000
EC ₇ - EC ₈	290	1800	51	110000	56000	95000
EC ₈ - EC ₁₀	83	110	21	8100	5000	8500
EC ₁₀ - EC ₁₂	180	590	31	28000	5000	9700
EC ₁₂ - EC ₁₆	330	2300	57	37000	5100	10000
EC ₁₆ - EC ₂₁	540	1900	110	28000	3800	7700
EC ₂₁ - EC ₃₅	1500	1900	820	28000	3800	7800
EC ₃₅ - EC ₄₄	1500	1900	820	28000	3800	7800
Aliph + Arom EC >44-70	1800	1900	2100	28000	3800	7800
<i>Aromatic</i>						
Benzene	0.16	0.49	0.035	50	72	100
Ethyl benzene	150	380	39	1200⁽⁸⁾ [35000]	1200⁽⁸⁾ [24000]	1200⁽⁸⁾ [22000]
Toluene	270	1300	51	1900⁽⁸⁾ [110000]	1900⁽⁸⁾ [56000]	1900⁽⁸⁾ [95000]
Xylene ⁽⁹⁾	98	120	70	1200⁽⁸⁾ [14000]	1200⁽⁸⁾ [42000]	1200⁽⁸⁾ [23000]
Phenol	290	420	140	1500⁽¹⁴⁾ (35000)	1500⁽¹⁴⁾ (10000)	1500⁽¹⁴⁾ (8300)
<i>Polycyclic Aromatic Hydrocarbons (PAH)</i>						
Naphthalene	5.6	5.6	10	460	4900	1900
Acenaphthylene	420	4600	69	97000	15000	30000
Acenaphthene	510	4700	85	97000	15000	30000
Fluorene	400	3800	67	68000	9900	20000
Phenanthrene	220	1500	38	22000	3100	6200
Anthracene	5400	35000	950	540000	74000	150000
Fluoranthene	560	1600	130	23000	3100	6300
Pyrene	1200	3800	270	54000	7400	15000
Benz(a)anthracene	11	14	6.5	170	29	56
Chrysene	22	31	9.4	350	57	110
Benzo(b)fluoranthene	3.3	4.0	2.1	44	7.2	15
Benzo(k)fluoranthene	93	110	75	1200	190	410
Benzo(a)pyrene	2.7	3.2	2	35	5.7	12
Indeno(123cd)pyrene	36	46	21	510	82	170
Dibenzo(ah)anthracene	0.28	0.32	0.27	3.6	0.57	1.3
Benzo(ghi)perylene	340	360	470	4000	640	1500
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00087	0.001	0.001	0.077	3.5	5
Trichloroethene (TCE)	0.034	0.036	0.091	2.6	120	91
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800
Tetrachlorethane (PCE)	0.39	0.4	1.5	42	1400	1100
1,1,1 Trichlorethane	18	18	110	1300	140000	76000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs
- Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM



Contaminants	Residential <u>with</u> home grown produce	Residential <u>without</u> home grown produce	Allotments	Commercial	Public open space near residential housing POS _{resi}	Public park POS _{park}
Metals						
Beryllium	1.7	1.7	35	12	2.2	63
Boron	290	11,000	45	240,000	21,000	46,000
Cadmium	10⁽¹³⁾ 22	85⁽¹³⁾ 150	1.8 3.9	230 410	120 220	560 880
Chromium III	910	910	18,000	8,600	1,500	33,000
Chromium VI	6 21	6 21	1.8 170	33 49	7.7 21	220 250
Lead	200	310	80	2,300	630	1,300
Mercury (<i>elemental</i>)	1	1	26	26	16	26⁽⁸⁾ [30]
Mercury (<i>inorganic</i>)	170	240	80	3600	120	240
Nickel	130 ⁽¹⁰⁾	180 ⁽¹⁰⁾	53 ⁽¹¹⁾	980 ⁽¹⁰⁾	230	800
Vanadium	410	1200	91	9000	2000	5000
Copper	2400	7100	520	68000	12000	44000
Zinc	3700	40000	620	730000	81000	170000
Semi-Metals and non-metals						
Arsenic	32⁽¹²⁾ 37	35⁽¹²⁾ 40	43⁽¹²⁾ 49	640⁽¹²⁾ 640	79 79	170 170
Antimony		550		7500	1500	3300
Selenium	350	600	120	13000	1100	1800
Inorganic chemicals						
Cyanide	34	34	34	34	34	34
Organic contaminants						
Aliphatic risk banded hydrocarbons - TPHCWG method						
EC ₅₋₅ - EC ₆	42	42	730	3200	570000	95000
EC ₆₋₆ - EC ₈	100	100	2300	7800	600000	150000
EC ₈₋₈ - EC ₁₀	27	27	320	2000	13000	14000
EC ₁₀₋₁₀ - EC ₁₂	130	130	2200	9700	13000	21000
EC ₁₂₋₁₂ - EC ₁₆	1100	1100	11000	59000	13000	25000
EC ₁₆₋₁₆ - EC ₃₅	65000	65000	260000	1600000	250000	450000
EC ₃₅₋₃₅ - EC ₄₄	65000	65000	260000	1600000	250000	450000
Aromatic risk banded hydrocarbons - TPHCWG method						
EC ₅₋₅ - EC ₇	70	370	13	26000	56000	76000
EC ₇₋₇ - EC ₈	130	860	22	56000	56000	87000
EC ₈₋₈ - EC ₁₀	34	47	8.6	3500	5000	7200
EC ₁₀₋₁₀ - EC ₁₂	74	250	13	16000	5000	9200
EC ₁₂₋₁₂ - EC ₁₆	140	1800	23	36000	5100	10000
EC ₁₆₋₁₆ - EC ₂₁	260	1900	46	28000	3800	7600
EC ₂₁₋₂₁ - EC ₃₅	1100	1900	370	28000	3800	7800
EC ₃₅₋₃₅ - EC ₄₄	1100	1900	370	28000	3800	7800
Aliph + Arom EC >44-70	1600	1900	1200	28000	3800	7800
Aromatic						
Benzene	0.08	0.3	0.017	28	72	90
Ethyl benzene	65	170	16	520⁽⁸⁾ [17000]	520⁽⁸⁾ [24000]	520⁽⁸⁾ [17000]
Toluene	120	610	22	860⁽⁸⁾ [59000]	860⁽⁸⁾ [56000]	860⁽⁸⁾ [87000]
Xylene ⁽⁹⁾	41	53	28	480⁽⁸⁾ [69000]	480⁽⁸⁾ [41000]	480⁽⁸⁾ [17000]
Phenol	180	310	66	760⁽¹⁴⁾ (31000)	760⁽¹⁴⁾ (10000)	760⁽¹⁴⁾ (7600)
Polycyclic Aromatic Hydrocarbons (PAH)						
Naphthalene	2.3	2.3	4.1	190	4900	1200
Acenaphthylene	170	2900	28	83000	15000	29000
Acenaphthene	210	3000	34	84000	15000	29000
Fluorene	170	2800	27	63000	9900	20000
Phenanthrene	95	1300	15	22000	3100	6200
Anthracene	2400	31000	380	520000	74000	150000
Fluoranthene	280	1500	52	23000	3100	6300
Pyrene	620	3700	110	54000	7400	15000
Benz(a)anthracene	7.2	11	2.9	170	29	49
Chrysene	15	30	4.1	350	57	93
Benzo(b)fluoranthene	2.6	3.9	0.99	44	7.1	13
Benzo(k)fluoranthene	77	110	37	1200	190	370
Benzo(a)pyrene	2.2	3.2	0.97	35	5.7	11
Indeno(123cd)pyrene	27	45	9.5	500	82	150
Dibenzo(ah)anthracene	0.24	0.31	0.14	3.5	0.57	1.1
Benzo(ghi)perylene	320	360	290	3900	640	1400
Chlorinated Aliphatic Hydrocarbons						
Vinyl chloride	0.00064	0.00077	0.00055	0.059	3.5	4.8
Trichloroethene (TCE)	0.016	0.017	0.041	1.2	120	70
1,1,1,2 Tetrachlorethane	1.2	1.5	0.79	110	1400	1500
Tetrachlorethane (PCE)	0.18	0.18	0.65	19	1400	810
1,1,1 Trichlorethane	8.8	9	48	660	140000	57000

Notes

- All values above are in mg/kg
- Numbers in bold are SGVs or GAC that are derived based on SGV report input parameters, numbers in italics are S4ULs, numbers in bold-italics are based on EIC/AGS/CL:AIRE numbers & input parameters and underlined numbers are C4SLs
- Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
- Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
- For residential, the building type is conservatively assumed to be a small terrace house where the development includes bungalows change to more conservative bungalow setting in computer model
- For commercial, the building type is conservatively assumed to be a pre 1970s office building, where the proposed development comprises houses, flat with living spaces changes setting in model accordingly
- For classrooms consider increasing the dust loading factor in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m⁻³
- Based on vapour saturation limit as suggested by EA / [] model value
- Lowest of o-, m- and p-xylene
- Based on comparison of inhalation exposure with inhalation TDI
- Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
- Based on a comparison of oral and dermal soil exposure with oral Index Dose only
- Averaged over and based on lifetime exposure
- Based on critical concentration for skin irritation in humans arising from contact with phenol in aqueous solution (number in brackets based on health effects following long term exposure for illustration)
- NA: Not applicable

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