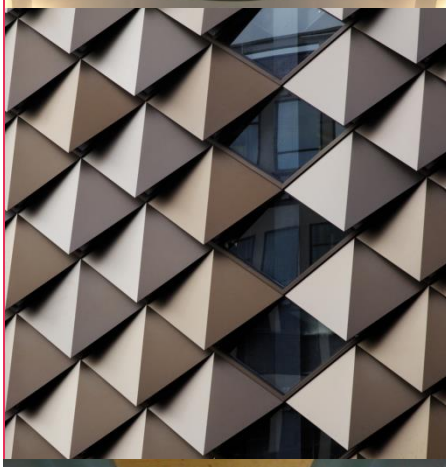








Moston Campus, Manchester

Remediation Strategy

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Client Name: One Manchester Developments Limited

Client Address: Lovell House, Archway 6, Hulme, Manchester, M15 5RN

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Rev	Description	Issued by	Checked	Date

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1.0 Introduction

This Remediation Strategy has been prepared by Curtins for Watson Homes (the Client) to provide guidance with respect to remedial requirements for the proposed development at former Manchester College Moston Campus, Ashley Street, Manchester, M9 4WT.

The development proposals are understood to comprise of a low-rise residential development of up to 58 dwellings of varying size and types with associated soft landscaping and areas of hardstanding for car parking.

The TP Bennett development plan is enclosed in *Appendix A*.

The site has been characterised through site investigation undertaken by Curtins (Ref. 2).

1.1 Requirements of the Remediation Strategy

The Remediation Statement 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;
- Recommendations for the specification of the cover of Made Ground soils in soft landscaped areas;
- Recommendations for appropriate PPE and managing asbestos appropriately during construction in the affected area of Site;
- Recommendations for installing appropriate ground gas protection measures in proposed apartment buildings;
- Proposals for the verification of the cover layer including a regime for verification and chemical analysis of the cover layer material;
- Proposals for the verification of gas protection measures; and
- A strategy for handling potentially contaminative incidents.

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.

1.3 References

The Remediation Strategy has been prepared with reference to the following reports;

- **Reference 1:** Curtins (2020) Phase 1 Preliminary Risk Assessment for Moston Campus, Ref. 074971-CUR-00-XX-RP-GE-001-V01; and
- **Reference 2:** Curtins (2022) Moston Campus Phase 2 Ground Investigation, Ref. 074971-CUR-00-XX-RP-GE-002-V03.

2.0 Ground Conditions

The following ground conditions section has been summarised, based on the Curtins Phase 2 Report (Ref. 2).

Plans showing the locations of the exploratory holes undertaken by Curtins is contained with *Appendix A* for reference.

2.1 Made Ground

The made ground encountered on site were not characteristic of landfill type waste. Made ground typically comprised a surface covering comprising asphalt or topsoil overlaying a granular and/or cohesive made ground. Made ground was encountered to a maximum depth of 3.00m bgl in CP102.

2.1.1 Topsoil/Surface Covering

Topsoil was encountered in exploratory boreholes WS02, WS03, WS09, WS14, WS103, WS109, TP101, TP103 and TP105 from ground level to depths of 0.20m and 0.50m bgl. Topsoil generally comprised brown slightly sandy clay/clayey sand with frequent rootlets.

Asphalt was encountered from ground level to depths of between 0.05m and 0.11m bgl in fourteen locations (WS04 – WS08, WS09A - WS13, WS106 – WS108 and BH102).

2.1.2 Granular Made Ground

Granular made ground was encountered in all exploratory holes, apart from TP101, TP103, TP105, WS01 to WS03, WS09, WS14, WS101, WS102 and BH101. It typically comprised black/dark grey slightly sandy gravel with high ash content overlying red/brown slightly sandy gravel with high ash content. Gravel is typically angular to subangular, fine to coarse of brick and other mixed lithologies.

In TP101, TP103 and TP105 granular made ground typically comprised blackish brown clayey gravelly sand with abundant roots and rootlets. Gravel is typically fine to coarse, angular to sub rounded including brick, concrete, metal fragments and sandstone.

In WS101 and WS106, only black slightly sandy gravel with high ash content was recorded and in WS103, WS104, WS105 and WS107 only red/brown slightly sandy gravel with high ash content was recorded.

In WS08, WS09A, BH102 the black/dark grey gravel was underlain by light brown gravel with high cobble content. Gravel is typically angular to subangular, fine to coarse of mixed lithologies. In BH102, an additional granular layer was encountered recorded as dark brown slightly clayey gravel with frequent angular cobbles of brick.

In WS110, light brown/grey slightly sandy gravel was encountered. Gravel is angular to subrounded, medium to coarse of limestone.

In BH201 and TP201-TP205, undertaken post demolition, granular made ground typically comprised dark brown sandy angular to subrounded fine to coarse gravel with high cobble content. Gravel typically comprised brick and concrete and cobbles are angular of brick.

In TP205, it was underlain by light grey/yellow slightly sandy angular to subangular medium to coarse gravel of limestone to 1.25m bgl.

2.1.3 Cohesive Made Ground

In WS10, WS11, WS12, WS108, WS109 and BH102 the granular made ground was underlain by very soft dark brown/black slightly gravelly clay. Gravel is typically angular to subangular, fine to coarse including brick, timber, concrete and glass.

In TP201 undertaken post demolition a band of firm orange/brown mottled grey slightly silty clay with occasional cobbles was encountered between 1.10m and 1.40m, above and below further granular made ground.

Cohesive made ground was encountered in WS01, WS02, WS03, WS07, WS09, WS14, WS101, WS102 and BH101. It typically comprised light/dark brown slightly sandy slightly gravelly clay with frequent cobbles. Gravel is angular to subangular, fine to coarse of brick, slate, concrete, sandstone, ceramic and timber. Cobbles are angular of brick.

The following obstructions were encountered within made ground soils during site works detailed in *Table 2.1* below.

Table 2.1 – *Obstructions Encountered*

Borehole Ref.	Obstruction	Depth (m bgl)
WS09	Concrete. Hand pit terminated and moved to WS09A.	1.35
TP107	Concrete foundations.	1.00

2.2 Glacial Till

Superficial deposits comprising glacial till were encountered underlying the made ground deposits in all the exploratory holes, except WS09 where the borehole was terminated due to a concrete obstruction and TP106 where made ground was encountered to the base of the trial pit at 1.80m bgl. Glacial till was encountered to depths of between 3.80m and 15.45m bgl. The base of the deposit was not encountered.

The glacial till typically comprised cohesive soils with interbedded granular layers at various depths.

The cohesive deposits were encountered in each exploratory hole, predominantly encountered as soft to very stiff brown mottled grey to reddish brown slightly sandy slightly gravelly Clay and slightly silty Clay. The sand is fine to coarse and the gravel angular to subrounded fine to coarse of sandstone with occasional quartz and mudstone.

Grey brown silt band was encountered in BH101 between 8.00m and 9.50m bgl and in BH102 between 3.00m and 4.70m bgl.

In TP205 between 1.40m – 2.10m bgl, soft light grey very silty clay was encountered.

Granular deposits were encountered in WS01, WS02, WS05, WS06, WS07, WS09A, WS10, WS11, WS12, WS13, WS14, TP204, BH201, CP101, CP102, WS101-WS108 predominantly encountered as medium dense to very dense light brown slightly clayey fine to coarse Sand.

119 SPT 'N' values were recorded in the Glacial Till material ranging from 1 to 50, generally increasing with depth.

2.3 Ground & Groundwater Contamination

As part of the Phase 2 Ground Investigation, a Generic Quantitative Risk Assessment (GQRA) was undertaken against *Commercial* Tier 1 thresholds protective of human health. A total of 26No. soil samples were tested and screened against "*Residential with Home Grown Produce*" end use thresholds. Exceedances were recorded with respect to lead, arsenic, and PAH within 5No. recovered soil samples. The exceedances are detailed in *Table 2.3*a.

Table 2.3. – *Soil GAC Exceedances for Residential End-Use*

Determinand	GAC threshold (mg/kg)	Concentration (mg/kg)				
		WS02 (0.35m bgl)	WS10 (0.45m bgl)	WS13 (0.35m bgl)	WS108 (1.10m bgl)	WS104 (0.65m bgl)
Arsenic	32	56	108	-	43	71
Lead	200	299	434	338	380	280
Benzo(a)pyrene	3.0	-	4.65	-	39	
Benzo(b)fluoranthene	3.7	-	5.48	-	46	-
Benzo(a)anthracene	13	-	-	-	47	-
Chrysene	27	-	-	-	31	-
Dibenzo(a,h)anthracene	0.3	-	-	-	6.8	-

Selected soil samples were screened for asbestos. No suspected asbestos containing materials (ACMs) were identified in the exploratory hole logs however, laboratory screening identified asbestos as detailed in *Table 2.3b*.

Table 2.3b – *Asbestos identified during laboratory screening*

Exploratory Hole ID	Depth Encountered (m bgl)	Asbestos Identification	Quantification Analysis (% w/w)
WS09A	0.35	Chrysotile Loose Fibres Detected	<0.001
WS10	0.45	Chrysotile Loose Fibres Detected	<0.001
WS14	0.35	Amosite Board	3.791

2.3.1 Observed Potential Contamination

Olfactory and visual indicators of contamination noted during the site investigation are summarised in *Table 2.3.1* below.

Table 2.3.1 – *Olfactory & Visual Indicators of Contamination Identified*

Exploratory Hole Ref.	Depth (m bgl)	Description
WS10	0.30 – 2.00	Hydrocarbon odour.
WS108	0.80 – 1.80	Hydrocarbon odour.
WS109	1.45 – 2.30	Hydrocarbon odour.

A **Moderate** risk rating was identified to end-users from direct contact, inhalation and ingestion of contaminants within Made Ground soils which recorded exceedances of Arsenic, Lead and PAHs across the site.

A **Low to Very Low** risk was identified to surface waters and groundwater from leaching of contamination followed by vertical or horizontal migration over and through superficial soils.

2.4 Ground Gas Risk Assessment

Six ground gas monitoring visits have been undertaken across the site. With consideration of their proposed construction type the assessment was therefore undertaken in accordance with guidance within NHBC guidance within NHBC Report 04 (Ref. 3) for low rise housing.

Maximum carbon dioxide concentrations of 5.9%, 6.2% and 6.1% were recorded within WS01, WS03 and WS12. Methane was recorded within WS13 at 0.3%.

The risk to the end-user the development from soil gases is therefore considered to be **Moderate/Low** with Amber 1 protection measures required with the risk assessment summarised below**.**

Consideration of the recorded soil gas flow rates, presented above, enables Gas Screening Values (GSVs) to be evaluated in accordance with NHBC Report 04 (Ref. 3). Based on a maximum steady state recorded carbon dioxide concentration of 6.2% and a GSV of 0.00372 l/hr, and for methane a

concentration of 0.3% has calculated a GSV of 0.0018 l/hr. Given the construction type- low rise housing with a ventilated underfloor void (minimum 150mm), the assessment indicates Amber 1 gas regime requiring gas protection measures.

The Curtins Phase 1 Report (Ref. 1) confirms the site is situated in a lower probability radon area where <1% of homes are above the radon action level. On this basis radon protection measures are not considered necessary in the construction of new dwellings or extensions.

3.0 Conceptual Site Model

A Conceptual Site Model (CSM) for the site has been developed as part of the site investigation that was undertaken at the site and considered based on the current enabling works proposed.

The CSM details a number of pollutant linkages at the site, however, based on the risk assessments undertaken, the potential contaminant linkages (PCLs) listed in *Table 3.1* were identified as requiring remediation to enable the safe re-development of the site.

Table 3.1 – *Potential Contaminant Linkages*

PCL	Sources	Receptor	Potential Pathway	Remediation Recommended
1	Made Ground soils containing elevated concentrations of PAHs, arsenic, lead, and asbestos fibres/containing materials.	**On-site** Construction workers **Off-site** Residents Passers-by	Direct contact, dermal uptake, soil and dust ingestion and inhalation. Inhalation of dust and fibres (off-site)	Appropriate PPE for construction staff and suitable asbestos management measures during construction
2	Made Ground soils containing elevated concentrations of PAHs, arsenic, lead and asbestos fibres/ containing materials.	**On-site** End Users (Residents) Future Maintenance Workers	Direct contact, dermal uptake, soil and dust ingestion and inhalation.	Clean capping within soft landscaped areas - Thickness ranging depending on end use.
3	Elevated concentrations of soil gas (CO2) identified in site soils across the site.	**On-Site** End Users (Residents) Future Maintenance Workers Staff Construction Workers	Vertical and horizontal migration through the superficial and bedrock deposits.	Amber 1 Gas Protection Measures.

4.0 Remedial Works

In this document the term 'remediation' is used to define specific works required to address potential issues arising from contamination in site soils and ground gases, with due account taken of the known history of the site and the proposed end-user.

With reference to the Conceptual Site Model and the potential contaminant linkages detailed in *Table 3.1* three 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.; and
- **Remedial Action 2:** Engineered capping to serve as physical barrier between Made Ground and site surface in soft landscaped areas, preventing direct contact, dermal uptake and limiting the derivation of dust.
- **Remedial Action 3:** Provision of gas protection measures within all proposed buildings on site.

Measures for dealing appropriately to unexpected contamination encountered on site are outlined within Appendix C.

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) Regulations, 2015 which require that potential risks to human health and the environment from construction activities are appropriately identified and all necessary steps taken to eliminate / manage that risk.

It has been assumed that any future construction works on site will be undertaken in compliance with these requirements to address PCL1 (*Table 3.1*).

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 utilising their own additional testing and delineation if they deem it to be required. Subsequently the specialist groundworks contractor is to compile a method statement to establish an appropriate management, monitoring and supervisory procedure for the movement of soils as part of the required cut and fill (earthworks) operations. The specialist remediation contractor is to be responsible for management and record keeping as detailed in their method statement document.

Where, from the site investigations, materials 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 fibre release to site workers.

Laboratory screening identified asbestos fibres and ACM within three samples with a concentration of <0.001% $^{w}/_{w}$ within WS09A at 0.35m and WS10 at 0.45m, and a concentration of 3.791% $^{w}/_{w}$ within WS14 at 0.35m. Curtins Exploratory Hole Plan Drawing in *Appendix A* should be consulted for the location asbestos was identified during Curtins Ground Investigations (Ref. 2).

No further asbestos fibres of Asbestos Containing Material (ACM) debris was encountered during the ground investigations however it is possible that further ACM exist on site and close to the location encountered.

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

Good practice prescribes that any fragments or asbestos containing materials where identified (WS09A, WS10 & WS14) should be picked where possible and to be kept separated in line with those from any soil arisings. This is typically carried out by picking visible fragments at the point of excavation. Such operations are carried out by suitably qualified staff, wearing disposal overalls (type 5/6), gloves and fine dust (FPP3) masks in combination with adoption of dust suppression techniques and monitoring or other applicable methods as recommended by the Asbestos Management Specialist. The qualified staff are to be trained in the identification of asbestos at source. The qualification and competencies of all operatives undertaking monitoring and calibration documentation of equipment should be provided to the Engineer.

Affected Made Ground should not be crushed or in any way treated due to risk of asbestos fibre release. It may be possible to use such 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 primary PCL identified at the site relates to the direct contact, dermal uptake, soil and dust ingestion and inhalation PAHs, arsenic, lead and asbestos fibres in soil and soils and soil derived dust (PCL 2, *Table 3.1*).

The potential for exposure to these contaminants is highest within proposed soft landscaped areas where receptors (residents, maintenance staff and public) at the site are most likely to come in contact with the contaminated Made Ground soils.

Hardstanding, including building footprint, vehicular tarmac, pedestrian tarmac and concrete block paving are considered sufficient to break the potential contaminant linkage, PPL 2, detailed in *Table 3.1* and therefore no specific remediation measures, above activities required for construction, are considered necessary if and where these are installed at the site.

It is therefore recommended that verified clean capping, is installed in proposed soft landscaped areas.

The proposed end use of the site includes areas of residential development including dwellings of various size and construction type with parking and gardens. The thickness and make up of capping should therefore vary with respect the proposed end use and contaminants encountered.

It is recommended that within front and rear gardens of residential housing should have a minimum of 600mm clean capping as residents may plant and consume home grown produce but they are unlikely to excavate to deeper than 600mm in typical gardening activities.

The risk level is therefore lower for public open space where planting and consumption of homegrown produce is not anticipated and exposure to potentially contaminated soils is reduced, a minimum depth of 450mm capping is therefore recommended in these areas.

Notwithstanding, given Asbestos fibres and ACM was identified within soils across the site within three samples, it is recommended that capping is underlain by anti-dig separation layer (high visibility warning geotextile or a break layer) in these areas. For continuity and given the possibility of further fibres or ACMs existing in made ground soils in close proximity to where encountered, it is recommended that this anti-dig separation layer is therefore also extended to any soft landscaped areas beneath gardens WS10 and WS14. The area around WS09A is shown to be within the road, this hardstanding layer will break the source-receptor pathway therefore no capping is required within this area but hand picking should be undertaken around this area to remove visible fragments of asbestos before construct the road.

The capping thickness recommended are in line with Manchester City Council's guidance on depth of cover systems and capping layers as contained within their Planning & Contaminated Land Technical Guidance Document.

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

Table 4.2 *Engineered Capping Details for Soft Landscaping Areas*

Location	Remedial Measures Required	Rationale
Soft Landscaped Areas in Areas of Residential Housing	Provision of a minimum **600mm** clean capping. The capping layer may comprise of a combination of suitable subsoil and topsoil but topsoil should be of a minimum 150mm thickness.	Remove potential for exposure of on-site receptors via direct contact, dermal uptake and soil and dust ingestion and inhalation.
Soft Landscaped Areas in Area of Residential for WS10 and WS14	Provision of a minimum **450mm** clean capping with underlying high visibility geotextile. The capping layer may comprise of a combination of suitable subsoil and topsoil but topsoil should be of a minimum 150mm thickness. The underlying geotextile should be high visibility to act as a warning to future ground workers. Alternatively, an aggregate break layer can be used to act as an anti dig layer instead of the geotextile which should be a minimum of 100mm thick which may form part of the overall capping thickness.	Remove potential for exposure of on-site receptors via direct contact, dermal uptake and soil and dust ingestion and inhalation.

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

4.3 Remedial Action 3 – Ground Gas Protection Measures

The primary Potential Pollutant Linkage (PPL) identified at the site relates to the acute risk of explosion and/or asphyxiation of property and end-users through the vertical and horizontal migration of hazardous gases (asphyxiating) from soil gas sources as identified in PPL 3 (*Table 3.1*) into proposed **residential dwellings** on site.

In this case, carbon dioxide was identified as the primary hazardous gas with methane recorded on one visit within one borehole, therefore gas protection measures for Amber 1 are to be implemented during the development of the site to mitigate the risk to the property and end-users.

At present the current assessment (based on the 2020 and 2021 Ground Investigation) recommended a conservative allowance of Amber 1 classification.

Amber 1 ground gas protection measures are to be designed by the Developer, but should incorporate:

- Ventilated underfloor void in accordance with BRE Report 414;
- Visqueen Low Permeability Gas Membrane – Yellow
- Appropriately and adequately sealed service entries; and
- All to membrane manufacturer's instructions and details.

Any changes to the proposed protection measures outlined above should be made with reference to NHBC Report 04 (Ref. 3).

4.3.1 Gas Membrane Specification

Where a gas resistant membrane is adopted, it must meet all the following criteria from BS8485:

i) Sufficiently impervious to methane and carbon dioxide with a methane gas transmission rate <40.0 ml/day/m^2/atm (average) for sheet and joints (tested in accordance with BS ISO 15105-1 manometric method);
ii) Capable after installation of providing a complete barrier to the entry of the relevant gas;
iii) Sufficiently durable to remain serviceable for the anticipated life of the building and duration of gas emissions;
iv) Sufficiently strong to withstand in service stresses (e.g. due to ground settlement if placed below a floor slab);
v) Sufficiently strong to withstand the installation process and following construction activities until covered (e.g. penetration from steel fibres in fibre reinforced concrete, penetration of reinforcement ties, tearing due to working above it, and dropping tools);
vi) Chemically resistant to degradation by other contaminants that might be present; and
vii) Verified in accordance with CIRIA C735.

It is recommended that an appropriately experienced and qualified workforce is employed to install gas protection systems. Installers should hold relevant qualifications such as Cskills Awards L2 NVQ diploma for the installation of gas membranes.

5.0 Engineered Capping Specification

This section outlines the required specification that the proposed engineered capping must meet to satisfy Remedial Action 2. This is not a specification for general fill materials, it is envisaged that this will be covered in an earthworks specification.

5.1 Sourcing of Materials

5.1.1 Off-Site Sources

It is anticipated that materials may be imported to the site for use in constructing the (450-600mm) clean engineered capping across the site. 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 elevated concentrations of various 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 it is anticipated that 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 BS 8601:2013 'Specification for subsoil and requirements for use'.

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 in accordance with Table 2 Section 6.3 of Manchester City Councils Planning and Contaminated Land Guidance document (Ref. 4). Required testing frequencies vary depending on the source of the material and its proposed end use.

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

Source	End Use	Testing Frequency
Imported Topsoil/Subsoil (Greenfield)	**Residential Gardens**	**Verification:** One sample every 200m^3 used (or a minimum of 3 No. samples whichever is greater), testing to be undertaken once material is imported to site.
	General Soft Landscaping	
Imported Topsoil/Subsoil (Remediated/ Brownfield/Unknown)	**Residential Gardens**	**Verification:** One sample every 50m^3 used (or a minimum of 3 No. samples whichever is greater), testing to be undertaken once material is imported to site.
	General Soft Landscaping	**Verification:** One sample every 150m^3 used (or a minimum of 3 No. samples whichever is greater), testing to be undertaken once material is imported to site.
Re-used/ Site Won Natural Soils	**Residential Gardens**	**Verification:** One sample every 50m^3 used (or a minimum of 3 No. samples whichever is greater), testing to be undertaken once material is imported to site.
	General Soft Landscaping	**Verification:** One sample every 150m^3 used (or a minimum of 3 No. samples whichever is greater), testing to be undertaken once material is imported to site.

Other sources may be applicable, however testing frequencies shall be confirmed with the Engineer prior to acceptance.

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 for use in 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) 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)
Virgin Quarried Material for use in break layer	Not Applicable.
Crushed Hardcore, Stone, Brick for use in break layer	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) Total Petrol Hydrocarbons (Full TPHCWG analysis – aromatic/aliphatic split, Detection Limit mg/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 with Home Grown Produce'* screening criteria for soils in residential gardens. Concentrations of the above determinants shall not exceed the '*Residential without Home Grown Produce'* screening criteria for soils in public open space adjacent to apartments; 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 Validation of Capping Thickness

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 where applicable**.**

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 where applicable.

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

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

A photographic record of the hand excavated trial pits would also be required in accordance with the best practice examples.

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

6.1 Contaminated Soils

Surplus soils to be removed from site, which have been identified as unsuitable for re-use should be loaded onto a lorry, covered securely and transported directly to the landfill facility.

Where stockpiling is unavoidable, the stockpile should be located on an impermeable membrane and be covered also with a low permeability membrane at the end of each working day. Where soils are wet when excavated, measures should be taken to ensure there is no runoff from the soils onto the surrounding soils.

Duty of Care: Under his duty of care, the Principal Contractor shall ensure the proper and safe disposal of waste from each site after it has been passed on to another party. In this respect details of the landfill facility to be used and the company disposing of the waste with regard to hazardous and non-hazardous waste shall be provided to the Site Manager. Copies of Consignment Notices for special waste and Waste Transfer Notes for hazardous and non-hazardous waste shall be kept on site for review by Curtins Consulting.

6.2 Contaminative Incidents

One location encountered a subsurface obstruction during the ground investigation which included buried concrete associated with former structures. It is likely that some further ground features / structures exist that have not been recorded on plans and have not been encountered during the ground investigation works or demolition works.

Although considered unlikely 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. The procedure outlined in *Section 6.3* should also be adhered too and the Engineer shall approve all proposals for such remediation.

6.3 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 from of suspect material to a suitably licensed disposal facility (following guidance outlined in Section 6.1 above).

e) Manchester City Council and if relevant the Environment Agency are to be kept fully informed of any site such occurrences.

7.0 Verification

Validation visits shall be undertaken by an appropriately qualified environmental engineer throughout the construction phase to ensure that the requirements of the Remediation Strategy have been implemented at the site. It is anticipated records of the following will be taken during the below phases of work:

- Placement of the requisite depths of clean capping material in required areas (areas without hardstanding);
- Documentation of general works including asbestos management procedures during the works and records of contaminative incidents and any unexpected contamination; and
- Installation of gas protection measures in residential dwellings.

All associated documentation pertaining to the above will be supplied to the Engineer and incorporated within a Completion Report.

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

Verification through either hand excavated trial pits or comparison of reduced and final level surveys will all be included within the Completion Report to confirm the provision of a requisite depth and build up of clean capping.

Verification of all implemented gas protection measures will be required to ensure remediation has been undertaken as specified herein and demonstrate the effectiveness of the remediation (gas protection measures).

To verify the gas protection measures, it is assumed that the following will be undertaken:

- An appropriately experienced and qualified workforce is employed to install gas protection systems. Installers should hold relevant qualifications such as Cskills Awards L2 NVQ diploma for the installation of gas membranes.

The following verification records should therefore be obtained by Curtins:

- Photographic log of installation and testing if undertaken, of gas protection measures (floor slab and gas membrane).
- Internal inspection and verification records including any discrepancies and non-conformities in accordance with CIRIA C735.

The above records should be reviewed by an independent third party/Curtins which should include visits to site to provide a secondary visual verification.

The frequency and timing of visits by Curtins shall be determined following confirmation of the construction phase programme; however, it is anticipated that visits will be undertaken:

- During the placement of the floor slab (structural barrier to gases).
- During placement of the gas membrane (membrane barrier to gases).

Where alternate protection measures are adopted as outlined in *Section 4.2* or specialised installation staff are not used a revision to this plan/schedule will likely be required and validation visits potentially increased.

8.0 Reporting

A Completion Report will be required on completion of the works confirming that the remedial works have been completed satisfactorily. The report will contain information including the following:

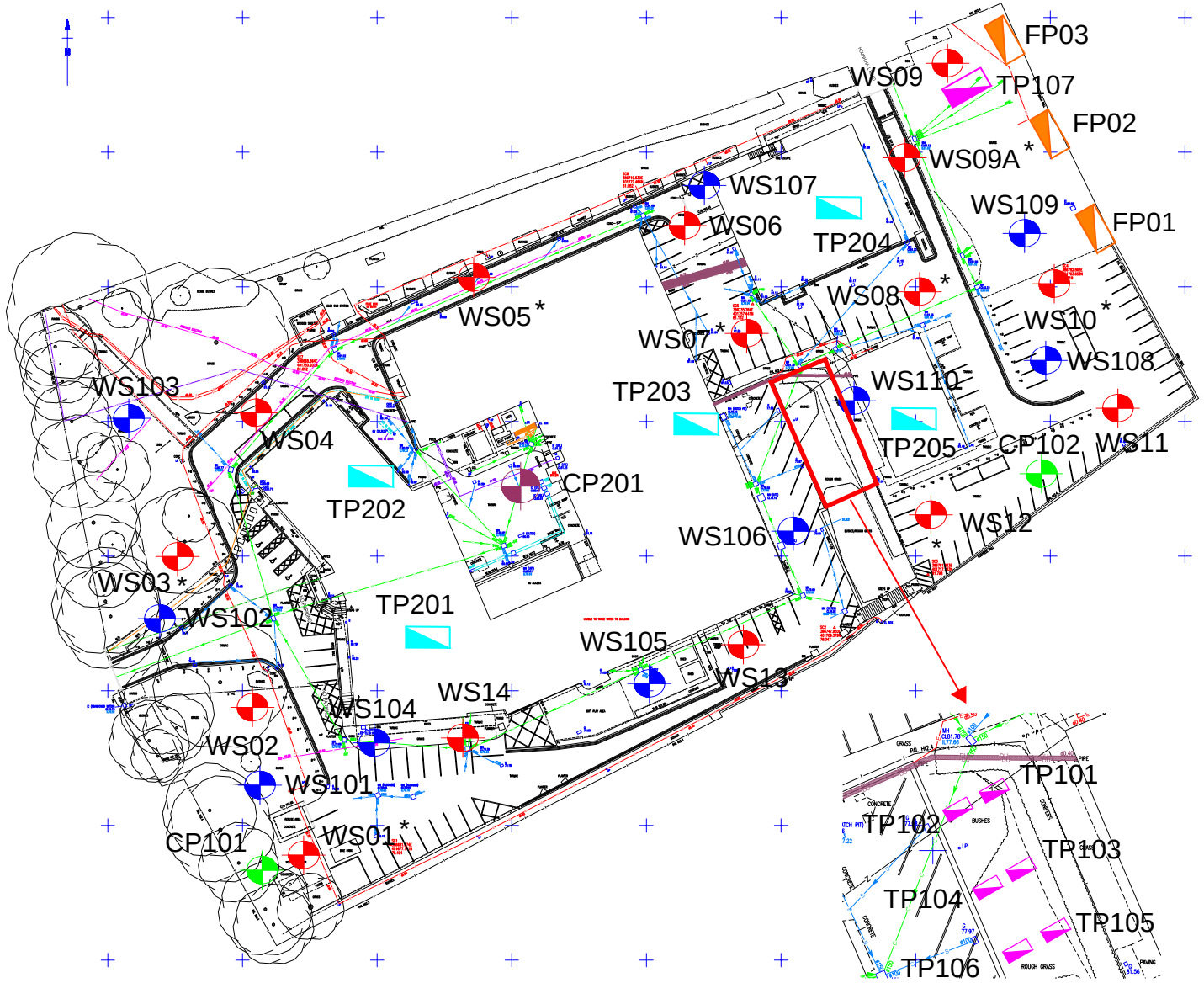
- Confirmation that the suspended floor slab gas protection has been installed as specified for the residential dwellings and forms an effective barrier, verified through a visual inspection with associated photographic record;
- Confirmation that the gas membrane is and has been installed as specified for the residential dwellings, verified during placement through inspection by specialist installers, with associated photographic record;
- Specification and details of the gas membrane used;
- Confirmation that the capping has been installed as specified within soft landscaped areas including capping thickness validation records and photographs, records should show the presence of the anti-dig geotextile/break layer where required;
- Confirmation of imported capping materials suitability including environmental chemistry testing results;
- Details and documentation of asbestos management measures utilised during the works;
- Confirmation that the remediation has been undertaken satisfactorily and in accordance with the Remediation Strategy;
- Confirmation that the remediation objective has been achieved (see *Section 4.0*);
- Details of any unexpected contamination encountered on site and appropriate measures taken to respond; and
- Revised conceptual model showing no potentially significant contaminant linkages remain at the site.

References

1. **Curtins** (2020) Phase 1 Preliminary Risk Assessment for Moston Campus, Ref. 074971-CUR-00-XX-RP-GE-001-V01
2. **Curtins** (2022) Moston Campus Phase 2 Ground Investigation, Ref. 074971-CUR-00-XX-RP-GE-002-V03
3. **NHBC** (2007) Guidance of Evaluation of Development Proposals on sites where methane and carbon dioxide are present. Report edition No. 4
4. **Manchester City Council** (2021) Planning & Contaminated Land- Technical Guidance.

Appendix A – Drawings

- *Curtins Exploratory Hole Location Plan*
- *Curtins Requirement for Engineered Capping Plan*



January 2020 Investigation

- Window Sample Borehole
- * Installed

May 2020 Investigation

- Window Sample Borehole
- Cable Percussive Borehole
- Foundation Pit
- Trial Pit

October 2021 Investigation

- Cable Percussive Borehole
- Trial Pit

Rev:	Description:	Date:	By:	Chkd:

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Status: INFORMATION

Project: Former Manchester College Moston Campus

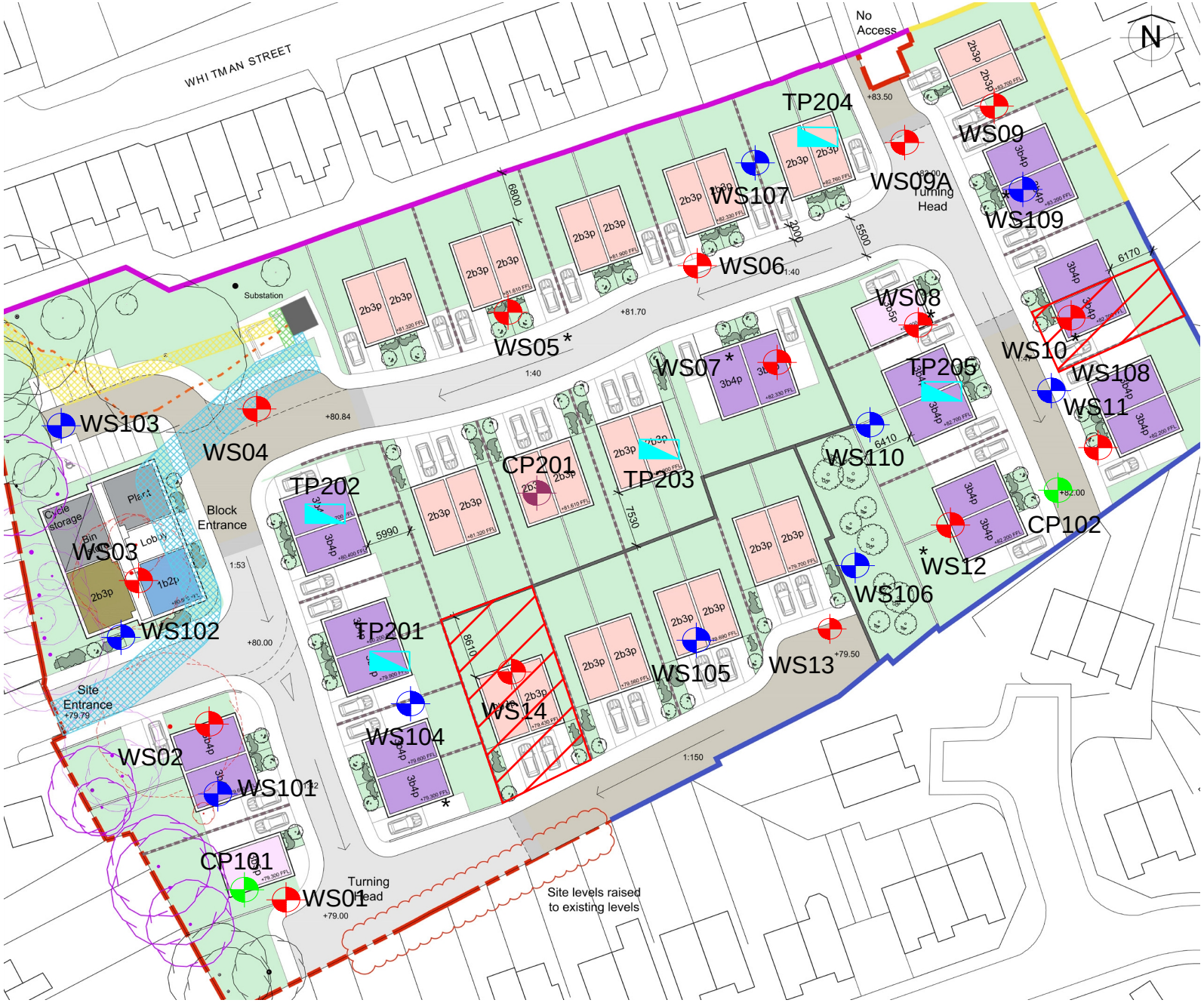
Drg Title: Exploratory Hole Location Plan

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	14/01/2019	PN	JJ

Drg No: 074971-CUR-00-XX-DR-GE-002-V03

Rev: /

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A GEOTEXTILE MEMBRANE IS REQUIRED UNDERLYING 450MM OF CLEAN CAPPING IN THESE GARDENS

ALL OTHER GARDENS AND SOFT LANDSCAPPING REQUIRE 600MM OF CLEAN CAPPING (150MM OF TOPSOIL AND 450MM OF SUBSOIL).

Rev:	Description:	Date:	By:	Chkd:

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Status: INFORMATION

Project: Former Manchester College Moston Campus

Drg Title: Capping Requirement Plan

Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	23/03/2022	RT	PN

Drg No: 074971-CUR-00-XX-DR-GE-80005

Rev: P01

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Appendix B – Screening Criteria for Imported Capping Materials

Adopted Soil Generic Assessment Criteria
Sandy loam with 6% SOM

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Contaminants	Residential with home grown produce	Residential without 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 *(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* 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						
$EC_{>5}$ - EC_6	*160*	*160*	*3900*	*12000*	*600000*	*180000*
$EC_{>6}$ - EC_8	*530*	*530*	*13000*	*40000*	*620000*	*320000*
$EC_{>8}$ - EC_{10}	*150*	*150*	*1700*	*11000*	*13000*	*21000*
EC_{10}-EC_{12}	*760*	*770*	*7300*	*47000*	*13000*	*24000*
EC_{12}-EC_{16}	*4300*	*4400*	*13000*	*90000*	*13000*	*26000*
$EC_{>16}$ - EC_{35}	*110000*	*110000*	*270000*	*1800000*	*250000*	*490000*
$EC>_{35}$ - EC_{44}	*110000*	*110000*	*270000*	*1800000*	*250000*	*490000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - EC_7	*300*	*1400*	*57*	*86000*	*56000*	*92000*
$EC>_7$ - EC_8	*660*	*3900*	*120*	*180000*	*56000*	*100000*
$EC_{>8}$ - EC_{10}	*190*	*270*	*51*	*17000*	*5000*	*9300*
EC_{10} - EC_{12}	*380*	*1200*	*74*	*34000*	*5000*	*10000*
EC_{12} - EC_{16}	*660*	*2500*	*130*	*38000*	*5000*	*10000*
$EC_{>16}$ - EC_{21}	*930*	*1900*	*260*	*28000*	*3800*	*7800*
$EC_{>21}$ - EC_{35}	*1700*	*1900*	*1600*	*28000*	*3800*	*7900*
$EC>_{35}$ - 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*
Tetrachlorethene (PCE)	*0.90*	*0.92*	*3.6*	*95*	*1400*	*1500*
1,1,1 Trichlorethane	*39*	*40*	*240*	*3000*	*140000*	*100000*

Notes

1. All values above are in mg/kg
2. **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
3. Soil organic matter (SOM) is assumed to be 6% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. 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
6. 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
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. 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)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 2.5% SOM

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Contaminants	Residential with home grown produce	Residential without 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 *(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* 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						
$EC_{>5}$ - 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*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC>_5$ - 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
Aromatic						
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*)
Polycyclic Aromatic Hydrocarbons (PAH)						
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*
Tetrachlorethene (PCE)	*0.39*	*0.4*	*1.5*	*42*	*1400*	*1100*
1,1,1 Trichlorethane	*18*	*18*	*110*	*1300*	*140000*	*76000*

Notes

1. All values above are in mg/kg
2. **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
3. Soil organic matter (SOM) is assumed to be 2.5% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. 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
6. 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
7. For classrooms consider increasing the dust loading fator in the 'Soil and Building Data' of the CLEA 1.04 model from 50 to 100µg m^{-3}
8. Based on vapour saturation limt as suggested by EA / [ ] model value
9. Lowest of o-, m- and p-xylene
10. Based on comparison of inhalation exposure with inhalation TDI
11. Based on comparison of oral, dermal, and inhalation exposure with the oral TDI
12. Based on a comparison of oral and dermal soil exposure with oral Index Dose only
13. Averaged over and based on lifetime exposure
14. 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)
15. NA: Not applicable

Adopted Soil Generic Assessment Criteria
Sandy loam with 1% SOM

curtins

Contaminants	Residential with home grown produce	Residential without 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 *(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* 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						
$EC_{>5}$ - EC_6	*42*	*42*	*730*	*3200*	*570000*	*95000*
$EC_{>6}$ - EC_8	*100*	*100*	*2300*	*7800*	*600000*	*150000*
$EC_{>8}$ - EC_{10}	*27*	*27*	*320*	*2000*	*13000*	*14000*
EC_{10}-EC_{12}	*130*	*130*	*2200*	*9700*	*13000*	*21000*
EC_{12}-EC_{16}	*1100*	*1100*	*11000*	*59000*	*13000*	*25000*
$EC_{>16}$ - EC_{35}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
$EC_{>35}$ - EC_{44}	*65000*	*65000*	*260000*	*1600000*	*250000*	*450000*
Aromatic risk banded hydrocarbons - TPHCWG method						
$EC_{>5}$ - EC_7	*70*	*370*	*13*	*26000*	*56000*	*76000*
$EC_{>7}$ - EC_8	*130*	*860*	*22*	*56000*	*56000*	*87000*
$EC_{>8}$ - EC_{10}	*34*	*47*	*8.6*	*3500*	*5000*	*7200*
EC_{10} - EC_{12}	*74*	*250*	*13*	*16000*	*5000*	*9200*
EC_{12} - EC_{16}	*140*	*1800*	*23*	*36000*	*5100*	*10000*
$EC_{>16}$ - EC_{21}	*260*	*1900*	*46*	*28000*	*3800*	*7600*
$EC_{>21}$ - EC_{35}	*1100*	*1900*	*370*	*28000*	*3800*	*7800*
$EC_{>35}$ - 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*
Tetrachlorethene (PCE)	*0.18*	*0.18*	*0.65*	*19*	*1400*	*810*
1,1,1 Trichlorethane	*8.8*	*9*	*48*	*660*	*140000*	*57000*

Notes

1. All values above are in mg/kg
2. **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
3. Soil organic matter (SOM) is assumed to be 1% - DEFAULT VALUE
4. Soil type is assumed to be sandy loam - DEFAULT SOIL TYPE
5. 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
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14. 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)
15. NA: Not applicable

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