

Oldham Road, Newton Heath, Remediation Strategy

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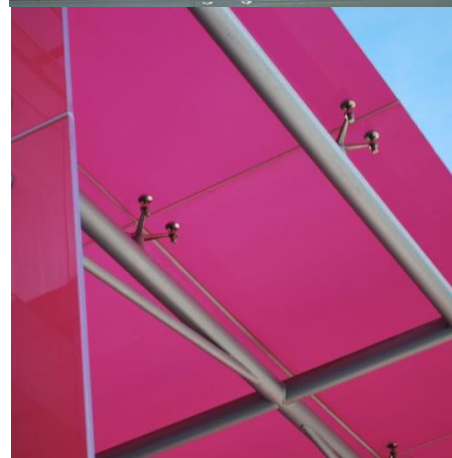
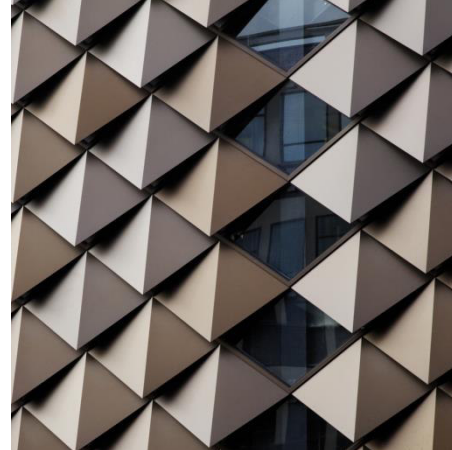
Client Name: One Manchester

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

Site Address: Land either side of YES GROUP, 1290 – 1328, Oldham Road,
Newton Heath, Manchester

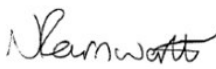
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1.0 Introduction

This Remediation Strategy has been prepared by Curtins for One Manchester (the Client) to provide guidance with respect to remedial requirements for two adjacent sites, hereinafter referred to as Site 1 and Site 2, off Oldham Road, Newton Heath, Manchester, M40 1HB. The site is centred on National Grid Reference SD880006 and covers an area of approximately 1.25 Ha.

The proposed development comprises 100 apartments within two blocks up to six storeys and 15 low-rise residential houses to the west of Newton Street (Site 1) and 24 low-rise residential houses to the east of Newton Street (Site 2), with associated areas of soft landscaping and car parking. The Proposed Site Plan is enclosed in Appendix A.

The site has been characterised through various stages of 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 1;
- 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 (2019) Phase 1 Preliminary Risk Assessment for Oldham Road, Newton Heath, Manchester, Ref 074031-CUR-00-XX-RP-GE-001-V01.
- **Reference 2:** Curtins (2021) Phase 2 Ground Investigation for Oldham Road, Newton Heath, Manchester, Ref 074031-CUR-00-XX-RP-GE-001-V01.

2.0 Ground Conditions

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

Curtins plans showing the locations of the exploratory holes undertaken during the investigation works are contained with *Appendix A* for ease of reference.

2.1 Made Ground

The Made Ground typically comprised a surface covering of topsoil/asphalt or concrete overlying predominantly granular Made Ground. Made Ground was encountered to a maximum depth of 3.50m bgl in CP102.

The base of the deposit was not encountered in WS01, WS02 – WS02C, WS04 – WS04B, WS203, WS204-204B, WS09A and WS11A due to borehole termination, termination was due to either obstructions or ingress of perched water.

Across Site 1, the base of the Made Ground was encountered at depths of generally 1.50-2.00m bgl, a maximum depth of 3.50m bgl was recorded within CP102 with natural superficial deposits encountered at 0.70m bgl in WS03. Across Site 2, the base of the Made Ground was encountered at depths of generally 0.60-0.95m bgl, with 1.90m thickness of Made Ground encountered in WS09.

A number of underground obstructions were identified in the made ground deposits as summarised in the Phase 2 report (Ref. 2).

2.1.1 Topsoil/Surface Covering

Topsoil was encountered in all exploratory holes, excluding WS01, WS03, WS201-WS205, CP101 and CP102, from ground level to depths between 0.05m and 0.36m bgl. In WS06, topsoil was encountered to a maximum depth of 0.80m bgl attributed to its location on a slight mound. Topsoil typically comprises brown to dark brown silty sandy slightly gravelly clay with frequent rootlets. Gravel comprised brick and ceramic.

Concrete was encountered from ground level to a depth of 0.08m bgl in WS01 and between 0.24m – 0.27m bgl within WS201 – WS203 located in the former warehouse.

Asphalt was encountered from ground level to depths between 0.06m and 0.09m bgl in WS204 and WS205.

2.1.2 Granular Made Ground

Granular Made Ground were encountered underlying the topsoil/surface covering in all exploratory holes, excluding WS05, WS09A, WS10, WS11, WS11A. It typically comprised grey

brown sandy gravel, light grey brown gravelly silty clayey fine to medium sand; and grey clayey sandy fine to coarse, sub-angular to angular gravel. Gravel typically comprised brick, coal, clinker, sandstone, concrete, slate and limestone.

Within WS02b, WS02c, WS04, WS04c, WS05, WS09, CP101, CP102 and CP103 at the base of the Made Ground black/grey slightly clayey sandy ashy gravel and brown/black slightly clayey slightly gravelly ashy medium to coarse sand was encountered.

2.1.3 Cohesive Made Ground

Cohesive Made Ground deposits were encountered in CP101, CP102, WS03, WS04, WS04A, WS04C, WS05, WS09, WS09A, WS10, WS11 and WS11A.

In WS05, WS09A, WS10, WS11 and WS11A, dark brown sandy silty gravelly clay was encountered underlying the topsoil from depths of 0.05m – 0.25m to depths between 0.60m – 1.20m bgl.

In WS03, WS04, WS04A and WS05, light brown/ orange brown sandy gravelly clay was encountered from depths of 0.20m to 0.40m bgl. In WS05, the deposit was encountered from 1.20m to 1.40m bgl.

In WS04C, grey sandy very gravelly clay was encountered between 0.20m to 0.40m bgl.

In CP101 (0.79m – 1.40m bgl), WS05 (1.40m – 1.95m bgl) and WS09 (0.90m – 1.90m bgl), grey/brown mottled black, sandy ash gravelly clay was encountered with a moderate ash content.

Gravel typically comprised brick, concrete, sandstone, limestone, coal, clinker, slag, mudstone and siltstone.

Reworked soil was encountered in CP102 (2.20m – 3.50m bgl) described as soft brown mottled grey sandy clay with occasional roots. The deposit was underlain by a sandstone flag, thought to be a former floor.

2.2 Glacial Till

Glacial till deposits were encountered underlying the base of the Made Ground in all exploratory holes, excluding WS01, WS02 – WS02C, WS04- WS04B, WS203, WS204-204B, WS09A and WS11A. The glacial till deposits encountered were predominantly cohesive. In CP101- CP103 granular glacial till deposits were encountered interbedded with the cohesive soils.

Glacial till deposits were encountered to depths of between 2.45m and 22.55m bgl. The base of the deposit was not encountered.

2.2.1 Cohesive Glacial Till

Cohesive glacial till deposits were predominantly encountered as soft brown mottled orange silty sandy clay, firm grey slightly sandy silty gravelly clay and firm to very stiff brown occasionally mottled laminated grey slightly silty slightly gravelly clay.

Gravel is typically rounded to subrounded, fine to coarse of mudstone, siltstone and sandstone.

In CP101 between 12.00m and 14.70m bgl, soft brown sandy clayey silt was encountered.

2.2.2 Granular Glacial Till

Granular glacial till deposits were encountered in WS05, CP101, CP102 and CP103.

Shallow granular deposits were encountered in WS05 between 1.95m to 2.00m bgl and 3.00m and 3.10m bgl described as medium dense brown clayey gravelly fine to coarse sand.

The granular deposits were encountered in CP101 (7.30m – 11.00m bgl), in CP102 (7.40m – 10.50m bgl, 11.80m – 15.50m bgl, 17.50m – 22.0m bgl) and in CP103 (7.70m – 8.80m bgl, 9.40m – 12.20m bgl, 13.00 – 16.50m bgl). The deposits were typically described as loose to medium dense slightly clayey, slightly gravelly, slightly silty fine to coarse sand.

2.3 Ground & Groundwater Contamination

As part of the Phase 2 Ground Investigation (Ref. 2), a Generic Quantitative Risk Assessment (GQRA) was undertaken against various Generic Assessment Criteria depending on their distinct proposed end use. Curtins Screening Zoning Plan is enclosed in Appendix A for reference.

2.3.1 Site 1 Screening of Soil Analysis Results

Site 1 was split into three zones relating to their proposed end uses;

- Zone 1 = 'Residential without home grown produce';
- Zone 2 = 'Residential with home grown produce'; and
- Zone 3 = 'Public open space near residential housing'.

Zone 1 Residential Apartments, 'Residential without home grown produce'

With respect to Zone 1, 'Residential without home grown produce' end use, PAH, TPHs and lead exceedances were recorded, detailed in *Table 2.3.1a*.

Table 2.3.1a – Soil GAC Exceedances for a Residential without home grown produce End-Use

Determinand	6% GAC threshold (mg/kg)	Concentration (mg/kg)			
		WS04c (0.70m bgl)	WS06 (0.90m bgl)	CP101 (0.25m bgl)	CP101 (0.60m bgl)
Lead	310	427	749	438	-
Benzo(a)pyrene	3.2	6.83	-	-	3.93
Benzo(b)fluoranthene	4.0	7.44	-	-	4.96
Dibenzo(ah)anthracene	0.32	0.56	-	-	0.45
TPH Aro >C21-C35	1900	2760	-	-	-

Zone 2 Residential Houses, 'Residential with home grown produce'

With respect to Zone 2, 'Residential with home grown produce' end use, a single Lead exceedance was recorded in the Made Ground of WS202 as detailed in *Table 2.3.1b*.

Table 2.3.1b – Soil GAC Exceedances for a Residential with home grown produce End-Use

Determinand	1% GAC threshold (mg/kg)	Concentration (mg/kg)
		WS202 (0.70m bgl)
Lead	200	221

Zone 3 Public Open Space, 'Public Open Space near residential housing'

With respect to Zone 3, 'Public open space near residential housing' end use, PAH and TPH exceedances were recorded in WS01 as detailed in *Table 2.3.1c*. WS01 is located with the former car park for the warehouse. It is likely these exceedances are due to a localised spill / leak within the car park; likely diesel given the heavier TPH fractions encountered.

Table 2.3.1c – Soil GAC Exceedances for a Public open space near residential housing End-Use

Determinand	2.5% GAC threshold (mg/kg)	Concentration (mg/kg)
		WS01 (0.15 bgl)
Benzo(a)anthracene	29	554
Benzo(a)pyrene	5.7	485
Benzo(b)fluoranthene	7.2	586
Benzo(k)fluoranthene	190	195
Chrysene	57	531
Dibenzo(ah)anthracene	0.58	90.5

Determinand	2.5% GAC threshold (mg/kg)	Concentration (mg/kg)
		WS01 (0.15 bgl)
Indeno(123-cd)pyrene	82	374
TPH Aro >C16-C21	3800	8110
TPH Aro >C21-C35	3800	48500

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 cement in WS02b, in Zone 3, at 0.45m bgl, identified as chrysotile cement with a % soil composition of 0.959% w/w.

2.3.2 Site 2 Screening of Soil Analysis Results

With respect to the proposed 'Residential with home grown produce' end use of the site (Residential Houses Only), Lead exceedances were noted within 3 No. recovered Made Ground soil samples, commonly ashy gravel or sand strata. The exceedances are detailed in Table 2.3.2.

Table 2.3.2 – Soil GAC Exceedances for a Residential housing with home grown produce End-Use

Determinand	6% GAC threshold (mg/kg)	Concentration (mg/kg)		
		WS08 (0.55m bgl)	WS09 (0.65m bgl)	WS13 (0.80m bgl)
Lead	200	455	588	987

No exceedances were recorded within the two natural soil samples when compared against 'Residential with home grown produce' 1% GACs.

2.3.3 Observed Potential Contamination

Olfactory and visual indicators of contamination noted during the site works is summarised in Table 2.3.3 below. Anthropogenic materials were also encountered throughout made ground soils including ash and clinker. This ash and clinker in Made Ground soils is indicative of PAH contamination recorded in the soils and is likely associated with historic land use, including as a mill, heavy industry, dye works and other commercial and mixed-use buildings.

Table 2.3.3 – Olfactory & Visual Indicators of Contamination Identified

Exploratory Hole Ref.	Depth (m bgl)	Description
WS205	0.72 – 2.00	Slight hydrocarbon odour.

A **Moderate** risk rating was identified to end-users from direct contact, inhalation and ingestion of contaminants within Made Ground soils on Site 1 and Site 2 which recorded exceedances of Lead, PAHs and Aromatic TPHs within Made Ground soils from WS01, WS04c, WS06, WS08, WS09, WS13 and CP101.

The development plan has changed slightly since this assessment with a larger area of Public Open Space now proposed in part of the area previously designated for Residential apartments. The extent of the Residential Housing area remains unchanged. The recent changes to development plans do not materially alter the risk rating and proposed remediation measures as further detailed in Section 4.0.

A **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

Eight ground gas monitoring visits have been undertaken across the two sites. Site 1 is split into apartment blocks and low-rise residential housing and Site 2 is solely low-rise residential housing.

With consideration of their proposed construction type the assessment was therefore undertaken in accordance with guidance within BS8485:2019 for proposed apartment blocks (Ref.3) and NHBC guidance within NHBC Report 04 (Ref.4) for low rise housing.

Maximum carbon dioxide concentrations of 8.2% for the apartment block area; 2.3% for the low-rise residential housing within Site 1; and 3.7% for Site 2 low-rise residential housing areas were recorded.

The risk to the end-user the development from soil gases is therefore considered to be **Moderate** for the apartment blocks (CS2) and **Low** for the low-rise residential housing on both Site 1 Site 2 (Green) with the risk assessment summarised below.

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.

2.4.1 Site 1 Apartment Blocks

In accordance with BS8485:2015 (Ref. 3) evaluation of the 'borehole' scenario (highest hazardous gas flow rate that is realistically possible, i.e. in a single borehole) records a

maximum Q_{hg} of 0.3198 l/hr for carbon dioxide with the highest steady flow rate of 3.9 l/hr in WS4C.

In accordance with BS8485:2015 the 'borehole' GSV indicates a Characteristic Situation 2 (CS2) gas regime requiring ground gas protection measures for the apartment buildings.

2.4.2 Site 1 Low rise Residential Housing Site 1

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. 4).

Based on a maximum steady state recorded carbon dioxide concentration of 2.3% and a GSV of 0.0023 l/hr, given the construction type- low rise housing with a ventilated underfloor void (minimum 150mm), the assessment indicates Green gas regime not requiring gas protection measures for the low-rise housing on Site 1.

2.4.3 Low Rise Residential Housing Site 2

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. 4).

Based on a maximum steady state recorded carbon dioxide concentration of 4.2% and a GSV of 0.0042 l/hr, given the construction type- low rise housing with a ventilated underfloor void (minimum 150mm), the assessment indicates Green gas regime not requiring gas protection measures for the low-rise housing on Site 2.

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, lead, TPHs 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, lead, TPHs 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 (CO ₂) identified in site soils beneath proposed apartments.	On-Site End Users (Residents) Future Maintenance Workers Staff Construction Workers	Vertical and horizontal migration through the superficial and bedrock deposits.	Characteristic Situation 2 Gas Protection Measures for apartments only.

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 cement in WS02b, in Zone 3 (close to proposed public open space), at 0.45m bgl, identified as chrysotile cement with a % soil composition of 0.959% w/w. 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 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, TPHs, 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 housing, residential apartments, and public open space as thus the site was zoned for the purposes of the GQRA. The thickness and make up of capping should therefore vary with respect the proposed end use and contaminants encountered. Curtins GAC Zoning Plan is enclosed in Appendix A.

It is recommended that within front and rear gardens of residential housing (Zone 2) 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 around residential apartments (Zone 1) and public open space (Zone 3) 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 cement was identified within soils at one location (part of Zone 3 - proposed area of public open space) it is recommended that capping is underlain by anti-dig separation layer (high visibility warning geotextile or a break layer) in this area. It is noted that development plans have changed slightly since issue of Curtins Phase 2 report and GAC zoning plan with a large area of public open now extending into what was zoned as part of the proposed apartment development. Minimal soft landscaping is now proposed around the proposed apartments. 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 what was identified as Zone 1 (proposed apartments).

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
All Soft Landscaped Areas in Area of Residential Apartments and Public Open Space (Area formerly identified as Zones 1&3)	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.
All Soft Landscaped Areas in Areas of Residential Housing (Area formerly identified as Zone 2)	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.

Curtins Engineered Capping Requirement Plan enclosed in Appendix A further clarifies which distinct areas have each capping requirement.

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 **apartment buildings** on site.

No gas protection measures are considered necessary in the proposed residential houses on site as these have been assessed as 'Green' by an assessment undertaken in accordance with NHBC guidance.

In this case, carbon dioxide was identified as the primary hazardous gas and therefore, gas protection measures are to be implemented during the development of the site to mitigate the risk to the property and end-users.

It is recommended that the building type (apartments) is classified as *Type A Building* in accordance with BS:8485:2015 +A1:2019 'Code of practice for the design of protective measures for methane and carbon dioxide ground gases for new buildings'.

On this basis, a **minimum protection score of 3.5 points** should be achieved in non-ventilated areas as a minimum, in accordance with BS 8485. A minimum of two types of protection are required from i) a structural barrier, ii) ventilation measures, iii) gas membrane.

It is understood that the chosen protection elements at the time of writing will include:

- 1) Cast in-situ reinforced suspended slab with minimal penetrations - *1.5 points*¹; and
- 2) Gas resistant membrane meeting the criteria set identified below and verified in accordance with CIRIA C735 2014 'Good practice on the testing and verification of protection systems for buildings against hazardous ground gases. - *2 points*.

¹ *To achieve a score of 1.5 the suspended slab should be well reinforced to control cracking and have minimal penetrations cast into the slab.*

Any changes to the proposed protection measures outlined above should be made with reference to BS 8485.

4.3.1 Gas Membrane Specification

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

- i) Sufficiently impervious to methane and carbon dioxide with a methane gas transmission rate $<40.0 \text{ ml/day/m}^2/\text{atm}$ (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.

If the above criteria are met (as set out within BS8485) then a gas resistant membrane, that is correctly installed and verified, can achieve *2 points*.

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.5). 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 (Zone 2)	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 (Zone 1&3)	
Imported Topsoil/Subsoil (Remediated/ Brownfield/Unknown)	Residential Gardens (Zone 2)	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 (Zone 1&3)	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 (Zone 2)	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 (Zone 1&3)	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

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

The site has been used for a wide range of uses including a dye works, housing and a warehouse during the period covered by available historical mapping.

Subsurface obstructions that the ground investigation encountered 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 apartment buildings.

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.

Based on this assumption, the relatively low risk categorisation of the site (Characteristic Situation 2) and given only two buildings are to be installed with protection measures, in accordance with CIRIA C735 much of the verification may be carried out by on site staff (appropriately trained and experienced) with independent inspection from a third party/Curtins to review and compile all records.

The following verification records should therefore be obtained by the specialist installer contractor/on site staff:

- 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 apartment building 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 apartment building, 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 Statement;
- 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** (2019) Phase 1 Preliminary Risk Assessment for Oldham Road, Newton Heath, Manchester, Ref 074031-CUR-00-XX-RP-GE-001-V01.
2. **Curtins** (2021) Phase 2 Ground Investigation for Oldham Road, Newton Heath, Manchester, Ref 074031-CUR-00-XX-RP-GE-001-V01.
3. **NHBC** (2007) Guidance of Evaluation of Development Proposals on sites where methane and carbon dioxide are present. Report edition No. 4
4. **British Standards Institution.** (2019) BS8485 Code of Practice for the Design of Protective Measures for Methane and Carbon Dioxide Ground Gases for New Buildings.
5. **Manchester City Council** (2021) Planning & Contaminated Land- Technical Guidance.

Appendix A – Drawings

- *TP Bennett Proposed Site Plan T8130-G-0-020-T1.*
- *Curtins Exploratory Hole Location Plan*
- *Curtins Generic Assessment Criteria Screening Zoning Plan*
- *Curtins Requirement for Engineered Capping Plan*



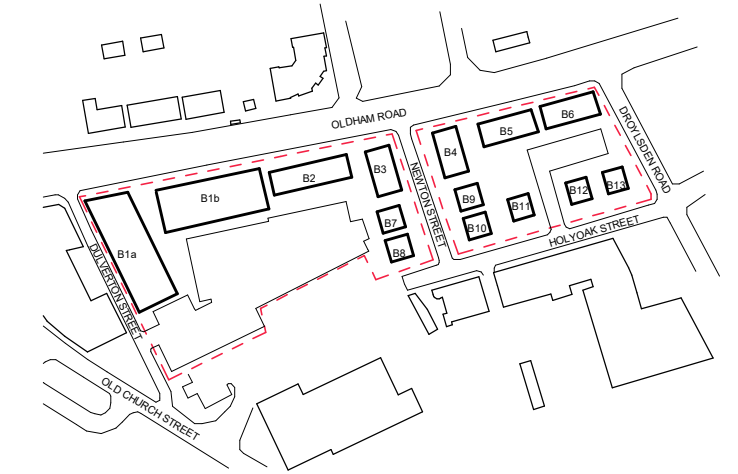
CLIENT
One Manchester

STRUCTURAL ENGINEER
Curtins Consulting

SERVICES ENGINEER
PSD Limited

CONSULTANT
Wilkinson Cowan Partnership Ltd

KEY PLAN



NOTES:
DO NOT SCALE. FIGURED DIMENSIONS ONLY TO BE TAKEN FROM THIS DRAWING. CHECK DIMENSIONS ON SITE AND REPORT DISCREPANCIES TO THE ARCHITECT.

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Accommodation = 139 Holmes		
Apartments	Houses	
100	39	
Apartment 1 1b2p 50m ²	41 (41%)	
Apartment 2 2b3p 61m ²	59 (59%)	
TH Type 1 3b4p 2.5 Storey 95.1m ² (39.9m ² /floor + 15.3m ² loft)	21no.	
House Type 2 2b3p 2 Storey 70.6m ² (35.3m ² /floor)	14no.	
TH Type 3 3b5p 3 Storey 106.8m ² (35.5m ² /floor)	4no.	

Tender notes	
Levels	All spot elevations are indicative at this stage and require further coordination with the civil engineer and landscape architect.

T1	02-11-2020	Issued For Tender	JMG	AJL
PD1	12-10-2020	Initial Issue	JMG	AJL
No.	Date	Comments	Drawn	Checked

Revisions	Issue Status

Tender

tp bennett
architecture
interiors
planning

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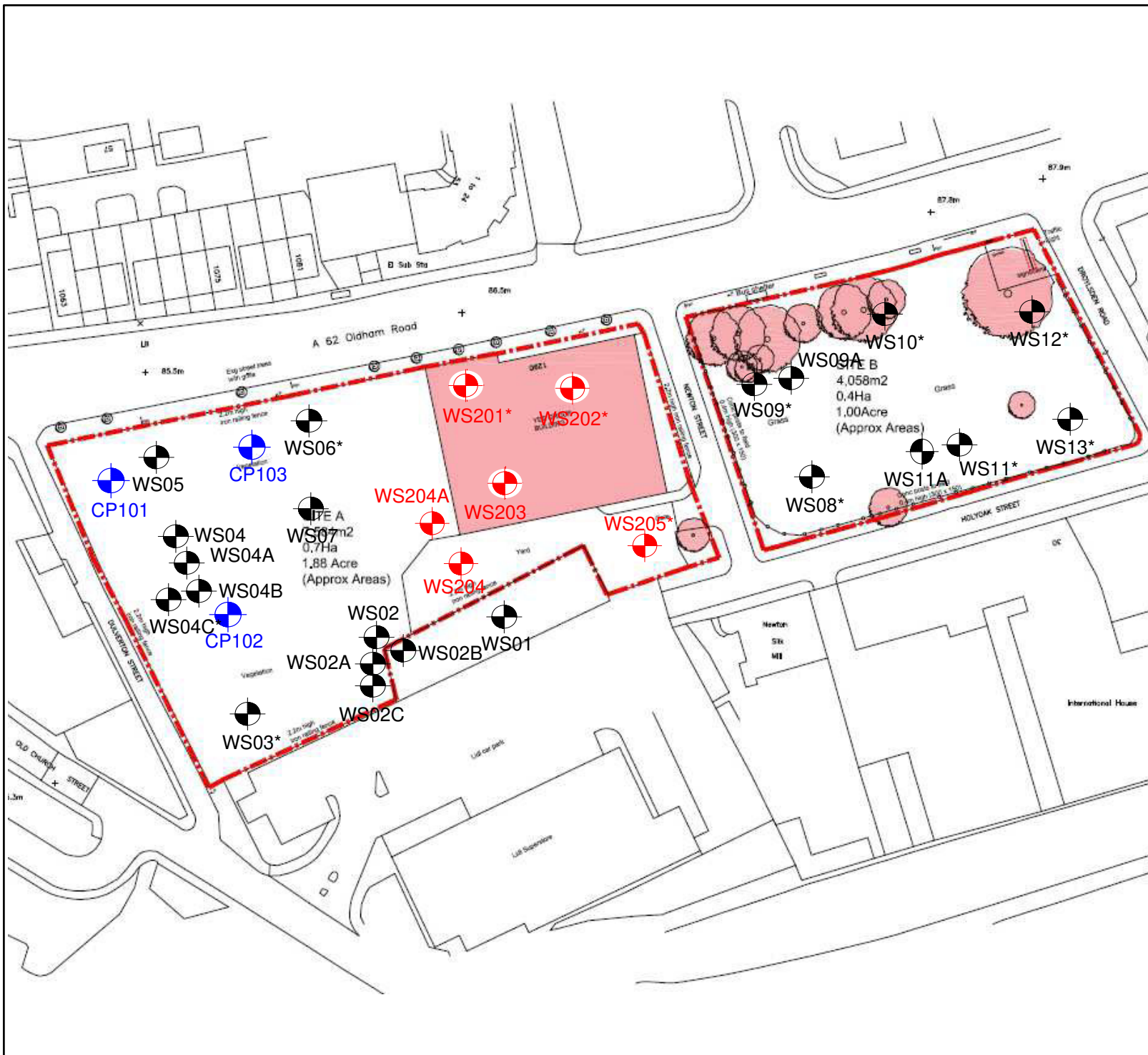
Project
**Residential Development
Newton Heath
Manchester**

Drawing Title
Site Plan

Drawn	Date	Scale @ A1	Alt. Ref.
JMG	02/10/2020	1:400	
Tp bennett Project No.			
T8130	G 0	020	T1

Legend: Major Fabric Elements Contact Details

Facing Brickwork	Winstanley Dorton Manor Lancashire Brick and Tile Ltd Tel: +44 1294 400493 e-mail: simon.jones@lancashirebrick.co.uk Contact: Simon Jones
Zinc Roofing & Cladding	VM Zinc Plus: Andrew Zink VM Building Solutions UK Tel: +44 203 445 6640 e-mail: andrew.ward@vmbuildingsolutions.com Contact: Andrew Ward
Roof Tiling	Marley Edgemoor: Anthracite Marley Ltd Tel: +44 7816493757 e-mail: lydia.hunter@marley.co.uk Contact: Lydia Hunter



PROPOSED LOCATIONS FOR SITE INVESTIGATION

- 2019 WINDOW SAMPLE BOREHOLE LOCATIONS
- CABLE PERCUSSIVE BOREHOLE LOCATIONS
- WINDOW SAMPLE BOREHOLE LOCATIONS

NOTES:
* Denotes ground gas/groundwater monitoring standpipe installed within exploratory hole. See exploratory hole logs for installation details.

Rev:	Description:	Date:	By:	Chkd:
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Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status: INFORMATION

Project: OLDHAM ROAD, NEWTON HEATH, MANCHESTER

Drg Title: EXPLORATORY HOLE LOCATION PLAN

Scale: NTS	Size: A3	First Issue: 23/10/2020	Drawn: RT	Checked: SH
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Drg No: 074031-CUR-00-XX-DR-GE-80004	Rev: P01
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PROPOSED LOCATIONS FOR SITE INVESTIGATION

2019 WINDOW SAMPLE BOREHOLE LOCATIONS

CABLE PERCUSSIVE BOREHOLE LOCATIONS

WINDOW SAMPLE BOREHOLE LOCATIONS

RESIDENTIAL WITHOUT PLANT UPTAKE

RESIDENTIAL WITH PLANT UPTAKE

PUBLIC OPEN SPACE NEAR RESIDENTIAL HOUSING

NOTES:
 * Denotes ground gas/groundwater monitoring standpipe installed within exploratory hole. See exploratory hole logs for installation details.

Rev:	Description:	Date:	By:	Chkd:
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Status:				
INFORMATION				
Project:				
OLDHAM ROAD, NEWTON HEATH, MANCHESTER				
Drg Title:				
GENERIC ASSESSMENT CRITERIA SCREENING ZONING PLAN				
Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	13/11/2020	PN	SH
Drg No:				Rev:
074031-CUR-00-XX-DR-GE-80005				P01

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- Front and rear gardens require a minimum of 600mm clean capping cover
- Areas of soft landscaping require a minimum of 450mm clean capping cover underlain by a geotextile membrane or break layer

Further information detailed within the remediation strategy ref. 074031-CUR-00-XX-RP-GE-003

Rev:	Description:	Date:	By:	Chkd:
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Status:				
INFORMATION				
Project:				
OLDHAM ROAD, NEWTON HEATH, MANCHESTER				
Drg Title:				
REQUIREMENTS FOR ENGINEERED CAPPING				
Scale:	Size:	First Issue:	Drawn:	Checked:
NTS	A3	15/11/2021	RT	NF
Drg No:				Rev:
074031-CUR-00-XX-DR-GE-80006				V01
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Appendix B – Screening Criteria for Imported Capping Materials

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

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- 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
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- 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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