

LIVERPOOL FC ACADEMY REMEDIATION STRATEGY

Curtins Ref: 088269-CUR-XX-XX-T-GE-00005

Revision: P01

Issue Date: 31 March 2026

Client Name: Liverpool FC

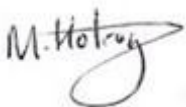
Client Address: Anfield Road, Liverpool, Merseyside, L4 0TH

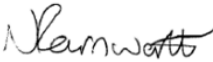
Site Address: Liverpool FC Academy, The Liverpool Way, Liverpool, L33 7ED

Rev	Description	Issued by	Checked	Date
P01	Issue	RT	MH	31 March 2026

This report has been prepared for the sole benefit, use, and information for the client. The liability of Curtins Consulting Limited with respect to the information contained in the report will not extend to any third party.

Author	Signature	Date
R Taylor BSc (Hons) MSc GradCIWEM Senior Geo-Environmental Engineer		31 March 2026

Reviewed	Signature	Date
Matthew Holroyd BSc (Hons) MSc Senior Geo-Environmental Engineer		31 March 2026

Authorised	Signature	Date
Niall Farnworth BSc (Hons) MCIWEM C.WEM Principal Geo-Environmental Engineer		31 March 2026

CONTENTS

1 Introduction	5	
1.1 Requirements of the Remediation Strategy	5	
1.2 Definitions	6	
1.3 References	6	
2 Ground Conditions	7	
2.1 Topsoil	7	
2.2 Made Ground	7	
2.2.1 Granular Made Ground	7	
2.2.2 Cohesive Made Ground	7	
2.2.3 Relic Topsoil	7	
2.3 Shirdley Hill Sand	8	
2.4 Glacial Till	8	
2.4.1 Cohesive Glacial Till	8	
2.4.2 Granular Glacial Till	8	
2.5 Chester Formation Sandstone	8	
2.5.1 Weathered Bedrock	8	
2.5.2 Competent Bedrock	8	
3 Ground & Groundwater Contamination	9	
3.1 Ground Contamination	9	
3.1.1 Mott Macdonald (2017) Ground Investigation	9	
3.1.2 Curtins (2025) Phase 2 Ground Investigation	9	
4 Conceptual Site Model	10	
5 PCL 2 – Asbestos Impacted Soils, Further Assessment of Risk to End User		11
6 Remedial Works	12	
6.1 Remedial Action 1 – Contamination and Asbestos Management During Construction	12	
7 Specification for Site Won and Imported Soils	14	
7.1 Sourcing of Materials	14	
7.1.1 Off-Site Sources	14	
7.1.2 On-site Sources	14	
7.2 Imported Topsoil	14	
7.3 Imported Subsoil	14	
7.4 Chemical Composition of Soils	14	
8 Strategy for Handling Potentially Contaminated Soils and Contaminative Incidents of Site	16	
8.1 Unexpected Contamination & Watching Brief	16	

8.2 Contaminative Incidents	16
8.2.1 Contaminated Water	16
8.3 Guidance for Stockpiling Materials	17
8.4 Health & Safety	17
8.4.1 Contractor Method Statements	18
8.4.2 Excavation & Other Works	18
8.5 Environmental Controls	18
8.5.1 Surface Water Run-Off	18
8.6 Airborne Particles/Vapour/Odour	18
8.7 Control of Spillage	19
9 Verification	20
10 Reporting	21

FIGURES

<i>Figure 1 – Site Location Plan</i>	5
--------------------------------------	---

TABLES

Table 1 – Potential Contaminant Linkages	10
Table 2 - Environmental Chemistry Testing Frequency for Soils	15
Table 3 - Environmental Chemistry Analysis Suite for Soils	15

APPENDICES

Appendix A – Drawings & Specifications	
Appendix B – CL:AIRE Decision Support Tool for the Qualitative Risk Ranking of Work Activities and Receptors Involved in or Exposed to Asbestos in Soil or Construction & Demolition Materials	
Appendix C – Screening Criteria for Imported Materials	

1 INTRODUCTION

This Remediation Strategy has been prepared by Curtins for Liverpool FC (the Client) to provide guidance with respect to remedial requirements for the proposed development site at the Liverpool FC Academy, The Academy Way, Liverpool, L33 7ED.

The development proposals comprise of the construction of a new indoor pitch in the west of the site, new show pitch with spectator stand in the north, extension of the existing carpark, extension and refurbishment of the existing Academy Building, and associated hard and soft landscaping.

The site has been characterised through a desk-based Phase 1 Geo-Environmental Assessment (Ref. 1) and a Phase 2 Geo-Environmental Assessment (Ref. 2) undertaken by Curtins in November 2025 and March 2026 respectively.



Figure 1 – Site Location Plan

The site is irregular shaped and is approximately 5.63 Ha. The site is currently in use as Liverpool FC Academy and comprises of two academy buildings, an indoor pitch, two outdoor pitches, and a hardstanding car park with associated soft/hard landscaping.

1.1 Requirements of the Remediation Strategy

The Remediation Strategy is to account for the following;

- A description of the materials likely to be encountered by the developer and their contractor/sub-contractors;
- Proposals for excavations with respect to the materials likely to be encountered;
- Revised risk ratings associated with ground contamination and primary pollutant linkages remaining;
- Further assessment with regards to the specification of the cover of Made Ground soils in proposed soft landscaped areas;
- Recommendations for appropriate PPE and managing asbestos appropriately during construction;
- A strategy a watching brief during groundworks and for handling potentially contaminative incidents, and;
- Proposals for the verification of remedial measures, including a regime for verification and chemical analysis of the cover layer material.

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 existing reports;

- **Reference 1:** Curtins (2025) *Liverpool FC Academy Phase 1 Preliminary Risk Assessment*. Ref. 088269-CUR-XX-XX-T-GE-00004-P01
- **Reference 2:** Curtins (2026) *Liverpool FC Academy Phase 2 Ground Investigation Report*. Ref. 088269-CUR-XX-XX-T-GE-00005-P04
- **Reference 3:** Mott MacDonald (2017) *Proposed Training Campus for Liverpool Football Club and Enhancements, Ground Investigation Report*, Ref. 364442|001|B, dated May 2017

2 GROUND CONDITIONS

The following sections present a summary of the ground conditions identified during the Curtins intrusive ground investigation.

2.1 Topsoil

Topsoil was encountered in thirteen locations from ground level to maximum depths ranging between 0.10m to 0.31m bgl (38.52m to 36.07m AOD). Topsoil was largely localised in two areas, including the football pitch and associated soft landscaping located in the west of the site and the soft landscaping in the north of the site. Topsoil was generally encountered as a 'brown fine to coarse medium sand with frequent rootlets'.

2.2 Made Ground

Made Ground soils were encountered in all exploratory hole locations excepting WS03 and generally comprised of granular Made Ground soils with localised cohesive deposits.

2.2.1 Granular Made Ground

Granular Made Ground was encountered either underlying Topsoil or from ground level and was generally recorded maximum depths of 0.30m to 1.55m bgl (37.91m to 37.90m AOD). This deposit typically comprised of a 'greyish brown to dark brown slightly clayey gravelly sand with variable cobble content' or 'brown to dark brown fine to coarse sand'.

Greater thicknesses of granular Made Ground were recorded in RBH06 and WS01 in the south of the site.

The deeper Made Ground within WS01 comprises dark brown or light brown slightly clayey gravelly sand, including fragments of brick, concrete and limestone. There is also cohesive Made Ground recorded between 0.31m and 0.80m and 2.45m and 3.00m bgl. WS01 is located within the footprint of a former football pitch, that historic mapping suggests was historically situated at a lower level than the surrounding land.

The deeper Made Ground within RBH06 is attributed to the fact that this location was drilled from the top of an embankment, and situated within the same football pitch footprint as WS01. RBH06 is located slightly east of the proposed building footprint. Soils comprise dark brown clayey gravelly sand with fragments of brick, concrete, sandstone and coal from 0.30m to 4.00m bgl (37.98m to 34.19m AOD).

The greatest extent of granular Made Ground soils is present along the sites northeastern and southwestern boundaries. Anthropogenic materials recorded in the granular Made Ground generally comprised of brick, concrete, sandstone, limestone, plastic, pottery and slag.

Below made ground in WS01 and RBH04 a limited thickness of slightly organic soils was encountered, this may comprise a relic topsoil material.

2.2.2 Cohesive Made Ground

Cohesive Made Ground was encountered in four locations (HP08, WS01, WS02 and RBH04), either underlying or interbedded with granular Made Ground soils. Cohesive Made Ground was encountered from depths ranging between 0.50m to 1.30m bgl (35.93m to 35.22m AOD) with thicknesses of the deposit ranging between 0.10m and 2.20m.

Soils comprise dark brown, light brown or black sandy gravelly clay with fragments of brick, concrete and limestone.

2.2.3 Relic Topsoil

A thin layer of potential relic topsoil was encountered in two locations. These materials were recorded as organic clay, with fragments of wood and plant debris in WS01 (33.38m AOD to 33.18m AOD), and organic sand in RBH04 (37.90m AOD to 37.50m AOD). The soils appear localised to these locations, and were not recorded in shallow excavations across the central area of the site.

2.3 Shirdley Hill Sand

Deposits consistent with the Shirdley Hill Sands were encountered in four boreholes (WS01, WS02, RBH04 and RBH05). This deposit was recorded to be underlying the Made Ground soils and was encountered from depths ranging between 0.60m and 3.00m bgl (38.02m and 33.38m AOD). The thickness of the Shirdley Hill Sands ranged between 0.20m and 1.45m. This deposit was typically described as a *'Light brown to brown slightly gravelly fine to coarse sand'*.

2.4 Glacial Till

Superficial deposits indicative of Glacial Till was encountered in eleven No. locations, either underlying the Made Ground or Shirdley Hill Sand deposits. Glacial Till was encountered from depths ranging between 0.40m and 2.15m bgl (36.03m to 37.30m AOD).

2.4.1 Cohesive Glacial Till

Glacial Till was largely encountered as a cohesive deposit from depths ranging between 0.84m to 4.00m bgl (35.68m to 34.19m AOD) with thickness of cohesive Glacial Till ranging between 0.30m and 1.47m. This deposit did not appear to be localised and was recorded to be underlying the entirety of the site dipping in a northern to southern direction. This deposit was typically described as a *'Soft to stiff brown or grey sandy, slightly gravelly occasionally silty clay'*.

2.4.2 Granular Glacial Till

Granular Glacial Till deposits were encountered from depths ranging between 0.50m and 4.70m bgl (36.10m and 33.49m AOD), with proven thicknesses ranging between 0.20m and 1.48m. This deposit was typically described as *'reddish brown, brown or grey slightly clayey, gravelly sand'*.

2.5 Chester Formation Sandstone

2.5.1 Weathered Bedrock

Granular soils indicative of weathered bedrock of the Chester Formation was encountered within six No. locations immediately underlying the Glacial Till deposits encountered from depths of 2.23m to 5.05m bgl (35.32mm to 33.14m AOD), with proven thicknesses ranging between 0.48m and 0.67m.

These soils were typically described completely weathered sandstone recovered as *'very dense reddish brown gravelly coarse sand with occasional bands of grey sand. Gravel is fine to coarse subangular sandstone'*.

2.5.2 Competent Bedrock

Bedrock deposits indicative of the Chester Formation was encountered in five No. locations (RBH01, RBH02, RBH03, RBH04 and RBH06).

This deposit was described as a weak to medium strong reddish-brown sandstone.

3 GROUND & GROUNDWATER CONTAMINATION

3.1 Ground Contamination

3.1.1 Mott Macdonald (2017) Ground Investigation

As part of the previous Matt Macdonald (2017) Ground Investigation, an initial human health risk assessment was undertaken against '*Commercial*' end use or '*Public Open Space*' end use criteria. With respect to the Mott Macdonald risk assessment, no exceedances were reported against the adopted thresholds.

Two samples were reported as containing asbestos. This included a sub-sample taken from WS02 at 1.00m bgl (Chrysotile fibres) from cohesive Made Ground within demolition spoil, in the southwest corner of the football pitch in the south of the site, and RBH01 at 0.50m bgl (chrysotile) from granular Made Ground located in the banked ground in the southeast corner of the site. Asbestos quantification was undertaken on the samples by two different tests: gravimetric quantification (GQ) and Phase Contrast Optical Microscopy (PCOM). The quantity of asbestos present in the sample from WS02 was reported as 0.0025% by GQ and <0.001% by PCOM. The quantity in RBH01 was reported as <0.001% in both tests.

3.1.2 Curtins (2025) Phase 2 Ground Investigation

As part of the Curtins (2025) Phase 2 Ground Investigation, a Generic Quantitative Risk Assessment (GQRA) was undertaken against '*Commercial*' Generic Assessment Criteria for soils protective of Human Health with respect to the proposed use of the area.

With respect to the proposed end-use, no exceedances were reported above the GAC thresholds within any samples tested. Soil samples were also screened for asbestos. Loose fibres of amosite were identified in HP11 at 0.20-0.30m bgl, within Made Ground soils (slightly clayey, slightly gravelly fine to coarse sand). Asbestos quantification was scheduled on this sample, which determined a concentration of <0.001%, by weight percentage.

A Moderate/low risk to end users and constructions workers was concluded, with recommendations made for further consideration regarding engineered capping in soft landscaping and appropriate PPE and sanitary facilities for construction workers.

4 CONCEPTUAL SITE MODEL

A Conceptual Site Model (CSM) for the site has been developed as part of the Curtins Phase 2 Ground Investigation that was undertaken at the site and considered based on the current 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 1* were identified as requiring remediation to enable the safe re-development of the site.

Table 1 – Potential Contaminant Linkages

PCL	Sources	Receptor	Risk	Potential Pathway	Remediation Recommended
1	Asbestos fibres identified in the Mott Macdonald ground investigation in soil samples collected from WS02 at 1.00m bgl and RBH01 at 0.50m bgl. Asbestos quantification confirmed concentrations of 0.0025% in WS02 and <0.001% in RBH01.	Construction Workers	Moderate/Low	Inhalation of dust particles and dermal contact.	The Principal Contractor to implement asbestos management plan during groundworks and construction works. Construction risk assessments and method statements to follow recommendations to the asbestos management plan. Groundworkers to be provided with appropriate PPE and sanitary facilities during works.
2	Asbestos fibres identified during the Curtins ground investigation in soil samples collected from HP11 at 0.30m bgl. Quantification confirmed concentrations of <0.001% by weight percentage of amosite loose fibres.	Site End Users (Athletes, maintenance staff and public)	Moderate/Low	Inhalation of dust particles and dermal contact.	It is understood that parts of the proposed development are likely to be covered by hardstanding, therefore limiting any potential contact by the future site user in these areas. The risk in new soft landscaped areas, subject to further consideration and assessment.

Section 7 presents a strategy for handling unexpected contamination or contaminative incidents. It is further recommended that periodic site visits are undertaken by a Geo-Environmental Engineer to record any unexpected contamination.

5 PCL 2 – ASBESTOS IMPACTED SOILS, FURTHER ASSESSMENT OF RISK TO END USER

The primary PCL identified at the site relates to the direct contact, dermal uptake, soil and dust ingestion and inhalation of asbestos fibres in soil and soils and soil derived dust (PCL 2, *Table 1*).

The potential for exposure to asbestos fibres is highest within soft landscaped areas where receptors (athletes, maintenance staff and public) at the site are most likely to come in contact with the contaminated Made Ground soils. The development proposals and plans are included within *Appendix A*.

Hardstanding, including the building footprints, vehicular tarmac, pedestrian tarmac and concrete, block paving and porous tarmac (installed within the indoor sports pitch) are considered sufficient to break the potential contaminant linkage, PCL 2, detailed in *Table 1*; and therefore, no specific remediation measures, above activities required for construction, are considered necessary if and where these are installed at the site. With consideration of the laboratory analysis results, the following locations are recorded to be located beneath hardstanding of proposed building footprint:

- Curtins HP11 (0.30m bgl) – Situated in an area of proposed car parking. Where Made Ground soils are retained, the surface covering will prevent end user exposure.
- MML WS02 (1.00m bgl) – The sample was obtained at depth, where soils were reported to be covered by 0.20m Topsoil and 0.30m orangish yellow clayey sand. The location is beneath the proposed new build indoor pitch, which will mitigate exposure to site end users.
- MML RBH01 (0.50m) – Situated at the top of the embankment southwest of current showpitch. Location similar to Curtins RBH06, which did not identify asbestos fibres in a sample obtained at 0.50m – 0.60m bgl. The latest exploratory hole logs indicate 0.30m of topsoil overlies Made Ground. Development proposals indicate that a hardstanding access road will be constructed in this area, with adjacent soft landscaping.

Curtins have undertaken further assessment of the asbestos identified in MML RBH01, to assess the mitigation which may be required in soft landscaping in this area. Curtins have undertaken an assessment utilising the CL:AIRE Decision Support Tool for the Qualitative Risk Ranking of Work Activities and Receptors Involved in or Exposed to Asbestos in Soil or Construction & Demolition Materials. The results of this assessment are included in *Appendix B*. The assessment identified a Very Low Risk to site end users in the landscaping area around MML RBH01, on the basis that:

- Trace concentrations (<0.001% chrysotile fibres) were identified in MML RBH01 (0.50m bgl).
- Small area of soft landscaping shown provide limited disturbance to underlying Made Ground soils.
- Soft landscaping will be installed with a suitable growing medium to support growth of grass/other soft landscaping.
- Material will be buried at 'shallow depth' with potential to be disturbed by excavation.

On this basis, a formal cover system is not deemed to be required, and sufficient cover will be provided through either hardstanding or installation of a growing medium in the soft landscaping area.

No further asbestos materials / fibres were encountered during the ground investigation. It is considered that no further action is required across the remainder of the site to mitigate asbestos risks to end users.

6 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 1*, and additional assessment discussed in Section 5, one Remedial actions is recommended in order for the site to be brought up to a condition that is deemed 'suitable for use';

- **Remedial Action 1:** Asbestos Management Plan and provision of suitable PPE and sanitary facilities during construction works.

Measures for dealing appropriately to unexpected contamination encountered on site are outlined within Section 7.3.

6.1 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 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) prescribe 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.

Section 3 should be consulted together with Curtins' Phase 2 Ground Investigation Report, Exploratory Hole Location Plan Drawing and Exploratory Hole Logs (Ref. 2) and the Mott MacDonald Ltd. Ground Investigation Report (Ref. 3) for the locations, depths and type of asbestos identified during ground investigation.

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.

Existing Made Ground should not be crushed or in any way treated due to risk of asbestos fibre release. It may be possible to use Made Ground soils as general fill subject to in situ trial tests and where managed appropriately by the Method Statement compiled by the Asbestos Management Specialist.

7 SPECIFICATION FOR SITE WON AND IMPORTED SOILS

This section outlines the required chemical testing specification that soils utilised during construction of the proposed soft landscaping area must meet. This does not cover general fill materials as it is anticipated this will be covered within the earthwork specification.

7.1 Sourcing of Materials

7.1.1 Off-Site Sources

It is anticipated that materials may be imported to the site for use in constructing of soft landscaping areas. It is strongly recommended that materials are sourced from reputable suppliers and comprise materials that have been suitably processed to produce standardised materials.

It is not recommended that materials are imported directly from 'donor' development sites. Imported material will also require verification testing to ensure suitability for reuse, and it is strongly advised that the Contractor undertake their own independent verification testing if accepting material from a third party, rather than relying on supplier reports.

It is understood that crushed hardcore stone and brick may be imported for use in earthworks such as in construction of a crane mat during the construction works but as discussed requirements for testing should be accounted for in an Earthworks Specification.

7.1.2 On-site Sources

Based on the findings of the Ground Investigation, it is considered that Topsoil may be suitable for re-use in landscaped areas or football pitches. Further analysis to confirm suitability with BS3882:2015 will be required in line with specification below, and subject to landscape architects specification and requirements.

It is unlikely that the general shallow Made Ground could be considered 'uncontaminated', 'clean' or 'suitable' material for re-use as a subsoil or topsoil in soft landscaped areas due to the presence of asbestos fibres at three separate locations across the site.

It is possible that under a Materials Management Plan (MMP) topsoil from other areas of the site could be transferred to other areas of the site for use in soft landscaping areas, subject to compliance with the Landscape Architect's specification and appropriate testing.

7.2 Imported Topsoil

Imported Topsoil may 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 proposed soft landscaped areas. Where topsoil is imported, it is to be 'Multipurpose' in accordance with BS 3882:2015 'Specification for Topsoil and Requirements for Use', unless otherwise stated in the Landscape Architect's Specification.

The topsoil should also be confirmed to be 'suitable for use' as per the analysis outlined in *Section 6.4*.

7.3 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 6.4* and compliant with BS 8601:2013 'Specification for subsoil and requirements for use' unless otherwise stated in the Landscape Architect's Specification.

7.4 Chemical Composition of Soils

All materials used in soft landscaping should not contain concentrations of contaminants that present an unacceptable risk to the health of future site occupants or off-site receptors.

The Contractor shall be responsible for demonstrating that imported material is 'clean' and therefore suitable for use in soft landscaping, in accordance with the Landscape Architect's specification. This will include the recovery of samples for laboratory testing from both the material source and verification testing of material following delivery to

site. The required testing frequencies for materials source types are detailed below. Other sources may be applicable, however testing frequencies shall be confirmed with the Engineer prior to acceptance.

The environmental chemistry testing requirements and frequency are as Table 2 & Table 3. Additions to the suite and frequency of sampling may be required based on the source of 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 2 - Environmental Chemistry Testing Frequency for Soils to Be Used In Soft Landscaping

Impacted Soils	Testing Frequency
Imported Topsoil/Subsoil (Greenfield/ Manufactured)	On Site Verification: One sample every 250m ³ used or a minimum of 3 No. samples, whichever is greater, testing to be undertaken once material is imported to site.
Imported Topsoil/Subsoil (Remediated/ Brownfield/ Unknown)	On Site Verification: One sample every 50m ³ used, or a minimum of 6 No. samples, whichever is greater, testing to be undertaken once material is imported to site.
Topsoil/Subsoil from other areas of the site	On Site Verification: One sample every 250m ³ used, or a minimum of 3 No. samples, whichever is greater, testing to be undertaken once material has been placed/stockpiled for use.
Virgin Quarried Materials	On Site Verification: One sample per 1,500m ³ used (or a minimum of 2 No. samples, whichever is greater), testing to be undertaken once material has been placed/stockpiled for use.

Table 3 - Environmental Chemistry Analysis Suite for Soils

Suite Reference	Environmental Chemistry Analysis
Greenfield, Brownfield or Manufactured Soils	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 0.01mg/kg for each banding C5 to C10 and 1mg/kg for bandings above C10)

Assessment criteria: Concentrations of the above determinants shall not exceed the 'Residential without Home Grown Produce' screening criteria (contained within Appendix C).

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 may be made for specific soil sources whereby the Soil Organic Matter ranges.

8 STRATEGY FOR HANDLING POTENTIALLY CONTAMINATED SOILS AND CONTAMINATIVE INCIDENTS OF SITE

8.1 Unexpected Contamination & Watching Brief

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.

1. Cease and make safe all excavations in this location and report observations to the Site Manager.
2. The Site Manager is to notify the Geo-Environmental Engineer (Curtins).
3. Under guidance of the Engineer take representative samples of the suspect materials and forward to a suitably accredited laboratory for analysis.
4. Contaminated Land Planning Officer and if relevant the Environment Agency are to be kept fully informed of any such occurrences. Contaminated Land Planning Officer must agree the strategy for dealing with unexpected contamination before works continue in that area.
5. Await Engineers instructions with respect to re-commencement of the works and or removal from of suspect material to a suitably licensed disposal facility.

It is recommended that in addition to the above that periodic site visits are undertaken by the Engineer (watching brief) to record and document works during the groundworks phase including, for example, during site preparation, removal of contaminated soils from site as well as visiting site as soon as potential contamination or unexpected ground conditions are observed by the contractor.

Records of any unexpected contamination must be included within the Remediation Completion Report.

Where visual or olfactory evidence of contamination is identified (e.g. fuel odours, free phase contamination, asbestos containing materials), or where materials are revealed which do not accord with the previously observed and recorded descriptions, presented in ground investigation reports for the site, the procedure outlined above is to be complied with:

8.2 Contaminative Incidents

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

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

Where the damage is caused to the underside of a tank and seepage is vertical, the contaminants may present a risk of polluting the groundwater. In this instance and subject to the findings of a risk assessment boreholes may be required to prove and intercept the contaminant. The contaminant will then be pumped into suitable containers.

The procedure outlined in *Section 7.1* should also be adhered too and the Engineer shall approve all proposals for such remediation.

8.2.1 Contaminated Water

In the unlikely event that potentially contaminated perched water is encountered during below ground level demolition works, the water should be pumped into a suitable container, which may be a specifically constructed tank, where the water may be sampled for chemical assessment for potential contaminants of concern accounting for the sites historic land use, and as identified in the ground investigation report(s).

Should contaminated groundwater be encountered at the top of the natural strata, the Contractor must cease works, and an assessment by the Contractor and Engineer must be undertaken to determine suitable methodologies for continuing works, where appropriate.

Free phase contamination was not identified within groundwater bodies, however if encountered during remediation works, the products shall be removed and placed into a specific storage tank for assessment and removal from site.

Contaminated perched water or groundwater is unlikely to be disposable into a foul water sewer and will likely require disposal off-site. Contaminated perched water must not be allowed to flow directly into the underlying natural site soils, particularly where granular Tidal Flat Deposits are encountered beneath Made Ground.

Guidance on managing contaminated water is given in the jointly issued document produced by Water UK, Environment Agency, NIEA, Natural Resources Wales, DWI, Fera, Defra's CBRN Recovery Team and NFCC National Resilience, titled Protocol for the Disposal of Contaminated Water and Associated Waste Incidents, broadly comprising a system of:

1. **Contain** Closed containers, contained at source.
2. **Identify** Chemical analysis of water, seek specialist advice where required.
3. **Treat** Is site treatment practicable to allow safe disposal?
4. **Dispose** Remove from site by appropriate method, following all relevant guidance and regulation.

The following bodies must be contacted in the event of perched water contaminative incidents:

- Water/Waste Water Companies (United Utilities)
- Environment Agency

8.3 Guidance for Stockpiling Materials

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, or off-site. Soil stockpiles must be placed in an arrangement that minimises potential for contamination of adjacent stockpiles or materials (i.e. do not place 'clean' imported soils next to contaminated arisings). Additional measures may be required subject to the nature of materials encountered (e.g. sumps), and should be implemented in conjunction with recommendations from the Engineer.

Unsuitable soils **may** contain high concentrations of potential contaminants of concern, suitable warning signs or protection measures should be placed around stockpiles to inform site staff and visitors.

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.

Duty of Care: Under their 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, and inclusion in a Ground Condition Report on completion of demolition and regrading works.

8.4 Health & Safety

This section details health and safety requirements associated with contaminated land but does not seek to cover all aspects to be managed by the Contractor under CDM Regulations and detailed in Method Statements. As detailed in Section 5.1, an asbestos management plan should be developed prior to commencement of groundworks, and the requirements implemented, during groundworks.

The works are likely to generate soils, dust, and other materials that may be impacted with asbestos. The Contractor shall incorporate in its health and safety plan provisions for protecting personnel from hazards associated with these materials. The health and safety plan should also incorporate personnel decontamination requirements and facilities.

8.4.1 Contractor Method Statements

The Contractor is required to prepare method statements relating to the separate tasks highlighted and provide these to the client or Principal Designer along with the Engineer for review prior to the commencement of the related works.

The Contractor shall induct all its employees and subcontractors into the relevant aspects of their health and safety plan and method statements prior to each employee and/or subcontractor commencing works on site.

No works shall commence until the clients' nominated Principal Designer has approved the task specific method statement.

8.4.2 Excavation & Other Works

Before commencement of any excavation or other works, the following minimum precautions should be observed:

- Clearance of services;
- Appropriate 'Danger' notices displayed, and exclusion 'work' zone enforced;
- Exclusion of ignition sources within the work zone;
- Provision of a water supply hose/mist to damp down the area in the event that asbestos fibres are disturbed; and
- Exclusion of personnel from the immediate worksite except for those directly involved with the phase of works.
- The above listed precautions do not override other precautions that will need to be covered by the Contractor's overall Health and Safety Plan, aspects such as firefighting, PPE, excavation stability/shoring (if required) etc.

8.5 Environmental Controls

Environmental Controls are the responsibility of the Contractor. However, in general this section details specific requirements for potentially contaminated soils and is not intended to cover all aspects to be managed by the Contractor and detailed within their Method Statements.

Without limiting the Contractor's obligations, it shall be their responsibility to comply with all applicable laws, regulations and rules relating to potential contamination with regard to:

- Surface water run-off.
- Airborne particulates/vapours/odour; and,
- Control of spillage.

Method statements are to be provided to the Engineer and should incorporate the environmental management measures pertaining to the above factors, with further detail given below.

8.5.1 Surface Water Run-Off

The Contractor is responsible for ensuring that site surface water run-off does not leave the site.

The Contractor is to provide for necessary surface water diversion systems as required to keep the construction area free from excess surface or groundwater that may interfere with the works.

All personnel engaged by the Contractor should be trained in response techniques (e.g., use of absorbent materials, etc.) to ensure that any surface water run-off with fuel leakage impact or associated potentially contaminated soil is managed appropriately.

8.6 Airborne Particles/Vapour/Odour

The Contractor is responsible for the implementation of dust suppression in work areas, using water or other means of suppression that are not considered harmful to the environment. The Contractor should also set out procedures for

the mitigation of any potential odors that may arise from exposed contaminated soils that could affect off-site users (adjacent residents).

8.7 Control of Spillage

During the phase of works, any type of spillage (including fabricating, hydraulic oils, fuels and/or other materials) should be immediately contained, removed, and disposed of, with any further surrounding areas cleaned.

9 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. This includes periodic visits/watching brief during groundworks. It is anticipated records of the following will be taken during the below phases of work:

- Documentation of general works including records from watching brief, asbestos management procedures during the works and records of contaminative incidents and any unexpected contamination; and,
- Placement of the topsoil/subsoil in landscaping areas to conform with the Landscape Architect Specification.
- Removal of contaminated soils from site for off-site disposal.

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 of cover in soft landscaping areas.

The frequency and timing of visits by Curtins shall be determined following confirmation of the construction phase programme and the chosen protection elements.

10 REPORTING

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

- Details and documentation of asbestos management measures utilised during the works;
- Confirmation that the soft landscaping has been installed as specified within the Landscape Architect Specification in soft landscaped areas, including photographs;
- Confirmation of suitability of materials for soft landscaped areas including environmental chemistry testing results;
- Records of waste transfer notes and consignment notes for contaminated material disposed of off-site.
- 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 5.0*);
- 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.

It should be noted that the above list does not include the requirements of an Earthworks Completion report and Materials Management Completion report (where soils are re-used under an MMP) which may also be required in addition to the above remediation completion report.

APPENDICES

Appendix A – Drawings & Specifications

Appendix B – CL:AIRE Decision Support Tool for the Qualitative Risk Ranking of Work Activities and Receptors Involved in or Exposed to Asbestos in Soil or Construction & Demolition Materials

Appendix C – Screening Criteria for Imported Materials

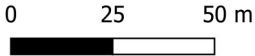
Appendix A - Drawings & Specifications



Legend

Exploratory Holes

- Hand Pit
- Foundation Pit
- Soak Away Trial Pit
- Dynamic Sample Borehole
- Rotary Cored Borehole
- Window Sample Borehole
- Red line boundary

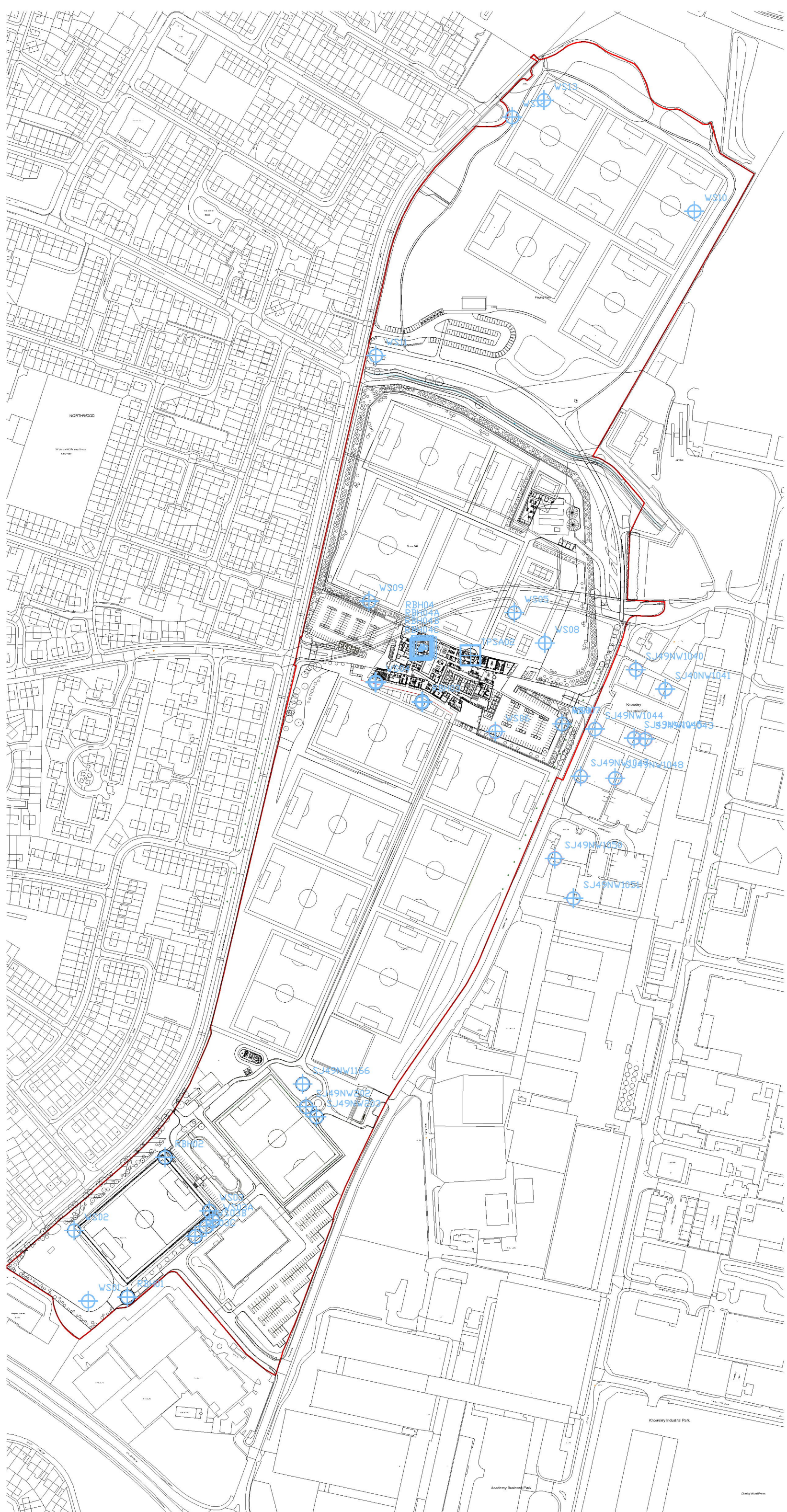


Curtins

Curtins Consulting Ltd
Merchant Exchange, 17-19 Whitworth Street West,
Manchester, M1 5WG
t: 0161 236 2394
e: manchester@curtins.com
www.curtins.com

Structures - Civils - Environmental - Infrastructure - Transport Planning - Sustainability - Expert Advisory Services
Birmingham - Bristol - Cardiff - Douglas - Edinburgh - Kendal - Leeds - Liverpool - London - Manchester - Nottingham

Status				
INFORMATION				
Project:				
Liverpool FC Academy				
Drg Title:				
Exploratory Hole Location Plan				
Scale:	Size:	Issue Date:	Drawn:	Checked:
See Scale	A3	28/11/2025	JP	NF
Drg No:				Rev:
088269-CUR-00-XX-DR-GE-80002				P01



Appendix B - CL:AIRE Decision Support Tool for the Qualitative Risk Ranking of Work Activities and Receptors Involved in or Exposed to Asbestos in Soil or Construction & Demolition Materials

Decision Support Tool for Receptor Risk Ranking

Stage 1		Score
Hazard Identification		
Select ACM type (run model for each type to generate 'Worst Case' output)	Free dispersed fibres/fibre bundles	2
Extent of degradation of ACMs	Disaggregated (dominated by loose fibrous material; extreme degradation in ACM and/or free asbestos fibres/fibre bundles)	4
Friability and degree of bonding by matrix (ACM matrix, not ground materials)	Friable ACM or ACM with fibres not linked in any matrix (free dispersed fibres/fibre bundles)	4
Distribution of Visible Asbestos Across Affected Area	No visible ACMs/fibre bundles	0
Asbestos fibre type	Chrysotile alone	0
Sub-total		10
Hazard ranking		Low

No warranty, expressed or implied, or reliance, is provided in relation to the use of this tool.
It is contingent on users to satisfy themselves that the output from the tool is relevant and appropriate to the assessment being made.



Joint Industry Working Group

Asbestos in Soil and Construction & Demolition Materials

Stage 2		Score
Emission Factors		
Amount of asbestos fibre in selected ACM/fibre type as % of host material	Trace quantities - <0.0001 to <0.001 %wt/wt	0
Respirable fibre index for ACM - RIVM report 711701034 (2003)	Low	2
Activity type and effect on deterioration of ACMs	Minimal disturbance, no deterioration expected	1
Best description of primary host material matrix	Coarse to Fine Sand	2
Sub-total		5
Exposure ranking		Low

Stage 3		Score	
Pathway and Receptor Sensitivity			
Receptor category	Public open space or building	No score required	
Age of Receptor	School age (>5 and <16)	3	
Duration of exposure/site occupancy	<1 hour in any week (e.g. short duration work or equivalent infrequent exposure event when exposure aggregated over 1 yr)	0	
Receptor ranking		3	Low
Combined hazard, exposure and receptor ranking			Low
Pathway: Distance of Receptor from Source	In or within 10m of area of disturbance	4	
Pathway: Depth to impacted material	Material buried at shallow depth, potential to be disturbed by excavation	C	
Pathway ranking		4C	Low
Overall ranking			Very Low



Project Reference	B088269
Site Name	Liverpool FC Academy
Client	Liverpool FC
Run by	MH
Date	31-Mar-26
Reviewed by	NF
Characterisation of scenario being evaluated	Risk associated with loose fibres of Chrysotile asbestos fibres in MML RBH01 (0.50m bgl) at concentrations of <0.001% w/w in Made Ground soil. Location in the vicinity of proposed soft landscaping. Soft landscaping to include a small cover layer of topsoil as detailed in Landscape Architect Specification (growing medium).
Interpretation of scenario ranking by DST	Risk considered to be very low, no further actions or formal capping layer required. To be read in conjunction with Curtins Phase 2 Ground Investigation Report and Remediation Strategy.

Appendix C - Screening Criteria for Imported Materials

Human Health GQRA Rationale and Hierarchy

Background

Detailed guidance on human health risk assessment is available within several documents, published by both the Environment Agency, Defra, CL:AIRE, LQM/CIEH and Public Health England as referenced below (references a-h).

A Generic Quantitative Risk Assessment (GQRA) is carried out for the Potential Contaminant Linkages (PCLs) investigated by screening of soil contamination data against relevant Generic Assessment Criteria where available.

Generic Assessment Criteria are available for a range of different land use scenarios, soil organic matter (SOM) and soil types. Curtins have adopted available GACs for a sandy loam soil at 1%, 2.5% and 6% SOM using various sources.

GAC Hierarchy

A summary of and hierarchy for adopted GACs is identified below:

- i) **Category 4 Screening Levels (C4SLs):** In March 2014 Defra published C4SLs for arsenic, benzene, benzo(a)pyrene, cadmium, hexavalent chromium, and lead as part of the 'Phase 1 Project'. These values were derived to support the revised Part 2A Statutory Guidance issued in 2012 in which four categories of contaminated land are included, ranging from Category 1 (significant/high risk) to Category 4 (low risk). In 2018 the 'Phase 2 Project' commenced which aims to develop C4SLs for a range of further contaminants. Currently available Phase 2 C4SLs include vinyl chloride, trichloroethene, tetrachloroethene, naphthalene, cis-1,2 dichloroethene, trans 1, 2 dichloroethene and per / polyfluoroalkyl substances (PFAS) and inorganic mercury. Where contaminant concentrations do not exceed C4SLs, there is no risk that the land poses a significant possibility of significant harm (SPoSH) or the level of risk is low, as such land can be demonstrated to be in Category 4 and cannot be determined as contaminated land. The C4SLs are proposed to be more pragmatic (whilst still strongly precautionary) in comparison with SGVs and S4UL's outlined below.
- ii) **Suitable for Use Levels (S4ULs):** In 2015 LQM and the Chartered Institute of Environmental Health published generic assessment criteria for 89 substances including metals, BTEX, TPH, polycyclic aromatic hydrocarbons, phenols, chlorinated solvents and other volatile organic compounds. The S4ULs represent a minimal risk to long term human health, derived using health criteria values. The methodology for deriving the S4ULs is based on the Environment Agency CLEA model with consideration of developments in UK human health exposure assessment, in particular the additional land uses and exposure assumptions.
- iii) **Other Supplementary Screening Criteria:** In addition to those developed by LQM/CIEH (outlined above), other third party organisations have derived SSVs for a wider range of contaminants and land uses using the CLEA Model. Curtins have adopted these numbers where applicable, including those developed EIC/AGS/CL:AIRE and SoBRA published thresholds.

Alternative Assessment Approaches

PAH – Benzo(a)pyrene Surrogate Marker Assessment

In September 2017 Public Health England (PHE) (Ref. h) published guidance for the use of a surrogate marker approach to assess the risk posed by soil contamination with the genotoxic polycyclic aromatic hydrocarbons (PAHs). The guidance indicates that the use of a marker compound, such as Benzo(a)pyrene, provides a consistent indicator of the amount of 7 other genotoxic PAHs commonly tested for in soil including benz(a)anthracene, chrysene, benzo(b)fluoranthene, benzo(k)fluoranthene, dibenzo(a,h)anthracene, indeno(123cd)pyrene and benzo(ghi)perylene.

Where PAH concentrations of these 8 no. PAHs are present within pre-determined ratios in soil, provided in the guidance, this approach is used, comparing soil concentrations of the marker compound with a Category 4 Screening Level, or site specific assessment criteria. An individual compound assessment is carried out for other PAH compounds not considered in the PHE guidance.

An individual compound assessment is carried out for all PAH compounds where pre-determined ratios are not met for the surrogate marker approach.

Notes

Curtins Generic Assessment Criteria provide further information and notes to be read in conjunction with this assessment rationale.

Human Health GQRA Rationale and Hierarchy



References

- a) Environmental Agency. (2009) Contaminated Land Exposure Assessment (CLEA) v1.071 model.
- b) Environment Agency. (2009) Human Health Toxicological Assessment of Contaminants in Soil (report no. SC050021/SR2).
- c) Environment Agency. (2009) Updated Technical Background to the CLEA Model (report no.SC050021/SR3).
- d) Environment Agency (2005) The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils Science Report P5-080/TR3.
- e) Department of Environment Food and Rural Affairs (DEFRA). (2012) Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance (report no. PB13735).
- f) CL:AIRE (2014) Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, SP1010 Rev 2.
- g) LQM & CIEH (2015) S4ULs for Human Health Risk Assessment.
- h) Public Health England (2017) Contaminated Land Information Sheet: Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony	-	550	-	7500	-	-		
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	200	300	86	5100	610	1300		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	42	42	730	3200	570000	95000	304	
Aliphatic EC>6 - EC8 TPHs	100	100	2300	7800	600000	150000	144	
Aliphatic EC>8 - EC10 TPHs	27	27	320	2000	13000	14000	78	
Aliphatic EC>10-EC12 TPHs	130	130	2200	9700	13000	21000	48	
Aliphatic EC>12-EC16 TPHs	1100	1100	11000	59000	13000	25000	24	
Aliphatic EC>16 - EC35 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aliphatic EC>35 - EC44 TPHs	65000	65000	260000	1600000	250000	450000	8.48	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	70	370	13	26000	56000	76000	1220	
Aromatic EC>7 - EC8 TPHs	130	860	22	56000	56000	87000		869
Aromatic EC>8 - EC10 TPHs	34	47	8.6	3500	5000	7200		613
Aromatic EC10 - EC12 TPHs	74	250	13	16000	5000	9200	364	
Aromatic EC12 - EC16 TPHs	140	1800	23	36000	5100	10000	169	
Aromatic EC>16 - EC21 TPHs	260	1900	46	28000	3800	7600		
Aromatic EC>21 - EC35 TPHs	1100	1900	370	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1100	1900	370	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1600	1900	1200	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.2	0.89	0.039	27	140	190		
Ethyl benzene	47	83	16	5700	24000	17000		518
Toluene	130	880	22	56000	56000	87000		869
Xylene	56	79	28	5900	41000	17000	478 (o-xylene) 576 (p-xylene)	625 (m-xylene)
MTBE	49	73	23	7900			20400	
Phenol	280	750	66	760	760	760		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	15	15	65	1600	11000	800	76.4	
Acenaphthylene	170	2900	28	83000	15000	29000	86.1	
Acenaphthene	210	3000	34	84000	15000	29000	57	
Fluorene	170	2800	27	63000	9900	20000	30.9	
Phenanthrene	95	1300	15	22000	3100	6200	36	
Anthracene	2400	31000	380	520000	74000	150000		1.17
Fluoranthene	280	1500	52	23000	3100	6300		
Pyrene	620	3700	110	54000	7400	15000		
Benzo(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 (only)	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								
Chloroethene (Vinyl chloride)	0.0064	0.015	0.0017	1.1	7.8	18		
1,1-Dichloroethene (DCE)	0.23	0.23	2.8	26			2230	
Cis 1,2, Dichloroethene (DCE)	0.46	0.5	0.89	38	3800	2800	3940	
Trans 1,2, Dichloroethene (DCE)	0.9	0.93	3.7	69	13000	5600	3420	
Trichloroethene (TCE)	0.0093	0.0097	0.032	0.73	76	41		
Tetrachloroethene (PCE)	0.31	0.32	2	24	3200	1400		
1,1,1,2 Tetrachloroethane	1.2	1.5	0.79	110	1400	1500		
1,1,1 Trichloroethane	8.8	9	48	660	140000	57000		1425
1,2-Dichloroethane (Ethylene Dichloride)	0.11	0.16	0.054	12	300	300		
Tetrachloromethane	0.026	0.026	0.45	2.9	890	190		
Trichloromethane (Chloroform)	0.91	1.2	0.42	99	2500	2600		
Per- and Polyfluoroalkyl Substances (PFAS)								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	200	300	86	5100	610	1300		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic contaminants								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	78	78	1700	5900	590000	130000	558	
Aliphatic EC>6 - EC8 TPHs	230	230	5600	17000	610000	220000	322	
Aliphatic EC>8 - EC10 TPHs	65	65	770	4800	13000	18000		190
Aliphatic EC>10-EC12 TPHs	330	330	4400	23000	13000	23000		118
Aliphatic EC>12-EC16 TPHs	2400	2400	13000	82000	13000	25000	59	
Aliphatic EC>16 - EC35 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aliphatic EC>35 - EC44 TPHs	92000	92000	270000	1700000	250000	480000	21	
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	140	690	27	46000	56000	84000	2260	
Aromatic EC>7 - EC8 TPHs	290	1800	51	110000	56000	95000	1920	
Aromatic EC>8 - EC10 TPHs	83	110	21	8100	5000	8500		1500
Aromatic EC10 - EC12 TPHs	180	590	31	28000	5000	9700	899	
Aromatic EC12 - EC16 TPHs	330	2300	57	37000	5100	10000	419	
Aromatic EC>16 - EC21 TPHs	540	1900	110	28000	3800	7700		
Aromatic EC>21 - EC35 TPHs	1500	1900	820	28000	3800	7800		
Aromatic EC>35 - EC44 TPHs	1500	1900	820	28000	3800	7800		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1800	1900	2100	28000	3800	7800		
Aromatic Hydrocarbons								
Benzene	0.17	0.7	0.034	47	72	100		
Ethyl benzene	110	190	39	13000	24000	22000		1220
Toluene	290	1900	51	110000	56000	95000		1920
Xylene	130	180	67	14000	42000	23000	1120	1470
MTBE	84	120	44	13000			33100	
Phenol	550	1300	140	1500	1500	1500		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	36	36	130	3700	15000	1200	183	
Acenaphthylene	420	4600	69	97000	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
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		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	36	36	130	3700	15000	1200	183	
Acenaphthylene	420	4600	69	97000	15000	30000	212	
Acenaphthene	510	4700	85	97000	15000	30000	141	
Fluorene	400	3800	67	68000	9900	20000	76.5	
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		
Benzo(a)anthracene	11	14	6.5	170	29	56		
Chrysene	22	31	9.4	350	57	110		
Benzo(b)fluoranthene	3.3	4	2.1	44	7.2	15		
Benzo(k)fluoranthene	93	110	75	1200	190	410		
Benzo(a)pyrene (only)	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								
Chloroethene (Vinyl chloride)	0.01	0.019	0.0031	1.4	7.8	19		
1,1-Dichloroethene (DCE)	0.4	0.41	5.6	46			3940	
Cis 1,2, Dichloroethene (DCE)	0.78	0.84	1.7	64	3800	2400	6610	
Trans 1,2, Dichloroethene (DCE)	1.6	1.7	0.75	120	13000	7000	6170	
Trichloroethene (TCE)	0.02	0.02	0.072	1.5	78	54		
Tetrachlorethene (PCE)	0.7	0.71	4.8	55	3300	1900		
1,1,1,2 Tetrachlorethane	2.8	3.5	1.9	250	1400	1800		
1,1,1 Trichlorethane	18	18	110	1300	140000	76000		2915
1,2-Dichloroethane (Ethylene Dichloride)	0.18	0.24	0.1	17	210	330		
Tetrachloromethane	0.056	0.056	1	6.3	920	270		
Trichloromethane	1.7	2.1	0.83	170	2500	2800		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

Contaminants	Residential with Home Grown Produce	Residential Without Home Grown Produce	Allotments	Commercial	Public open space (Residential)	Public park POS _{park}	Solubility Saturation Limit (mg/kg)	Vapour Satuation Limit (mg/kg)
Metals, Semi-Metals & non-metals								
Antimony		550		7500				
Arsenic	37	40	49	640	79	170		
Beryllium	1.7	1.7	35	12	2.2	63		
Boron	290	11000	45	240000	21000	46000		
Cadmium	22	150	3.9	410	220	880		
Chromium III	910	910	18000	8600	1500	33000		
Chromium VI	21	21	170	49	21	250		
Copper	2400	7100	520	68000	12000	44000		
Lead	200	310	80	2300	630	1300		
Mercury (elemental)	1.2	1.2	21	58	16	30		25.8
Mercury (inorganic)	200	300	86	5100	610	1300		
Methylmercury	11	15	6	320	40	68		
Nickel	130	180	53	980	230	800		
Selenium	250	430	88	12000	1100	1800		
Vanadium	410	1200	91	9000	2000	5000		
Zinc	3700	40000	620	730000	81000	170000		
Inorganic Compounds								
Cyanide	24	24	24	1400	24	24		
Organic Compounds								
Aliphatic Risk Banded Hydrocarbons - TPH CWG method								
Aliphatic EC5 - EC6 TPHs	160	160	3900	12000	600000	180000	1150	
Aliphatic EC>6 - EC8 TPHs	530	530	13000	40000	620000	320000	736	
Aliphatic EC>8 - EC10 TPHs	150	150	1700	11000	13000	21000		451
Aliphatic EC>10-EC12 TPHs	760	770	7300	47000	13000	24000		283
Aliphatic EC>12-EC16 TPHs	4300	4400	13000	90000	13000	26000	142	
Aliphatic EC>16 - EC35 TPHs	110000	110000	270000	1800000	250000	490000		
Aliphatic EC>35 - EC44 TPHs	110000	110000	270000	1800000	250000	490000		
Aromatic Risk Banded Hydrocarbons - TPH CWG method								
Aromatic EC5 - EC7 TPHs	300	1400	57	86000	56000	92000	4710	
Aromatic EC>7 - EC8 TPHs	660	3900	120	180000	56000	100000		4360
Aromatic EC>8 - EC10 TPHs	190	270	51	17000	5000	9300		3590
Aromatic EC10 - EC12 TPHs	380	1200	74	34000	5000	10000	2150	
Aromatic EC12 - EC16 TPHs	660	2500	130	38000	5000	10000		
Aromatic EC>16 - EC21 TPHs	930	1900	260	28000	3800	7800		
Aromatic EC>21 - EC35 TPHs	1700	1900	1600	28000	3800	7900		
Aromatic EC>35 - EC44 TPHs	1700	1900	1600	28000	3800	7900		
Long Chain Aliphatic and Aromatic Hydrocarbons								
Aliphatic and Aromatic EC >44-70	1900	1900	3000	28000	3800	7900		
Aromatic Hydrocarbons								
Benzene	0.87	3.3	0.18	98	140	230		
Ethyl benzene	260	440	91	27000	25000	27000		2840
Toluene	690	3900	120	180000	56000	100000		4360
Xylene	310	430	160	30000	43000	31000	2620	
MTBE	160	220	90	24000			62700	
Phenol	420	2300	280	3200	3200	3200		
Polycyclic Aromatic Hydrocarbons (PAH) - Benzo(a)pyrene Surrogate Marker Approach, with reference to C4SL PAH Surrogate Marker Check Sheet where appropriate								
Benzo(a)Pyrene (C4SL Surrogate Marker Approach)	5	5.3	5.7	77	10	21		
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
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		
Polycyclic Aromatic Hydrocarbons (PAH) - Individual Compound Assessment								
Naphthalene	85	85	200	8400	17000	1900	432	
Acenaphthylene	920	6000	160	100000	15000	30000	506	
Acenaphthene	1100	6000	200	100000	15000	30000	336	
Fluorene	860	4500	160	71000	9900	20000	183	
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		
Benzo(a)anthracene	13	15	13	180	29	62		
Chrysene	27	32	19	350	57	120		
Benzo(b)fluoranthene	3.7	4	3.9	45	7.2	16		
Benzo(k)fluoranthene	100	110	130	1200	190	440		
Benzo(a)pyrene (only)	3	3.2	3.5	36	5.7	13		
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								
Chloroethene (Vinyl chloride)	0.017	0.029	0.0058	2.2	7.8	19		
1,1-Dichloroethene (DCE)	0.82	0.82	12	92			7940	
Cis 1,2, Dichloroethene (DCE)	1.5	1.6	3.6	120	3900	3100	12900	
Trans 1,2, Dichloroethene (DCE)	3.3	3.4	16	260	13000	9100	12600	
Trichloroethene (TCE)	0.043	0.045	0.16	3.4	79	69		
Tetrachloroethene (PCE)	1.6	1.6	11	130	3400	2500		
1,1,1,2 Tetrachloroethane	6.4	8.2	4.4	560	1400	2100		
1,1,1 Trichloroethane	39	40	240	3000	140000	100000		6392
1,2-Dichloroethane (Ethylene Dichloride)	0.31	0.41	0.19	29	310	380		
Tetrachloromethane	0.13	0.13	2.4	14	950	400		
Trichloromethane	3.4	4.2	1.7	350	2500	3100		
PFAS								
Perfluorooctanoic Acid (PFOA)	0.0076	0.041	0.0014	0.6	0.079	0.17		
Perfluorononanoic Acid (PFNA)	0.013	0.041	0.0027	0.6	0.079	0.17		
Perfluorohexane Sulfonic Acid (PFHxS)	0.0081	0.041	0.0015	0.6	0.079	0.17		
Perfluorooctane Sulfonic Acid (PFOS)	0.0073	0.041	0.0013	0.6	0.079	0.17		

- 1) All Values are in mg/kg, reported to 2 significant figures.
- 2) Numbers in bold are C4SLs, Numbers in italics are S4ULs, Numbers underlined are EIC/AGS/CL:AIRE GACs, Numbers in red are SoBRA Acute Generic Assessment Criteria.
- 3) Assumptions and key notes made when deriving the Generic Assessment Criteria are contained within the relevant guidance documents, references:
 - a) Contaminated Land: Applications in Real Environments (2014) SP1010 - Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Final Project Report (Revision 2b)
 - b) Land Quality Management Ltd. (2015) The LQM/CIEH S4ULs for Human Health Risk Assessment.
 - c) CL:AIRE, EIC, AGS (2010) Soil Generic Assessment Criteria for Human Health Risk Assessment.
 - d) Society of Brownfield Risk Assessment (2020) Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil.
 - e) Environment Agency (2009) Human Health Toxicological Assessment of Contaminants in Soil, Science Report - SC050021/SR2.
- 4) Generic Assessment Criteria listed in the following order of preference: C4SLs, S4ULs, CL:AIRE/AGS/EIC Generic Assessment Criteria, Other relevant Generic Assessment Criteria where GACS associated with the prioritised GACs are not available as outlined further in Curtins Rationale and Hierarchy notes.
- 5) To use Benzo(a)pyrene as a surrogate marker for PAH contamination, the assumptions set out in the relevant C4SL documentation must be met. A C4SL PAH surrogate marker checklist is appended.
- 6) Naphthalene is a volatile PAH. The C4SL values are derived on the basis of chronic exposure and risks to human health, and do not explicitly account for acute risks (e.g. a one off ingestion of a significant amount of soil by a young child) where the inhalation pathway is the main risk driver. Further consideration of the acute risk may be required in external settings (POS_{park} and POS_{resi}) where the GAC is substantially greater than the residential equivalent, to account for the possibility of acute exposure to the ingestion of naphthalene. The theoretical solubility saturation limit of naphthalene in soil is substantially lower than the GAC value, and therefore it is likely that free phase contamination would be present where the GAC is exceeded. In such a situation, it is unlikely that the product would remain in-situ untreated, and consideration of remediation / mitigation methods would be required.
- 7) Where the C4SL surrogate marker checklist indicates the PAH ratios are not suitable, individual PAH compounds must be assessed individually against the relevant contaminant specific assessment criteria.
- 8) Risk associated with additive effects of TPH contamination needs to be assessed in addition to the individual bandings, using the following equation:

$$HI = \sum HQ \quad Fi = \sum \frac{\text{Measured Concentration, } Fi \text{ (mg/kg)}}{\text{Relevant GAC (mg/kg)}} Fi$$

Where: **HI** = Hazard Index **HQ** = Hazard Quotient **Fi** = Fraction index

Where the HI > 1, there may be a risk to human health.
- 9) Exposure to all xylene isomers to be considered together. Values detailed in this table are the lowest (most conservative) of o-, m- and p- xylene isomers.
- 10) PFAS assessment also uses a hazard index approach to ensure the total exposure from all four PFAS compounds combined does not exceed the LLTC_{oral}. Where the hazard index exceeds 1, further consideration or assessment of the risk is required, even where none of the individual C4SL values are exceeded.
- 11) PFAS C4SL values are interim. The C4SL has been derived using the sum of the four PFAS compounds as the basis of the low level of toxicological concern. The term interim reflects concerns raised by the Committee on Toxicity (COT) and the fact that further work by the COT and others may results in the need for the LLTC to be updated.
- 12) Generic Assessment Criteria assume no free phase contamination is present. Where free phase contamination is present, further assessment may be required.
- 13) Solubility Saturation Limit and Vapour Saturation Limit are provided in accordance with relevant guidance documents. Where these values are exceeded, and the vapour pathway is an important contributing pathway to exposure, then the following should be considered:
 - Free phase contamination may be present
 - Exposure from vapour pathways will be over predicted.
 - Where the vapour pathway is >90% of exposure then it is unlikely that the relevant HCV will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Additional assessment should be undertaken where this is the case, with consideration that:

 - Exposure is unlikely to reach the relevant HCV and the risk based on the assumed conceptual model is likely to be negligible.
 - Vapour pathway exposure should be calculated using algorithms suitable for free phase or NAPL sources
 - Screening could be considered using the lower saturation limit, which is the approach adopted by the USEPA. However, this may not be practical in many cases because of very low limits and is in any case highly conservative.

Where the vapour pathway is the only exposure pathway considered then effective assessment criteria should be derived manually in accordance with guidance outlined in CLEA Science Report SC050021/SR4
- 14) The C4SL for inorganic mercury considers chronic exposure risk only. Further assessment of acute risks may be required. Refer to guidance provided in SoBRA (2020) Development of Acute Generic Assessment Criteria for Assessing Risks to Human Health from Contaminants in Soil.