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HUMBERSIDE MATERIALS LABORATORY LTD.

Phase 3: Remediation Strategy

41 Eastgate South, Driffield

Produced for Mr N Smith

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0.0	Document for issue	R Lester *Geo-Environmental Engineer*	M Driver *Director*	November 2022
1.0	Amended to reflect hardstanding or artificial grass in garden areas	R Lester *Geo-Environmental Engineer*	M Driver *Director*	February 2023

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1 Introduction

Humberside Materials Laboratory Limited (HML) were commissioned by Mr N Smith to produce a remediation strategy for a proposed (residential) development on land at 9 Eastgate South, Driffield, East Yorkshire. The land is hereinafter referred to as *the site*.

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1.1 Aims

The aim of this remediation strategy is to provide a robust framework of procedures to ensure the site is suitably remediated and is fit for the proposed residential end use.

1.2 Scope

The scope of this remediation strategy includes details of:

1. What remediation is required
2. Who will undertake the remediation works and
3. What remediation methods will be employed
4. How the remediation works will be validated and verified

While health and safety risks involved with the proposed remediation measures described herein have been considered, this document does not provide a method statement for works based on health and safety risk assessments. Safe systems of work should be designed and adopted by those implementing the remediation measures detailed herein.

1.3 Background

The site has been the subject of previous site investigation reports by Humberside Material Laboratory (HML), as follows.

- HML Phase 1 (desk study) Report: 41 Eastgate South, Driffield (HML ref.: 1493/5898/P/P1) dated October 2022

- HML Phase 2 (ground investigation) report: 41 Eastgate South, Driffield (HML ref.: 1493/5898/P/P2) dated October 2022

2 Site Constraints

2.1 Proposed development

The proposed works comprise nine new two-storey houses and associated infrastructure following the removal of existing buildings, as per ERYC planning applications (e.g. 22/01552/PLF).

Updates to the proposed site development mean that there will not be any soft landscaping in most of the plots. The only soft garden areas are anticipated inside the northern boundary wall where a band of trees and shrubs is to be planted.

2.2 Site description

The site is located off Eastgate South, Driffield, East Yorkshire, post code YO25 6LW, around grid reference 502640, 457830. The site is about 65m by 30m in plan area.

The existing site is a former building materials depot and includes:

- Two existing disused former commercial buildings
- A large area of concrete apron / hardstanding

The site is relatively level, with a very slight rise towards the northeast. Ground levels range between about 17m and 18m above Ordnance Datum (AOD).

2.3 Site history

There has been some previous redevelopment at the site. Historical commercial and industrial usage at the site, includes:

- Unknown commercial usage (in the east half of the site) – mid-19th century
- Oil cake and manure works (whole site) – late 19th century to mid-20th century
- Seed mill (whole site) – 1960s and 1970s
- Builders' merchants / depot – 1980s to 2010s

Nearby historical commercial and industrial land usage includes:

- Former depot (0m north) – 1970s to 1990s
- Cattle market (10m west) – late 19th century to 2010s
- Frozen food depot / works (20m south) – 1960s to present day
- Gas works and holders (150m west) – mid 19th century to 1990s
- Gravel pit (170m northwest) – mid 19th century
- Iron & Brass Foundry (180m west) – mid 19th century

2.4 Geology, hydrogeology and hydrology

Based on inspected geological, historical and topographical information, the provisionally anticipated ground conditions are as shown below (in Table 1).

Table 1: Summary of anticipated geology (determined before site works)

Strata	*Description*	*Depth to base (m bgl)*
Made ground	Could include rubble and reworked natural soils	<2
Glaciofluvial deposits (GFD)	Mainly sands and gravels	5 – 6
Glacial till	Mainly boulder clay	
Flamborough Chalk	White flint free chalk	50 – 100
Other chalk	White chalk	>150

The groundwater is of some limited vulnerability. The anticipated underlying GFD sands and gravels are a Secondary Aquifer – A, while the deeper chalk is a Principal Aquifer. There is a reported water authority licensed abstraction for potable use 624m northwest, but the site is not within 1km of a groundwater source protection zone (SPZ).

The Beck – possibly the nearest surface water feature – is only about 76m southwest (c. 2m below site ground levels). There is a (probably unused) *surface water abstraction* for the former Driffield Cattle Market (108m west). However, the site is reported to be in an area with a low probability of flooding.

2.5 Environmental information

Other environmental data includes the following.

- The site is not in an area affected by radon. No radon protection will be needed at the site
- The site is in a Nitrate Vulnerable Zone (NVZ) for surface water and groundwater. Otherwise, there are no identified sensitive land uses
- The former depot (0m north) appears to be a Registered Waste Transfer Site operated by Yorkshire Water Services Ltd authorised to transfer excavation waste containing asbestos cement
- There are many sewage discharge consents into the nearby The Beck (e.g. 102m south). There are also many reported pollution incidents concerning The Beck.
- Evidently, there is a scrapyard at Providence Works (107m west) – metal recycling site (mixed)
- The infilled gas holders (144m west) are a Historical Landfill Site. There are no other nearby Historical Landfill Sites (within 1km) or BGS Recorded Landfill Sites, Local Authority Recorded Landfill Sites or Registered Landfill Sites
- Identified Potentially Infilled Land includes a former chalk pit (392m north) and an old brick works (498m northeast). There could also be some nearby infilled ditches (109m west) and (341m south)

3 Ground Conditions & Contamination

3.1 Ground conditions

The findings of the recent HML investigation indicated the following sub-strata at the site.

- **Made ground:**
  - Layer of concrete hardstand – 0.12m to 0.20m in thickness
  - Below the (external) concrete apron, most made ground comprises rubbly construction waste mainly consisting of brick with some concrete, tile, slag and chalk
  - No odours noted
  - Total depth of made ground: 0.18m to 1.05m – generally thickest in the southeast and thinnest in the northwest
- **Glaciofluvial Deposits (GFD):**
  - Revealed to a depth ranging between 1.40m (WS5) and 2.95m (WS1) BEGL
  - Mainly comprises: Medium dense (to dense) silty/clayey (to very silty/clayey) very sandy GRAVEL or very gravelly SAND. Gravel is chalky
  - Locally, includes some shallow firm clay (e.g. in WS4 from 0.5m to 1.25m depth) and a band of deeper firm clay (in WS1 from 1.65m to 1.85m depth)
- **Glacial till:**
  - Revealed to a depth of at least 3.45m BEGL
  - Comprises: Firm/stiff (sandy) silty CLAY with occasional gravel (i.e. boulder clay)

No standing groundwater or inflows were observed in any of the recent boreholes which were drilled to a depth of up to 3.45m below ground level (BEGL).

3.1.1 Visual olfactory evidence of contamination

Noted indicators of potential contamination include:

- Rubbly made ground (recorded below most of the site)

3.2 Contamination screening

Eight samples of relatively shallow ground material were previously tested for the presence of metals, PAHs & asbestos. Four samples were also tested for TPH. Most testing was carried out on samples of rubbly made ground.

Some asbestos fibres (chrysotile) and GAC exceedances of metal were detected in samples of near surface made ground, as detailed below (in Table 2). No PAH or TPH GAC exceedances were found.

Table 2: Summary of GAC exceedances										
			Location:	WS1	WS1	WS2	WS3	WS4	WS5	WS5	WS6
			Depth (m bgl):	0.18-0.50	0.50-0.80	0.17-0.30	0.17-0.41	0.16-0.40	0.13-0.50	0.70-1.05	0.17-0.60
			Soil type:	GFD sand/gravel		Rubbly made ground					
			HML sample ref:	64498	64499	64500	64501	64502	64503	64504	64505
			Subcontractor ref.:	113066-1	113066-2	113066-3	113066-4	113066-5	113066-6	113066-7	113066-8
Element		GAC* (mg/kg) 1% SOM	GAC* (mg/kg) 2.5% SOM	GAC* (mg/kg) 6% SOM	Concentration detected (mg/kg)							
Metals	Arsenic	37			6.1	3.0	8.6	197	19	13	24	9.7
	Beryllium	1.7			<1	<1	<1	<1	2.5	5.8	1.1	<1
	Copper	100			9.8	6.2	8.0	42	52	135	87	34
	Lead	200			9.3	6.7	16	302	43	120	2330	125
PAHs		-	-	-	NGED	NGED	NGED	NGED	NGED	NGED	NGED	NGED
Asbestos	screening	-			NAD	NAD	NAD	chrysotile	chrysotile	NAD	chrysotile	NAD
	form	-			-	-	-	Loose fibres	Loose fibres	-	Loose fibres	-
	quantity	-			-	-	-	0.008	0.001	-	0.001	-
TPH		-	-	-	NGED	-	-	NGED	NGED	-	NGED	-

* based on residential end use. NAD – no asbestos detected. NGED – no GAC exceedances detected

3.3 Contamination assessment

Three relevant contamination linkages (RCL1 to RCL3) have been identified by the revised risk assessment, as summarised below (in Table 3). These are the only plausible contamination linkages considered to have unacceptable risk.

Table 3: Relevant contamination linkages (RCLs)					
Ref.	Source	Pathway	Receptor	Risk rating	Potential area of risk
RCL1	1. Made ground beneath the site 2. Historical land use: oil cake and manure works 3. Historical land use: seed mill 4. Historical land use: builders' merchants / depot 5. Adjacent depot (0m north) **Metals, PAHs, asbestos, petroleum hydrocarbons**	Inhalation, ingestion, absorption	Residential site users	Moderate	Direct exposure in soft gardens and landscaping
RCL2			Ground-workers	Low / Moderate	During groundworks
RCL3		Absorption	Building materials	Low / Moderate	Direct exposure (to soil and soil leachate) below ground

4 Remediation options appraisal

The objectives for the remediation works include the following.

- Provide a safe environment for proposed end users (occupants and site workers)
- Minimise contamination risks to construction workers, adjacent residents and other receptors to acceptable levels
- Implement a sustainable approach to the remediation works

Contamination linkages are generally broken by either (a) removing the source, (b) severing the pathway, (c) moving the receptors or (d) a combination of any of the above three (a – c).

4.1 RCL1

RCL1 concerns the risk of harm to future site users from direct exposure (inhalation of dust, ingestion or absorption) of contaminants (e.g. asbestos and metals) within *in situ* ground material via proposed soft landscaped and garden areas.

4.1.1 *Remediation options*

Possible remediation options to address RCL1 could include the following.

Option 1. Install a cover system in soft garden and soft landscaped areas (remove source & break the pathway)

Option 2. Remove all potentially contaminated sub-surface soils from soft gardens and soft landscaped areas (remove the source)

Option 3. On-site clean up of the *in situ* soil materials (remove the source)

Option 4. Install a hardstanding layer across the site (break the pathway)

Option 1, installing a cover system, offers a very robust and practicable solution. It can be reasonably sustainable if local landfills/recycling facilities and sources of clean soils are used. There may also be potential to re-use any clean, site won (natural) soils within the site to increase the sustainability. The soils for removal from proposed soft landscaping/garden areas are not expected to contain gross contamination, so might potentially be readily recycled by a local company and turned into a useable product (although this is subject to waste compliance testing, e.g. WAC tests and assessment by local landfills/recycling facilities).

Option 2, removing all potentially contaminated sub-surface soil from soft landscaped areas, might offer a very suitable option in view of the current proposals (for the only anticipated soft landscaping is inside the northern boundary of the site where made ground appears to be very thin; generally, less than 0.4m in thickness). It should be simple to identify the extent of potentially contaminated soils as the made ground has

been revealed to consistently contain manmade materials, mainly fragments of brick). Unlike Option 1, there is no clear depth at which to install a base marker or barrier for clean backfill soils; the excavation and disposal is limited to the extent and depth of the made ground.

Option 3, cleaning up the *in situ* soil materials on-site, might theoretically provide a potentially more sustainable remediation solution, eliminating the need to remove waste off-site. However, current remediation technologies do not provide simple solutions for cleaning up inorganic asbestos and metals contamination. The small size of the site means there is insufficient economy of scale available to make it economically or environmentally viable to bring clean up plant and operations to the site.

Option 4, installing a hardstanding layer across the site, is unrealistic for the development proposed – especially for the proposed wooded area inside the northern boundary. The development is low rise residential and is expected to include some soft landscaping areas and/or gardens. Nevertheless, the developer has chosen to install artificial grass instead of soft landscaped areas and gardens. The artificial grass could be underlain by a hard-dig barrier to prevent future pathways between the underlying made ground and site users.

4.1.2 Chosen remediation measures

Accordingly, the salient features of the chosen remediation solution (for the reasons given above, in Section 4.1.1) are as follows.

Option 2. Remove all potentially contaminated sub-surface soils from soft gardens and soft landscaped areas (remove the source) – FOR THE PROPOSED WOODED AREA AT THE REAR (NORTH) OF THE SITE

AND

Option 4. Install a hardstanding layer across the site (break the pathway) – BELOW PROPOSED ARTIFICIAL GRASS AREAS IN GARDENS AND PUBLIC OPEN SPACES

The above chosen solution(s) is subject to no significant unforeseen contamination being encountered. Should any unforeseen visual or olfactory evidence of contamination be detected, then this must be investigated to the satisfaction of the local planning authority and any other relevant regulatory bodies. If unforeseen contamination is revealed, remediation measures would be subject to review.

The above solutions avoid the construction of soil cover systems. Such cover systems should not be required beneath buildings / roads / permanent hardstanding where there will be no viable (ingestion or absorption) pathway between site occupants and

the identified contamination sources. Permanent hardstanding is typically where the asphalt, concrete, paving or compacted granular stone fill means there is an insignificant likelihood that the area could be converted into soft landscaping in future. At least **250mm** of compacted gravel or other hard dig material (e.g. asphalt or concrete) is required to achieve this in garden areas – to ensure that future site users cannot be exposed to possibly deeper rubbly made ground.

4.2 RCL2

RCL2 concerns the risk of harm to groundworkers (and members of the public) from direct exposure (inhalation of dust, ingestion or absorption) of contaminants (e.g. asbestos and metals) from *in situ* ground material during construction activities.

4.2.1 Remediation options

The Main Contractor will be responsible for devising suitable safe methods of work to minimise health and safety risks from construction activities. The contractor must manage the risks in accordance with legal requirements including relevant health and safety and environmental regulations. Therefore, the remediation options appraisal for RCL2 is beyond the scope of this report.

4.2.2 Chosen remediation

Nevertheless, some site management guidance is provided to the contractor (in Section 5). However, adherence with this guidance should not discharge any of the contractor's legal obligations to provide a safe working environment. It is still the responsibility of the Contractor to design, set up and maintain suitable, safe methods of working and contractor risk assessments and method statements must comply with relevant health and safety regulations such as the Control of Asbestos Regulations (2012).

No clearly identifiable asbestos contaminated material ACM was noted during the recent HML investigation (in August 2022). However, there is always potential for unexpected contamination and a watching brief should be put in place to monitor for ACMs during ground works. Should any suspected ACMs be identified, works should be stopped, and the area screened off and immediate assistance sought from a competent environmental engineer.

4.3 RCL3

RCL3 concerns the risk of harm to building materials from absorption of contaminants (e.g. sulphates and hydrocarbons) within *in situ* ground material. This could affect buried concrete (through sulphate attack) and water supply pipework (e.g. through permeation by hydrocarbons).

The required remediation to avoid sulphate attack on buried concrete is by provision of sulphate resistance to BRE Special Digest 1 classification DS-3, AC-2s. This should be provided as a matter of course and is subject to validation and verification by building inspectors and warranty providers, as detailed, for example, in Clause 3.19 of NHBC Standards. Accordingly, no further remediation verification is required.

4.3.1 Remediation options

Nevertheless, some mitigation measures are needed to ensure that clean water pipework is not permeated by contaminants such as hydrocarbons. The following options are provided:

Possible remediation options to address RCL3 could include the following.

Option 1. Install barrier pipe across the site (break the pathway)
Option 2. Replace any contaminated made ground with clean soils to create a clean corridor of soil around the water supply pipes (remove the source)

Option 1, installing barrier pipework offers a very robust and practicable solution.

Option 2, providing clean service corridors is less robust, as there is always potential for migration of contamination.

4.3.2 Chosen remediation measures

The chosen remediation solution is as follows.

Option 1. Install barrier pipe (e.g. Protectaline™) across the site

5 Remediation strategy

5.1 Contractors and personnel

The following parties are named key stakeholders in the remediation works.

- *Client and project manager for the site:* to be confirmed
- *Main contractor:* to be confirmed
- *Appointed independent Environmental Engineer:* to be confirmed
- *The licenced landfill site for material removed from site:* to be confirmed
- *Local Authority:* East Riding of Yorkshire Council (ERYC)
- *Source of imported topsoil:* to be confirmed
- *Source of imported granular materials:* to be confirmed

The success of the remediation is dependent on good operational procedures and communication links between the different parties. There is a strict obligation to keep the local authority informed of any problems or requests for variations to this remediation strategy.

5.2 Outline remediation strategy

The remediation works shall include the following steps (possibly in the order shown).

Step 1. Carry out site preparation works (e.g. site clearance, utilities surveys)
Step 2. Install barrier pipework in agreement with local water authority (Yorkshire Water)
Step 3. Complete structural construction works
Step 4. Inspect, sample and test any site won soils identified for potential reuse within the soft wooded garden area inside the northern site boundary
Step 5. Import clean soils (ideally, following inspections and testing) from off-site, as necessary, for use in the soft wooded garden area inside the northern site boundary
Step 6. Import clean construction materials for the construction of 250mm-thick hard-dig layer in gardens and public open spaces
Step 7. Remove *in situ* made ground in ALL garden areas (and public open spaces) to at least 0.25m below final ground level (bfgl) before an inspection by an Environmental Engineer of rear garden areas
Step 8. Install hardstanding in rear gardens and public open spaces using clean imported materials
Step 9. Carry out validation works on installed hardstanding in rear gardens (including inspection pits)
Step 10. Prepare and submit (Phase 4) validation / verification report for the remediation works

The above steps are a summary of the remediation requirements only. All other requirements outlined within this Phase 3 Remediation Strategy must also be complied with, especially those outlined below (in Section 5.2).

All remediation works are subject to validation and verification at the completion of works. All relevant evidence and documentation related to the remediation works must be retained and included in the verification report. Further details are presented later (in Section 7).

Remediation works shall not begin until the strategy has been approved by the local planning authority (LPA).

5.2 Detailed remediation strategy

Step 1: Carry out site preparation works (e.g. site clearance, utilities surveys)

This step is to be carried out by (or under the direct supervision of) the Main Contractor.

The removal of the existing buildings must be carried out by competent persons following a safe system of work approved in agreement with the local planning authority and relevant demolition and waste regulations. All demolition material shall be removed off site.

Step 2: Install barrier pipework in agreement with local water authority (Yorkshire Water)

This step is to be carried out by the Main Contractor who will need to purchase barrier pipework and fittings and have them delivered to site. Receipts of purchase and/or delivery notes shall be retained to provide evidence of procurement. Photographs shall be taken and recorded of the installed barrier pipework.

Alternatively, the developer shall obtain documentary evidence (e.g. a letter) from Yorkshire Water Services to explain that barrier pipework is not required.

Step 3: Complete structural construction works

This step is to be carried out by the Main Contractor.

As discussed above (in Section 4.2), the construction works shall be carried out in such a way as to mitigate risks to groundworkers and members of the public as well as the natural and built environment. A watching brief should be put in place to monitor for unexpected contamination (e.g. ACMs, strong odours, petroleum staining).

Step 4: Inspect, sample and test any site won soils identified for potential reuse within the soft wooded garden area inside the northern boundary

This step is to be carried out by the Main Contractor. The Environmental Engineer may be employed to carry out some inspections, sampling and testing.

If clean, natural soils are excavated during site works, they could be suitable for use within the soil cover system. This could include clean, natural soils excavated from foundation and service trenches or road foundations from around the site.

There could be clean glacial sands present at shallow depth, especially in the west of the site (for example as revealed in WS1 at depths greater than 0.18m). This is likely to be revealed as light-coloured silty sand, possibly with chalky gravel. Clean excavated soils shall be set aside (away from potentially contaminated spoil to mitigate any risk of cross contamination) for potential re-use within cover systems.

The Main Contractor shall provide the Environmental Engineer with notes/records of exactly where site won, clean, natural soils have come from (including depths and locations on the site).

Any site won, clean soil to be re-used within cover systems will need to be inspected by an Environmental Engineer to check its suitability. Ideally, this will take place at an early stage. The Environmental Engineer will carry out appropriate sampling and testing to confirm the suitability of site won material.

Step 5. Import clean soils (and carry out inspections and testing) from off-site, as necessary, for use in the soft wooded garden area inside the northern site boundary

This step will be mainly carried out by the Main Contractor and/or Client. The Environmental Engineer will carry out any inspections and ensure sufficient, suitable material is sampled and tested to prove imported soils are clean and suitable for use.

Ideally, sampling and testing of proposed imported material (e.g. topsoil) for the soft wooded area should be undertaken as early as possible and prior to importation. Otherwise, there is a risk of unnecessary costs to remove or treat any unsuitable imported soils.

To help ensure that suitable topsoil material is procured, YALPAG guidance recommends the purchaser (e.g. Client or Contractor) should ask the supplier the following questions.

- *What proof is there of the material source? Is it greenfield, brownfield, etc.?*
- *Will all the material be coming from the same source?*
- *Is the material a suitable growing medium?*
- *Has the supplier evidence of sampling and testing the imported material including tests for the suitable contaminants, as detailed below (in Table 4)?*

- *Were the contamination tests performed by a laboratory with UKAS and MCERTS accreditation for the tests?*
- *Is a copy of the whole laboratory report available and does it include an interpretive section?*
- *Will the provided certificate be dated within the last 2 months?*

Ideally, an Environmental Engineer should perform an initial inspection of (topsoil) material prior to importation. During this inspection and all subsequent inspections, the Environmental Engineer should check the imported topsoil material is:

- A suitable growing medium
- Free from obvious contamination and signs of asbestos containing materials
- Not from a location suspected to be inhabited with invasive or injurious plants
- Free from strong or unsuitable odours
- Free from unsuitable material e.g. bricks, timber and glass

Imported clean cover system soils shall be deposited within the site in such a manner that they cannot be cross-contaminated by any other materials (e.g. by placing on a clean plastic sheet).

The Environmental Engineer shall design a suitable test regime to prove imported soils are clean and suitable for use. The scope of testing on imported soils shall depend on the source origin (greenfield / manufactured or brownfield / screened) which must be verified with documentation. The testing provided by suppliers must be performed on the identified material destined for site. If insufficient documentation is provided from the supplier, additional sampling and testing will be needed and the minimum rates of sampling and testing are given below (in Table 4), based on current YALPAG guidance (available online from LPA websites).

Table 4: Imported soil sampling and testing requirements

*Contaminant**	*Greenfield / Manufactured source*	*Brownfield / Screened source*	*Virgin quarried material*	*Crushed hardcore, stone, brick (excluding asphalt)*
Metals	✓	✓	✓	✓
PAHs	✓	✓		✓
Asbestos	✓	✓		✓
TPHs		✓		✓
Soil organic matter	✓	✓		
pH	✓	✓		
Minimum rate of testing:	3 samples or 1 per 250m³ +	6 samples or 1 per 100m³ +	1 or 2 samples	1 per 500m³

* other contaminants (e.g. phenols, cyanide, BTEX, MTBE) may require testing for brownfield/screened/recycled sources subject to assessment

+ whichever number of samples is more & dependent on source & receptor (could be up to 1 sample per 50m³)

The use of topsoil from a greenfield or manufactured source (not a brownfield or screened source) could significantly reduce contamination testing costs.

Any shortfall in test data shall be satisfied with additional testing from sampling by an Environmental Engineer of the imported material. The sample(s) will be taken either from the stockpile or from the placed soil. Often, samples are taken from the placed soil when the cover system thickness can also be verified, but there is a risk the material will need to be removed if tests suggest the soils are not sufficiently free of contamination.

Brownfield, screened or recycled imported soils may require testing for additional contaminants depending on the source. This will be subject to an assessment by the Environmental Engineer which will consider former land use of the source site and potential contaminants of concern and will require local planning authority agreement.

The acceptance criteria (or screening values) for the testing on (imported/site won) cover system soils are presented later (in Appendix B). The testing must be undertaken by a UKAS / MCERTS laboratory, accredited for the type of tests involved.

No imported material found to contain contamination above the assessment criteria limits shall be allowed to remain on site. The Environmental Engineer shall inform the Client who shall ensure the Contractor removes the material off site and provides the Environmental Engineer with copies of waste transfer notes as documentary evidence.

Step 6. Import clean construction materials for the construction of 250mm-thick hard-dig layer in gardens and public open spaces

This step shall be carried out by the Main Contractor.

Only clean aggregates or surfacing materials shall be imported to install in gardens. These materials will be installed below artificial grass, patios, driveways and footpaths to at least 250mm thickness.

Imported stone aggregate for placement in gardens will need to be sampled and tested based on the requirements detailed above (in Step 5 and Table 4). Any suspected contaminated construction materials shall be removed off site or inspected by an environmental engineer for approval for use in gardens or to be removed off site.

Step 7. Remove in situ soils in ALL soft garden areas (and public open spaces) to at least 0.25m below final ground level (bfgl)

This step shall be carried out by the Main Contractor.

In situ below ground material shall be removed down to a depth at least 250mm below final ground level (bfgl) in gardens and soft landscaped areas to accommodate a 250mm

hard-dig layer, as shown in the enclosed drawings (in Appendix A). Should final ground levels be raised, the depth required for removal could be reduced commensurately.

Contaminated material at this stage and advanced stages will be either removed directly from site by loading into vehicles or, alternatively, stockpiled in such a manner (i.e. underlain with plastic sheeting) as to contain it and stop the spread of contamination, prior to loading for transport and disposal.

The receiving landfill / recycling site (or soil treatment facility, STF) for waste material shall be supplied by the Client or Contractor with available existing test data from the site (e.g. the HML Phase 2 site investigation report and WAC test results) for their classification and acceptance that the material is suitable for their (landfill / treatment) site.

The Contractor must retain documentary evidence to demonstrate the suitable removal of waste soils. The volumes and timings of exported material shall be recorded in site notes. Copies of all consignment, transfer and delivery notes and tickets shall be retained and passed to the Environmental Engineer for inclusion within the (Phase 4) validation / verification report.

Step 8. Install hardstanding in rear gardens and public open spaces using clean imported materials

This step shall be carried out by the Main Contractor. Extensive photos will need to be taken of the 250mm-thick hardstanding (i.e. hard-dig material) during installation.

Following successful completion (or before, if necessary) of the structural works, the hardstanding and artificial grass can be installed in garden and soft landscaped areas. This shall be placed to a thickness of 0.25m below final ground levels.

The hardstanding will include at least 250mm of compacted well-graded stone (e.g. Type 1) or solid surfacing materials (e.g. concrete or asphalt). The base of the hard dig layer will include a geotextile separation layer.

A section of a typical hard dig layer is shown later (in Appendix A) along with a plan of the required remediation areas.

A base geotextile (e.g. Fastrack™ 1800) shall be placed over the garden areas prior to the laying of imported granular fill and soils. This will fulfil the role of separation and marker layer between the cover system and underlying remaining made ground.

The Contractor shall ensure that extensive photographs are taken during installation of the 250mm-thick hard-dig materials to show the following.

- Location of the geotextile

- Close-up photos to show the quality and thickness of the hard dig materials
- Background features to prove the location of the close-up photos
- Site stockpile or quarantine areas

Tape measures or measuring staffs will need to be included in the close-ups to demonstrate the thickness of the cover system elements. Site identification boards or other media should also be included to detail the dates, photo locations and site name.

Step 9. Carry out validation works on installed cover system (including inspection pits)

This step shall be carried out by the Environmental Engineer.

The Environmental Engineer shall carry out hand dug inspection pits to test the hard-dig nature of the installed hard-dig materials below the proposed artificial grass. This shall be carried out at a frequency no less than once per plot. Nine inspection pits are anticipated. Should the engineer be able to successfully dig through the hard-dig layer then it will need to be remediated by removal and re-installation.

The Environmental Engineer shall record the progress hand digging through the hard dig layer and log and photograph any encountered materials (soil, stone and geotextile). This information shall be retained for inclusion in the Phase 4 (validation/verification) report.

The Environmental Engineer shall carry out tests on excavated samples from the inspected cover system, as required. This shall include tests on any samples which are suspected to contain elevated levels of contamination (e.g. due to the presence of man-made materials). Tests may also be carried out to meet the minimum sampling and testing requirements for imported material, as detailed earlier (in Table 4) and later (in Appendix B).

Step 10. Prepare and submit (Phase 4) validation / verification report for the remediation works

The Environmental Engineer shall prepare a validation / verification report as per the requirements detailed later (in Section 7). This shall be submitted to the local planning authority for review.

6 Site Management Procedures

The proposed remediation measures, discussed previously herein, consider the long-term risk at the site to human health and other environmental receptors. However, in the short-term, there are potential health, safety and environmental risks during the construction works.

The Main Contractor at site is fully responsible for devising their own suitable safe working practices to address all existing health, safety and environmental risks during the construction phase. The following guidance is provided to highlight some of these hazards and risks which should be dealt with by the contractor's method statements and risk assessments.

6.1 Health and safety

The HML site investigation report identified some contamination in the near surface soils at the site. Some loose asbestos fibres and elevated levels of metals were detected in shallow made ground soils. These contaminants can be potentially toxic.

No ACMs were detected. Nevertheless, there is always the potential for asbestos containing materials within made ground. The risk from asbestos in made ground should never be discounted.

Some basic minimum measures to protect site workers from the hazards of contaminated soil should include the following.

- Inform site staff about anticipated soil contaminants and related hazards and safety measures, e.g. through site inductions, toolbox talks, etc.
- Provide personnel protective equipment (PPE), e.g. boots, helmets and gloves, for the use of ground workers
- Provide and enforce designated safe areas for smoking, eating and drinking
- Provide suitable hygiene facilities for washing, drying and changing
- Display contact details for emergency services
- Ensure there are no naked flames or other ignition sources where hazardous ground gas is a potential risk (e.g. in confined spaces)
- Implement suitable procedures to prevent the generation and spread of dust

The site is near some existing residential dwellings. Appropriate safety precautions should be employed for working near to domestic properties.

6.1.1 Site security and working hours

The site is to be secure when work is not being undertaken once construction has started. Entry and egress shall be controlled when the site is active.

Site working hours are expected to be Monday to Friday 07:30am to 17:30pm and 08:00am to 14:00pm on Saturday, unless written consent for extended hours is given by the local authority.

6.2 Dust, odours and fumes

The contractor should minimise emissions to air and take all necessary precautions to prevent the accumulation and spread of smoke emissions, fumes, dust or odours from site plant, stored fuel or other substances and prevent them from drifting around the site or into the nearby properties and public space. A record of any complaints received should be kept for comparison against daily work logs.

6.2.1 Dust

During excavations, soil stockpiling and other earth movements, measures will need to be implemented to prevent migration of dust.

The contractor should introduce suitable working methods and dust suppression techniques to mitigate the generation and spread of dust. Suitable health and safety protocols should be determined through appropriate consultations with qualified asbestos specialists. The following measures are options that should help minimise and control dust.

- Soil dampening (e.g. on bare earth and stockpiles) especially during dry weather
- Dust curtains
- Wheel washing and street sweeping
- Sheets/hoarding around site, plant or other locations
- Sheeting for lorries entering/leaving the site
- Liaison with neighbours
- Designated areas for parking and loading/unloading
- Low drop heights during movement of soils
- Cessation of potential dust-spreading activities during high winds

6.2.2 Odours

No strong odours are anticipated during the remediation works, i.e. during the excavation and movement of soil materials. If unexpected odours are detected, such works must halt and the local planning authority must be informed. Works shall only continue after further investigation by an environmental specialist with appropriate local authority approval.

6.2.3 *Fumes*

All work plant should be maintained in good repair and should meet legal emission standards. Plant should not be left running for long periods when not directly in use. Consideration should be given to the use of electrically powered plant instead of diesel.

6.3 Noise and Vibration

Some noise is unavoidable during construction works. Nevertheless, the following measures should help minimise the generation of noise and vibration:

- Good maintenance of plant
- The use of silencers on plant, if required
- Switching off plant when not in use
- Unloading and loading of material within designated areas
- Coordinating plant and lorry movements to reduce site traffic
- Liaison with neighbours

The site is adjacent to a residential area. Therefore, any activities likely to generate unusually large amounts of noise and ground vibration (e.g. sheet pile driving) might be potentially unsuitable. Any such works should be approved in advance by the local authority.

Procedures to reduce noise and vibration are detailed in BS 5228-1:2009+A1:2014 (Code of practice for noise and vibration control on construction and open sites).

6.4 Fuel, oils and chemicals

Measures and procedures should be put in place to prevent leaks and spills of oil, fuel or chemicals. Further information on this is provided in Guidance for Pollution Prevention, GPP2, produced by the EA and other organisations, available free online. The measures and procedures include:

- Suitable bunding or overflow storage (110% capacity of liquid storage volume)
- Locks on valves and covers to prevent vandalism
- Drip trays for diesel-fired engines, pumps and generators
- Suitably maintained diesel-engined plant
- Spill kits with staff suitably trained in their application
- An oil, chemical and product inventory for the site
- Site drainage plans
- Emergency procedures (included in the site induction)

Regular inspections should be made of on-site discharge points, bunding, drainage systems, oil separators (and drip-trays) to check that these are in good condition.

The storage, itinerary, and use of hazardous materials on-site should be conducted in accordance with the Control of Substances Hazardous to Health (COSHH) regulations (2002). Records should be maintained of all hazardous materials on-site.

6.5 Unforeseen Contamination

Protocols shall be in place to deal with unforeseen potentially contaminated materials identified by visual or olfactory evidence (i.e. the presence of staining, odours or harmful substances, etc.). The protocols should include the following.

- Cessation of work in the area followed by immediately informing an Environmental Engineer and the local authority to agree how to deal with the material
- Fencing off the area of concern
- Testing of potentially contaminated material, as required
- Removal of contaminated soils for segregation, storage or stockpiling within a bunded and covered area, as appropriate
- Extraction of contaminated groundwater to be placed in suitable containers
- Transfer off-site of contaminated soil, if necessary
- Testing of samples from the base/ sides of excavations
- Recording of the locations, quantities and nature of any removed materials, results of tests and the subsequent actions taken

6.6 Other pollution control measures

Any discharges to local watercourses or surface water drainage should only be made with the appropriate discharge consents. These can be obtained from the Environment Agency and or local drainage authority. For example, appropriate consents should be obtained where wastewater, e.g. from a wheel wash, needs to be poured into drains.

Procedures will be required to reduce the migration of suspended solids (e.g. silts and fine sands). All soil should be stockpiled away from surface water features and drains and where the gradient is at a minimum. Rain protection covers and/or water collection gutters should be used where surface run-off of silty water could occur. These measures can also mitigate any risks of migration of potentially contaminated leachate from stockpiled or surface soils.

6.7 Utilities

Service locations should be investigated at an early stage in the development to minimise project costs and potential disruptions. Services should be turned off / disconnected as appropriate to make safe during development and minimise any health, safety or environmental risks.

7 Validation and Verification

7.1 Verification requirements

Validation of the remediation works comprises three elements:

1 Verification of the depth of the hard-dig layer and the suitability of the constituent material in gardens and public open spaces
2 Verification of the removal of potentially contaminated made ground in the soft wooded area inside the northern site boundary
3 Verification of the purchase and installation of barrier pipe for water supply

Validation shall be carried out by suitably qualified and experienced environmental specialists (e.g. from HML). Validation will be achieved with the aid of appropriate inspections, sampling, testing, photographing and collection of relevant documentation.

Validation and verification shall meet the requirements of suitable guidance, e.g. as outlined in the latest version of YALPAG's *Verification Requirements for Cover Systems: Technical Guidance for Developers, Landowners and Consultants.*

The purpose of the validation / verification phase (Phase 4) is to ensure that all the remediation works have been carried out as specified. Therefore, the following items shall be directly checked and verified to be satisfactory (or otherwise) compared with the requirements specified within this document.

- Imported (or *in situ*) soil sampling and testing
- Visual / olfactory inspection records of imported materials
- Photos to removal of made ground in the soft wooded area inside the northern site boundary
- Photos to show placement and thicknesses of suitable material in the hard dig layers in gardens and public open spaces
- Inspection records of hard-dig layer inspection pits
- Documentary evidence of import/export of soil or waste to or from the site
- Documentary evidence (e.g. receipts or delivery tickets) and/or photos to prove the installation of barrier pipe or copies of correspondence from the local water authority stating that barrier pipe is not required

7.2 Phase 4 (validation / verification) report

A verification / validation report shall be produced by the appointed independent engineer at the end of all remediation works. The report shall include the following (e.g. as per the latest YALPAG requirements).

- Site details including planning application reference
- Summary of areas and remediation works undertaken

- Diary of events
- Details of quantity, location for disposal, conveyance notes for contamination materials removed from site
- Details of source, test data and quantity for hard dig layer materials
- Details of geotextile used below the hard dig layers
- Details of imported clean materials including the location, quantity and test data at the specified rate
- Photographic record of the works and depths of soil cover
- Results of chemical analyses
- Evidence of installation of barrier pipe
- Details of any non-conformances and rectifications

A full copy of the final verification report shall be forwarded to the local authority for their review.

Appendix A

Plans & Photographs

Notes:

1. Do not scale
2. Locations of all features are approximate only
3. Background image from Kevin Hardcastle Architectural Consultant, drawing number 2080:1 (Revision A, dated April 2022)
4. This drawing should be read in conjunction with the latest revision of the HML Phase 3 Remediation strategy (HML ref.: 1493/5898/P/P3)
5. Made ground will need to be removed from the soft wooded area. 250mm of clean hard-dig is needed below gardens

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HUMBERSIDE MATERIALS LABORATORY LIMITED
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Telephone & Fax 01652 652753
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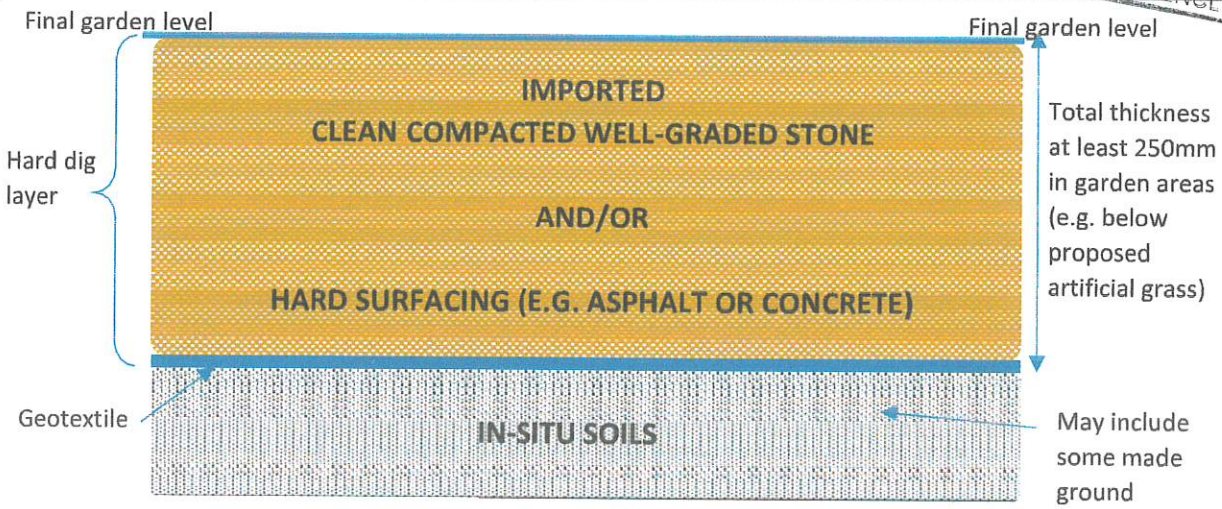
Drawing Title: **Remediation location plan**
Drawing No.: 1493-5898-P3-01 Revision: 1
Site: 41 Eastgate South, Driffield
Client: Mr N Smith
Project No.: 1493/5898/P
Date: 01/02/2023

Notes:

1. Do not scale from this drawing
2. This drawing should be read in conjunction with the HML Phase 3 Remediation strategy (HML ref.: 1493/5898/P/P3)
3. Imported topsoil shall meet British Standards BS 3882:2015 topsoil specification for at least uppermost 100mm
4. Topsoil and subsoil shall be a suitable growing medium
5. All remaining soils shall be free from obvious contamination and signs of asbestos containing materials
6. Any imported soils shall not be from a location suspected to be inhabited with invasive or injurious plants
7. All placed soils shall be free from strong or unsuitable odours
8. All soils shall be free from unsuitable material e.g. bricks, timber and glass
9. Geotextile shall be a suitable separator layer (e.g. Fastrack 1800 or similar)
10. No potentially contaminated materials shall be placed in the hard dig layer or soft wooded area.



HARD DIG LAYER IN GARDENS

All sub-surface made ground material removed from this area

SOFT WOODED AREA (INSIDE SITE NORTHEAST BOUNDARY)

HUMBERSIDE MATERIALS LABORATORY LIMITED
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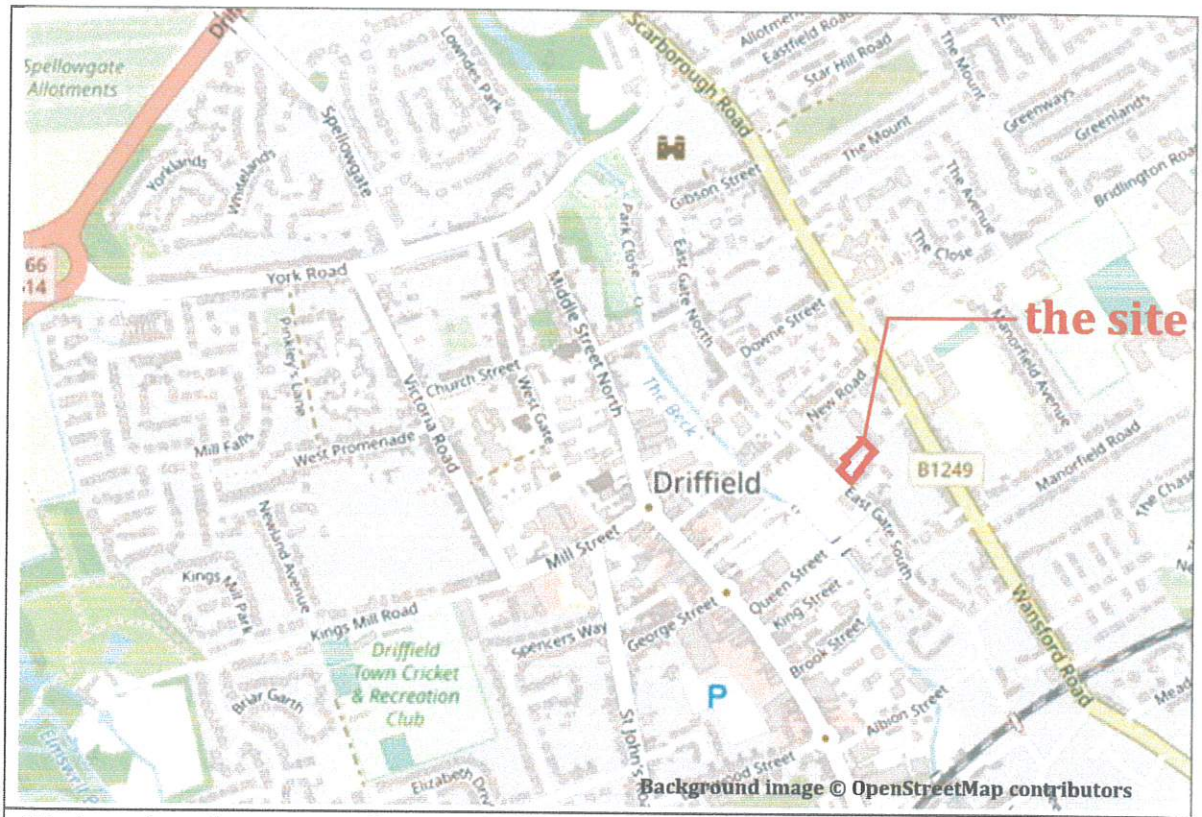
www.humbersidematerialslab.co.uk

Drawing Title: **Cross-sections through remediation**
Drawing No.: 1493-5898-P3-02 Revision: 1
Site: 41 Eastgate South, Driffield
Client: Mr N Smith
Project No.: 1493/5898/P
Date: 01/02/2023

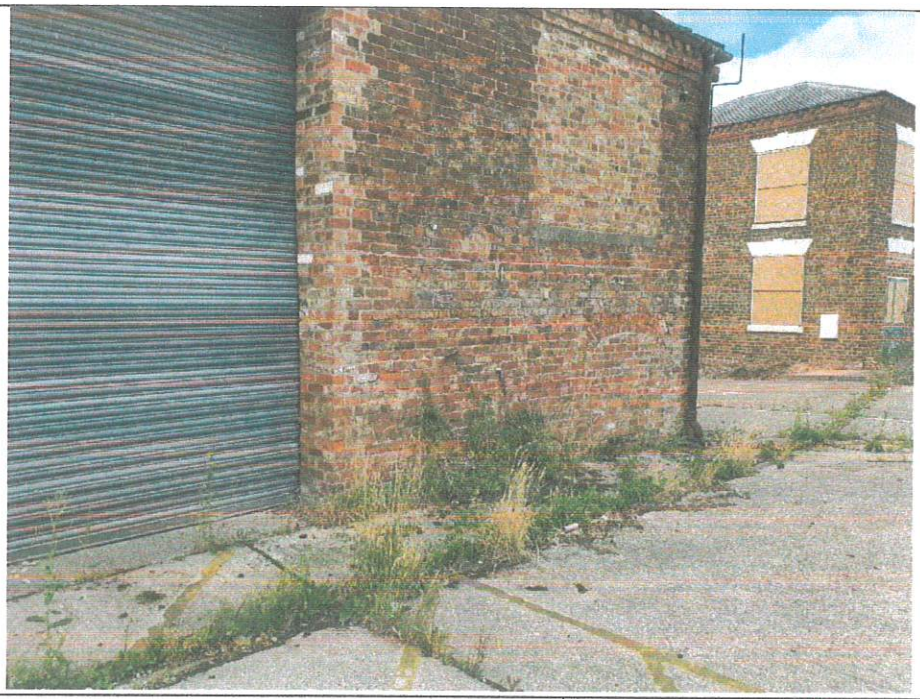


Site location plan *Date copied:* 14 Oct 2022 *Source:* openstreetmap.org

Aerial photograph: 1 *Date copied:* 14 Oct 2022 *Source:* Google Earth Pro®

3D view: 1 *Date copied:* 14 Oct 2022
Photo direction: East
Description: Google Earth 3D view of the site

Camera position:



Site photo: 1 *Date:* 26 Aug 2022
Photo direction: West
Description: Existing disused warehouse building

Camera position:

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Site photo: 2 *Date:* 26 Aug 2022
Photo direction: Northwest
Description: Existing disused house (left) and reception (right) buildings

Camera position:

Site photo: 3 *Date:* 26 Aug 2022
Photo direction: North
Description: Existing disused reception (left) and store (right) building

Camera position:

Site photo: 4 *Date:* 26 Aug 2022
Photo direction: Northeast
Description: Existing disused reception and store (left) building & concrete hardstanding/apron

Camera position:

Appendix B

Generic acceptance criteria (GAC) for imported or site won soils for use in gardens

The acceptance criteria (or screening values) for the imported topsoil (and other soils for use in gardens) are mostly taken from the LQM/CIEH S4ULs for human risk assessment based on a residential context (with potential for home grown produce), as reproduced below (in Tables A to C), although some screening values are taken from published C4SLs (e.g. lead and benzoapyrene). The testing must be undertaken by a UKAS / MCERTS laboratory, accredited for the type of tests involved.

Table A – Metals (and metalloids) acceptance criteria

Element	*mg/kg*
Arsenic	37
Beryllium	1.7
Boron	290
Cadmium	11
Chromium III	910
Chromium VI	6
Lead	200
Mercury Element	1.2
Mercury Inorganic	40
Mercury Methyl	11
Selenium	250
Copper	2400
Nickel	130
Zinc	3700

Table B - Total Petroleum hydrocarbons (TPHs) acceptance criteria

TPH aliphatic				*TPH aromatic*			
Equivalent carbon fraction	*Residential with plant uptake mg/kg*			*Equivalent carbon fraction*	*Residential with plant uptake mg/kg*		
	1% SOM	*2.5% SOM*	*6% SOM*		*1% SOM*	*2.5% SOM*	*6% SOM*
C5-6	42	78	160	C5-7	70	140	300
C6-8	100	230	530	C7-8	130	290	660
C8-10	27	65	150	C8-10	34	83	190
C10-12	130 (48)	330 (118)	760 (283)	C10-12	74	180	380
C12-16	1100 (24)	2400 (59)	4300 (142)	C12-16	140	330	660
C16-35	65000 (8.5)	92000 (21)	110000	C16-21	260	540	930
C35-44	65000 (8.5)	78	160	C21-35	1100	1500	1700
-	-			C35-44	1100	140	300

Figures in parentheses are the vapour or soluble saturation limits

Table C – Polycyclic aromatic hydrocarbons (PAHs) acceptance criteria							
Compound	*Residential with plant uptake mg/kg*			*Compound*	*Residential with plant uptake mg/kg*		
	1% SOM	2.5% SOM	6% SOM		1% SOM	2.5% SOM	6% SOM
Genotoxic PAHs				**Non genotoxic PAHs**			
Benzo(a)pyrene*	5.0	5.0	5.0	Acenaphthene	210	510	1100
*benzo(a)pyrene is a surrogate marker for the eight genotoxic PAHs including benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, benzo(k)fluoranthene, benzo(ghi)perylene, chrysene, dibenz(ah)anthracene & indeno(123-cd)pyrene based on CL:AIRE (2014) *C4SL – SP1010 Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, Appendix E provisional C4SLs for benzo(a)pyrene as a surrogate marker for PAHS*				Acenaphthylene	170	420	920
				Anthracene	2400	5400	11000
				Fluoranthene	280	560	890
				Fluorene	170	400	860
				Naphthalene	2.3	5.6	13
				Phenanthrene	95	220	440
				Pyrene	620	1200	2000

No asbestos fibres shall be detected