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# Remediation Method Statement Report

Old Clayton Kennels and Cattery, Storrington Road, Washington, West Sussex RH20 4AG

On behalf of the Highwood Group

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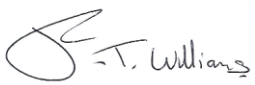
| v.3.01 |  |  |  |
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# 1. INTRODUCTION

## 1.1. General

Ground and Water Limited were instructed by the Highwood Group to produce a Remedial Method Statement for the site at the Old Clayton Kennels and Cattery, Storrington Road, Washington, West Sussex RH20 4AG.

## 1.2. Aims of the Investigation

The aim of this report was to supply the client and their designers with information regarding the ground conditions underlying the site to assist them in preparing an appropriate scheme for development.

This Remediation Method Statement Report must be read in conjunction with the following reports referenced:

- Omnia Phase I-II Geo-Environmental Site Assessment Report referenced A11530/1.2, dated April 2022. This report referred to a previous Desk Study Report: *Merebrook Consulting Ltd, Phase 1 Assessment (Desk Study), Land at Clayton Kennels, Storrington Road, Washington, (Ref: DS-18373-13-246REVB) Dated February 2014*;

- Ground and Water Limited, Phase II Site Investigation Report v3.01 (GWPR6344/SIR/May 2025);

The techniques adopted for the investigation were chosen considering the requirements of the client, anticipated ground conditions, and bearing in mind the nature of the site, limitations to site access and other logistical limitations.

## 1.3. Conditions and Limitations

This report has been prepared based on the terms, conditions and limitations outlined within Appendix A. Reference has been made to a historical site investigation by another company. Ground and Water Limited cannot be held liable for any shortcomings.

This report has been modified following comments by Horsham District Council and supersedes the Remediation Method Statement produced by Ground and Water Limited reference GWPR6344/GIR/July 2025 v2.01.

## 1.4. Technical Glossary

Generic technical terms and their description can be viewed within the glossary provided within Appendix B.

## 2. SITE SETTING

### 2.1. Site Location

The site comprised a ~1.35ha approximately rectangular shaped plot of land located on the northern side of Storrington Road. The site was located to the north-west of Washington, West Sussex and on the northern boundary of the South downs National Park.

The national grid reference for the centre of the site was approximately TQ 48773 18002. A site location plan can be seen in Figure 1 with the site development area shown in Figure 2.

### 2.2. Site Description

At the time of the four phases of site works undertaken between November 2024 and March 2025, the site comprised the buildings of a former kennels and cattery including a reception, dog accommodation, animal training area, and two residential properties – as well as temporary structures which included sheds and compost heaps. Areas of hardstanding and soft landscaped were noted between and around the structures.

Additional site works were then undertaken during May 2025 when it was noted that all structures had been demolished and the areas of hardstanding had been removed from the site.

### 2.3. Proposed Development

At the time of reporting, August 2025, the proposed development was understood to comprise the demolition of the existing buildings on-site and the construction of a two storey, 60-bed care home alongside eight (8no.) bungalows with associated vehicle parking, soft landscaping and access roads.

The proposed development fell within Geotechnical Design Category 2 in accordance with Eurocode 7. The proposed development plan can be seen within Figure 3.

The proposed development plan is shown in Figure 3.

### 2.4. Previous Third Party Ground Investigations

The results of the previous desk studies and ground investigation were reported in the Omnia Phase I-II Geo-Environmental Site Assessment Report referenced A11530/1.2, dated April 2022.

The main features of the site history were:

- The review of the site history showed that the site was part of Clayton Farm from at least 1875. From 1971, the farm buildings were split into “Kennels” on-site and “Old Clayton” off-site. Since then the construction of new kennels buildings and a connecting road between them has taken place along with landscaping and the installation of a drain along the site’s western boundary.

- The land directly to the north and west of the site has been fields since at least 1875. From 1957-1961, two sand pits were excavated to the north and west of the site, with associated infrastructure (small buildings and roadways) and ponds. By 1971, land immediately north of the site was used by RMC Engineering Works. By 1980, the sand pits were disused, but the ponds remained. By 2001, the western pit had been expanded into Sandgate Park Quarry and

the engineering works had constructed two additional buildings. By 2015, the engineering works' buildings had been demolished and replaced with residential development. In 2021, the houses were complete but the ponds in the northern pit remained.

The key findings of the intrusive investigation were:

- Topsoil and Made Ground were found to a depth of between 0.80 – 1.00m bgl.
- Soils described as weathered Folkestone Formation were found to a maximum depth of 2.00m bgl overlying the unweathered Folkestone Formation to a maximum depth of 3.50m bgl. The base of the formation was not encountered.
- Groundwater was not encountered.

The key findings of the geo-environmental assessment were:

- Elevated concentrations of PAHs were found in one location (SA101) within the Made Ground between 0.80 – 1.00m bgl.
- Chrysotile asbestos fibres were found in the near surface Made Ground in two locations (WS109 and HP108).
- A total of five (5no.) ground gas monitoring rounds were undertaken on the site with one visit being undertaken during a period of low and falling pressure and a further two of the visits being undertaken during the winter months, typically considered to be 'worse case' conditions. Based on the five monitoring rounds, in accordance with BS 8485(2015)+A1(2019), the site was classified as Characteristic Situation 1 CS1 that did not require special ground gas protection measures.

The report concluded that the key findings of the geotechnical assessment were:

- It was proposed that foundations within the natural soils could be founded at a depth of 1.20-2.20m bgl across the site, subject to confirmation of line loadings. As a result of soft/loose soils in the western portion of the site, foundations should be locally deepened onto higher strength soils.

The report recommended the following further investigations:

- Further trial holes to delineate the extent of the asbestos and PAH contamination identified.

- Additional intrusive investigation of the inaccessible areas of the site following demolition of the existing structures.

- The drilling of deeper boreholes to facilitate the design of deeper piles by a specialist piling contractor.

## 2.5. Conceptual Site Model

The tabulated Conceptual Site Model based upon results of the Updated Conceptual Site Model developed as part of the Omnia Phase I-II Geo-Environmental Site Assessment Report referenced A11530/1.2, dated April 2022 is outlined overleaf. For ease of reference and understanding, the risks have been classified within this risk assessment against four possible levels / categories, summarised in the table below. Any risk deemed to be negligible within the Preliminary Risk Assessment have been excluded from this report.

| Risk Categories used in the Tabulated CSM | |
|---|---|
| **Low Risk** | Regarding this potential SPR linkage, the site is considered suitable for the proposed end-use and there is not considered to be an unacceptable risk to receptors. However, it is considered that further investigation to confirm this is recommended. |
| **Moderate Risk** | Regarding this potential SPR linkage, the site may not be suitable for the proposed end-use in its current condition and there may be an unacceptable risk to receptors. Further investigation is required to confirm this. |
| **High Risk** | Regarding this potential SPR linkage, the site is probably or certainly not suitable for proposed end-use and there is likely to be an unacceptable risk to receptors. Contaminants probably or certainly present and urgent action required in the short term. |

| Tabulated Conceptual Site Model – Pollutant Linkage Summary (On-Site Sources) | | | |
|---|---|---|---|
| Potential Sources | Potential Absorption Pathways | Potential Receptors | Risk Classification |
| Made Ground from construction/ demolition activities. Elevated PAHs and asbestos fibres found previously:<br>• Asbestos,<br>• PAHs,<br>• TPHs,<br>• VOCs,<br>• Sulphates, and<br>• Metals. | • Direct ingestion of soil and soil derived dust<br>• Dermal contact of soil and soil derived dust<br>• Inhalation of dust (indoors and outdoors) with elevated concentration of determinands<br>• Ingestion of home-grown produce, and soils attached<br>• Direct ingestion of groundwater<br>• Inhalation of volatile vapour (indoors and outdoors) | **Human Health**<br>• End Users (Residents/Future site visitors)<br>• Construction workers during development<br>• Site operatives during maintenance works<br>• Neighbours and public | **Moderate** |
| | • Direct uptake of groundwater<br>• Direct uptake of determinands in the soil | **Flora and Fauna**<br>• Vegetation within soft landscaped areas | **Moderate** |
| | • Anthropogenic (man-made) pathways<br>• Vertical and lateral migration in permeable strata<br>• Surface water runoff | **Controlled Waters**<br>• Principal Aquifer (Folkestone Formation)<br>• Lake ~110m to north-west | **Low** |
| Aggressive ground conditions with Made Ground and natural ground, including groundwater:<br>• Sulphates,<br>• PAH/TPH.<br><br>Based on previous investigation, the sulphates fell into Class DS-1 and AC-2z. | • Direct contact with aggressive ground conditions | **Building Materials and Services**<br>• Buried Concrete<br>• Underground services (water pipes) | **Low** |
| Ground gases generated by area of historical landfilling extending within western boundaries of the site and Made Ground:<br>• Methane,<br>• Carbon Dioxide,<br>• Hydrogen Sulphide, and<br>• Carbon Monoxide.<br><br>Based on previous ground-gas monitoring, the site falls into the CS1 classification. | • Migration through anthropogenic & natural pathways<br>• Inhalation of Asphyxiating gases<br>• Explosion (methane only) | **Human Health**<br>• End Users (Residents/Future site visitors)<br>• Construction workers during development (especially in confined spaces)<br>• Site operatives during maintenance works in confined spaces<br>• Neighbours and public | **Low** |
| | • Migration through anthropogenic & natural pathways<br>• Explosion (methane only) | **Building Materials and Services**<br>• Buildings<br>• Confined spaces<br>• Underground services | **Low** |

| Tabulated Conceptual Site Model – Pollutant Linkage Summary | | | (Off-Site Sources) |
|---|---|---|---|
| Potential Sources | Potential Absorption Pathways | Potential Receptors | Risk Classification |
| Made Ground from adjacent historical area of landfilling. Elevated PAHs and asbestos fibres found previously:<br>• Asbestos,<br>• PAHs,<br>• TPHs,<br>• VOCs,<br>• Sulphates, and<br>• Metals. | • Direct ingestion of soil and soil derived dust<br>• Dermal contact of soil and soil derived dust<br>• Inhalation of dust (indoors and outdoors) with elevated concentration of determinands<br>• Direct ingestion of groundwater<br>• Inhalation of volatile vapour (indoors and outdoors) | **Human Health**<br>• End Users (Residents/Future site visitors)<br>• Construction workers during development<br>• Site operatives during maintenance works<br>• Neighbours and public | **Moderate** |
| | • Direct uptake of groundwater | **Flora and Fauna**<br>• Vegetation within soft landscaped areas | **Low** |
| Aggressive ground conditions associated with impacted groundwater;<br>• Sulphates,<br>• PAH/TPH.<br>Based on previous investigation, the sulphates fell into Class DS-1 and AC-2z. | • Direct contact with aggressive ground conditions | **Building Materials and Services**<br>• Buried Concrete<br>• Underground services (water pipes) | **Low** |
| Ground gases generated by adjacent areas of historical landfilling to the immediate west and ~119m to the north:<br>• Methane,<br>• Carbon Dioxide,<br>• Hydrogen Sulphide, and<br>• Carbon Monoxide.<br>Based on previous ground-gas monitoring, the site falls into the CS1 Classification. | • Migration through anthropogenic & natural pathways<br>• Inhalation of Asphyxiating gases<br>• Explosion (methane only) | **Human Health**<br>• End Users (Residents/Future site visitors)<br>• Construction workers during development (especially in confined spaces)<br>• Site operatives during maintenance works in confined spaces<br>• Neighbours and public | **Low** |
| | • Migration through anthropogenic & natural pathways<br>• Explosion (methane only) | **Building Materials and Services**<br>• Buildings<br>• Confined spaces<br>• Underground services | **Low** |

# 3. SUMMARY OF PREVIOUS INVESTIGATION

## 3.1. Summary of Previous Ground and Water Site Investigations

Previous phases of site works have been undertaken by Ground and Water Limited at the site and this report should be read in conjunction with GWPR6344 v3.01/GIR/May 2025. The various phases and their findings are summarised below.

**Phase I November 2024 and Phase II January 2025 (Phase II Ground Investigation Report Ref.: GWPR6344 v1.01/GIR/February 2025)**

Phase I was undertaken between 27th – 29th November 2024. Seven trial pits (TP1 – TP7) were machine excavated to depths of between 1.20 - 2.00m bgl. Infiltration tests in accordance with the principles of BRE365 were undertaken in the trial pits. In addition, 5No. Windowless Sampler Boreholes (WS1 – WS5) to a depth of between 2.00 – 3.00m bgl. The density of the soils prevented further progress of WS1 and WS2 below 2.50m and 2.00m bgl respectively.

In addition, seven Trial Pits (CPA, CPC - CPG) were hand excavated to a maximum depth of 0.50m bgl .in order to obtain samples for contamination purposes in order to delineate three areas of contamination identified during the earlier investigation. Due to the presence of a hard surfaced access road, it was not possible to excavate the proposed CPB trial pit.

Phase II was undertaken between 6th and 10th January 2025 and comprised the drilling of 2No. Cable Percussion Boreholes (BH1 and BH2) to a depth of 20.00m bgl.

**Contamination Assessment**

Based on the proposed development, the results of the chemical laboratory testing were compared to the Generic Assessment Criteria (GAC) for a 'Residential with homegrown produce' land-use scenario, as this was considered the most appropriate land-use scenario.

The comparison between the laboratory analysis and the assessment criteria indicated that the determinands were identified at below the adopted screening values and were not considered to represent an unacceptable risk to future receptors.

Two samples of Made Ground (CPA/0.20m and CPC/0.10m bgl) were targeted at delineating where elevated concentrations of PAHs were identified in the previous investigation. The results indicated that the location of the elevated PAHS can be treated as a localised hotspot. Likewise, four samples of Made Ground (CPD/0.15m, TP1/0.15m, WS1/0.20m and WS2/0.20m bgl) and four samples of Topsoil (CPE/0.15m, CPF/0.15m, CPG/0.15m and CPH/0.15m bgl) were targeted at delineating an area where asbestos was found during the previous investigation. Since no asbestos was found this location could also be treated as a localised hot spot.

It should be noted that some areas of the site were inaccessible at the time of investigation due to the buildings from the former kennels and cattery. Therefore, it was recommended that further investigation works and testing should be undertaken within these areas post demolition and targeted at proposed garden areas to assess the risks posed by underlying soils and the need for any further remediation.

**Groundwater**

Given anticipated low mobility of the contaminants found and not excessive exceedances, moderately deep groundwater conditions and the conceptual site model showing the nearest surface water receptor was 110m from the site, it is not expected that the soils on-site represent an unacceptable risk to controlled water receptors. No further action is considered necessary.

**Phase III February 2025 and Phase IV March 2025 (Updated Phase II Ground Investigation Report Ref.: GWPR6344 v2.01/GIR/April 2025)**

Phase III was undertaken on 5th February 2025, when TP1 and TP3 – TP7 were re-excavated and had their depths extended by ~0.50m bgl to enable a repeat of the BRE 365 infiltration tests.

Phase IV was undertaken on 31st March 2025 and comprised the machine excavation of ten trial pits (TP201 - TP210) to obtain samples of the Topsoil from across the site to confirm its suitability for reuse in the soft landscaped areas of the proposed development.

**Contamination Assessment**

Based on the proposed development, the results of the chemical laboratory testing were compared to the Generic Assessment Criteria (GAC) for a 'Residential with homegrown produce' land-use scenario, as this was considered the most appropriate land-use scenario.

The comparison between the laboratory analysis and the assessment criteria indicated that the determinands were identified at below the adopted screening values and were not considered to represent an unacceptable risk to future receptors.

Loose fibres of chrysotile asbestos were identified in one sample of the Topsoil during Phase IV of the current investigation (TP204/0.20m bgl). Quantification was undertaken on the sample and indicated that asbestos was present at < 0.001%.

A quantification risk assessment was carried out for the concentration recorded, in accordance with the guidance within CIRIA 733. A summary of the results is shown in the table below.

| Asbestos Risk Assessment | | | | |
|---|---|---|---|---|
| **Sample** | **Mesothelioma Accumulated Risk (fibres/ml.year)** | **Mesothelioma Risk** | **Lung Cancer Accumulated Risk (fibres/ml.year)** | **Lung Cancer Risk** |
| TP204/0.20m | 0.00091 | Insignificant | 0.00065 | Insignificant |

Based on CIRIA Table 14.1 for Mesothelioma and CIRIA Table 14.3 for Lung Cancer, the risk for TP204/0.20m bgl was considered to be insignificant.

No asbestos has been identified in the remaining samples in which fibres were noted during Phase IV.

No fibres were identified during the earlier phases of the investigation.

An **Asbestos Management Strategy** should be put in place so that any potentially asbestos containing materials are identified and removed from site in a suitable manner to prevent cross-contamination.

**Phase V May 2025 (Updated Phase II Ground Investigation Report Ref.: GWPR6344 v3.01/GIR/May 2025)**

Phase V was undertaken on 5th May 2025 and comprised the machine excavation of five trial pits (TP301 – TP305) under the footprint of the demolished buildings to obtain soil samples for additional contamination testing.

Based on the proposed development, the results of the chemical laboratory testing were compared to the Generic Assessment Criteria (GAC) for a 'Residential with homegrown produce' land-use scenario, as this was considered the most appropriate land-use scenario.

The comparison between the laboratory analysis and the assessment criteria indicated that the determinands were identified at below the adopted screening values and were not considered to represent an unacceptable risk to future receptors.

No asbestos was detected in the additional samples tested.

**Soils Encountered during Phase I - V May 2025**

The succession of conditions and description of soils encountered in the trial holes conducted across the November 2024 to May 2025 site works in descending order is tabulated below.

| Summary of Strata Encountered | | | |
|---|---|---|---|
| **Strata** | **Top Depth (m bgl)** | **Base Depth (m bgl)** | **Thickness (m)** |
| **TOPSOIL (BH1 - BH2, WS3 - WS5, TP2 - TP3 and TP5 - TP7, CPE – CPH, TP201 – TP210 only):** Dark brown slightly sandy slightly gravelly CLAY. Sand is fine to medium grained. Gravel is subangular to sub-rounded fine to coarse flint. | GL | 0.15 – 1.10m | 0.15 – 1.10m |
| **MADE GROUND (WS1, WS and TP4 only):** Tarmac. | GL | 0.10 – 0.15m | 0.10 – 0.15m |
| **MADE GROUND (WS1 - WS2, TP1 and TP4, CPA, CPC, CPD only):** Dark brown clayey sandy GRAVEL. The sand was fine to coarse and the gravel was fine to coarse, sub-angular to sub-rounded flint (60%) and concrete (40%). | GL – 0.10m | >0.10 – 0.70m | 0.20 – 0.60m |
| **MADE GROUND (TP301 – 305 only):** Pale brown sandy gravelly CLAY. Sand is fine to medium grained. Gravel is sub-angular to sub-rounded fine to coarse brick (40%), concrete (40%), flint (10%), slate (5%) and metal (5%). | GL | 0.30 – 1.40m | 0.30 – 1.40m |
| **HEAD DEPOSITS (BH1 - BH2, WS1 - WS2, TP1 - TP4 and TP6 - TP7, CPD – CPH, TP201 – TP210, TP301 - 305 only):** Brown sandy CLAY, light brown silty slightly sandy slightly gravelly CLAY to brown clayey gravelly SAND. The sand was fine to medium grained. Gravel is sub-angular to subrounded fine to medium flint. | 0.15 – 1.40m | 0.25 – 1.80m | 0.25 – 1.45m |
| **FOLKESTONE FORMATION (BH1 - BH2, WS1 - WS4, TP1 – TP7 only):** Reddish brown or orangish brown to light brown fine to medium grained SAND. | 0.30 – 1.80m | >1.00 - >20.00m | >0.20 – >18.50m |

### 3.2. Water Supply Pipe Risk Assessment

As part of the proposed development it is expected that new water supply pipes will be installed at the site. Water supply pipes have the potential to be exposed to contaminants in the ground that can

lead to unacceptable concentrations within the drinking water. If a risk is identified, specialist pipes that are protective of the drinking water are required.

A pipe selection risk assessment should be submitted to the water supply company as part of the development based on the supplier's assessment criteria. An indication of whether there is likely to be a risk can be seen tabulated below, where the PE pipe thresholds are based on *UKWIR Contaminated Land Assessment Guidance, 2014*.

| Pipe Selection Risk Assessment | | | |
|---|---|---|---|
| **Determinand** | **PE Pipe Threshold (mg/kg)** | **Laboratory Analysis Range (mg/kg)** | **Was the Threshold Exceeded?** |
| Total BTEX and MTBE | 0.1 | LOD | No |
| Total VOCs | 0.5 | - | No |
| Total SVOCs | 2 | - | No |
| Phenols | 2 | < 2 | No |
| TPH EC5 – EC10 (aliphatics and aromatics) | 2 | LOD | No |
| TPH EC10 – EC16 (aliphatics and aromatics) | 10 | < 1 – 2.8 | No |
| TPH EC16 – EC40 (aliphatics and aromatics) | 500 | < 10 – 91 | No |
| Naphthalene | 5 | LOD | No |

The results from the current investigation indicate that no determinands were above the threshold for the use of a PE pipe at the site.

### 3.3. Groundwater Risk Assessment

In the UK, the water environment is protected under a number of regulatory regimes, mainly governed by the Environment Agency. The Environment Agency is consulted when there may be a risk to Controlled Waters, or where a pollution incident has occurred historically. The Water Framework Directive is implemented in various guises covering groundwater, surface water and drinking water supply.

The DEFRA online maps indicated that the majority of the site was located on a Principal Aquifer associated with the bedrock deposits of the Folkestone Formation. The Gault Clay formation in the south-west corner was classified as Unproductive Strata.

From analysis of hydrogeological and topographical maps the groundwater table was anticipated to be encountered at depth within the Folkestone Formation. Perched water was also likely to be found within the Made Ground, especially after periods of intense or prolonged rainfall. It was considered that the groundwater was flowing northwards in alignment with local topography.

The nearest surface water feature was a lake noted ~110m to the north-west.

During the original investigation reported in the Omnia Phase I-II Geo-Environmental Site Assessment Report referenced A11530/1.2, dated April 2022, Topsoil and Made Ground were found to a depth of between 0.80 – 1.00m bgl. Soils described as weathered Folkestone Formation were found to a maximum depth of 2.00m bgl overlying the unweathered Folkestone Formation to a maximum depth of 3.50m bgl. Groundwater was not encountered.

During the current site investigations undertaken by Ground and Water Limited, Topsoil and Made Ground was encountered to 0.70m bgl, overlying sandy gravelly clay and gravelly clayey sand of the Head Deposits overlying the fine to medium sand of the Folkestone Formation to the base of the deep boreholes (20.00m bgl). Groundwater was not encountered during the ground investigation.

Given anticipated low mobility of the contaminants found and not excessive exceedances, moderately deep groundwater conditions and the conceptual site model showing the nearest surface water receptor was 110m from the site, it is not expected that the soils on-site represent an unacceptable risk to controlled water receptors. No further action is considered necessary.

### 3.4. Ground Gas Risk Assessment

Ground-gas risk assessment was beyond the scope of the current investigation.

A period of ground-gas monitoring was undertaken as part of the previous ground investigation and reference should be made to the Omnia Phase I-II Geo-Environmental Site Assessment Report referenced A11530/1.2, dated April 2022. The site was classified as Characteristic Situation CS1 where no specific gas protection measures are required. **However, the report suggested further ground-gas monitoring to confirm the classification given.**

### 3.5. Vapour Risk Assessment

The CSM identified limited sources of contamination that may pose an unacceptable risk to receptors through vapours. BTEX/MTBE were at LOD during the chemical laboratory testing.

# 4. REMEDIATION METHOD STATEMENT

## 4.1. Soils

Based on the available information within this report it was proposed that the following remedial methodology shall be undertaken around the three locations of contamination centred on trial holes SA101, WS109 and HP108 with the area delineated by the holes excavated/drilled during the current investigation.

For the hotspot centred on WS109:

- A reduce dig of 500mm in the vicinity of WS109 to expose the natural soils;
- Validation samples shall be taken from the base and sides of the excavation and tested.
- Until the laboratory test results are received the excavation will remain open. Should these samples indicate unacceptable concentrations, further removal is required.
- Following receipt of the results confirming no contamination remains, the placement of 500mm certified clean capping of Subsoil and Topsoil;
- Validation of the clean capping system by a suitably trained Ground and Water Limited engineer.

For the hotspot centred on HP108 which is located close to a tree protection zone TPZ:

- In areas outside the TPZ:
    - A reduce dig of 800mm to expose the natural soils;
    - Validation samples shall be taken from the base and sides of the excavation and tested.
    - Until the laboratory test results are received the excavation will remain open. Should these samples indicate unacceptable concentrations, further removal is required.
    - Following receipt of the results confirming no contamination remains, the placement of 800mm certified clean capping of Subsoil and Topsoil;
    - Validation of the clean capping system by a suitably trained Ground and Water Limited Engineer.
- In areas within the TPZ:
    - A reduce dig of a maximum of 100mm by hand to avoid damage to any roots;
    - Placement of a geotextile membrane;
    - Placement of 100mm certified clean capping of Topsoil;
    - Validation of the membrane and clean capping system by a suitably trained Ground and Water Limited Engineer.

For the hotspot centred on SA101 which is located close to a tree protection zone TPZ:

- In areas outside the TPZ:
    - A reduce dig of 10000mm to expose the natural soils;
    - Validation samples shall be taken from the base and sides of the excavation and tested.
    - Until the laboratory test results are received the excavation will remain open. Should these samples indicate unacceptable concentrations, further removal is required.
    - Following receipt of the results confirming no contamination remains, the

placement of 1000mm certified clean capping of Subsoil and Topsoil;
    - Validation of the clean capping system by a suitably trained Ground and Water Limited Engineer.
- In areas within the TPZ:
    - A reduce dig of a maximum of 100mm by hand to avoid damage to any roots;
    - Placement of a geotextile membrane;
    - Placement of 100mm certified clean capping of Topsoil;
    - Validation of the membrane and clean capping system by a suitably trained Ground and Water Limited Engineer.

#### 4.1.1. Reduce Dig

Made Ground and Topsoil shall be removed to the minimum defined depth for the relevant hotspot in a 5m radius centred on the relevant trial hole location to allow for the placement of clean soils. Samples must be taken from the base and walls of the excavation and tested for PAHs in the case of SA101 or asbestos in the case of WS109 and HPA108 to enable validation that the unacceptable concentrations have been removed. Should these samples indicate unacceptable concentrations, further removal is required.

Materials shall be removed and stockpiled on an impermeable liner with raised edges and covered at all times. This contamination stockpile destined for removal from site shall be stored away from imported soils to avoid cross-contamination. Materials to be removed off-site must be classified by carrying out Waste Acceptance Criteria (WAC) testing. A registered contractor must undertake the removal of waste. Consignment notes for the removal of waste must be obtained and kept for inclusion within the final validation Report.

#### 4.1.2. Clean Capping of Soil

Following receipt of the results of the validation sampling and testing confirming removal of the contamination, the resulting void shall be backfilled with clean certified soils. In areas outside the TPZ, it is recommended that at least the top 150mm of the clean capping should comprise suitable Topsoil for use as a growing medium. It is a requirement that this shall be no less than 100mm thick.

Inside the TPZ the 100mm shall comprise Topsoil overlying a geotextile marker membrane between the clean soils above and the potentially contaminated soils below.

Validation samples of the backfill material shall be taken. For imported soils, the source of the imported soil must be clarified as to whether it is from a brownfield or greenfield site to therefore determine ratio of chemical analysis required. Chemical analysis for a general suite of contaminants on imported greenfield material should be taken at a ratio of 1 sample per 200m$^3$ of soil or a minimum of 3 samples (whichever is greater). If the Topsoil is from a brownfield site, a minimum of 6 samples or 1 per 50m$^3$ is required (whichever is greater).

All subsoil and topsoil must be fit for purpose to ensure that the receptors cannot come into contact with determinands that could be detrimental to their health, see ‘Imported Material’ Section 4.4.

### 4.1.3. Validation

The remediation works outlined above will need to be inspected and independently validated by a Ground and Water Limited Engineer. All excavations will need to be inspected, documented and photographed.

The remediation works shall be validated through a site visit, sampled and photographed by a suitably trained Ground and Water Limited Engineer following the reduce dig and then after placement of the clean soils.

Validation samples of the backfill material shall be taken. The source of the imported soil must be clarified as to whether it is from a brownfield or greenfield site to therefore determine ratio of chemical analysis required. Chemical analysis for a general suite of contaminants on imported greenfield material should be taken at a ratio of 1 sample per 200m$^3$ of soil or a minimum of 3 samples (whichever is greater). If the topsoil is from a brownfield site, a minimum of 6 samples or 1 per 50m$^3$ is required (whichever is greater).

## 4.2. Ground Gas and Vapours

Based on the monitoring previously undertaken, the site warrants classification as **Characteristic Situation CS1**, where no precautions to prevent the ingress of ground-gas are needed. **However, the report suggested further ground-gas monitoring to confirm the classification given.**

With regards to the risk from vapours, BTEX-MTBE analysis did not show elevated levels that may indicate further testing may be needed.

## 4.3. Discovery Strategy

There may be areas of contamination that have not been identified during the course of the intrusive investigation (e.g. underground storage tanks and within bund). Such occurrences may be discovered during the demolition and construction phases for the redevelopment of the site.

Groundworkers must be instructed to report to the Site Manager any evidence for such contamination; this may comprise visual indicators, such as fibrous materials within the soil, discolouration, or odours and emission. Upon discovery advice must be taken from a suitably qualified person before proceeding, such that appropriate remedial measures and health and safety protection may be applied.

Should a new source of contamination be suspected or identified then the Local Authority will need to be informed.

## 4.4. Imported Materials

Any soil which is to be imported onto the site must undergo chemical analysis to prove that it is suitable for the purpose for which it is intended.

The soil must be fit for purpose and must either be supplied with traceable chemical laboratory test certificates or be tested, prior to placing (ideally) and after placing, to ensure that the future receptors (human health and vegetation) cannot come into contact with compounds that could be detrimental

to their health. The compounds that are to be tested for are those given in the Generic Assessment Criteria, which can be viewed in Appendix D of this report.

Chemical analyses must be undertaken at a rate of 1 validation trial hole per plot or area of soft-landscaping. The source of the imported soil must be clarified as to whether it is from a brownfield or greenfield site to therefore determine ratio of chemical analysis required. Chemical analysis for a general suite of contaminants on imported greenfield material should be taken at a ratio of 1 sample per 200m$^3$ of soil or a minimum of 3 samples (whichever is greater). If the Topsoil is from a brownfield site, a minimum of 6 samples or 1 per 50m$^3$ is required (whichever is greater).

Validation trial holes must also prove the depth of the clean cover and inspect quality of the material (free from visible contamination, invasive species or unsuitable material such as brick, timber, glass).

Any test certificates supplied with the imported Topsoil shall be passed onto Ground and Water Limited for inclusion within our Validation Report.

### 4.5. Waste Disposal

The excavation of foundations and other soils is likely to produce waste which will require classification and then recycling or removal from site.

Under the Landfill (England and Wales) Regulations 2002 (as amended), prior to disposal, all waste must be classified as either: Inert; Non-hazardous; or Hazardous.

The Environment Agency's Hazardous Waste Technical Guidance (WM3) document outlines the methodology for classifying wastes. Once classified the waste can be removed to the appropriately licensed facilities, with some waste requiring pre-treatments prior to disposal.

Following the investigation, two samples from Phase II, ten samples from Phase IV and five samples from Phase V were submitted to the analytical laboratory to undergo a suite of testing for contamination testing, as discussed in the previous sections. Sampling depths were chosen to reflect the receptor of concern, human health, and typically comprised a surface or near surface sample and periodically to 1.00m bgl. Any horizon where olfactory or visual evidence of contamination was present was also sampled.

Based on a risk phase analysis of the chemical laboratory test results, in accordance with EC Hazardous Waste Directive and undertaken by Ground and Water Limited, the majority of the samples of Topsoil and all samples of Made Ground encountered on-site were NON-HAZARDOUS. The results of the assessment are given within Appendix H.

The presence of cement bound Chrysotile Asbestos Fibres within the Topsoil of TP204 may mean the waste classification of this material is increased to **HAZARDOUS**. Hazardous waste requires pre-treatment prior to removal. The site may need to be registered as a Hazardous waste producer should such waste be removed from the site.

It is important to note that whilst we consider our in-house assessment tool to be an accurate interpretation of the requirements of WM3, therefore producing an initial classification in accordance with the guidance, this method classifies soils as either non-hazardous or hazardous and landfill

operators have their own assessment tools and can often come to different conclusions. As a result, some landfill operators could refuse to take apparently suitable waste. It is recommended that the receiving landfill views the results of this assessment and the chemical laboratory results to determine their own classification.

In addition to the samples described above, one sample of Made Ground from Phase V (TP305/0.20m bgl) was scheduled to undergo Waste Acceptance Criteria (WAC) testing with single batch leachate from the sample. The results indicate that sample conformed to the Inert Waste Classification.

It should be noted that the receiving landfill may see the presence of Made Ground within the soils to be indicative of a non-hazardous classification despite the presence of the WAC testing certificates indicating that it is inert. Therefore, it shall be considered that all Made Ground is classified as Non-hazardous, subject to finalising with the receiving landfill.

Where contaminated soils are to be removed, they shall be placed on an impermeable membrane (visqueen or similar) to ensure that no cross-contamination of soils occurs.

### 4.6. Validation Strategy

Any remedial works undertaken on the site will need to be inspected and independently validated by a Ground and Water Limited Engineer. All remedial excavations will need to be inspected, documented and photographed.

Following completion of all the remediation and validation works outlined above, a report must be submitted to the local authority for approval. The report shall include:

- Photographic evidence of removal of the contamination hotspots;
- Full details of the source of the imported soil (company, location, permit);
- Supplier test certificate for any imported clean cover material;
- Trial pit logs to confirm ground conditions;
- Laboratory analysis results from the independent testing;
- Independent confirmation of clean cover thickness;
- Copies of Waste Transfer Notes for the removed material.

Full liaison must be made with the statutory authority, prior to the implementation of this method statement and/or the removal of any material from site. All works must be undertaken to meet their full approval.

### 4.7. Health and Safety

All works associated with construction will need to take into account the presence of asbestos fibres within the Made Ground at the concentrations noted within the report. The Method Statements must ensure that not only site operative/workers are protected from any potential release of asbestos fibres but also that local residents are not affected.

All future maintenance workers/service operatives, working within areas of hardstanding (including beneath the footprint of building), will need to take into account the presence of Made Ground potentially containing fibrous asbestos within their work Method Statements.

Groundworkers must maintain a good standard of personal hygiene including the wearing of overalls, boots, gloves and eye protectors and the use of dust masks during periods of dry weather.

To prevent exposure to airborne dust by both the general public and construction personnel the site shall be kept damp during dry weather and at other times when dust were generated as a result of construction activities.

The site shall be securely fenced at all times to prevent unauthorised access. Washing facilities shall be provided and eating restricted to mess huts.

The presence of loose Asbestos fibres within the Made Ground will need to be take into account when producing Method Statement for construction and remedial works. Dampening down of excavation is likely to be required along with FFP3 masks, gloves and overalls for all site operatives. Perimeter dust monitoring may be required.

# FIGURES

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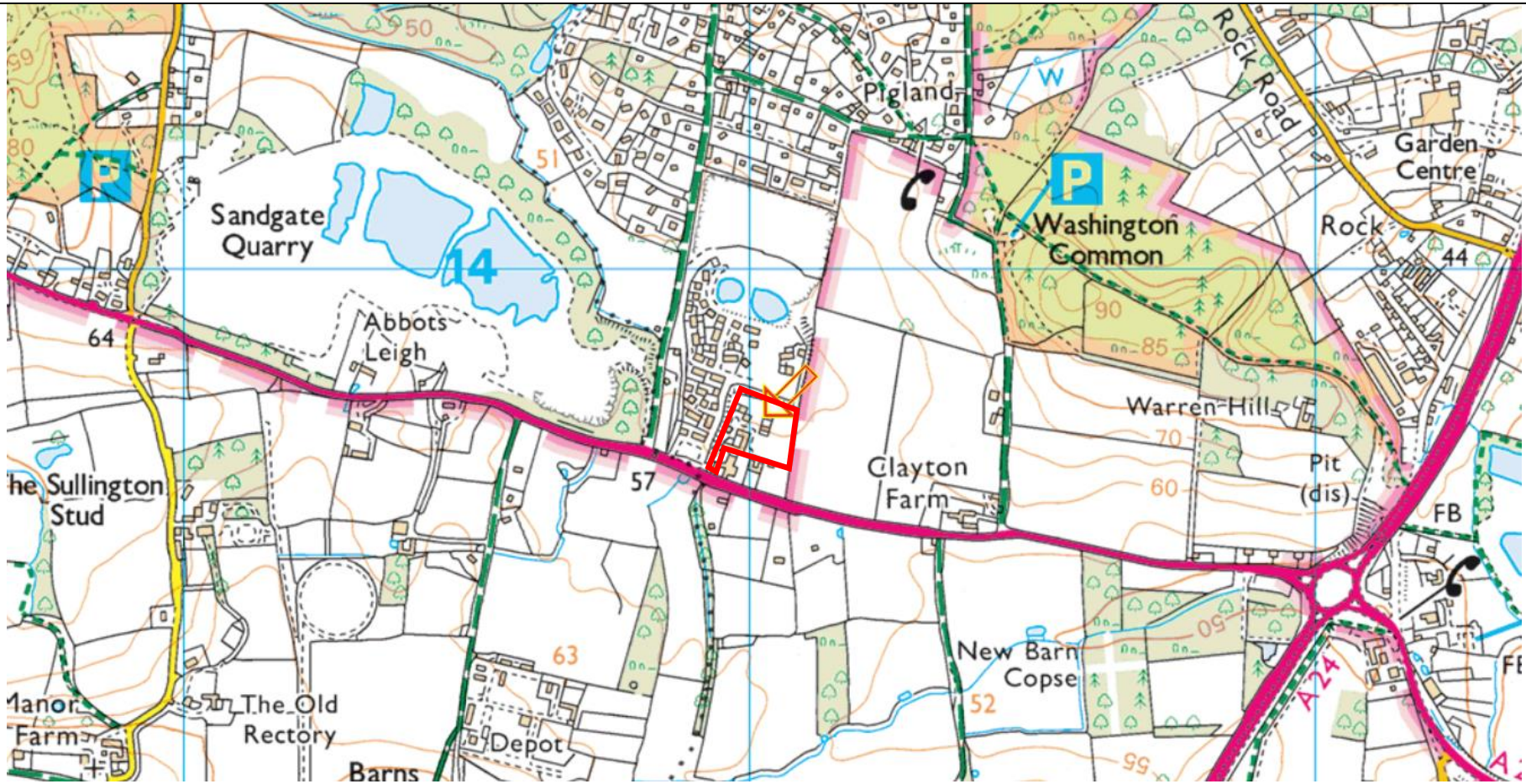


| | |
|---|---|
| **Project:** Old Clayton Kennels and Cattery Storrington Rd Washington West Sussex RH20 4AG | **Figure 1** |
| **Client:** Highwood Group | **Date:** August 2025 |
| **Site Location Plan** | **Ref:** GWPR6344 |




**APPROXIMATE SITE BOUNDARY**

| | | |
|---|---|---|
| **Project:** Old Clayton Kennels and Cattery Storrington Rd Washington West Sussex RH20 4AG | | **Figure 2** |
| **Client:** Highwood Group | **Date:** August 2025 | |
| **Site Development Area** | **Ref:** GWPR6344 | |




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**APPROXIMATE SITE BOUNDARY**

| | |
|---|---|
| **Project:** Old Clayton Kennels and Cattery Storrington Rd Washington West Sussex RH20 4AG | **Figure 3** |
| **Client:** Highwood Group | **Date:** August 2025 |
| **Proposed Development Plan** | **Ref:** GWPR6344 |

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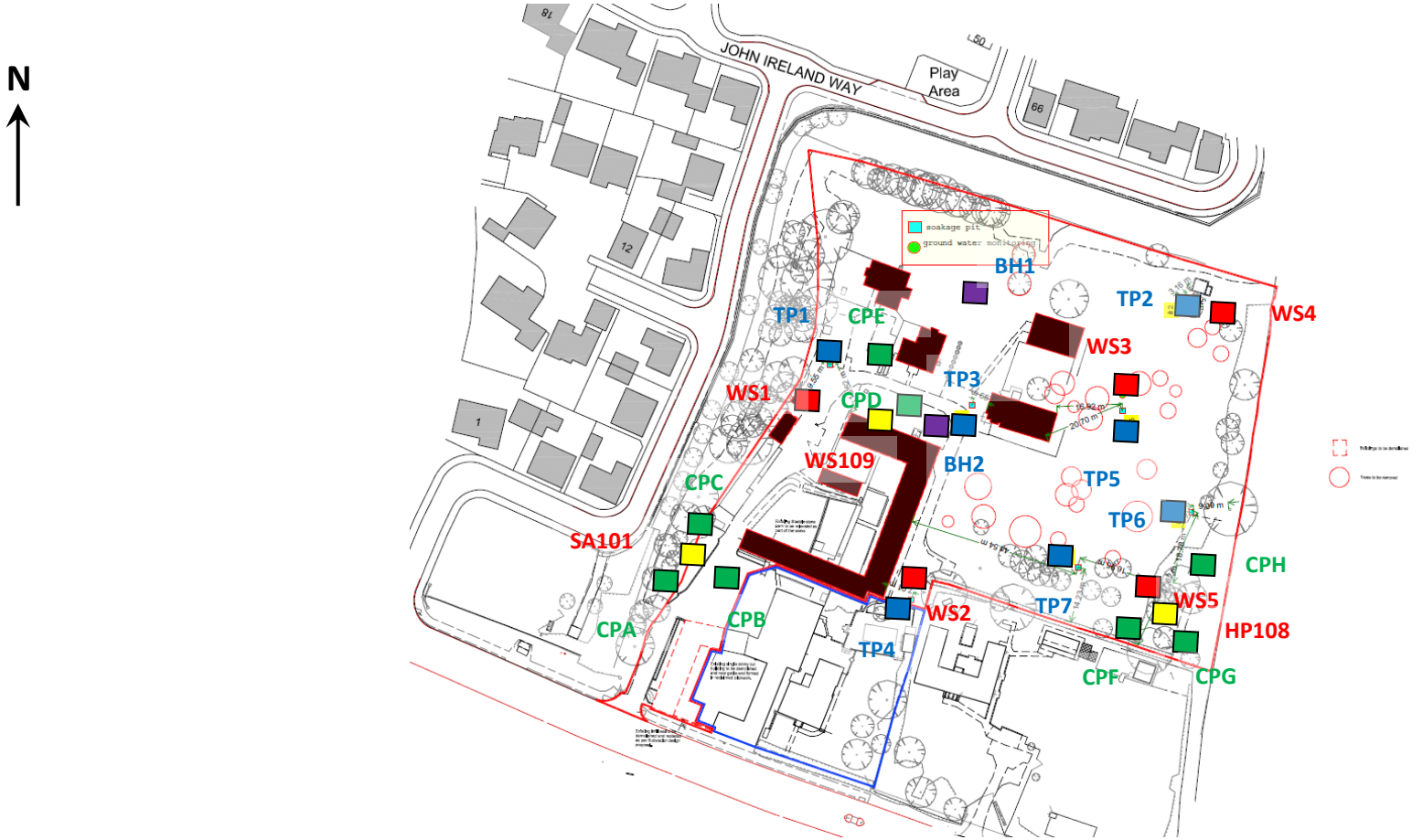
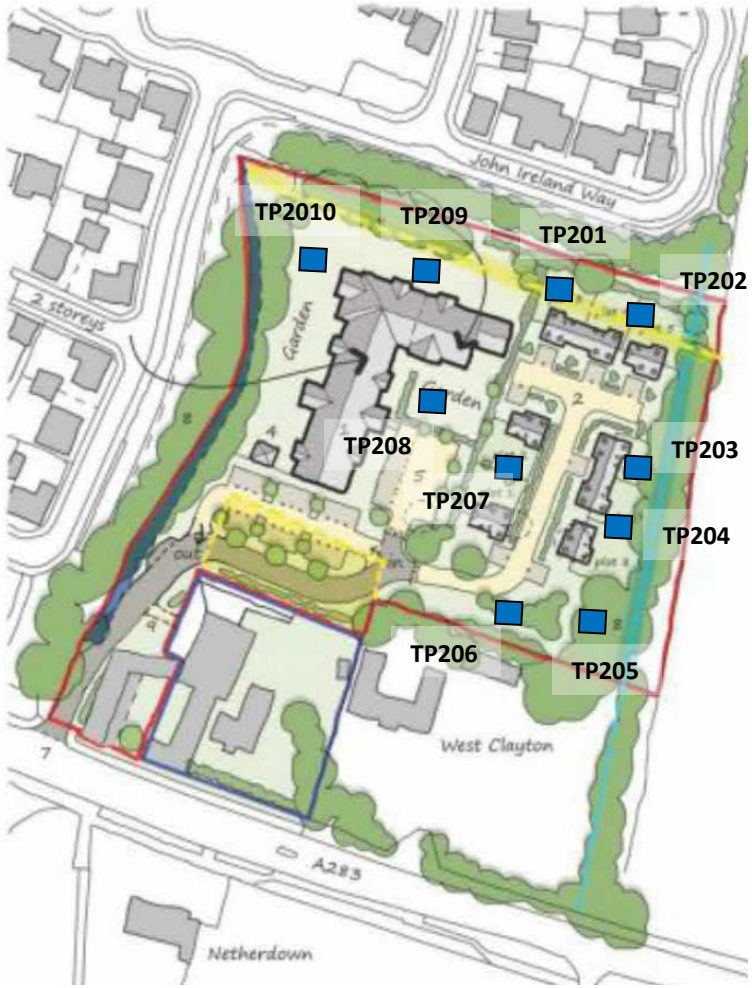



| | |
|---|---|
| **Project:** Old Clayton Kennels and Cattery Storrington Rd Washington West Sussex RH20 4AG | **Figure 4** |
| **Client:** Highwood Group | **Date:** August 2025 |
| **Trial Hole Location Plan** | **Ref:** GWPR6344 |

ground&water

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**APPROXIMATE SITE BOUNDARY**

| | |
|---|---|
| **Project:** Old Clayton Kennels and Cattery Storrington Rd Washington West Sussex RH20 4AG | **Figure 5** |
| **Client:** Highwood Group | **Date:** August 2025 |
| **Phase IV Trial Hole Location Plan** | **Ref:** GWPR6344 |

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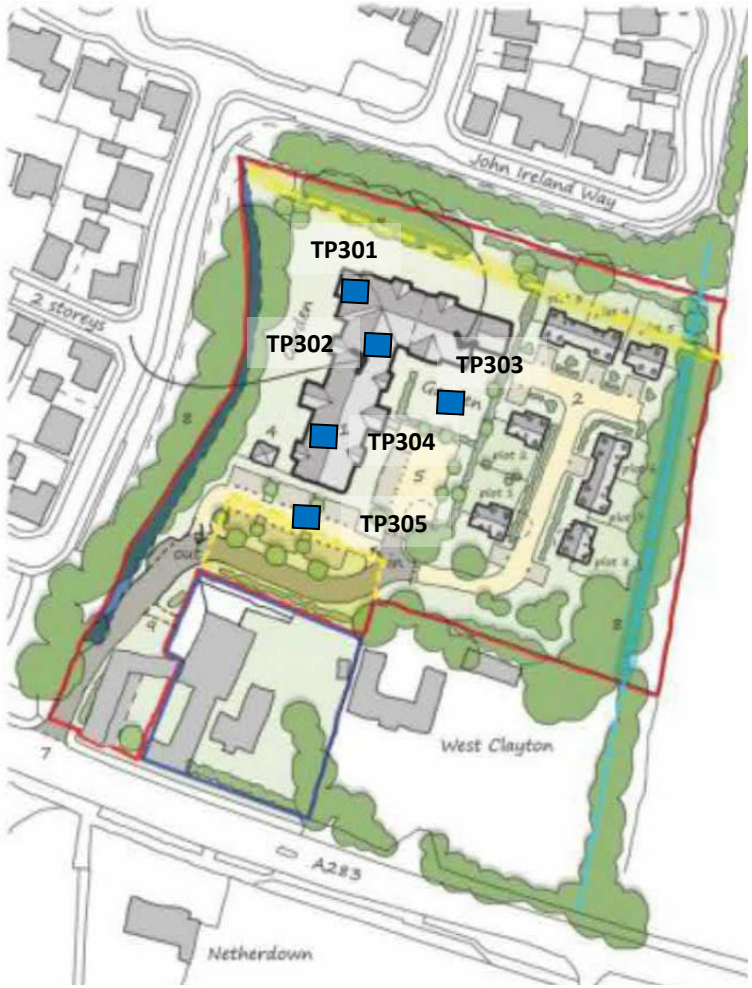


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APPROXIMATE SITE BOUNDARY

| | | |
|---|---|---|
| **Project:** Old Clayton Kennels and Cattery Storrington Rd Washington West Sussex RH20 4AG | | **Figure 6** |
| **Client:** Highwood Group | **Date:** August 2025 | |
| **Phase V Trial Hole Location Plan** | **Ref:** GWPR6344 | |

# APPENDIX A: Conditions and Limitations

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The ground is a product of continuing natural and artificial processes. As a result, the ground will exhibit a variety of characteristics that vary from place to place across a site, and also with time. Whilst a ground investigation will mitigate to a greater or lesser degree against the resulting risk from variation, the risks cannot be eliminated.

The report has been prepared on the basis of information, data and materials which were available at the time of writing. Accordingly, any conclusions, opinions or judgements made in the report should not be regarded as definitive or relied upon to the exclusion of other information, opinions and judgements.

The investigation, interpretations, and recommendations given in this report were prepared for the sole benefit of the client in accordance with their brief; as such these do not necessarily address all aspects of ground behaviour at the site. No liability is accepted for any reliance placed on it by others unless specifically agreed in writing.

Any decisions made by you, or by any organisation, agency or person who has read, received or been provided with information contained in the report ("you" or "the Recipient") are decisions of the Recipient and we will not make, or be deemed to make, any decisions on behalf of any Recipient. We will not be liable for the consequences of any such decisions.

Current regulations and good practice were used in the preparation of this report. An appropriately qualified person must review the recommendations given in this report at the time of preparation of the scheme design to ensure that any recommendations given remain valid in light of changes in regulation and practice, or additional information obtained regarding the site.

Any Recipient must take into account any other factors apart from the Report of which they and their experts and advisers are or should be aware. The information, data, conclusions, opinions and judgements set out in the report may relate to certain contexts and may not be suitable in other contexts. It is your responsibility to ensure that you do not use the information we provide in the wrong context.

This report is based on readily available geological records, the recorded physical investigation, the strata observed in the works, together with the results of completed site and laboratory tests. Whilst skill and care has been taken to interpret these conditions likely between or below investigation points, the possibility of other characteristics not revealed cannot be discounted, for which no liability can be accepted. The impact of our assessment on other aspects of the development required evaluation by other involved parties.

The opinions expressed cannot be absolute due to the limitations of time and resources within the context of the agreed brief and the possibility of unrecorded previous in ground activities. The ground conditions have been sampled or monitored in recorded locations and tests for some of the more common chemicals generally expected. Other concentrations of types of chemicals may exist.

The conclusions and recommendations relate to the Old Clayton Kennels and Cattery, Storrington Road, Washington, West Sussex RH20 4AG.

Trial hole is a generic term used to describe a method of direct investigation. The term trial pit, borehole or window sampler borehole implies the specific technique used to produce a trial hole.

The depth to roots and/or of desiccation may vary from that found during the investigation. The client is responsible for establishing the depth to roots and/or of desiccation on a plot-by-plot basis prior to the construction of foundations. Where trees are mentioned in the text this means existing trees, recently removed trees (approximately 15 years to full recovery on cohesive soils) and those planned as part of the site landscaping.

Ownership of copyright of all printed material including reports, laboratory test results, trial pit and borehole log sheets, including drillers log sheets, remain with Ground and Water Limited. Licence is for the sole use of the client and may not be assigned, transferred or given to a third party.

Only our client may rely on this report and should this report or any information contained in it be provided to any third party we accept no responsibility to the third party for the contents of this report save to the extent expressly outlined by us in writing in a reliance letter addressed from us to the third party.

Recipients are not permitted to publish this report outside of their organisation without our express written consent.

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# APPENDIX B: Technical Glossary

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# TECHNICAL GLOSSARY

The list of possible definitions within the report may be seen below. Please note that some definitions may not be relevant to this report.

**HYDROGEOLOGY:**

A **Principal Aquifer** is a layer of rock or drift deposits that have high intergranular and/or fracture permeability - meaning they usually provide a high level of water storage. They may support water supply and/or river base flow on a strategic scale. In most cases, principal aquifers are aquifers previously designated as major aquifer.

**Secondary aquifers** include a wide range of drift deposits with an equally wide range of water permeability and storage capacities.

**Secondary (A) Aquifers** consist of deposits with permeable layers capable of supporting water supplies at a local rather than strategic scale, and in some cases forming an important source of base flow to rivers. These are generally aquifers formerly classified as Minor Aquifers.

**Secondary (B) Aquifers** consist of deposits with predominantly lower permeability layers with may stoke and yield limited amounts of groundwater due to localised features such as fissures, think permeable horizons and weathering. These are generally the water-bearing parts of the former non-aquifers.

**Secondary Aquifers (Undifferentiated)** are assigned in cases where it has not been possible to attribute either category A or B to a rock type. In most cases, this means that the layer in question has previously been designated as both a minor aquifer and non-aquifer in different locations due to the variable characteristics of the rock type.

**Unproductive Strata** are rock layers with low permeability that have negligible significance for water supply or river base flow. These were formerly classified as non-aquifers.

**FLOOD ZONES:**

**Environment Agency Flood Zone 2**, defined as; land having between a 1 in 100 and 1 in 1,000 annual probability of river flooding; or land having between a 1 in 200 and 1 in 1,000 annual probability of sea flooding.

**Environment Agency Flood Zone 3** shows the extent of a river flood with a 1 in 100 (1%0 or greater chance of occurring in any year or a sea flood with a 1 in 200 (0.5%) or greater chance of occurring in any year.

**Environment Agency Flood Zone 3 area that benefits from flood defences**, defined as; land and property in this flood zone would have a high probability of flooding without the local flood defences. These protect the area against a river flood with a 1% chance of happening each year, or a flood from the sea with a 0.5% chance of happening each year.

**GROUNDWATER SOURCE PROTECTION ZONES (SPZS):**

**Inner zone (SPZ1):** This zone is 50 day travel time of pollutant to source with a 50 metres default minimum radius.

**Outer zone (SPZ2):** This zone is 400 day travel time of pollutant to source. This has a 250 or 500 metres minimum radius around the source depending on the amount of water taken.

**Total catchment (SPZ3):** This is the area around a supply source within which all the groundwater ends up at the abstraction point. This is the point from where the water is taken. This could extend some distance from the source point.

**Zone of special interest (SPZ4):** This zone is where local conditions require additional protection.

**IN-SITU STRENGTH GEOTECHNICAL TESTING:**

**Windowless Sample and/or Cable Percussion and/or Rotary Boreholes** provide samples of the ground for assessment but they do not give any engineering data. The standard penetration test (SPT) is an in-situ dynamic penetration test designed to provide information on the geotechnical engineering properties of soil. The test uses a thick-walled sample tube, with an outside diameter of 50mm and an inside diameter of 35mm, and a length of around 650mm. This is driven into the ground at the bottom of a borehole by blows from a slide hammer with a weight of 63.5kg falling through a distance of 760mm. The sample tube is driven 150mm into the ground and then the number of blows needed for the tube to penetrate each 75mm up to a depth of 450mm is recorded. The sum of the number of blows is termed the "standard penetration resistance" or the "N-value".

**Dynamic Probing** involves the driving of a metal cone into the ground via a series of steel rods. These rods are driven from the surface by a hammer system that lifts and drops a 63.5kg (SHDP) hammer onto the top of the rods through a set height, thus ensuring a consistent energy input. The number of hammer blows that are required to drive the cone down by each 100mm increment are recorded. These blow counts then provide a comparative assessment from which correlations have been published, based on dynamic energy, which permits engineering parameters to be generated. (The Dynamic Probe 'Super Heavy' (SHDP) Tests were conducted in accordance with BS 1377; 1990; Part 9, Clause 3.2).

# APPENDIX C: Asbestos Management Strategy

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geotechnical and environmental consultants

ground&water

# Asbestos Management Strategy

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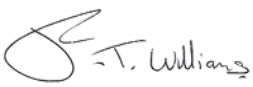
| Site: Old Clayton Kennels and Cattery, Storrington Road, Washington, West Sussex RH20 4AG |

| |
|---|
| Client: Highwood Group |

| Report Reference: GWPR6344/AMS/August 2025 | | | Status: Final |
|---|---|---|---|
| Issue | Prepared By | Checked By | Verified By |
| v.1.01 |  |  |  |
| | Roger Foord<br>BA (Hons) MSc DIC CGeol<br>FGS CIHM<br>Senior Engineer | Miltiadis Mellios<br>MSc(Eng) CGeol FGS<br>MIEnvSc GMICE<br>Principal Engineer | Francis Williams MGeol (Hons)<br>FGS CEnv CGeol<br>Director |

Site Investigations | Environmental Consultants | Geotechnical Engineers

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**1. Management Plan**

The Principal Contractor to be appointed by Highwood Group, will be responsible for ensuring compliance with this strategy.

The measures outlined in the following sections are designed to ensure that potential contamination does not endanger groundworkers or end-users of the proposed development and those end-users do not come into contact with potentially contaminated materials.

- Further to this asbestos management strategy, on-site induction/toolbox talks should be given to all site workers. These toolbox talks should highlight the site-specific asbestos risks and what procedures should be undertaken to minimise the risk of exposure to workers (e.g. damping down and appropriate PPE use when excavating/disturbing any soils where residual asbestos is present). Any personnel on-site should be made aware of this Asbestos Management Strategy as part of the toolbox talks.
- The site manager and any Ground and Water Limited Engineers/Technicians should have asbestos awareness qualifications.
- Asbestos containing soils must not be reused on-site. Therefore, any soils of the Made Ground containing asbestos that is excavated must be removed to a suitably licensed facility.
- All groundworks where there is excavation/disturbance of the asbestos contaminated Made Ground on-site should be undertaken with sufficient damping down to minimize the production of dust/airborne asbestos fibres. Damping down should be undertaken using a water tanker/bowser/other suitable water supply which can cover the area of excavation/disturbance with a fine spray of water.
- There may be areas of contamination/buried asbestos containing materials (ACMs) that have not been identified during the intrusive investigation. Such occurrences may be discovered during the construction phases for the redevelopment of the site. Groundworkers should be instructed to report to the Site Manager if they encounter any evidence for such contamination.

Should evidence of potential ACM's or fibres be identified during the works then the following procedures should be adopted:

- Upon discovery of suspected ACMs, groundworks within the vicinity should be halted and Ground and Water Limited should be informed such that appropriate remedial measures and health and safety protection may be applied.
- It is considered likely that any further asbestos remediation required on-site will be Non-licensed Non-notifiable Asbestos Activity. Ground and Water Limited Engineers are all non-licensed operatives. However, should pipe lagging or loose fill installation/fibrous materials be encountered, HSE will need to be notified and remediation will need to be undertaken by an appropriately licensed asbestos removal contractor.
- Should a new source of contamination be suspected or identified then the Local Authority will need to be informed.
- It is recommended that in the event of contamination being identified, remedial works are supervised by a Ground and Water Limited Engineer. This will allow for supervision and segregation of the waste produced whilst remedial works are ongoing. This may reduce overall disposal costs.
- Stockpiled materials, destined for removal from site, must be placed on an impermeable liner with raised edge and must be covered at all times.
- Stockpiles will need to be named/assigned to differentiate and their location and size marked.

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- It is recommended a separate skip be brought to site that is designated as the asbestos skip for all contaminated PPE and samples to be disposed in. Given the nature of the works these works are likely to be classified as a Non-licensed Non-notifiable Asbestos Activity. Ground and Water Limited Engineers are all non-licensed operatives.

**2. General/Site Safety**

General PPE required during the works will be:

- Safety glasses;
- Gloves;
- Hard Hat, safety boots and hi-vis jackets;

Should potential ACMs be encountered then the following PPE would also be required until such point as it can be proven that the asbestos has been successfully remediated:

- Face-Fitted PP3 Particulate Masks;
- 2x 16 – 18L Knapsack Sprayers to minimise dust production during sampling.
- Tyvex suits (Type 6 Minimum) and Shoe covers.

Mobile telephones will be held by designated personnel and these would be used to contact the emergency services in the event of an emergency. Wearing shorts is not allowed.

Should further remediation be necessary, supervision of the work area will be undertaken by a Ground and Water Limited Engineer during works. We have assumed that the Main Contractor will cordon off the working area associated with the remediation.

We have assumed that a suitable water supply will be present on-site to enable damping down of soils and excavations.

All site operatives/personnel will need to comply with site regulations.

**3. Sampling**

Fragments of suspected cement bound asbestos identified during the works will be double bagged in accordance with the Non-licensed training undertaken. Cement bound debris will be placed within the red plastic bags first and sealed with a swan-neck and zip tie. The red bag will then be placed within an additional white bag with swan neck and zip tie closure.

The double bags will then be placed within the asbestos skips present on-site.

**4. Decontamination**

At the end of the day, and any subsequent days work, all PPE, including masks, suits and shoe covers, will be double bagged in line with the requirements of the bound asbestos materials and disposed of in the same way.

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**5. Dust and Vapours**

All groundworks where there is excavation/disturbance of the Made Ground on-site should be undertaken with sufficient damping down to minimize the production of dust/airborne asbestos fibres, this includes damping down of material in buckets and tyres during vehicle movement.

Damping down should be undertaken using a water tanker/bowser/other suitable water supply which can cover the area of excavation/disturbance with a fine spray of water.

# APPENDIX D:
# Soil
# Assessment
# Criteria

2 The Long Barn, Norton Farm, Selborne Road, Alton, Hampshire GU34 3NB
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**Ground and Water Limited**

**Soil Guideline Values and Generic Assessment Criteria**

The Contaminated Land Regime reflects the UK Government's stated objectives of achieving sustainable development through the 'suitable for use approach'. At preliminary risk assessment stage, risks are evaluated qualitatively. As the site investigation progresses to a generic or detailed quantitative risk assessment, data is collected and assessment criteria are utilised to evaluate whether the contaminants represent an unacceptable risk to the identified receptors.

## 1. Contaminated Land Exposure Assessment Model (CLEA)

Current United Kingdom risk assessment practice is based on the Contaminated Land Exposure Assessment Model (CLEA).

The CLEA Guidance comprises the following documents:

1) EA Science Report SC050021/SR2: Human health toxicological assessment of contaminants in soil.
2) EA Science Report SC050021/SR3: Updated technical background to the CLEA model.
3) EA CLEA Bulletin (2009).
4) CLEA software version 1.07 (2015)
5) Toxicological reports and SGV technical notes.

The CLEA guidance and tools:

- Do not cover other types of risk to humans, such as fire, suffocation or explosion, or short-term and acute exposures;
- Do not cover risks to the environment, such as groundwater, ecosystems or buildings;
- Do not provide a definitive test for telling when human health risks are significant; and
- Are not a legal requirement in assessing land contamination risks. They are not part of the legal regime for Part 2A of the Environmental Protection Act 1990.

The CLEA guidance derives soil concentrations of contaminants above which (in the opinion of the EA) there may be a concern that warrants further investigation. It does not provide a definitive test for establishing that the risk is significant.

### 1.1. Land-use Scenarios

The CLEA model uses a range of standard land-use scenarios to develop conceptual exposure models outlined in the following sections.

#### 1.1.1. Residential (with home grown produce) (RwHP)

Generic scenario assumes a typical two-storey house built on a ground bearing slab with a private garden having a lawn, flowerbeds and a small fruit and vegetable patch.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil and indoor dust ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and indoor dust and inhalation of indoor and outdoor dust and vapours.
- Building type is a two-storey small-terraced house.

A sub-set of this land-use is residential apartments with communal landscaped gardens where the consumption of home grown vegetables will not occur. (Residential without homegrown produce (RwoHP)).

### 1.1.2. Allotments

Provision of open space (about 250sq.m) commonly made available to tenants by the local authority to grow fruit and vegetable for their own consumption. Typically, there are a number of plots to a site which may have a total area of up to 1 hectare. The tenants are assumed to be adults and that young children make occasional accompanied visits.

Although some allotment holders may choose to keep animals including rabbits, hens, and ducks, potential exposure to contaminated meat and eggs is not considered.

- Critical receptor is a young female child (zero to six years old)
- Exposure duration is six years.
- Exposure pathways include direct soil ingestion, consumption of homegrown produce and any adhering soil, skin contact with soils and inhalation of outdoor dust and vapours.
- There is no building.

### 1.1.3. Commercial/Industrial

The generic scenario assumes a typical commercial or light industrial property comprising a three-storey building at which employees spend most time indoors and are involved in office-based or relatively light physical work.

- Critical receptor is a working female adult (aged 16 to 65 years old).
- Exposure duration is a working lifetime of 49 years.
- Exposure pathways include direct soil and indoor dust ingestion, skin contact with soils and dusts and inhalation of dust and vapours.
- Building type is a three-storey office (pre 1970).

## 2. LQM/CIEH Suitable 4 Use Levels (S4UL)

For derivation of these S4UL reference must be made to:

Nathanial, P., McCaffrey, C., Gillet, A., Ogden, R., Nathanial, J., *The LQM/CIEH S4UL's for Human Health Risk Assessment*. **Land Quality Press**. 2015

### 2.1. S4UL Background

The Land Quality Management/Chartered Institute of Environmental Health (LQM/CIEH) S4UL for a given land use is the concentration of the contaminant in soil at which the predicted daily exposure,

as calculated by the CLEA software, equals the Health Criteria Value. The S4ULs have been derived for substances based on various generic land use and soil organic matter contents.

The final output for each contaminant represents a synthesis of new toxicological (and fate and transport) reviews published since the preparation of the 2nd edition LQM/CIEH GAC's (Nathanial et al., 2009).

In the derivation of LQM/CIEH S4UL's the principles of 'minimal' or 'tolerable' risk enshrined in SR2, which has not been withdrawn, has been maintained.

### 2.2. S4UL Land-use

S4UL's have been derived for the basic CLEA land-uses, as described in section 1.2, and for two new land uses:

- Public Open Spaces near Residential Housing (POSresi).
- Public Park (POSpark).

#### 2.2.1. Public Open Spaces near Residential Housing (POSresi)

Includes the predominantly grassed areas adjacent to high density housing, the central green area on many 1930's – 1970's housing estates, and smaller areas commonly incorporated in newer developments as informal grassed areas or more formal landscaped areas with a mixture of open space and covered soils with planting. It is assumed that the close proximity to the place of residence will allow tracking back of soil to occur.

#### 2.2.2. Public Park (POSpark)

An area of open space, usually owned and maintained by the local authority, provided for recreational uses including family visists and picnics, children's play area, informal sporting activities (not a dedicated sports pitch), and dog walking. It is assumed that tracking back of soils into places of residence will be negligible.

The following LQM/CIEH S4Uls (Copyright Land Quality Management Limited) have been reproduced with permission, to the publication number S4UL3072.

## 3. Category 4 Screening Levels (C4SLs)

In the case of Lead, no SGV or GAC has been published to date. This is likely to be due to the toxicity review that is currently being undertaken by the Environment Agency. In the absence of updated toxicity information the SGV derived using CLEA 1.07 methodology and related toxicity will be used.

The overall objective of the C4SLs research project was to assist the provision of technical guidance in support of Defra's revised Statutory Guidance (SG) for Part 2A of the Environmental Protection Act 1990 (Part 2A) (Defra, 2012a). Specifically, the project aimed to deliver:

- A methodology for deriving C4SLs for four generic land-uses comprising residential, commercial, allotments and public open space; and
- A demonstration of the methodology, via the derivation of C4SLs for six substances – arsenic, benzene, benzo(a)pyrene, cadmium, chromium (VI) and lead.

To help achieve a more targeted approach to identifying and managing contaminated land in relation to the risk (or possibility) of harm to human health, the revised SG presented a new four category

system for considering land under Part 2A, ranging from Category 4, where there is no risk that land poses a significant possibility of significant harm (SPOSH), or the level of risk is low, to Category 1, where the risk that land poses a significant possibility of significant harm (SPOSH) is unacceptably high. More specific guidance on what type of land should be considered as Category 4 (Human Health) is provided in Paragraphs 4.21 and 4.22 of the revised SG, as follows:

> *"4.21 The local authority should consider that the following types of land should be placed into Category 4: Human Health:*
> *(a) Land where no relevant contaminant linkage has been established.*
> *(b) Land where there are only normal levels of contaminants in soil, as explained in Section 3 of this Guidance.*
> *(c) Land that has been excluded from the need for further inspection and assessment because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of this Guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of this Guidance.*
> *(d) Land where estimated levels of exposure to contaminants in soil are likely to form only a small proportion of what a receptor might be exposed to anyway through other sources of environmental exposure (e.g. in relation to average estimated national levels of exposure to substances commonly found in the environment, to which receptors are likely to be exposed in the normal course of their lives).*
>
> *4.22 The local authority may consider that land other than the types described in paragraph 4.21 should be placed into Category 4: Human Health if following a detailed quantitative risk assessment it is satisfied that the level of risk posed is sufficiently low."*

The C4SLs are intended as "relevant technical tools" (in relation to Paragraph 4.21(c)) to help local authorities and others when deciding to stop further assessment of a site, on the grounds that it falls within Category 4 (Human Health).

The Impact Assessment (IA), which accompanied the revised SG (Defra, 2012b) provides further information on the nature and potential role of the C4SLs. Paragraph 47(h) of the IA states that:

> *"The new statutory guidance will bring about a situation where the current SGVs/GACs are replaced with more pragmatic (but still strongly precautionary) Category 4 screening levels (C4SLs) which will provide a higher simple test for deciding that land is suitable for use and definitely not contaminated land."*

A key distinction between the Soil Guideline Values (SGVs) and the C4SLs is the level of risk that they describe. As described by the Environment Agency (2009a):

> *"SGVs are guidelines on the level of long-term human exposure to individual chemicals in soil that, unless stated otherwise, are tolerable or pose a minimal risk to human health."*

The implication of Paragraph 47(h) of the IA is that minimal risk is well within Category 4 and that the C4SLs should describe a higher level of risk which, whilst not minimal, can still be considered low enough to allow a judgement to be made that land containing substances at, or below, the C4SLs would typically fall within Category 4. This reflects Paragraph 4.20 of the revised SG, which states:

> *"4.20 The local authority should not assume that land poses a significant possibility of significant harm if it considers that there is no risk or that the level of risk posed is low. For the purposes of this Guidance, such land is referred to as a "Category 4: Human Health" case. The authority may decide that the land is a Category 4: Human Health case as soon as it considers it has evidence to this effect, and this may happen at any stage during risk assessment including the early stages."*

C4SLs, therefore, should not be viewed as "SPOSH levels" and they should not be used as a legal trigger for the determination of land under Part 2A.

The generic screening values referred to before usually take the form of risk-based Soil Guideline Values (SGVs) or other Generic Assessment Criteria (GACs) that are most typically derived using the Environment Agency's Contaminated Land Exposure Assessment (CLEA) model, as described in the Environment Agency's SR2, SR3 and SR7 reports (EA, 2009b & c; EA, 2008). It is anticipated that C4SLs will be used in a similar manner; as generic screening criteria that can be used within a GQRA, albeit describing a higher level of risk than the SGVs.

The suggested approach to the development of C4SLs consists of the retention and use of the CLEA framework, modified according to considerations of the underlying science within the context of Defra's policy objectives relating to the revised SG. Within this context, it is suggested that the development of C4SLs may be achieved in one of three ways, namely:

- By modifying the toxicological parameters used within CLEA (while maintaining current exposure parameters);
- By modifying the exposure parameters embedded within CLEA (while maintaining current toxicological "minimal risk" interpretations); and
- By modifying both toxicological and exposure parameters.

There is also a suggested check on "other considerations" (e.g., background levels, epidemiological data, sources of uncertainty) within the approach, applicable to all three options.

It is suggested that a new term is defined for the toxicological guidance values associated with the derivation of C4SLs – a Low Level of Toxicological Concern (LLTC). A LLTC should represent an intake of low concern that remains suitably protective of health, and definitely does not approach an intake level that could be defined as SPOSH.

## 4. CL:AIRE Generic Assessment Criteria (GAC)

For derivation of the CL:AIRE Generic Assessment Criteria (GAC) reference should be made to the following report:

> CL:AIRE, *The Soil Generic Assessment Criteria for Human Health Risk Assessment.* **Contaminated Land: Applications in the Real Environment**. 2009.

Within this report, Contaminated Land: Applications in Real Environments (CL:AIRE) provided Generic Assessment Criteria (GAC) in accordance with the CLEA software and the principles outlined previously for a further 35 contaminants sometimes encountered on land affected by contamination.

## 5. SoBRA Acute GAC

The Society of Brownfield Risk Assessment (SoBRA) identified that most human health risk assessments focus on the chronic risks arising from long-term exposure to specific substances. As chronic risks often occur at lower doses than acute risks, they are often the key drivers, however, in some instances the acute dose may also be an important consideration within risk assessments.

The methodology for deriving the acute GAC were related to two distinct receptor groups:

- Members of the public, where the 'critical' receptor for this group will typically be a female child, which is consistent with CLEA residential and Public Open Space/allotments land-uses;
- Workers involved with excavations. The critical receptor for this group is assumed to be a female working adult, without the use of PPE.

The acute GACs relate to short term exposure of high concentrations of a substance that lead to acute effects. They are not considered to be average exposures across a specific / defined area. As a result, the GACs should be normally be compared with the maximum likely concentration that the individual may be exposed to, and not the average concentration within a specific area.

The SoBRA acute GAC will primarily be used for contaminants that do not currently have any GAC, most notably Cyanide.

## 6. Detailed Quantitative Risk Assessments (DQRA)

Where the adoption of a GAC is not appropriate, for instance when the intended land-use is at variance the CLEA standard land-uses, then a DQRA may be undertaken to develop site specific values for relevant soil contaminants.

- Establishing the plausibility that generic exposure pathways exist in practice by measurement and observation.
- Developing more accurate parameters using site data.

## 7. Phytotoxicity

CLEA guidance only addresses human health toxicity; assessment of plant toxicity (phytotoxicity) is based on threshold trigger values obtained from the following source:

- BS3882:2015 – *Specification for Topsoil*

The trigger values are relevant only to those contaminants, where present in excess, have the potential to inhibit plant growth, or kill plants (Cu, Ni and Zn). The criteria have been based on a wide range of planting that are common within a multi-purpose topsoil.

## 8. Statistical Tests

DEFRA R&D Publication CLR 7 (DOE 1994) addressed the statistical treatment of test results and their comparison to Soil Guideline Values.

Consideration must be given to the appropriate area of land to be considered termed the critical averaging area.

For a communal open space or commercial land-use, the critical averaging area will depend on the proposed layout. For a residential use with private gardens the averaging area is the individual plot.

It may be appropriate to compare the upper 95$^{th}$ percentile concentration with the Soil Guideline Value, subject to applying a statistical test to establish that the range of concentrations are reasonably consistent and belonging to the same underlying distribution of data.

CL:AIRE published guidance in 2020, *Guidance in comparing soil contamination data with a critical concentration,* superseding the CL:AIRE/CIEH 2008 report of the same name. The guidance provides ways to assist land contamination stakeholders to apply statistical methods to their data to enable decisions under the legislative framework; either planning system or Part 2A of the Environmental Protection Act 1990.

The use of the statistical tests should only be applied if the following statements are valid for the datasets:

- Averaging areas, as well as the smallest area of concern have been identified on the basis of the CSM, including the desk study and/or the site walkover;
- The sample locations were chosen using a simple random, stratified random or stratified systematic (square, herringbone or triangular grid) sampling pattern, rather than being targeted to locations suspected of being contaminated;
- The sample locations are relatively evenly spread across the area and are not clustered, to avoid giving undue weight to some parts of the site over others in the calculated statistics;
- The analyses do not suggest a hotspot or outlier of contamination that should be treated as a separate zone. This has been established by a histogram and/or a names statistical test;
- The sample locations are all taken from one population (i.e. the same material);
- Where an averaging zone encompasses several averaging areas, analyses do not show a spatial trend or other spatial pattern across that zone; and
- The number of samples has been shown to be sufficient for a statistical analysis.

Any included statistical spreadsheet is based on an in-house method of statistical analysis, in line with those outlined within the CL:AIRE guidance (2020).

**Treatment of Hot-Spots**

- A statistical test is applied to establish whether the data is a part of a single set, or whether data outliers are present.
- Provided that the data is based on random sampling and no distinct contamination source was present at the sampling location, the hot-spot(s) may be excluded and the mean of the remaining data assessed.

## 9. Ground and Water Limited Soil Assessment Criteria

The Soil Assessment Criteria used in the preparation of the Generic Quantitative Risk Assessment are tabulated in the following pages, where the source of each has been outlined in the previous sections.

## 9.1. Inorganics

| SoBRA – Acute Generic Assessment Criteria | | | | | | |
|---|---|---|---|---|---|---|
| **Determinand** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **Cyanide** | 24 | 24 | 24 | 1400 | 24 | 24 |

## 9.2. Metals

| C4SL Low Level of Toxicological Concern | | | | | | |
|---|---|---|---|---|---|---|
| **Determinand** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **Lead** | < 200 | < 310 | < 80 | < 2300 | < 630 | < 1300 |

| LQM/CIEH Suitable 4 Use Levels – Metals and Semi-metals | | | | | | |
|---|---|---|---|---|---|---|
| **Determinand** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **Arsenic** | 37 | 40 | 43 | 640 | 79 | 170 |
| **Beryllium** | 1.7 | 1.7 | 35 | 12 | 2.2 | 63 |
| **Boron** | 290 | 11000 | 45 | 240000 | 21000 | 46000 |
| **Cadmium** | 11 | 85 | 1.9 | 190 | 120 | 532 |
| **Chromium (III)** | 910 | 910 | 18000 | 8600 | 1500 | 33000 |
| **Chromium (VI)** | 6 | 6 | 1.8 | 33 | 7.7 | 220 |
| **Copper** | 2400 | 7100 | 520 | 68000 | 12000 | 44000 |
| **Elemental Mercury** | 1.2 | 1.2 | 21 | 58 | 16 | 30 |
| **Inorganic Mercury** | 40 | 56 | 19 | 1100 | 120 | 240 |
| **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 |

| Phytotoxicity (Harmful to Plants) Threshold Trigger Values | | | |
|---|---|---|---|
| **Determinand** | **Soil pH < 6.0 (mg/kg)** | **Soil pH 6.0 – 7.0 (mg/kg)** | **Soil pH > 7.0 (mg/kg)** |
| **Copper** | 100 | 135 | 200 |
| **Nickel** | 60 | 75 | 110 |
| **Zinc** | 200 | 200 | 300 |
| **Notes:**<br>BS3882:2015 – *Specification for Topsoil*. Based on a wide range of common plants that will be exposed to multi-purpose topsoil. Toxicity of contaminant may also be impacted by pH of soils.<br>Site observation of plant vitality may give additional guidance. | | | |

| CL:AIRE Soil Generic Assessment Criteria | | | | |
|---|---|---|---|---|
| **Determinand** | **Residential (mg/kg)** | **Residential without plant uptake (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| **Antimony** | ND | 550 | ND | 7500 |
| **Barium** | ND | 1300 | ND | 22000 |
| **Molybdenum** | ND | 670 | ND | 17000 |
| ND – Not derived | | | | |

## 9.3. Total Petroleum Hydrocarbons (TPHs)

### 9.3.1. BTEX Compounds

| LQM/CIEH Suitable 4 Use Levels – BTEX Compounds | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Determinand** | **Soil Organic Matter** | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **Benzene** | 1.0% SOM | 0.087 | 0.38 | 0.017 | 27 | 72 | 90 |
| | 2.5% SOM | 0.170 | 0.70 | 0.034 | 47 | 72 | 100 |
| | 6.0% SOM | 0.370 | 1.40 | 0.075 | 90 | 73 | 110 |
| **Toluene** | 1.0% SOM | 130 | 880 | 22 | 56000 | 56000 | 87000 |
| | 2.5% SOM | 290 | 1900 | 51 | 110000 | 56000 | 95000 |
| | 6.0% SOM | 660 | 3900 | 120 | 180000 | 56000 | 100000 |
| **Ethylbenzene** | 1.0% SOM | 47 | 83 | 16 | 5700 | 24000 | 17000 |
| | 2.5% SOM | 110 | 190 | 39 | 13000 | 24000 | 22000 |
| | 6.0% SOM | 260 | 440 | 91 | 27000 | 25000 | 27000 |
| **o-Xylene** | 1.0% SOM | 60 | 88 | 28 | 6600 | 41000 | 17000 |
| | 2.5% SOM | 140 | 210 | 67 | 15000 | 42000 | 24000 |
| | 6.0% SOM | 330 | 480 | 160 | 33000 | 43000 | 33000 |
| **m-Xylene** | 1.0% SOM | 59 | 82 | 31 | 6200 | 41000 | 17000 |
| | 2.5% SOM | 140 | 190 | 74 | 14000 | 42000 | 24000 |
| | 6.0% SOM | 320 | 450 | 170 | 31000 | 43000 | 33000 |
| **p-Xylene** | 1.0% SOM | 56 | 79 | 29 | 5900 | 41000 | 17000 |
| | 2.5% SOM | 130 | 180 | 69 | 14000 | 42000 | 23000 |
| | 6.0% SOM | 310 | 430 | 160 | 30000 | 43000 | 31000 |
| *SOM = Soil Organic Matter Content (%)* | | | | | | | |

### 9.3.2. Total Petroleum Hydrocarbons – Aliphatic

| LQM/CIEH Suitable 4 Use Levels For TPH | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Aliphatic** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **EC 5-6** | 1.0% SOM | 42 | 42 | 730 | 3,200 (304) [sol] | 570,000 (304) [sol] | 95,000 (304) [sol] |
| | 2.5% SOM | 78 | 78 | 1,700 | 5,900 (558) [sol] | 590,000 | 130,000 (558) [sol] |
| | 6.0% SOM | 160 | 160 | 3,900 | 12,000 (1150) [sol] | 600,000 (1150)[sol] | 180,000 (1150) [sol] |
| **EC >6-8** | 1.0% SOM | 100 | 100 | 2,300 | 7,800 (144) [sol] | 600,000 | 150,000 (144) [sol] |
| | 2.5% SOM | 230 | 230 | 5,600 | 17,000 (322) [sol] | 610,000 | 220,000 (322) [sol] |
| | 6.0% SOM | 530 | 530 | 13,000 | 40,000 (736) [sol] | 620,000 | 320,000 (736) [sol] |
| **EC >8-10** | 1.0% SOM | 27 | 27 | 320 | 2,000 (78) [sol] | 13,000 | 14,000 (78) [sol] |
| | 2.5% SOM | 65 | 65 | 770 | 4,800 (118) [vap] | 13,000 | 18,000 (118) [vap] |
| | 6.0% SOM | 150 | 150 | 1,700 | 11,000 (451) [vap] | 13,000 | 21,000 (451) [vap] |
| **EC >10-12** | 1.0% SOM | 130 (48) [vap] | 130 (48) [vap] | 2,200 | 9,700 (48) [sol] | 13,000 | 21,000 (48) [sol] |
| | 2.5% SOM | 330 (118) [vap] | 330 (118) [vap] | 4,400 | 23,000 (118) [vap] | 13,000 | 23,000 (118) [vap] |
| | 6.0% SOM | 760 (283) [vap] | 760 (283) [vap] | 7,300 | 47,000 (283) [vap] | 13,000 | 24,000 (283) [vap] |
| **EC >12-16** | 1.0% SOM | 1,100 (24) [sol] | 1,100 (24) [sol] | 11,000 | 59,000 (24) [sol] | 13,000 | 25,000 (24) [sol] |
| | 2.5% SOM | 2,400 (59) [sol] | 2,400 (59) [sol] | 13,000 | 82,000 (59) [sol] | 13,000 | 25,000 (59) [sol] |
| | 6.0% SOM | 4,300 (142) [sol] | 4,400 (142) [sol] | 13,000 | 90,000 (142) [sol] | 13,000 | 26,000 (142) [sol] |
| **EC >16-35** | 1.0% SOM | 65,000 (8.48) [sol] | 65,000 (8.48) [sol] | 260,000 | 1,600,000 | 250,000 | 450,000 |
| | 2.5% SOM | 92,000 (21) [sol] | 92,000 (21) [sol] | 270,000 | 1,700,000 | 250,000 | 480,000 |
| | 6.0% SOM | 110,000 | 110,000 | 270,000 | 1,800,000 | 250,000 | 490,000 |
| **EC >35-44** | 1.0% SOM | 65,000 (8.48) [sol] | 65,000 (8.48) [sol] | 260,000 | 1,600,000 | 250,000 | 450,000 |
| | 2.5% SOM | 92,000 (21) [sol] | 92,000 (21) [sol] | 270,000 | 1,700,000 | 250,000 | 480,000 |
| | 6.0% SOM | 110,000 | 110,000 | 270,000 | 1,800,000 | 250,000 | 490,000 |

*SOM = Soil Organic Matter Content (%)*

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.

[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

### 9.3.3. Total Petroleum Hydrocarbons – Aromatic

| LQM/CIEH Suitable 4 Use Levels For TPH | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Aromatic** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **EC 5-7 (Benzene)** | 1.0% SOM | 70 | 370 | 13 | 26,000 (1220) [sol] | 56,000 | 76,000 (1220 [sol] |
| | 2.5% SOM | 140 | 690 | 27 | 46,000 (2260) [sol] | 56,000 | 84,000 (2260) [sol] |
| | 6.0% SOM | 300 | 1,400 | 57 | 86,000 (4710) [sol] | 56,000 | 92,000 (4710) [sol] |
| **EC >7-8 (Toluene)** | 1.0% SOM | 130 | 860 | 22 | 56,000 (869) [vap] | 56,000 | 87,000 (869) [sol] |
| | 2.5% SOM | 290 | 1,800 | 51 | 110,000 (1920) [sol] | 56,000 | 95,000 (1920) [sol] |
| | 6.0% SOM | 660 | 3,900 | 120 | 180,000 (4360) [vap] | 56,000 | 100,000 (4360) [vap] |
| **EC >8-10** | 1.0% SOM | 34 | 47 | 8.6 | 3,500 (613) [vap] | 5,000 | 7,200 (613) [vap] |
| | 2.5% SOM | 83 | 110 | 21 | 8,100 (1500) [vap] | 5,000 | 8,500 (1500) [vap] |
| | 6.0% SOM | 190 | 270 | 51 | 17,000 (3850) [vap] | 5,000 | 9,300 (3580) [vap] |
| **EC >10-12** | 1.0% SOM | 74 | 250 | 13 | 16,000 (364) [sol] | 5,000 | 9,200 (364) [sol] |
| | 2.5% SOM | 180 | 590 | 31 | 28,000 (899) [sol] | 5,000 | 9,700 (889) [sol] |
| | 6.0% SOM | 380 | 1,200 | 74 | 34,000 (2150) [sol] | 5,000 | 10,000 |
| **EC >12-16** | 1.0% SOM | 140 | 1,800 | 23 | 36,000 (169) [sol] | 5,100 | 10,000 |
| | 2.5% SOM | 330 | 2,300 (419) [sol] | 57 | 37,000 | 5,100 | 10,000 |
| | 6.0% SOM | 660 | 2,500 | 130 | 38,000 | 5,000 | 10,000 |
| **EC >16-21** | 1.0% SOM | 260 | 1,900 | 46 | 28,000 | 3,800 | 7,600 |
| | 2.5% SOM | 540 | 1,900 | 110 | 28,000 | 3,800 | 7,700 |
| | 6.0% SOM | 930 | 1,900 | 260 | 28,000 | 3,800 | 7,800 |
| **EC >21-35** | 1.0% SOM | 1,100 | 1,900 | 370 | 28,000 | 3,800 | 7,800 |
| | 2.5% SOM | 1,500 | 1,900 | 820 | 28,000 | 3,800 | 7,800 |
| | 6.0% SOM | 1,700 | 1,900 | 1,600 | 28,000 | 3,800 | 7,900 |
| **EC >35-44** | 1.0% SOM | 1,100 | 1,900 | 370 | 28,000 | 3,800 | 7,800 |
| | 2.5% SOM | 1,500 | 1,900 | 820 | 28,000 | 3,800 | 7,800 |
| | 6.0% SOM | 1,700 | 1,900 | 1,600 | 28,000 | 3,800 | 7,900 |
| **EC >44-70** | 1.0% SOM | 1,600 | 1,900 | 1,200 | 28,000 | 3,800 | 7,800 |
| | 2.5% SOM | 1,800 | 1,900 | 2,100 | 28,000 | 3,800 | 7,800 |
| | 6.0% SOM | 1,900 | 1,900 | 3,000 | 28,000 | 3,800 | 7,900 |

*SOM = Soil Organic Matter Content (%)*

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.

[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

## 9.4. Polycyclic Aromatic Hydrocarbons (PAHs)

| LQM/CIEH Suitable 4 Use Levels For Polycyclic Aromatic Hydrocarbons (PAHs) | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Determinands** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| **Acenapthene** | 1.0% SOM | 210 | 3,000 (57.0) [sol] | 34 | 84,000(57.0) [sol] | 15,000 | 29,000 |
| | 2.5% SOM | 510 | 4,700(141) [sol] | 85 | 97,000(141) [sol] | 15,000 | 30,000 |
| | 6.0% SOM | 1100 | 6,000(336) [sol] | 200 | 100,000 | 15,000 | 30,000 |
| **Acenapthylene** | 1.0% SOM | 170 | 2,900(86.1) [sol] | 28 | 83,000(86.1) [sol] | 15,000 | 29,000 |
| | 2.5% SOM | 420 | 4,600(212) [sol] | 69 | 97,000(212) [sol] | 15,000 | 30,000 |
| | 6.0% SOM | 920 | 6,000(506) [sol] | 160 | 100,000 | 15,000 | 30,000 |
| **Anthracene** | 1.0% SOM | 2,400 | 31,000(1.17) [vap] | 380 | 520,000 | 74,000 | 150,000 |
| | 2.5% SOM | 5,400 | 35,000 | 950 | 540,000 | 74,000 | 150,000 |
| | 6.0% SOM | 11,000 | 37,000 | 2,200 | 540,000 | 74,000 | 150,000 |
| **Benzo(a)anthracene** | 1.0% SOM | 7.20 | 11 | 2.90 | 170 | 29 | 49 |
| | 2.5% SOM | 11 | 14 | 6.50 | 170 | 29 | 56 |
| | 6.0% SOM | 13 | 15 | 13 | 180 | 29 | 62 |
| **Benzo(a)pyrene** | 1.0% SOM | 2.20 | 3.20 | 0.97 | 35 | 5.70 | 11 |
| | 2.5% SOM | 2.70 | 3.20 | 2.00 | 35 | 5.70 | 12 |
| | 6.0% SOM | 3.00 | 3.20 | 3.50 | 36 | 5.70 | 13 |
| **Benzo(b)flouranthene** | 1.0% SOM | 2.60 | 3.90 | 0.99 | 44 | 7.10 | 13 |
| | 2.5% SOM | 3.30 | 4.00 | 2.10 | 44 | 7.20 | 15 |
| | 6.0% SOM | 3.70 | 4.00 | 3.90 | 45 | 7.20 | 16 |
| **Benzo(ghi)perylene** | 1.0% SOM | 320 | 360 | 290 | 3,900 | 640 | 1,400 |
| | 2.5% SOM | 340 | 360 | 470 | 4,000 | 640 | 1,500 |
| | 6.0% SOM | 350 | 360 | 640 | 4,000 | 640 | 1,600 |
| **Benzo(k)flouranthene** | 1.0% SOM | 77 | 110 | 37 | 1,200 | 190 | 370 |
| | 2.5% SOM | 93 | 110 | 75 | 1,200 | 190 | 410 |
| | 6.0% SOM | 100 | 110 | 130 | 1,200 | 190 | 440 |
| **Chrysene** | 1.0% SOM | 15 | 30 | 4.10 | 350 | 57 | 93 |
| | 2.5% SOM | 22 | 31 | 9.40 | 350 | 57 | 110 |
| | 6.0% SOM | 27 | 32 | 19 | 350 | 57 | 120 |
| **Dibenzo(ah)anthracene** | 1.0% SOM | 0.24 | 0.31 | 0.14 | 3.50 | 0.57 | 1.10 |
| | 2.5% SOM | 0.28 | 0.32 | 0.27 | 3.50 | 0.57 | 1.30 |
| | 6.0% SOM | 0.30 | 0.32 | 0.43 | 3.60 | 0.58 | 1.40 |
| **Flouranthene** | 1.0% SOM | 280 | 1,500 | 52 | 23,000 | 3,100 | 6,300 |
| | 2.5% SOM | 560 | 1,600 | 130 | 23,000 | 3,100 | 6,300 |
| | 6.0% SOM | 890 | 1,600 | 290 | 23,000 | 3,100 | 6,300 |
| **Flourene** | 1.0% SOM | 170 | 2,800 (30.9) [sol] | 27 | 63,000(30.9) [sol] | 9,900 | 20,000 |
| | 2.5% SOM | 400 | 3,800(76.5) [sol] | 67 | 68,000 | 9,900 | 20,000 |
| | 6.0% SOM | 860 | 4,500(183) [sol] | 160 | 71,000 | 9,900 | 20,000 |
| **Indeno(123-cd)pyrene** | 1.0% SOM | 27 | 45 | 9.50 | 500 | 82 | 150 |
| | 2.5% SOM | 36 | 46 | 21 | 510 | 82 | 170 |
| | 6.0% SOM | 41 | 46 | 39 | 510 | 82 | 180 |
| **Napthalene** | 1.0% SOM | 15 | 36 | 65 | 1,600 | 11,000 | 800 |
| | 2.5% SOM | 36 | 36 | 130 | 3,700 | 15,000 | 1,200 |
| | 6.0% SOM | 85 | 85 | 200 | 8,400 | 17,000 | 1,900 |
| **Phenanthrene** | 1.0% SOM | 95 | 1,300(183) [sol] | 15 | 22,000 | 3,100 | 6,200 |
| | 2.5% SOM | 220 | 1,500 | 38 | 22,000 | 3,100 | 6,200 |
| | 6.0% SOM | 440 | 1,500 | 90 | 23,000 | 3,100 | 6,300 |
| **Pyrene** | 1.0% SOM | 620 | 3,700 | 110 | 54,000 | 7,400 | 15,000 |
| | 2.5% SOM | 1200 | 3,800 | 270 | 54,000 | 7,400 | 15,000 |
| | 6.0% SOM | 2000 | 3,800 | 620 | 54,000 | 7,400 | 15,000 |
| **Coal Tar (Benzo(a)pyrene used as marker compound)** | 1.0% SOM | 0.79 | 1.2 | 0.32 | 15 | 2.20 | 4.40 |
| | 2.5% SOM | 0.98 | 1.2 | 0.67 | 15 | 2.20 | 4.70 |
| | 6.0% SOM | 1.10 | 1.2 | 1.20 | 15 | 2.20 | 4.80 |

*SOM = Soil Organic Matter Content (%)*

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.

[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

## 9.5. Volatile and Semi-volatile Organic Compounds

| LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Determinands** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| ***Chloroalkanes & alkenes*** | | | | | | | |
| **1,2 Dichloroethane** | 1.0% SOM | 0.0071 | 0.0092 | 0.0046 | 0.67 | 29 | 21 |
| | 2.5% SOM | 0.011 | 0.013 | 0.0083 | 0.97 | 29 | 24 |
| | 6.0% SOM | 0.019 | 0.023 | 0.016 | 1.70 | 29 | 28 |
| **1,1,2,2 Tetrachloroethane** | 1.0% SOM | 1.60 | 3.90 | 0.41 | 270 | 1,400 | 1,800 |
| | 2.5% SOM | 3.40 | 8.00 | 0.89 | 550 | 1,400 | 2,100 |
| | 6.0% SOM | 7.50 | 17 | 2.00 | 1,100 | 1,400 | 2,300 |
| **1,1,1,2 Tetrachloroethane** | 1.0% SOM | 1.20 | 1.50 | 0.79 | 110 | 1,400 | 1,500 |
| | 2.5% SOM | 2.80 | 3.50 | 1.90 | 250 | 1,400 | 1,800 |
| | 6.0% SOM | 6.40 | 8.20 | 4.40 | 560 | 1,400 | 2,100 |
| **Tetrachloroethene** | 1.0% SOM | 0.18 | 0.18 | 0.65 | 19 | 1,400 | 810 [sol](424) |
| | 2.5% SOM | 0.39 | 0.40 | 1.50 | 42 | 1,400 | 1,100 [sol](951) |
| | 6.0% SOM | 0.90 | 0.92 | 3.60 | 95 | 1,400 | 1,500 |
| **1,1,1 Trichloroethane** | 1.0% SOM | 8.80 | 9.00 | 48 | 660 | 140,000 | 57,000 [vap](1425) |
| | 2.5% SOM | 18 | 18 | 110 | 1,300 | 140,000 | 76,000 [vap](2915) |
| | 6.0% SOM | 39 | 40 | 240 | 3,000 | 140,000 | 100,000 [vap] (6392) |
| **Tetrachloromethene** | 1.0% SOM | 0.026 | 0.026 | 0.45 | 2.90 | 890 | 190 |
| | 2.5% SOM | 0.056 | 0.056 | 1.00 | 6.30 | 920 | 270 |
| | 6.0% SOM | 0.130 | 0.130 | 2.40 | 14 | 950 | 400 |
| **Trichloroethene** | 1.0% SOM | 0.016 | 0.017 | 0.041 | 1.20 | 120 | 70 |
| | 2.5% SOM | 0.034 | 0.036 | 0.091 | 2.60 | 120 | 91 |
| | 6.0% SOM | 0.075 | 0.080 | 0.210 | 5.70 | 120 | 120 |
| **Trichloromethane** | 1.0% SOM | 0.91 | 1.20 | 0.42 | 99 | 2,500 | 2,600 |
| | 2.5% SOM | 1.70 | 2.10 | 0.83 | 170 | 2,500 | 2,800 |
| | 6.0% SOM | 3.40 | 4.20 | 1.70 | 350 | 2,500 | 3,100 |
| **Vinyl Chloride** | 1.0% SOM | 0.00064 | 0.00077 | 0.00055 | 0.059 | 3.50 | 4.80 |
| | 2.5% SOM | 0.00087 | 0.00100 | 0.00100 | 0.077 | 3.50 | 5.00 |
| | 6.0% SOM | 0.00014 | 0.00150 | 0.00180 | 0.120 | 3.50 | 5.40 |
| ***Explosives*** | | | | | | | |
| **2,4,6 Trinitrotoluene** | 1.0% SOM | 1.60 | 65 | 0.24 | 1,000 | 130 | 260 |
| | 2.5% SOM | 3.70 | 66 | 0.58 | 1,000 | 130 | 270 |
| | 6.0% SOM | 8.10 | 66 | 1.40 | 1,000 | 130 | 270 |
| **RDX (Hexogen/Cyclonite/1,3,5-trinitro-1,3,5-triazacyclohexane)** | 1.0% SOM | 120 | 13,000 | 17 | 210,000 | 26,000 | 49,000(18.7)[sol] |
| | 2.5% SOM | 250 | 13,000 | 38 | 210,000 | 26,000 | 51,000 |
| | 6.0% SOM | 540 | 13,000 | 85 | 210,000 | 27,000 | 53,000 |
| **HMX (Octogen/1,3,5,7-tetrenitro-1,3,5,7-tetrazacyclo-octane)** | 1.0% SOM | 5.70 | 67,00 | 0.86 | 110,000 | 13,000 | 23,000(0.35)[vap] |
| | 2.5% SOM | 13 | 67,00 | 1.90 | 110,000 | 13,000 | 23,000(0.39)[vap] |
| | 6.0% SOM | 26 | 67,00 | 3.90 | 110,000 | 13,000 | 24,000(0.48)[vap] |
| **Atrazine** | 1.0% SOM | 3.30 | 610 | 0.50 | 9,300 | 1,200 | 2,300 |
| | 2.5% SOM | 7.60 | 620 | 1.20 | 9,400 | 1,200 | 2,400 |
| | 6.0% SOM | 17.40 | 620 | 2.70 | 9,400 | 1,200 | 2,400 |

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

| LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Determinands** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| ***Pesticides*** | | | | | | | |
| **Aldrin** | 1.0% SOM | 5.70 | 7.30 | 3.20 | 170 | 18 | 30 |
| | 2.5% SOM | 6.60 | 7.40 | 6.10 | 170 | 18 | 31 |
| | 6.0% SOM | 7.10 | 7.50 | 9.60 | 170 | 18 | 31 |
| **Dieldrin** | 1.0% SOM | 0.97 | 7.00 | 0.17 | 170 | 18 | 30 |
| | 2.5% SOM | 2.00 | 7.30 | 0.41 | 170 | 18 | 30 |
| | 6.0% SOM | 3.50 | 7.40 | 0.96 | 170 | 18 | 31 |
| **Dichlorvos** | 1.0% SOM | 0.032 | 6.40 | 0.0049 | 140 | 16 | 26 |
| | 2.5% SOM | 0.066 | 6.50 | 0.0100 | 140 | 16 | 26 |
| | 6.0% SOM | 0.140 | 6.60 | 0.0220 | 140 | 16 | 27 |
| **Alpha - Endosulfan** | 1.0% SOM | 7.40 | 160(0.003)[vap] | 1.20 | 5,600(0.003)[vap] | 1,200 | 2,400 |
| | 2.5% SOM | 18 | 280(0.007)[vap] | 2.90 | 7,400(0.007)[vap] | 1,200 | 2,400 |
| | 6.0% SOM | 41 | 410(0.016)[vap] | 6.80 | 8,400(0.016)[vap] | 1,200 | 2,400 |
| **Beta - Endosulfan** | 1.0% SOM | 7.00 | 190(0.00007)[vap] | 1.10 | 6,300(0.00007)[vap] | 1,200 | 2,400 |
| | 2.5% SOM | 17 | 320(0.0002)[vap] | 2.70 | 7,800(0.0002)[vap] | 1,200 | 2,400 |
| | 6.0% SOM | 39 | 440(0.0004)[vap] | 6.40 | 8700 | 1,200 | 2,500 |
| **Alpha - Hexachlorocyclohexanes** | 1.0% SOM | 0.23 | 6.90 | 0.035 | 170 | 24 | 47 |
| | 2.5% SOM | 0.55 | 9.20 | 0.087 | 180 | 24 | 48 |
| | 6.0% SOM | 1.20 | 11 | 0.210 | 180 | 24 | 48 |
| **Beta - Hexachlorocyclohexanes** | 1.0% SOM | 0.085 | 3.70 | 0.013 | 65 | 8.10 | 15 |
| | 2.5% SOM | 0.200 | 3.80 | 0.032 | 65 | 8.10 | 15 |
| | 6.0% SOM | 0.460 | 3.80 | 0.077 | 65 | 8.10 | 16 |
| **Gamma - Hexachlorocyclohexanes** | 1.0% SOM | 0.06 | 2.90 | 0.0092 | 67 | 8.2 | 14 |
| | 2.5% SOM | 0.14 | 3.30 | 0.0230 | 69 | 8.2 | 15 |
| | 6.0% SOM | 0.33 | 3.50 | 0.0540 | 70 | 8.2 | 15 |
| ***Chlorobenzenes*** | | | | | | | |
| **Chlorobenzene** | 1.0% SOM | 0.46 | 0.46 | 5.90 | 56 | 11,000 | 1,300(675)[sol] |
| | 2.5% SOM | 1.00 | 1.00 | 14 | 130 | 13,000 | 2,000(1520)[sol] |
| | 6.0% SOM | 2.40 | 2.40 | 32 | 290 | 14,000 | 2,900 |
| **1,2-Dichlorobenzene** | 1.0% SOM | 23 | 24 | 94 | 2,000 (571) [sol] | 90,000 | 24,000(571)[sol] |
| | 2.5% SOM | 55 | 57 | 230 | 4,800 (1370) [sol] | 95,000 | 36,000(1370)[sol] |
| | 6.0% SOM | 130 | 130 | 540 | 11,000 (3240) [sol] | 98,000 | 51,000(3240)[sol] |
| **1,3-Dichlorobenzene** | 1.0% SOM | 0.40 | 0.44 | 0.25 | 30 | 300 | 390 |
| | 2.5% SOM | 1.00 | 1.10 | 0.60 | 73 | 300 | 440 |
| | 6.0% SOM | 2.30 | 2.50 | 1.50 | 170 | 300 | 470 |
| **1,4-Dichlorobenzene** | 1.0% SOM | 61 | 61 | 15 | 4,400 (224)[vap] | 17,000[g] | 36,000 (224)[vap] |
| | 2.5% SOM | 150 | 150 | 37 | 10,000 (540)[vap] | 17,000[g] | 36,000 (540)[vap] |
| | 6.0% SOM | 350 | 350 | 88[g] | 25,000 (1280)[vap] | 17,000[g] | 36,000 (1280)[vap] |
| **1,2,3,-Trichlorobenzene** | 1.0% SOM | 1.50 | 1.50 | 4.70 | 102 | 1,800 | 770(134)[vap] |
| | 2.5% SOM | 3.60 | 3.70 | 12 | 250 | 1,800 | 1,100(330)[vap] |
| | 6.0% SOM | 8.60 | 8.80 | 28 | 590 | 1,800 | 1,600(789)[vap] |
| **1,2,4,-Trichlorobenzene** | 1.0% SOM | 2.60 | 2.60 | 55 | 220 | 15,000 | 1,700(318)[vap] |
| | 2.5% SOM | 6.40 | 6.40 | 140 | 530 | 17,000 | 2,600(786)[vap] |
| | 6.0% SOM | 15 | 15 | 320 | 1,300 | 19,000 | 4,000(1880)[vap] |
| **1,3,5,-Trichlorobenzene** | 1.0% SOM | 0.33 | 0.33 | 4.70 | 23 | 1,700 | 380(36.7)[vap] |
| | 2.5% SOM | 0.81 | 0.81 | 12 | 55 | 1,700 | 590(90.8)[vap] |
| | 6.0% SOM | 1.90 | 1.90 | 140 | 130 | 1,800 | 860(217)[vap] |

[vap] – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
[sol] – GAC presented exceeds the soil saturation limit, which is presented in brackets.

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

| LQM CIEH General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | | | |
|---|---|---|---|---|---|---|---|
| **Determinands** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** | **POSresi (mg/kg)** | **POSpark (mg/kg)** |
| ***Chlorobenzenes (cont.)*** | | | | | | | |
| **1,2,3,4,- Tetrachlorobenzene** | 1.0% SOM | 15 | 24 | 4.40 | 1,700(122)$^{vap}$ | 830 | 1,500(122)$^{vap}$ |
| | 2.5% SOM | 36 | 56 | 11 | 3,080(304)$^{vap}$ | 830 | 1,600 |
| | 6.0% SOM | 78 | 120 | 26 | 4,400(728)$^{vap}$ | 830 | 1,600 |
| **1,2,3,5,- Tetrachlobenzene** | 1.0% SOM | 0.66 | 0.75 | 0.38 | 49(39.4)$^{vap}$ | 78 | 110(39)$^{vap}$ |
| | 2.5% SOM | 1.60 | 1.90 | 0.90 | 120(98.1)$^{vap}$ | 79 | 120 |
| | 6.0% SOM | 3.70 | 4.30 | 2.20 | 240(235)$^{vap}$ | 79 | 130 |
| **1,2,4, 5,- Tetrachlobenzene** | 1.0% SOM | 0.33 | 0.73 | 0.06 | 42(19.7)$^{sol}$ | 13 | 25 |
| | 2.5% SOM | 0.77 | 1.70 | 0.16 | 72(49.1)$^{sol}$ | 13 | 26 |
| | 6.0% SOM | 1.60 | 3.50 | 0.37 | 96 | 13 | 26 |
| **Pentachlrobenzene** | 1.0% SOM | 5.80 | 19 | 1.20 | 640(43.0)$^{sol}$ | 100 | 190 |
| | 2.5% SOM | 12 | 30 | 3.10 | 770(107)$^{sol}$ | 100 | 190 |
| | 6.0% SOM | 22 | 38 | 7.00 | 830 | 100 | 190 |
| **Hexachlorobenzene** | 1.0% SOM | 1.80(0.20)$^{vap}$ | 4.10 (0.20)$^{vap}$ | 0.47 | 110(0.20)$^{vap}$ | 16 | 30 |
| | 2.5% SOM | 3.30(0.50)$^{vap}$ | 5.70 (0.50)$^{vap}$ | 1.10 | 120 | 16 | 30 |
| | 6.0% SOM | 4.90 | 6.70 (1.2)$^{vap}$ | 2.50 | 120 | 16 | 30 |
| ***Phenols & Chlorophenols*** | | | | | | | |
| ***BTEX*** | 1.0% SOM | 280 | 750 | 66 | 760$^{dir}$(31,000) | 760$^{dir}$(11,000) | 760$^{dir}$(8,600) |
| | 2.5% SOM | 550 | 1,300 | 140 | 1,500$^{dir}$(35,000) | 1,500$^{dir}$(11,000) | 1,500$^{dir}$(9,700) |
| | 6.0% SOM | 1100 | 2,300 | 280 | 3,200$^{dir}$(37,000) | 3,200$^{dir}$(11,000) | 3,200$^{dir}$(11,000) |
| **Chlorophenols (4 Congeners)** | 1.0% SOM | 0.87 | 94 | 0.13 | 3,500 | 620 | 1,100 |
| | 2.5% SOM | 2.00 | 150 | 0.30 | 4,000 | 620 | 1,100 |
| | 6.0% SOM | 4.50 | 210 | 0.70 | 4,300 | 620 | 1,100 |
| **Pentachlorophenols** | 1.0% SOM | 0.22 | 27(16.4)$^{vap}$ | 0.03 | 400 | 60 | 110 |
| | 2.5% SOM | 0.52 | 29 | 0.08 | 400 | 60 | 120 |
| | 6.0% SOM | 1.20 | 31 | 0.19 | 400 | 60 | 120 |
| ***Others*** | | | | | | | |
| **Carbon Disulphide** | 1.0% SOM | 0.14 | 0.14 | 4.80 | 11 | 11,000 | 1,300 |
| | 2.5% SOM | 0.29 | 0.29 | 10 | 22 | 11,000 | 1,900 |
| | 6.0% SOM | 0.62 | 0.62 | 23 | 47 | 12,000 | 2,700 |
| **Hexachloro-1,3-Butadiene** | 1.0% SOM | 0.29 | 0.32 | 0.25 | 31 | 25 | 48 |
| | 2.5% SOM | 0.70 | 0.78 | 0.61 | 68 | 25 | 50 |
| | 6.0% SOM | 1.60 | 1.80 | 1.40 | 120 | 25 | 51 |

$^{vap}$ – GAC presented exceeds the vapour saturation limit, which is presented in brackets.
$^{sol}$ – GAC presented exceeds the soil saturation limit, which is presented in brackets.

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

| CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | |
|---|---|---|---|---|---|
| **Determinands** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| **1,1,2 Trichloroethane** | 1.0% SOM | 0.60 | 0.88 | 0.28 | 94 |
| | 2.5% SOM | 1.20 | 1.8 | 0.61 | 190 |
| | 6.0% SOM | 2.70 | 3.9 | 1.40 | 400 |
| **1,1-Dichloroethane** | 1.0% SOM | 2.40 | 2.50 | 9.20 | 280 |
| | 2.5% SOM | 3.90 | 4.10 | 17 | 450 |
| | 6.0% SOM | 7.40 | 7.70 | 35 | 850 |
| **1,1-Dichloroethene** | 1.0% SOM | 0.23 | 0.23 | 2.80 | 26 |
| | 2.5% SOM | 0.40 | 0.41 | 5.60 | 46 |
| | 6.0% SOM | 0.82 | 0.82 | 12 | 92 |
| **1,2,4-Trimethylbenzene** | 1.0% SOM | 0.35 | 0.41 | 0.38 | 42 |
| | 2.5% SOM | 0.85 | 0.99 | 0.93 | 99 |
| | 6.0% SOM | 2.00 | 2.30 | 2.20 | 220 |
| **1,2-Dichloropropane** | 1.0% SOM | 0.024 | 0.024 | 0.62 | 3.3 |
| | 2.5% SOM | 0.042 | 0.042 | 1.20 | 5.9 |
| | 6.0% SOM | 0.084 | 0.085 | 2.60 | 12 |
| **2,4-Dimethylphenol** | 1.0% SOM | 19 | 210 | 3.10 | 16000* |
| | 2.5% SOM | 43 | 410 | 7.20 | 24000* |
| | 6.0% SOM | 97 | 730 | 17 | 30000* |
| **2,4-Dinitrotoluene** | 1.0% SOM | 1.50 | 170* | 0.22 | 3700* |
| | 2.5% SOM | 3.20 | 170 | 0.49 | 3700* |
| | 6.0% SOM | 7.20 | 170 | 1.10 | 3800* |
| **2,6-Dinitrotoluene** | 1.0% SOM | 0.78 | 78 | 0.12 | 1900* |
| | 2.5% SOM | 1.70 | 84 | 0.27 | 1900* |
| | 6.0% SOM | 3.90 | 87 | 0.61 | 1900* |
| **2-Chloronapthalene** | 1.0% SOM | 3.70 | 3.80 | 40 | 390* |
| | 2.5% SOM | 9.20 | 9.30 | 98 | 960* |
| | 6.0% SOM | 22 | 22 | 230 | 2200* |
| **Biphenyl** | 1.0% SOM | 66* | 220* | 14 | 18000* |
| | 2.5% SOM | 160 | 500* | 35 | 33000* |
| | 6.0% SOM | 360 | 980* | 83 | 48000* |
| **Bis (2-ethylhexyl) phthalate** | 1.0% SOM | 280* | 2700* | 47* | 85000* |
| | 2.5% SOM | 610* | 2800* | 120* | 86000* |
| | 6.0% SOM | 1100* | 2800* | 280* | 86000* |
| **Bromobenzene** | 1.0% SOM | 0.87 | 0.91 | 3.2 | 97 |
| | 2.5% SOM | 2.0 | 2.1 | 7.6 | 220 |
| | 6.0% SOM | 4.7 | 4.9 | 18 | 520 |
| **Bromodichloromethane** | 1.0% SOM | 0.016 | 0.019 | 0.016 | 2.1 |
| | 2.5% SOM | 0.030 | 0.034 | 0.032 | 3.7 |
| | 6.0% SOM | 0.061 | 0.070 | 0.068 | 7.6 |
| **Bromoform** | 1.0% SOM | 2.8 | 5.2 | 0.95 | 760 |
| | 2.5% SOM | 5.9 | 11 | 2.1 | 1500 |
| | 6.0% SOM | 13 | 23 | 4.6 | 3100 |
| **Butyl benzyl phthalate** | 1.0% SOM | 1400* | 42000* | 220* | 940000* |
| | 2.5% SOM | 3300* | 44000* | 550* | 940000* |
| | 6.0% SOM | 7200* | 44000* | 1300* | 950000* |

*soil concentration above saturation limit

VOC and SVOC table continued overleaf

VOC and SVOC table continued from previous page

| CL:AIRE General Assessment Criteria: Volatile and Semi-Volatile Organic Compounds | | | | | |
|---|---|---|---|---|---|
| **Determinands** | | **RwHP (mg/kg)** | **RwoHP (mg/kg)** | **Allotment (mg/kg)** | **Commercial (mg/kg)** |
| **Chloroethane** | 1.0% SOM | 8.3 | 8.4 | 110 | 960 |
| | 2.5% SOM | 11 | 11 | 200 | 1300 |
| | 6.0% SOM | 18 | 18 | 380 | 2100 |
| **Chloromethane** | 1.0% SOM | 0.0083 | 0.0085 | 0.066 | 1.0 |
| | 2.5% SOM | 0.0098 | 0.0099 | 0.13 | 1.2 |
| | 6.0% SOM | 0.013 | 0.013 | 0.23 | 1.6 |
| ***Cis* 1,2 Dichloroethene** | 1.0% SOM | 0.11 | 0.12 | 0.26 | 14 |
| | 2.5% SOM | 0.19 | 0.20 | 0.50 | 24 |
| | 6.0% SOM | 0.37 | 0.39 | 1.0 | 47 |
| **Dichloromethane** | 1.0% SOM | 0.58 | 2.10 | 0.10 | 270 |
| | 2.5% SOM | 0.98 | 2.80 | 0.19 | 360 |
| | 6.0% SOM | 1.70 | 4.50 | 0.34 | 560 |
| **Diethyl Phthalate** | 1.0% SOM | 120* | 1800* | 19* | 150000* |
| | 2.5% SOM | 260* | 3500* | 41* | 220000* |
| | 6.0% SOM | 570* | 6300* | 94* | 290000* |
| **Di-*n*-butyl phthalate** | 1.0% SOM | 13* | 450* | 2.00 | 15000* |
| | 2.5% SOM | 31* | 450* | 5.00 | 15000* |
| | 6.0% SOM | 67* | 450* | 12 | 15000* |
| **Di-*n*-octyl phthalate** | 1.0% SOM | 2300* | 3400* | 940* | 89000* |
| | 2.5% SOM | 2800* | 3400* | 2100* | 89000* |
| | 6.0% SOM | 3100* | 3400* | 3900* | 89000* |
| **Hexachloroethane** | 1.0% SOM | 0.20 | 0.22 | 0.27 | 22* |
| | 2.5% SOM | 0.48 | 0.54 | 0.67 | 53* |
| | 6.0% SOM | 1.10 | 1.30 | 1.60 | 120* |
| **Isopropylbenzene** | 1.0% SOM | 11 | 12 | 32 | 1400* |
| | 2.5% SOM | 27 | 28 | 79 | 3300* |
| | 6.0% SOM | 64 | 67 | 190 | 7700* |
| **Methyl *tert*-butyl ether (MTBE)** | 1.0% SOM | 49 | 73 | 23 | 7900 |
| | 2.5% SOM | 84 | 120 | 44 | 13000 |
| | 6.0% SOM | 160 | 220 | 90 | 24000 |
| **Propylbenzene** | 1.0% SOM | 34 | 40 | 34 | 4100* |
| | 2.5% SOM | 82 | 97 | 83 | 9700* |
| | 6.0% SOM | 190 | 230 | 200 | 21000* |
| **Styrene** | 1.0% SOM | 8.10 | 35 | 1.60 | 3300* |
| | 2.5% SOM | 19 | 78 | 3.70 | 6500* |
| | 6.0% SOM | 43 | 170 | 8.70 | 11000* |
| **Total Cresols (2-, 3-, and 4-methylphenol)** | 1.0% SOM | 80 | 3700 | 12 | 160000 |
| | 2.5% SOM | 180 | 5400 | 27 | 180000* |
| | 6.0% SOM | 400 | 6900 | 63 | 180000* |
| ***Trans* 1,2 Dichloroethene** | 1.0% SOM | 0.19 | 0.19 | 0.93 | 22 |
| | 2.5% SOM | 0.34 | 0.35 | 1.90 | 40 |
| | 6.0% SOM | 0.70 | 0.71 | 0.24 | 81 |
| **Tributyl tin oxide** | 1.0% SOM | 0.25 | 1.40 | 0.042 | 130* |
| | 2.5% SOM | 0.59 | 3.10 | 0.100 | 180* |
| | 6.0% SOM | 1.30 | 5.70 | 0.240 | 200* |

*soil concentration above saturation limit

| C4SL Low Level of Toxicological Concern | | | | | | | |
|---|---|---|---|---|---|---|---|
| Determinands | | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
| 1,2-Dichloroethane (Ethylene Dichloride) | 1.0% SOM | 0.11 | 0.16 | 0.054 | 12 | 300 | 300 |
| | 2.5% SOM | 0.18 | 0.24 | 0.10 | 17 | 310 | 330 |
| | 6.0% SOM | 0.31 | 0.41 | 0.19 | 29 | 310 | 380 |
| Cis-1,2-Dichloroethene | 1.0% SOM | 0.46 | 0.50 | 0.89 | 38 | 3,800 | 2,000 |
| | 2.5% SOM | 0.78 | 0.84 | 1.7 | 64 | 3,800 | 2,400 |
| | 6.0% SOM | 1.5 | 1.6 | 3.6 | 120 | 3,900 | 3,100 |
| Tetrachloroethene (PCE) | 1.0% SOM | 0.31 | 0.32 | 2 | 24 | 3,200 | 1,400 |
| | 2.5% SOM | 0.70 | 0.71 | 4.8 | 55 | 3,300 | 1,900 |
| | 6.0% SOM | 1.60 | 1.60 | 11 | 130 | 3,400 | 2,500 |
| Trans-1,2-Dichloroethene | 1.0% SOM | 0.90 | 0.93 | 3.70 | 69 | 13,000 | 5,600 |
| | 2.5% SOM | 1.60 | 1.70 | 7.50 | 120 | 13,000 | 7,000 |
| | 6.0% SOM | 3.30 | 3.40 | 16 | 260 | 13,000 | 9,100 |
| Trichloroethene (TCE) | 1.0% SOM | 0.0093 | 0.0097 | 0.032 | 0.73 | 76 | 41 |
| | 2.5% SOM | 0.020 | 0.020 | 0.072 | 1.5 | 78 | 54 |
| | 6.0% SOM | 0.043 | 0.045 | 0.16 | 3.4 | 79 | 69 |
| Vinyl Chloride (Chloroethene) | 1.0% SOM | 0.0064 | 0.015 | 0.0017 | 1.1 | 7.8 | 18 |
| | 2.5% SOM | 0.010 | 0.019 | 0.0031 | 1.4 | 7.8 | 19 |
| | 6.0% SOM | 0.017 | 0.029 | 0.0058 | 2.2 | 7.8 | 19 |

### 9.6. Per- and Polyfluoroalkyl Substances (PFAS)

| Interim C4SLs for PFOA, PFNA, PFHxS and PFOS | | | | | | |
|---|---|---|---|---|---|---|
| Determinand | RwHP (mg/kg) | RwoHP (mg/kg) | Allotment (mg/kg) | Commercial (mg/kg) | POSresi (mg/kg) | POSpark (mg/kg) |
| PFOA | 0.076 | 0.041 | 0.0014 | 0.60 | 0.079 | 0.17 |
| PFOS | 0.013 | 0.041 | 0.0027 | 0.60 | 0.079 | 0.17 |
| PFHxS | 0.0081 | 0.041 | 0.0015 | 0.60 | 0.079 | 0.17 |
| PFNA | 0.0073 | 0.041 | 0.0013 | 0.60 | 0.079 | 0.17 |

### 9.7. Asbestos

No asbestos or asbestos containing materials (ACM's) are considered acceptable on-site from a human health perspective. Therefore the GAC for asbestos & ACM's within any imported material should be none detected (ND).