**Remediation and Verification Strategy for Contaminated Soils**

**FORMER GREENSIDE MILLS**
**SKELMANTHORPE**

for

**Lovell Partnerships Limited**

Report Number 4499

September 2025

Michael D Joyce Associates LLP
Geotechnical and Geoenvironmental Consultants
Registered Office: 531 Denby Dale Road West, Calder Grove, Wakefield, West Yorkshire, WF4 3ND
**T** +44(0)1924 360458 **E** mdja@geoenvironmental.co.uk **W** www.geoenvironmental.co.uk

# Remediation and Verification Strategy for Contaminated Soils

# FORMER GREENSIDE MILLS, SKELMANTHORPE

***Contents***



***Appendices***

# 1 INTRODUCTION

1.1 On behalf of Lovell Partnerships Limited, Sirius Geotechnical Limited prepared a Remediation Strategy for the former Greenside Mills in Skelmanthorpe. This was presented as Report No. C9297/RS, dated November 2023, and titled, "Strategy for Remedial and Preparatory Works - Former Greenside Mills, Skelmanthorpe."

1.2 The original strategy for Remedial and Preparatory Works was prepared by Sirius Geotechnical. The primary objective of the remediation works remains to discharge relevant planning conditions whilst mitigating the transient and long-term risk to human health receptors from potential contaminants within Made Ground, hydrocarbon hotspots, mill pond sediments and Made Ground, which have recorded elevated concentrations of contamination.

1.3 At the request of Lovell Partnerships Limited, Michael D Joyce Associates LLP has subsequently been commissioned to prepare a revised Remediation and Verification Strategy for Contaminants encountered at the site.

1.4 This revised Remediation and Verification Strategy is based upon the original Sirius Remediation Strategy, but incorporates the findings of a Supplementary Phase 2 Ground Investigation in order to address potential changes to the site carried out during initial site preparatory works. These findings are presented in Michael D Joyce Associates LLP Report No. 4496, "Supplementary Phase 2 Ground Investigation – Former Greenside Mills, Skelmanthorpe."

1.5 The supplementary investigation comprised window sampling boreholes and subsequent contamination testing. It also included a revised risk assessment and Conceptual Site Model to reflect any changes to the site.

1.6 The original Remediation Strategy included a number of remediation works that were carried out between the initial site preparatory works and the subsequent supplementary ground investigation. As such, these have been assessed in the light of the findings of the supplementary investigation. These remediation works are discussed in the Contaminated Land Review carried out by Michael D Joyce Associates LLP, Report No. 4493, dated August 2025, which also includes the associated verification works.

1.7 A separate Remediation Strategy has been produced in respect of ground gases, namely, "Remediation and Verification Strategy for Ground Gases - Former Greenside Mills, Skelmanthorpe", Michael D Joyce Associates LLP Report No. 4494, dated August 2025.

## 2 COMPLETED REMEDIAL WORKS

2.1 The Sirius Remediation Strategy identified three specific 'hotspots" where remediation works were required, namely;

- *Consolidation of shallow mineworkings*
- *Removal of asbestos impacted soils*
- *Assessment of pond sediments and removal of oily substance from culvert.*

2.2 These have been carried out and their validation is documented in the 'Contaminated Land Review'. It should be noted that these remedial works will also be subject to the application of a clean cover system. This will afford additional protection in the unlikely event that any contamination remains.

2.3 The original Remediation Strategy also provided recommendations in respect of site clearance/preparation, namely;

- Services
- Tree Protection
- Invasive Plant Removal
- Site Clearance
- Stockpiles.

2.4 These have been addressed as part of the initial site clearance works.

# 3 EARTHWORKS

**The following was specified in the Sirius Remediation Strategy. These continue to apply in respect of the so-called "inaccessible area", which was not subject to initial site clearance works.**

## 3.1 Earthworks Specification

Earthworks undertaken at the site shall be undertaken in accordance with the requirements of an appropriate Earthworks Specification. The Earthworks Specification is to be produced by the appointed specialist contractor and agreed with the Developer/Developer's Engineer, as well as the local highway's authority, building warranty provider and any other involved parties as necessary.

## 3.2 Soil Re-Use and Disposal

The re-use of site-won soils, and/or importation of soils from anther development site for use on the site, should be undertaken in accordance with a Materials Management Plan (MMP). Soils proposed for re-use on site as capping within soft landscaped areas should be tested in accordance with this report.

Soil materials for off-site disposal shall be sampled and analysed by the contractor at a frequency sufficient to allow the material to be adequately categorised.

Removal of any materials from the site should be undertaken in accordance with the current Duty of Care requirements and the latest version of EA Technical Guidance Document WM3, *Guidance on the Classification and Assessment of Waste.* The waste

may also be subject to Waste Acceptance Criteria (WAC) testing. It is recommended that discussion with landfill operators takes place at an early stage if off-site disposal is to be considered. Waste transfer notes/hazardous waste consignment notes shall be completed, signed and retained by all parties involved and retained by the contractor for a period of at least two years. The transfer note shall state the volume of waste, the nature of the material and statement of its chemical composition.

### 3.3 Grubbing up of Slabs, Hardstands and Foundations

Any remnant hardstanding, foundations, sub-structures, drainage and other relic structures associated with the former uses of the site should be broken out/removed to the full depth of the Made Ground where feasible. Selected materials suitable for re-use or recycling shall be retained on site for potential reuse within the works.

Excavations made to remove existing intact substances may need to be extended to facilitate the chosen foundation solution(s), where practicable.

All unsuitable materials, including, but not limited to, asbestos, metal, steel reinforcement, rags, plastic, timber or degradable material shall be removed.

All hard arisings/materials, where appropriate, shall be stockpiled, crushed and processed in agreed locations. The crushed product shall be inspected by the GE to confirm deleterious materials have been removed as far as practicable.

The crushed product should also be tested for the suite of determinands. If asbestos presence/absence testing returns positive results, then quantitative testing of the affected samples should be undertaken.

## 3.4 Excavation of Subsurface Structures

Previously identified substructures, as well as any other buried structures encountered during the earthworks shall be broken out and removed, where present within the footprint of proposed buildings, roads, paved areas, sewers and surface water drainage infrastructure, etc., to their full depth.

Possible exceptions to the above include any previously unidentified piled foundations. Any piled foundations that the contractor intends to leave in situ during enabling works shall be inspected by the GE, made safe, accurately surveyed and marked on a plan to determine their location in relation to the proposed development layout. Any such features that may require additional breaking out or other remedial works due to structural/build implications (e.g. may hinder foundation construction) shall be discussed the client.

It should be noted that, whilst breaking out of intact substructures to their full depth within proposed areas of public open space may not be strictly necessary to facilitate the proposed development, it could generate re-usable fill materials that are required to achieve the remediation objectives.

All hard arisings, where appropriate, shall be stockpiled, crushed and processed to create a suitable granular fill material.

## 3.5 General Excavations/Turnover

A turnover of Made Ground shall be undertaken, in order to identify previously unidentified intact subsurface features and areas of gross soil contamination. Any

intact subsurface features identified by the turnover should be removed to a depth suitable to facilitate proposed development works (e.g. foundation construction, drainage installation, etc.).

Previous investigation works have revealed Made Ground soils that are chemically and texturally unsuitable for use in soft-surfaced garden and landscaped areas across the site. These soils should be placed below suitable hardstanding, buildings, or appropriate clean cover system within gardens/areas of soft landscaping. Final remediation formation levels should allow for the placement of a clean cover layer, with minimum depth of 600mm in gardens/450mm in soft landscaped areas above a geomembrane. An additional 150mm reduction from finished ground level may be required in garden/soft landscaped areas where asbestos is present within Made Ground, should a coarse granular 'hard dig' layer option be used at the base of the clean cover layer.

During excavation works, the materials excavated should be inspected to ensure there are no areas of previously undetected contamination. Any soils exhibiting visual and/or olfactory evidence of gross contamination shall be placed in temporary stockpiles on hardstanding or heavy-duty Visqueen sheeting, suitably covered and bunded with appropriate signage and identification. The geoenvironmental engineer shall advise the contractor of any testing requirements to adequately classify the materials for potential re-use (with or without treatment works), or removal from site.

Any materials excavated not immediately placed in the deposition area shall be stored in clearly identified stockpiles. Surveys of any stockpiles shall be undertaken at regular intervals through the remediation works and provided to the GE, together with a description of their intended use.

Any stockpile of Made Ground soils shall be assumed to contain elevated concentrations of contaminants until proven otherwise through laboratory analysis. It shall be ensured that such materials are not allowed to cross-contaminate any clean areas of the site, nor are they allowed to contaminate any off-site areas or controlled waters.

The possibility of encountering unrecorded mine entries/bell pits on site cannot be discounted. Excavations should be inspected for any disturbed ground, associated with possible historic bell pits/mine entries/crop workings of the shallow coal.

If any evidence of unrecorded mining features are encountered, appropriate stabilisation by drill and grout treatment shall be carried out in accordance with a mineworkings drill and grout specification. Treatment of identified mineworkings shall meet with the requirements of relevant regulators, namely the Coal Authority and the local authority. If such mineworkings are identified, then works shall cease immediately in those areas and the advice sought from the GE.

### 3.6 Excavations within Asbestos-Impacted Soils

Where necessary, excavation, movement, stockpiling and placement of asbestos-contaminated soils/aggregates should be undertaken in accordance with a site-specific method statement and the Control of Asbestos Regulations 2012.

The following should be undertaken if ACMs are visible. An exclusion zone should be set out at the location of the impacted soils to be excavated, with access restricted for all site personnel except those specifically undertaking the works.

Where any visible fragments of ACM are identified, a hand-picking exercise should be undertaken during earthworks, where practicable, using Category B non-licensed asbestos work qualified personnel. All identified visible ACMs should be carefully picked, double-bagged and placed into a lockable skip for subsequent off-site disposal.

Following the above picking, any remaining soils containing residual asbestos (i.e. no visible ACMs and asbestos soil matrix concentration of <0.1%) may be carefully excavated and placed outside the footprint of proposed roads and drainage infrastructure at an appropriate depth to allow for the placement of hard surfacing or clean cover soils as necessary. These works should be supervised by Category B trained personnel, with the location and depths of placed impacted soils being accurately surveyed/recorded and marked on a constraints plan.

Any excavated soils containing visible ACMs, and/or asbestos fibres in concentrations >0.1% that are excavated must be removed from site as hazardous waste.

During all operations, the risk of dust release should be continuously assessed, and appropriate mitigation measures put in place. This is typically a bowser with hose attachment to wet down working areas and suppress dust, although other alternative techniques will be considered as necessary. Potential dust emissions from stockpiled soils should be mitigated by the application of water or stabilising agents and/or by covering with tarpaulin sheeting or other appropriate cover material.

Excavated 'residual' soils should be carefully placed within the deposition area and carefully compacted to minimise the risk of dust emission.

All site personnel undertaking the remedial works should be suitably trained for the task being undertaken and should wear the appropriate personal protective equipment/respiratory protective equipment (PPE/RPE), taking into account the weather conditions at the time of the works. Advice should be sought from a qualified and experienced asbestos surveyor/analyst if necessary. PPE/RPE may include;

- Cat 3 Type 5 coveralls.
- RPE (typically Sundstrom ½ mask fitted with P3 filter or equivalent).
- Boots that are easily cleanable.
- Disposable gloves.

Personal decontamination should be carried out in accordance with, and as applicable to, the HSE's Asbestos Essentials EM8 document. All disposable PPE/RPE should be treated as contaminated waste and disposed of appropriately.

The excavation and handling of asbestos-contaminated soils on the site may comprise notifiable non-licensed work. If this applies, the Health and Safety Executive (HSE) should be notified. Reference should be made to the CL:AIRE CAR-SOIL guidance[2] to determine whether the work is notifiable.

### 3.6.1 Verification Sampling

Following removal of any visually asbestos-impacted soils, the resultant excavation

[2]CL:AIRE, 2016. Control of Asbestos Regulations 2012 – Interpretation for Managing and Working with Asbestos in Soil and Construction and Demolition Materials: Industry guidance. CL:AIRE, London).

side walls and base will require sampling and verification by a suitably qualified geoenvironmental engineer.

Samples shall be taken on a nominal 5m grid by the GE, to verify that the area of asbestos impact has been substantially removed from within the identified impacted area, with the recovered samples being sent to an UKAS accredited laboratory for asbestos identification. If asbestos is positively identified by the analysis, additional quantitative asbestos analysis should be undertaken.

Where the results of laboratory testing indicate an asbestos concentration of >0.001% is present within the footprint of landscaped areas, additional soil shall be excavated from the sidewalls or base of the excavation, following which, further verification samples shall be recovered and tested in accordance with the method described above. This shall be an iterative process until verification test results confirm asbestos is not present at concentrations >0.001%.

Subsequent to removal of asbestos impacted soils from soft landscaped areas, a suitable clean cover should be provided, as described within Section 4.

The base of all excavations and location of all verification samples should be surveyed prior to deposition of replacement fill material/growth medium.

### 3.7 Previously Unidentified Contamination

There is the possibility that as yet undiscovered sources of contamination may be present which will require remediation. It is therefore considered that the following actions should be undertaken during site reclamation and preparatory works.

A watching brief should be carried out during the enabling works, with particular attention to;

- Evidence of asbestos containing materials.
- Visual or olfactory evidence of hydrocarbons.
- Made Ground differing significantly in nature from that previously identified during the site investigation works.

If previously unidentified contamination is encountered during any of the proposed works by any site personnel, the GE shall be notified immediately and works in the vicinity of the suspected contamination should be temporarily suspended. Additional laboratory analysis of previously unidentified contamination sources will be required in order to determine the requirements for remediation, assessed against appropriate assessment criteria.

If deemed appropriate the GE shall request additional and/or supplementary chemical testing, dependant on the nature of any materials encountered on site during the course of the remediation works. The analytical testing will be undertaken on a five-day turnaround and shall be forwarded to the GE as they become available. The results shall be compared with the threshold guideline values given in this Strategy. Should any analyte exceed the concentrations shown, then the GE will advise upon further works required.

## 3.8 Re-profiling/In-filling

Earthworks are required to achieve proposed final development levels. The volume of soil to be imported to site is to be determined following completion of cut and fill calculations.

Any areas requiring infilling shall be made level, by terracing if necessary, with a nominal fall of 1 in 50. The base of all excavations shall be surveyed prior to the placement of the engineered fill.

The base of any excavation or surface prepared by the contractor to accept fill material shall be proof-rolled using a vibratory roller and any soft spots encountered investigated, removed as necessary and replaced with suitable fill materials.

Once a clean working surface has been exposed/created and approved by the GE, suitable fill materials shall be laid and compacted in accordance with an appropriate Earthworks Specification.

Areas of fill shall be benched into adjacent areas in accordance with BS6031:2009, 'Code of Practice for Earthworks'.

Any fill placed within excavations within the footprint of proposed buildings or structures should be compatible with the proposed founding solution.

Any materials excavated and not immediately placed in the deposition area shall be stored in clearly identified stockpiles. Surveys of any stockpiles shall be undertaken at

regular intervals through the remediation works and provided to the GE, together with a description of their intended use.

Any stockpile of soils shall be assumed to contain elevated concentrations of contaminants until proven otherwise via laboratory analysis. It shall be ensured that such materials are not allowed to cross-contaminate any clean areas of the site, nor are they allowed to contaminate any off-site areas or controlled waters.

### 3.9 Control Testing

The contractor shall undertake appropriate earthworks control testing. All control testing shall be carried out in accordance with the relevant British Standard or other relevant guidance, except where the specification adopts alternative methodologies.

If the results of control / validation tests indicate that the fill is being placed and compacted in such a way that the desired level of compaction is not being achieved, the contractor shall further compact or if necessary, shall excavate the affected work and replace with new fill, compacted to meet the specification requirements.

### 3.10 Control of Waters

The contractor shall ensure that potentially contaminated waters and leachate from excavations or stockpiling areas do not reach watercourses, surface water drains, etc. The contractor shall ensure contaminated waters or leachate do not discharge onto ground outside of the site, or enter surface water courses or drains.

All such waters will be treated on site as necessary for subsequent disposal to the foul sewer or alternatively removed from site by tanker to a suitable disposal facility. The contractor will be responsible for obtaining all necessary permits, licenses and consents for disposal to foul sewers.

Contaminated waters pumped from excavations should be stored appropriately and subject to appropriate chemical analysis prior to disposal. Any discharges to foul sewer should be recorded in relation to date, time, quantity and quality. All records should be maintained at all times and be made available for inspection upon request.

In addition, measures should be in place to prevent the run-off of site water containing dust or silt, or mobilisation of existing pond sediments into the surface water feature.

The appointed earthworks contractor should produce detailed Method Statements describing how these objectives will be achieved.

### 3.11 Adoptable Highways

Where applicable, the details of remedial works undertaken within the footprint of adoptable highways should be agreed in advance with the adopting Local Authority.

# 4 CLEAN COVER SOILS

## 4.1 Clean Cover System Thickness

Previous investigation works have identified chemically and texturally unsuitable Made Ground across the site. A clean cover system shall be applied to all private gardens/areas of soft landscaping.

The makeup of the required clean cover system (capping layer) shall be as shown in Table 4.1.

**Table 4.1 - Required Clean Cover Layer Makeup**

| | Minimum Thickness (mm) | | | |
|---|---|---|---|---|
| | **Subsoil** | **Topsoil** | **Soil Thickness** | |
| **Private Gardens (front and Rear)** | 450 | 150 | 600 | 150mm Granular Hard Dig Layer Or Geotextile Separator Required at Base |
| **Soft Landscaped/ POS Areas** | 300 | 150 | 450 | 150mm Granular Hard Dig Layer Or Geotextile Separator Required at Base |

Thickness

## 4.2 Topsoil and Subsoil

The geomembrane, topsoil and subsoil shall be placed by the contractor responsible for the construction phase of the works. It shall be ensured that topsoil / subsoil material is of an appropriate quality and that concentrations of contaminants do not exceed the maximum concentrations stipulated in tables provided within Appendix B for gardens andsoft landscaped/ POS areas.

Any material used within the growth medium shall be inspected to ensure that they are suitable. It shall be clean and free of foreign debris, building waste materials, timber and other deleterious matter.

Site-won subsoil proposed for re-use shall be placed in stockpiles for future placement by the contractor responsible for the development works. It is assumed that all topsoil will be imported.

Any material used within the growth medium shall be inspected to ensure that they are suitable. It shall be clean and free of foreign debris, building waste materials, timber and other deleterious matter.

Site-won subsoil proposed for re-use shall be placed in stockpiles for future placement by the contractor responsible for the development works. It is assumed that all topsoil will be imported.

Any materials used within the clean cover layer shall be tested in accordance with the guidance given in the YALPAG document *Verification Requirements for Cover Systems,* Version 4.1, dated June 2021, included in Appendix C, and as summarised in Table 4.2,

below to ensure that contaminant concentrations do not exceed those stipulated in Appendix B for residential end-use.

**Table 4.2 - Sampling and Testing for Clean Cover Materials**

| Type | Number of Samples (per Material Type and Source) | Testing Schedule | Assessment Criteria |
|---|---|---|---|
| **Virgin Quarried Material** | 1 or 2 depending on the type of stone used | Standard metals/metalloids (As, Cd, Cr, Cr (VI), Cu, Hg, Ni, Pb, Se, Zn) | As per Appendix B |
| **Crushed Hardcore Stone, Brick (excluding asphalt)** | Minimum 1 per 500m$^3$ | Standard metals/metalloids (as above)<br>PAH (16 USEPA speciation)<br>Asbestos<br>Total TPH | |
| **Greenfield/ Manufactured Soils** | Minimum of 3 dependant on source, between 1 per 50m$^3$ and 1 per 250m$^3$ | Standard metals/ Metalloids (as above)<br>PAH (16 USEPA speciation)<br>Asbestos<br>pH and soil organic matter | |
| **Brownfield/ Screened Soils** | Minimum of 6 dependant on source, between 1 per 50m$^3$ and 1 per 100m$^3$ | Standard metals/metalloids (as above)<br>PAH (16 USEPA Speciation)<br>TPH (CWG banded)<br>Asbestos<br>pH and soil organic matter<br>Any additional analysis dependant on the history of the donor site. | |

The analysis should be undertaken at a UKAS accredited laboratory, with MCERTS accredited analysis used where available.

In general, the soils would be considered suitable for use within the clean cover when all recorded contaminant concentrations are less than the concentrations stated in Appendix B. Where a minority of samples tested contain contaminant concentrations greater than the relevant threshold values stated in Appendix 2, consideration can be given to undertaking statistical analysis to determine the suitability of the material as a whole, in accordance with current CL:AIRE guidance[3].

Existing reworked topsoil within the site are chemically unsuitable for use within the soil cover layer. Site-won clean natural subsoils from excavation for foundations, drainage etc. may be suitable for use, subject to careful segregation from contaminated soils, visual inspection and chemical analysis.

For imported soils, the test results shall be made available to the GE, and their acceptance given in writing, prior to any material being delivered to site.

([3] CL:AIRE, 2020. Professional Guidance: Comparing Soil Contamination Data with a Critical Concentration. CL:AIRE, Buckinghamshire).

## 4.3 Placement

The surface of any existing made ground should be levelled and compacted to reduce the risk of intermixing with the clean cover soil materials. The geomembrane shall then be placed to all gardens and landscaped/POS areas.

The clean cover subsoil and topsoil materials shall be lightly compacted following placement to limit future settlements.

It is envisaged that the clean cover shall be placed towards the end of the development programme. This will act to minimise the potential for disturbance of the growth medium and physical destruction of topsoil structure e.g., via plant trafficking following placement.

## 4.4 Verification

Verification of the depth of topsoil and subsoil (and the presence of hard-dig layer / geotextile separator, where required), shall be carried out by a suitably qualified GE by excavation of trial pits following placement.

Verification trial pits shall be excavated at a rate of 1 per 3 plots for private rear and front garden areas or spaced on a minimum of a 25m grid for landscaped / POS areas (minimum 3 per landscaped area).

Evidence for verifying placement of the clean cover, shall accord with the YALPAG document, *Verification Requirements for Cover Systems*, Version 4.1, included in Appendix C.

Turf, fencing, planting, etc., should not be placed until the GE has given confirmation that the soils meet the requirements of this Remediation Strategy.

Should any excavation of foundations, drainage or services, etc., extend below any placed 'clean' capping layer, and therefore encounter underlying made ground materials, then there is a potential for cross-contamination. This should be avoided where possible. Detailed Risk Assessments and Method Statements outlining the soil management for the site shall be provided for this work by the developer and their specialist sub-contractors.

# 5 GENERAL SITE REQUIREMENTS

## 5.1 Introduction

The contractor shall comply at all times with this Strategy, the Conditions of Contract and all relevant health and safety requirements. Site works will be supervised by a GE appointed by the client.

The contractor shall prepare and submit a programme for the works to the client prior to the commencement on site.

## 5.2 Health and Safety

The remediation and earthworks shall be undertaken in accordance with all relevant legislation including, but not limited to:

- The Health and Safety at Work etc. Act, 1974;
- Construction (Design and Management) Regulations (CDM Regulations), 2015;
- The Control of Substances Hazardous to Health (COSHH) Regulations, 2002; and
- The Control of Asbestos at Work Regulations, 2012 and the associated HSE's *Approved Code of Practice and Guidance.*

Contaminated soils are present on the site. During the remediation and construction, it will be necessary to protect the health and safety of site personnel. General guidance on these matters is given in the Health and Safety Executive (HSE) document '*Protection of Workers and the General Public during the Redevelopment of Contaminated Land* (HS(G)66)'.

In summary, the following measures are suggested to provide a minimum level of protection.

- All ground workers should be issued with high visibility clothing, hard hats, safety glasses, protective footwear and impermeable heavy-duty gloves. Personnel should be instructed in their correct use;
- Hand washing and boot cleaning facilities shall be provided;
- No smoking on site other than in designated areas, if any are present on site; and,
- Good practices relating to personal hygiene shall be adopted.

Before site operations are commenced, the necessary COSHH Assessment, Method Statements and Construction Phase Plan should be completed and issued by the contractor in accordance with The CDM Regulations.

All site personnel shall undergo a site-specific health and safety induction prior to starting work on site.

If an excavation meets the definition of a 'confined space' within the Confined Space Regulations 1997, entry must be undertaken in accordance with a safe system of work meeting the requirements of the HSE's *Safe Work in Confined Spaces - Confined Spaces Regulations 1997: Approved Code of Practice and Guidance* (Third Edition, 2014).

## 5.3 Fuel

Fuelling of any plant shall be undertaken in a designated area and all above ground fuel storage tanks shall comply with The Control of Pollution (Oil Storage) (England) Regulations 2001, (The Oil Storage Regulations).

Specifically, any fuel storage tanks should:

- Be situated within an oil-tight secondary containment system such as an impermeable bund;
- The secondary containment must provide storage of at least 110% of the tank's maximum capacity;
- Be located within a secured area; and
- All taps and valves should be fitted with a lock and be adequately secured when not in use.

Contractors shall provide a fuel spill kit, to be kept on site in an accessible place near to the designated refuelling area.

Waste oil, hydraulic fluid etc., should not be tipped directly or otherwise discharged onto site. Such materials shall be stored separately in a secure bunded area for off-site disposal. Waste oil is a Hazardous Waste, and disposal shall be undertaken by a registered carrier in accordance with the Waste (England and Wales) Regulations (2011).

## 5.4 Asbestos

Construction workers involved in the groundworks and construction during the site redevelopment and during future works (e.g., maintenance or replacement of underground services) should be vigilant and adopt a safe system of work, including use of appropriate personal protection equipment (PPE), hygiene precautions and good working practices (e.g., wetting of soils etc).

The contractor must ensure that all relevant personnel working on site are aware of the possible risk associated with the potential presence of asbestos within soils at the site and be vigilant during works. If visual evidence of additional ACMs is encountered during the works, advice should be sought from an appropriately qualified asbestos specialist and an appropriate strategy developed for the safe remediation of the material.

All groundworks contractors who could potentially come into contact with such materials shall be required to submit appropriate method statements and risk assessments clearly stating how any such risks will be managed.

During earthworks (i.e., excavation, sorting and placement of potentially asbestos-impacted made ground), made ground soils should be assumed to be potentially impacted by asbestos and therefore all reasonable measures should be put in place in order to minimise, as far as practicable, dust generation and therefore the potential release of asbestos fibres (if present). Appropriate management of all excavation arisings and other works shall be considered to ensure asbestos within excavated materials does not present a risk to site workers, or result in cross contamination of other areas of the site, or clean imported / site-won soils.

## 5.5 Dust Control and Monitoring

Appropriate measures shall be implemented at all times during the remediation works, to minimise any dust / asbestos fibre emissions.

Any haul roads shall, where practical to do so, be constructed of crushed hardcore products. These haul roads shall be maintained for the duration of their use to minimise any build-up of mud, loose spoil, etc. Mobile water bowsers and sprayers shall be made available to dampen unpaved haul roads and working areas. An adequate accessible supply of clean water shall be maintained at all times to allow dust suppression to be carried out at short notice.

Traffic both entering and working on the site shall obey an appropriate maximum speed limit to minimise dust generation.

Regular inspections of the public highway adjacent to the site entrance shall be carried out by the contractor. If deemed necessary, the highway shall be swept regularly to remove any mud, slurry or dust deposited by vehicles entering or departing the site, and a wheel wash provided for exiting vehicles, if required. If the contractor considers that significant amounts of any detritus have been deposited on the public highway, then operations shall be temporarily suspended until appropriate cleaning operations have been undertaken.

Any wagons that are to be used for the haulage of potentially contaminated material from the site shall be sheeted to prevent the release of fugitive dust.

When works involving potential disturbance of asbestos are undertaken, dust control mitigation (and where deemed necessary, monitoring) should be undertaken, in accordance with the Control of Asbestos Regulations 2012.

## 5.6 Noise

The requirements of BS 5228-1:2009 *'Code of Practice for Noise and Vibration Control on Construction and Open Sites. Noise'* shall be adhered to at all times.

All machinery shall be fitted with effective silencers and shall be serviced at regular intervals. No items of plant shall be operated with engine covers raised.

The location of any crushing plant shall take into consideration the location of neighbouring properties and other noise sensitive receptors and shall be located away from these areas and located adjacent to proposed stockpile locations, where possible and practicable.

## 5.7 Fires

No fires shall be permitted on site, unless previously agreed with the Local Authority.

# 6 VALIDATION AND REPORTING

The GE shall ensure that the requirements of this strategy are complied with. On satisfactory completion of all remediation works, the GE will provide a validation report, comprising relevant site records and act as certification that the remedial and ground preparation works have been carried out in accordance with this Strategy.

The verification report shall include the following:

- A description of the works undertaken;
- Records of the works;
- Progress photographs;
- Waste transfer notes / hazardous waste consignment notes;
- Laboratory test results;
- As built surveys, including base of excavation and final level survey, base and top of made ground;
- A statement that the works have been undertaken in accordance with the agreed specification.

A Validation Report is a strict requirement for works undertaken under the CL:AIRE DoWCoP.

A separate validation report specific to the treatment of shallow coal mine workings would be required for submission to the Coal Authority (this can form an appendix to the main remediation Validation Report if preferred).

Following the main phase of remediation earthworks, further validation reporting would be required, including the following:

- Validation of placement of clean cover layers, in accordance with Section 8, Appendix B and Appendix
- C of this Strategy.
- Validation of correct installation of ground gas protection measures.

# 7 REGULATORY APPROVAL

7.1 A copy of this specification Remedial Strategy should be forwarded by the client or their appointed planning agent to the Local Planning Authority and other parties as appropriate (e.g., the building warranty provider) for their approval prior to the works.

7.2 Detailed method statements from the Earthworks Contractor and any nominated sub-contractors may also be required to be submitted and approved in writing by the LPA prior to commencement of these works. Sufficient time should be allowed for regulatory approval to be obtained during the redevelopment programme.

A D Joyce

BSc MSc ARSM CEng CGeol CEnv MICE FGS SiLC SQP

September 2025

**Procedure Notes**

The desk study and/or ground investigation have been carried out using reasonable skill and care in accordance with the principles of Ground Investigation and Testing", BS5930: 2013 and BS10175: 2011 + A1: `2013, and the terms of the client's brief. The report has been prepared for the specific purposes notified at the time of the initial enquiry.

By its very nature any ground investigation only encounters and samples a small percentage of the ground. Consequently changes in ground conditions and soil properties can occur between any two exploratory points, for example local features such as soft ground, pockets of contamination and faults. This is also true of the exploration of mineworkings and such features can extend beneath parts of the site not investigated. Unrecorded bell pits and shafts can also exist between exploratory points. The ground investigation is designed to minimize such risks. Conclusions and recommendations are based on the information presented in this report, but unforeseen features may exist. No liability can be accepted for conditions not revealed by the exploratory holes. Therefore, actual ground conditions shall be noted during construction and further advice sought if they differ from those predicted. Michael D. Joyce LLP reserves the right to amend the conclusions and recommendations in the light of further information. Actual methods of construction or alternative designs shall be notified to Michael D. Joyce Associates LLP, such that the recommendations made can be reconsidered in the light of any changes.

Further investigation can be carried out to further reduce uncertainty and risk but ultimately these risks cannot be eliminated. Similarly a desk study normally only considers readily available information and further information could be held by other sources. In commissioning further research or investigation the cost/benefit of doing so must be considered.

It is assumed that groundlevels shall not change significantly from those at present. The groundwater conditions are based on observations made at the time of the investigation, unless stated otherwise. It shall be noted that the observations are subject to the method of the boring or excavation and that groundwater levels shall vary due to seasonal or other effects.

Where buildings are present on a site, structural and asbestos surveys have not been carried out, unless specifically stated. An Unexploded Ordnance Survey has not been carried out unless specifically stated. In relevant situations it would be prudent to commission such surveys.

Where information has been obtained from Third Parties, no liability can be accepted for the accuracy or completeness of this information. Where anecdotal evidence or speculations are presented, they must be treated as such and cannot be relied upon.

**APPENDIX 1**

Development Plan


## Notes:

This drawing, design and concept are copyright of STEN Architecture.

All Dimensions are to be verified on site before any work commences. If any discrepancies, errors or emissions are noted, these are to be reported to STEN Architecture immediately.

If any other drawings are referenced within this layout, please refer to the specific detailed drawing for design, materials and specific working practices.

## PLANNING LAYOUT KEY:

**Boundary treatments (see separate drawing for details)**

- Bin collection point (bin collection day only)
- Secure 6ft (length) x 2ft (width) x 4ft (height) timber cycle store on 8no. 450sq.flags (900mm x 1800mm). Dwellings with garages to have bicycle hook within for storage.
- Bin storage area on 6no. 450sq.flags (900mm x 1350mm )
- Wall mounted - Mode 3, Type 2, 7kW Electric Vehicle Charging Point
- Post mounted - Mode 3, Type 2, 7kW Electric Vehicle Charging Point

| REV: | DESCRIPTION: | BY: | DATE: |
|---|---|---|---|
| S | Gate to rear garden of plot 3 leading onto Marsden Street introduced. Bin storage area serving plot 3 repositioned. Both as per clients comments. | LS | 18.04.24 |
| R | Bin storage areas updated as per clients comments. | LS | 18.04.24 |
| Q | Title boundary line amended. Rear boundaries of plots 15-20 amended to meet title boundary. Both as per clients comments. | LS | 10.04.24 |
| P | Rear boundaries of plots 1-4, 7, 24 & 27-30 amended to meet title boundary as per clients comments. | LS | 02.04.24 |
| N | plot 09 moved east by 0.5m | BMS | 21.06.23 |
| M | 'Puttenham' house type renamed as 'Newbury' | BMS | 23.03.23 |
| L | EV charging point locations added | BMS | 15.03.23 |
| K | Tweaks to bin and cycle store positions as per client mark up | BMS | 10.01.23 |
| J | Cycle stores, bin store areas and patios added. Central path added between parking spaces. | BMS | 06.01.23 |
| H | 'AS' and 'OP' notes added to blocks, 1747 type handing corrected and side door added. Plot 1 amended to client's comments. | DS | 08.11.22 |
| G | Bin collection point serving plots 30-34 relocated closer to adoptable highway as per clients comments. | LS | 20.07.22 |
| F | Turning head serving plots 12-15 amended., positions of plots 12 and 14 amended to suit. Knee railing introduced to edge of turning head. All as per clients comments. | LS | 01.07.22 |
| E | Garage for plot 1 moved away from Saville Road. Plots 35-37 re-orientated to enable adjacent road to be reduced to private drive. Plots 33-34 moved forward to reduce height of retaining walls at rear. Other minor updates to Planning Officer comments. | BMS | 17.06.22 |
| D | Green walls moved back from footpath | BMS | 31.03.22 |
| C | Semi detached plots handed so entrance doors are on the high side | BMS | 24.03.22 |
| B | Plots to Saville Road amended to provide more rontage and opportunities for landscaping. Detached Osbourne removed. Additional footpaths and visitor parking added | BMS | 18.03.22 |
| A | Parking arrangement amended for plot 45 | BMS | 25.11.21 |

LOVELL

| | |
|---|---|
| Client | LOVELL |
| Project | Skelmanthorpe |
| Job Number | CAD |

STEN ARCHITECTURE

| Type | Floor Area Sq Ft | Bed | Total Units | Total | % Used |
|---|---|---|---|---|---|
| OPEN MARKET | | | | | |
| 3 BEDS | | | | | |
| Lansdown | 898 | 3 | 7 | 6286 | 15.2 |
| Lansdown detached | 898 | 3 | 2 | 1796 | 4.3 |
| Newbury semi | 1016 | 3 | 1 | 1016 | 2.2 |
| Newbury detached | 1016 | 3 | 4 | 4064 | 8.7 |
| Osbourne | 1205 | 3 | 13 | 15665 | 28.3 |
| | | | | | 58.7 |
| 4 BEDS | | | | | |
| Tattenham | 1530 | 4 | 7 | 10710 | 15.2 |
| Grassington | 1747 | 4 | 12 | 20964 | 26.1 |
| | | | | | 41.3 |
| **Total** | | | **46** | **60501** | |

| | ACRES | Hectares |
|---|---|---|
| Approx gross area | 4.6 | 1.86 |
| Approx nett area | 3.78 | 1.53 |
| Coverage per Acre | **16006** | **30** |

STEN ARCHITECTURE
STEN Architecture Ltd
The Studio
Harrison Street
Wakefield
WF1 1PS
Tel: 01924 950985
Web: www.sten-architecture.co.uk
Twitter: @STEN_arch
Facebook: stenarchitectureltd
Linkedin: Sten Architecture

CLIENT: LOVELL PARTNERSHIPS

SITE: Greenside Mills
Skelmanthorpe

TITLE: Planning Layout

| SCALE AT A1: | DATE: | DRAWN: | CHECKED: |
|---|---|---|---|
| 1:500 | 29.09.21 | BMS | -- |

| PROJECT NO: | DRAWING NO: | REVISION: |
|---|---|---|
| 2156 | 2156.01 | S |

N

Scaled @ 1:500

0 10m 20m 50m

**APPENDIX 2**

Threshold Concentrations for Clean Cover Materials

# The Sirius Group
# Stage 1 Threshold Concentrations for Clean Cover Material for Use in Gardens of Private Residential Properties

| Parameter | Threshold Concentration (mg/kg, unless otherwise stated) | | | Comment |
|---|---|---|---|---|
| | 1% SOM* | 2.5% SOM | 5% SOM | |
| **Metals/Metalloids** | | | | |
| Arsenic (inorganic) | 37 | | | |
| Cadmium | 11 | | | Soil pH 6-9 |
| Chromium (III) | 910 | | | |
| Copper | 200 | | | Based on phytotoxic effect |
| Lead | 200 | | | |
| Mercury (inorganic) | 40 | | | |
| Nickel | 130 | | | |
| Selenium | 250 | | | |
| Zinc | 450 | | | Based on phytotoxic effect |
| **Other Inorganics** | | | | |
| pH | <5 or >9 | | | Must be in range 5-9 |
| Water-Soluble Sulphate | 0.5 g/l | | | |
| **Organics** | | | | |
| **PAHs**** | | | | |
| ***Total 16 PAHs*** | ***100*** | ***100*** | ***100*** | Professional judgement |
| Benzo(a)pyrene | 2.1 | 2.1 | 2.2 | Genotoxic surrogate |
| Naphthalene | 1.0 | 2.3 | 4.6 | |
| **TPH†** | | | | |
| ***Sum of TPH fractions EC5-35*** | ***500*** | ***500*** | ***500*** | Professional judgement |
| Aliphatic EC 5-6 | 24 | 41 | 68 | |
| Aliphatic EC >6-8 | 53 | 110 | 210 | |
| Aliphatic EC >8-10 | 13 | 31 | 61 | |
| Aliphatic EC >10-12 | 62 | 150 | 300 | |
| Aliphatic EC >12-16 | 510 | 1200 | 2300 | |
| Aliphatic EC >16-35 | 41000 | 70000 | 90000 | |
| Aromatic EC >5-7 | 53 | 110 | 200 | |
| Aromatic EC >7-8 | 100 | 240 | 460 | |
| Aromatic EC >8-10 | 20 | 48 | 94 | |
| Aromatic EC >10-12 | 63 | 150 | 290 | |
| Aromatic EC >12-16 | 140 | 320 | 570 | |
| Aromatic EC >16-21 | 260 | 540 | 840 | |
| Aromatic EC >21-35 | 1100 | 1500 | 1700 | |
| TPH Hazard Index (no units) | <1 | <1 | <1 | |
| **BTEX‡** | | | | |
| Benzene | 0.063 | 0.13 | 0.24 | |
| **Miscellaneous Organics** | | | | |
| Phenol | 110 | 190 | 330 | |
| **Other Parameters** | | | | |
| Asbestos | Unsuitable if any fibres present | | | |

Based on sandy soil at a range of soil organic matter contents and assuming a standard residential with gardens land use. Alternative criteria may be specified for other soil types and SOM contents, for soils placed at depth, or for other land uses.

**Notes:**

* Soil organic matter; %SOM = 1.724 * %TOC.

** Soils must meet the specified criteria for each component AND the sum of 16 PAHs. The total is specified to prevent unsuitable materials being placed as cover. Where an individual PAH is not shown, then its criterion is greater than that for the sum or it is a genotoxic PAH assessed by using benzo(a)pyrene as a surrogate marker.

† Soils must meet the specified criteria for each component and the Hazard Index for TPH must be <1.0. The sum of TPH fractions must also be met to prevent unsuitable materials being placed as cover. Where an individual TPH fraction has a criterion greater than that for the sum of TPH fractions, the value is solely provided for the calculation of the Hazard Index.

‡ Components other than benzene are not genotoxic carcinogens and therefore assessed as part of the TPH mixture.

**Soils must have no visual or olfactory evidence of contamination.**

Version date: 20 August 2015

# The Sirius Group
# Stage 1 Threshold Concentrations for Clean Cover Soils for Use in Areas of Soft Landscaping

| Parameter | Threshold Concentration (mg/kg, unless otherwise stated) | | | Comment |
|---|---|---|---|---|
| | 1% SOM* | 2.5% SOM | 5% SOM | |
| **Metals/Metalloids** | | | | |
| Arsenic (inorganic) | 79 | | | |
| Cadmium | 120 | | | Soil pH 6-9 |
| Chromium (III) | 1500 | | | |
| Copper | 200 | | | Based on phytotoxic effect |
| Lead | 630 | | | |
| Mercury (inorganic) | 120 | | | |
| Nickel | 230 | | | |
| Selenium | 1100 | | | |
| Zinc | 450 | | | Based on phytotoxic effect |
| **Other Inorganics** | | | | |
| pH | <5 or >9 | | | pH to be in range 5-9 |
| Water-Soluble Sulphate | 0.5 g/l | | | |
| **Organics** | | | | |
| **PAHs**** | | | | |
| ***Total 16 PAHs*** | ***100*** | ***100*** | ***100*** | Professional judgement |
| Benzo(a)pyrene | 4.2 | 4.2 | 4.2 | Genotoxic surrogate |
| **TPH†** | | | | |
| ***Sum of TPH fractions EC5-35*** | ***500*** | ***500*** | ***500*** | Professional judgement |
| Aliphatic EC 5-6 | 520000 | 550000 | 570000 | |
| Aliphatic EC >6-8 | 560000 | 580000 | 600000 | |
| Aliphatic EC >8-10 | 12000 | 12000 | 12000 | |
| Aliphatic EC >10-12 | 13000 | 13000 | 13000 | |
| Aliphatic EC >12-16 | 13000 | 13000 | 13000 | |
| Aliphatic EC >16-35 | 250000 | 250000 | 250000 | |
| Aromatic EC >5-7 | 55000 | 55000 | 55000 | |
| Aromatic EC >7-8 | 55000 | 55000 | 55000 | |
| Aromatic EC >8-10 | 5000 | 5000 | 5000 | |
| Aromatic EC >10-12 | 5000 | 5000 | 5000 | |
| Aromatic EC >12-16 | 5000 | 5000 | 5000 | |
| Aromatic EC >16-21 | 3800 | 3800 | 3800 | |
| Aromatic EC >21-35 | 3800 | 3800 | 3800 | |
| TPH Hazard Index (no units) | <1 | <1 | <1 | |
| **BTEX‡** | | | | |
| Benzene | 71 | 72 | 72 | |
| **Miscellaneous Organics** | | | | |
| Phenol | 440 | 440 | 440 | 440mg/kg is the skin irritation threshold |
| **Other Parameters** | | | | |
| Asbestos | Fibres present | | | |

Based on sandy soil at a range of soil organic matter contents for areas of vegetated landscaping in residential or commercial land uses. Alternative criteria may be specified for other soil types and SOM contents, for soils placed at depth, or for other land uses.

**Notes:**

* Soil organic matter; %SOM = 1.724 * %TOC.

** Soils must meet the specified criteria for each component AND the sum of 16 PAHs. The total is specified to prevent unsuitable materials being placed as cover. Where an individual PAH is not shown, then its criterion is greater than that for the sum or it is a genotoxic PAH assessed by using benzo(a) pyrene as a surrogate marker.

† Soils must meet the specified criteria for each component and the Hazard Index for TPH must be <1.0. The sum of TPH fractions must also be met to prevent unsuitable materials being placed as cover. Where an individual TPH fraction has a criterion greater than that for the sum of TPH fractions, the value is solely provided for the calculation of the Hazard Index.

‡ Components other than benzene are not genotoxic carcinogens and therefore assessed as part of the TPH mixture.

**Soils must have no visual or olfactory evidence of contamination.**

Version date: 20 August 2015

**Maximum Permitted Concentrations (Assessment Criteria - Residential) - Supplementary analytes**

| Analyte | Maximum Permitted Concentrations (mg/kg) |
|---|---|
| Arsenic (total) | 37 (1) |
| Cadmium (total) | 11 (1) |
| Chromium (VI) | 910 (1) |
| Copper (total) | 200 (1) |
| Lead (total) | 200 (1) |
| Mercury (inorganic) | 40 (1) |
| Nickel (total) | 130 (1) |
| Selenium (total) | 250 (1) |
| Zinc (total) | 450 (1) |
| Phenols (total) | 110 (1) |
| Naphthalene | 1.0 (1) |
| Acenaphthylene | 170 (2) |
| Acenaphthene | 210 (2) |
| Fluorene | 170 (2) |
| Phenanthrene | 95 (2) |
| Anthracene | 2400 (2) |
| Fluoranthene | 280 (2) |
| Pyrene | 620 (2) |
| Benzo (a) anthracene | 7.2 (2) |
| Chrysene | 15 (2) |
| Benzo (b) fluoranthene | 2.6 (2) |
| Benzo (k) fluoranthene | 77 (2) |
| Benzo (a) pyrene | 2.1 (1) |
| Indeno (1,2,3 cd) pyrene | 27 (2) |
| Dibenz (a,h) anthracene | 0.24 (2) |
| Benzo (g,h,l) perylene | 320 (2) |
| Asbestos | None (1) |

***(1)*** *Maximum Permitted Concentration as specified by Sirius Remediation Strategy (assuming 1% SOM).*

***(2)*** *Maximum Permitted Concentration as specified by LQM/CIEH "S4ULS for Human Health Risk Assessment".*

**APPENDIX 3**

Verification Requirements for Clean Cover Systems -
YALPAG Version 4.1

# VERIFICATION REQUIREMENTS FOR COVER SYSTEMS

## Technical Guidance for Developers, Landowners and Consultants

**Yorkshire and Lincolnshire Pollution Advisory Group**

**Version 4.1 – June 2021**

The purpose of this guidance is to promote consistency and good practice for development on land affected by contamination. The Local Authorities in Yorkshire, Lincolnshire, the North East of England, East Anglia, Greater Manchester and St Helens who have adopted this guidance are shown below:






































# Contents



**Disclaimer**

**This guidance is intended to serve as an informative and helpful source of advice. YALPAG will review this guidance every three years, but readers must note that legislation, guidance and practical methods are inevitably subject to change and therefore should be aware of current UK policy and best practice. This note should be read in conjunction with prevailing legislation and guidance, as amended, whether mentioned here or not. Where legislation and documents are summarised this is for general advice and convenience, and must not be relied upon as a comprehensive or authoritative interpretation. Ultimately it is the responsibility of the person/company involved in the development or assessment of land to apply up-to-date working practices to determine the contamination status of a site and the remediation and verification requirements.**

**Acknowledgments**

**YALPAG would like to thank North Lincolnshire Council, Leeds City Council, City of Bradford Metropolitan District Council, Barnsley Metropolitan Borough Council, Rotherham Metropolitan Borough Council, Wakefield Council, and Tameside Metropolitan Borough Council, for producing this guidance.**

YALPAG would also like to acknowledge Liverpool City Council's Contaminated Land Team, Coopers Consulting Engineers for allowing us to use their guidance document and photographs and WSP Environmental Ltd for also donating photographs.

**Consultation**

39 Local Authorities and 6 Environmental Consultants were consulted over a four week period in 2010 during the production of the initial guidance. At that time, consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

49 Local Authorities and 25 Environmental Consultants were consulted in 2021, during the production of this version [4.1] of the guidance. Consultation comments were considered by the review panel and a number of revisions were made to the guidance to reflect these comments.

# Introduction

This guidance has been produced to help developers ensure that they can demonstrate that material brought onto a development site for gardens or areas of soft landscaping are suitable for use and do not present harm to people, the environment and/or property. It is intended to improve the quality of reports submitted to Local Authorities on this matter and to give contractors/consultants a point of reference to obtain approval for such work from their client. This guidance does not cover the geotechnical suitability of soils or materials, chemical suitability that does not affect human health e.g. sulphates, or importing soils contaminated with invasive (or injurious) plants.

The verification of cover systems should be an integral part of the remediation project and agreed between developers and regulators at an early stage in the project.

UK guidelines for remediation verification are set out within Land Contamination Risk Management[1] (LCRM) and the document on Verification of Remediation of Land Contamination[2]. This guidance note should be considered as supplementary advice in conjunction with these documents.

This guidance relates to the remediation of land contamination by using cover systems; however, the verification of the quality of imported material is equally important in other situations, such as raising levels for flood prevention or general landscaping works. This guidance could also be used in such instances.

# The Process of Verification

Implementation plans for remedial works should always be site specific. Where a cover system and potentially, excavation, is the main remedial method or a component of an overall site remediation, specific goals will need to be set that are linked directly to the risk management strategy for the site in question.

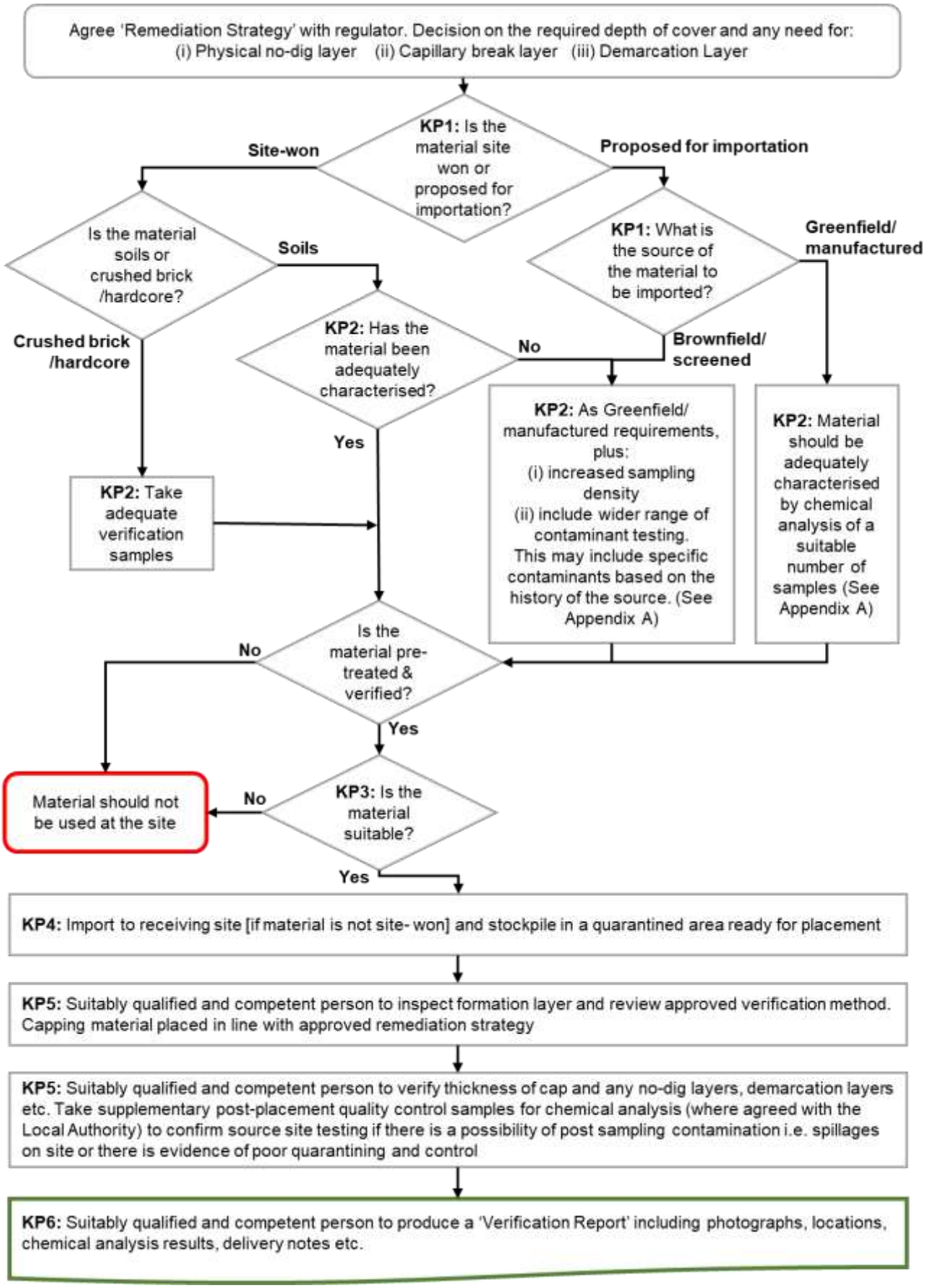
For cover and containment systems, verification will normally depend upon the provision of defensible measurements, observations and records. Critical factors to be considered are:

- What should be measured?
- When should they be measured?
- Where measurements need to be taken, what is the appropriate monitoring regime i.e. number and frequency of samples?
- Statistical constraints on sampling.

National Planning Policy Framework (NPPF) states that “planning policies and decisions should ensure that after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990”. The Verification Report is a key document to demonstrate compliance with NPPF, and the responsibility rests with the developer/applicant to submit the required Verification Report to complete the remediation and to discharge any planning conditions.

[1] Land Contamination Risk Management, Environment Agency, Oct 2020
[2] Verification of Remediation of Land Contamination. Environment Agency, Feb 2010

# Overview Flowchart



# Key Points

## KP1: Source of Material

Material can be sourced from site won material i.e. crushed brick/hardcore or site-won soils from existing open or landscaped areas. In the interest of sustainability, Local Authorities promote the use of such site-won material providing that they are suitable for the intended end use of the site.

Alternatively, material can be sourced from other developments and commercial companies. Dependent on the source of the material it can be classified as either from a 'Greenfield/Manufactured' or 'Brownfield/Screened' source.

Broadly speaking material can be classified as follows:

**Greenfield** – Where documentary evidence is provided confirming that the source site has not been developed and that no past contaminative uses have occurred. Should evidence not be provided or approved by the Local Authority, please note that the source would be expected to be assessed as though it were a brownfield source.

**Manufactured** – from a commercial company who manufacture material by mixing or blending mineral soils (subsoil or sand) with an organic amendment (compost). If other soil component sources are used, documentary evidence should be provided confirming that the source site has not been developed and that no past contaminative uses have occurred. Should documentary evidence not be provided or approved by the Local Authority, please note that the source would be expected to be assessed as though it were a brownfield source.

**Brownfield** – material from a donor site that has previously been developed

**Screened** – material from a company who deal with skip/demolition waste which is screened for unsuitable material i.e. bricks, wood, plastic etc.

## KP2: Characterisation of Material

It is essential that material is suitable for its intended use. Documentary evidence of the source of the material should be provided to the Local Authority. This may include desk study or site investigation reports. A defensible method is required to ensure the verification proposals are site specific and that the level of sampling reflects the need to ensure that imported material are suitable for their intended use.

Due to the diminishing supply of suitable Greenfield topsoil sources it has been found that the chemical quality of Greenfield sources is less reliable in certain areas. As a result the recommended analytical rate for the intended use of the development may vary between Local Authorities [see **Appendix 1a**].

### When should this be done?

Sampling of material should be undertaken as early as possible i.e. prior to placement [for site won material] and prior to importation [for imported material]. This is to avoid the costly exercise of re-excavating unsuitable material and the possibility of cross contamination. Where the assessor has confidence that the material is of sufficient quality (i.e. tested by supplier, used previously) it is acceptable to test the material on site. Although, if it is deemed unsuitable it would have to be either removed off site or pre-treated at the cost and time of the developer. It is recommended that some verification samples are also taken once this material has been delivered to site to confirm suitability for use. Soils can become contaminated during transportation or when stockpiled on site.

## What about certificates from commercial suppliers?

Where the material is provided by a commercial company, certificates or other industry Quality Protocol compliance i.e. WRAP, DoWCoP, will normally be accepted. This is on the proviso that it: (i) relates to the actual material being imported to the site and the type and amount of analysis is in line with what is prescribed in Appendix 1a; and, (ii) the certificates are less than two months old.

It is recommended that some additional verification samples are taken once this material has been delivered to site. Soils can become contaminated during transportation or when stockpiled on site.

Extreme caution should be given to importing material that has been recycled from demolition or skip waste as they could easily be contaminated e.g. asbestos containing materials. Please refer to "questions you should be asking your supplier" in **Appendix 1b** and include the responses in your report.

## British Standard

Imported soils should be as specified in BS 3882:2015 for topsoil and BS8601:2013 for subsoil as 'suitable for their intended purpose'. Both British Standards relate mostly to nutrient content of topsoil and phytotoxic contamination and they do not consider contaminants that pose a risk specifically to human health. Soils should be tested for contaminants that are considered to pose a risk to human health in addition to those specified in the relevant British Standards to ensure that they are suitable for their intended use.

## Initial screening

A visual / olfactory inspection of the material should be carried out by a suitably qualified and competent person to ensure that:

- It is a suitable growing medium;
- It is free from obvious contamination i.e. staining/free product etc.;
- It has not come from areas where Japanese Knotweed or other invasive or injurious plants, as specified by the Environment Agency, are suspected to have been growing;
- It is not odorous (could be considered a statutory nuisance);
- It is free from unsuitable material i.e. bricks, brick ties, timber and glass etc.); and,
- There are no visible signs of asbestos containing material (ACMs).

## Testing schedule & number of samples

Chemical testing will normally be required on any materials that are to be used as cover material, even where this includes first generation quarried material. This should be carried out by a suitably qualified and competent person.

**Appendix 1a** explains in detail the sampling and testing requirements for a typical residential development. These are only guidelines and it may be necessary to deviate away from them depending on local and site-specific factors. It is recommended that the developer discusses any deviation with the Local Authority.

The following criteria sets out the requirements for sampling and testing:

- **Virgin Quarried Material** sampling needs to be 1 or 2 samples depending on the type of stone utilised, to confirm the inert nature of the material. Testing to include standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn).

- **Crushed Hardcore, Stone, Brick (excluding asphalt)** a minimum of 1 sample per 500m$^3$. Testing to include standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH. Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).

- **Greenfield/ Manufactured Soils** a minimum of 3 samples or, dependent on source and receptor, between 1 per 50m$^3$ and 1 per 250m$^3$. Testing to include standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)).

- **Brownfield/ Screened Soils** a minimum of 6 samples or dependent on source and receptor, between 1 per 50m$^3$ and 1 per 100m$^3$. Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC). Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE).

The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs.

## KP3: Suitability of Material

Based on the characterisation of material above, the material should be either deemed suitable or unsuitable. Obviously unsuitable material should not be used (unless it is treated to reduce levels of contaminants below agreed target levels i.e. bioremediation – this would have to be agreed and included within the Remediation Strategy) and an alternative source of material should be sought by the developer. If the material is considered suitable it can be imported (if not site won) and stockpiled in a suitably quarantined area [refer to **KP4**].

## KP4: Stockpiling & Quarantining of Material

It is essential that the 'suitable' material is either placed in its intended area straight away i.e. soft/landscaped areas or stockpiled in a suitable quarantine area to prevent on-site contamination.

In the event that an assessor finds material has been stored in an unsuitable area, samples should be taken to confirm that no cross contamination has occurred (including a visual/olfactory check of the material). The material should then be suitably quarantined or placed at its intended location immediately.

## KP5: Verification of Required Depth

In line with the agreed Remediation Strategy, it is important to establish that the required depth has been achieved and is consistent across the site. There are two main ways to achieve this:

Depth testing in situ – small trial pit excavated to allow measurement of its depth by standardised tape measure or measuring staff.

Topographical surveys – accurate survey of the base and final formation layer height to establish the depth of cover.

### Specific Local Authority Policy

Please check with the local Contaminated Land Officer to establish:

- Which type of method for testing depth is accepted; and,
- The number of verification areas per property, plot, landscaped area or garden area (some Local Authorities recommend at least 2 per plot for residential developments).

**Important Note:** Where demarcation, physical no-dig and capillary break layers exist they should be verified for their thickness and presence during the time of their installation. Details of the demarcation layer should be agreed with the Contaminated Land Officer prior to placement. This will include the design, type and strength of the geotextile separator or visual warning membrane. The verification of depth and confirmation of such layers should be carried out by a suitably qualified and competent person.

## KP6: Reporting

The purpose of verification documentation is to provide transparent reasoning why the remediation was required, a methodology about how it was to be undertaken and proof that the specified works have been undertaken and to provide confirmation that the site is "suitable for its intended use".

The document is utilised not only to satisfy conditions of planning permissions but also is to be kept on record by the Local Authority should queries be raised during the lifetime of the development and to confirm to future purchasers that the site is suitable for use.

National Planning Policy Framework (NPPF) states that "planning policies and decisions should ensure that after remediation, as a minimum, land should not be capable of being determined as contaminated land under Part 2A of the Environmental Protection Act 1990". The Verification Report is a key document to demonstrate compliance with NPPF, and the responsibility rests with the developer/applicant to submit the required Verification Report to complete the remediation and to discharge any planning conditions.

It is also essential that other supporting documentation is included within a report carried out by a suitably qualified and competent person e.g. laboratory analysis results, delivery tickets for material, certificates for imported material (or if unavailable, documented evidence of the source of the Greenfield material), trial pit logs etc. A checklist has been included in **Appendix 2** to give an idea on what information should be recorded.

Additionally, any reporting should include details of any measures required to maintain the cover system integrity in the future e.g. successive construction phases (management plans) and longer term (restrictive covenants on title deeds).

## Photographic evidence for validating the depth of cover

The Local Authority ideally would recommend the following programme of photographs to be taken of the placement of inert cover:

- Photographs of any stockpiles and quarantine areas
- Proof that the depth of inert cover has been installed
- Proof of the quality of the material to be used as inert cover
- Proof there is a geotextile separator and visual warning membranes if used between the underlying material and suitable for use soils.
- Proof of the method of placement and different layers if appropriate
- Proof of the completed project
- Inclusion of background features which will aid locating the photograph
- Inclusion of site identification boards within the photos which show the date, position taken i.e. corner of plot 3 and the site name.
- Inclusion of photographs of site stockpiles and quarantine areas.

The presence of good quality photographs is essential to prove beyond doubt that the remediation has been done as specified both by method and position, and that the images have been taken from the specific area stated.

Refer to **Appendix 3** for examples of good photographic evidence.

# Appendix 1a – Sampling & Testing Matrix

| Type | Number of Samples | Testing Schedule | Assessment Criteria |
|---|---|---|---|
| | **Please note that these guidelines apply to a typical residential development, and relaxation of the guidelines or more stringent requirements may apply dependent on local and site specific factors. Therefore, <u>all parameters need to be agreed with the Local Authority</u>.** | | |
| Virgin Quarried Material | 1 or 2 depending on the type of stone utilised, to confirm the inert nature of the material. | Standard metals/metalloids (should include as a minimum As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn) | The assessment criteria need to be UK based, e.g. LQM S4ULs, Defra C4SLs or other similarly derived GACs. |
| Crushed Hardcore, Stone, Brick (excluding asphalt) | Minimum 1 per 500$m^3$ | Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, total TPH.<br><br>Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE). | |
| Greenfield/ Manufactured Soils | Minimum 3<br><br>Dependent on source and receptor, between 1 per 50$m^3$ and 1 per 250$m^3$ | Standard metals/metalloids (as above), PAH (16 USEPA speciation), asbestos, pH and soil organic matter (SOM) (or calculated from total organic carbon (TOC)). | |
| Brownfield/ Screened Soils | Minimum 6<br><br>Dependent on source and receptor, between 1 per 50$m^3$ and 1 per 100$m^3$ | Standard metals/ metalloids (as above), PAH (16 USEPA speciation), TPH (CWG banded), asbestos, pH and SOM (or calculated from TOC).<br><br>Any additional analysis dependant on the history of the donor site (e.g. phenol, total cyanide, BTEX, MTBE). | |

# Appendix 1b – Questions to Ask Your Soil Supplier Relating to Soil Quality

- What is the source of the material (refer to KP1)? If the source is Greenfield, can they provide evidence of this?
- Will all of the material be coming from the same source?
- Are you satisfied that the material is a suitable growing medium for the proposed end use?
- Has the supplier used an appropriate sampling protocol to ensure a representative sample is analysed? What volume of soil is represented by the analysis and does it comply with Appendix 1a?
- Does the testing include analysis of contaminants identified in Appendix 1a?
- Does the laboratory conducting the analysis have UKAS and MCERTS accreditation for the tests they are carrying out?
- Does the material comply with relevant waste regulations?
- Can I have a copy of the whole analysts report and does it include an interpretive section?
- Will the provided certificate be dated within the last 2 months?

# Appendix 2 – Checklist for Verification Reports

**Example only. Not to be considered as typical minimum requirements. Additional information should be included for non-cover systems aspects of the remediation i.e. gas protection measures etc.**

| **Site Details** | |
|---|---|
| Site Name / location | |
| Developer name | |
| Development use | |
| Plot No / description of landscaped area (inc plan of inspection areas) | |
| National Grid Reference | |
| Inspection visit date | |
| **Supporting Evidence** | |
| Description of remediation (as per agreed Remediation Method Statement including depths / thickness checks, topographical readings) | |
| Material tracking information (including way tickets etc.) | |
| Name of groundwork's remediation contractor | |
| Name of supervising environmental consultant | |
| Site Specific chemical analysis results | |
| Verification Photographs (inc. remarks) | |
| **Recommendations** | |
| Pass/fail | |
| If material fails, how will this be managed i.e. removed, treated | |
| Detail any further remedial works and/or inspection | |
| Signed off | |

**Failure to provide any of the above information may prevent planning conditions from being discharged.**

# Appendix 3 – Examples of Good Quality Photographs

**© Coopers Consulting Engineers**

Photograph 1:
Depth check of inert cover within area of public open space. Physical break layer and topsoil visible.


**© WSP**

Photograph 2:
Depth check of inert cover with Site & Location Information Board.

**© Coopers Consulting Engineers**

Photograph 3:
Depth check of inert cover within areas of front gardens.

**© Coopers Consulting Engineers**

Photograph 4:
Depth check of inert cover within areas of front gardens.

**© Coopers Consulting Engineers**

Photograph 5:
Depth check of inert cover within rear gardens. Taut string line spans across excavation.

**© Coopers Consulting Engineers**

Photograph 6: Depth check of inert cover within rear gardens. Taut string line spans across excavation.

**© Coopers Consulting Engineers**

Photograph 7: Shows the spatial location of the verification pit.

**© Coopers Consulting Engineers**

Photograph 8: Excavation within public open space and verification pit showing the presence of a remediation break layer at the base, a crushed sandstone inert fill overlain by topsoil.

**© Coopers Consulting Engineers**

Photograph 9: Inert crushed sandstone being delivered. The spatial area of the remediation can be observed from these photographs (old terrace housing).

**© Coopers Consulting Engineers**

Photograph 10: Inert crushed sandstone being delivered with visible remediation break layer. The spatial area of the remediation can be observed from these photographs (traffic lights).

**© Coopers Consulting Engineers**

Photograph 11:
Shows the remediation of the rear garden, with a significant depth (1.0m) of inert cover. This photograph has been stitched to form a panoramic photograph and hence there is slight distortion

**© Coopers Consulting Engineers**

Photograph 12:
Shows the remediation of the rear garden, with a significant depth (1.0m) of inert cover. Remediation break layer visible at the base of the excavation.

**APPENDIX 4**

Sirius Generic Assessment Criteria for Retained Soils

# SIRIUS GENERIC ASSESSMENT CRITERIA

## Context

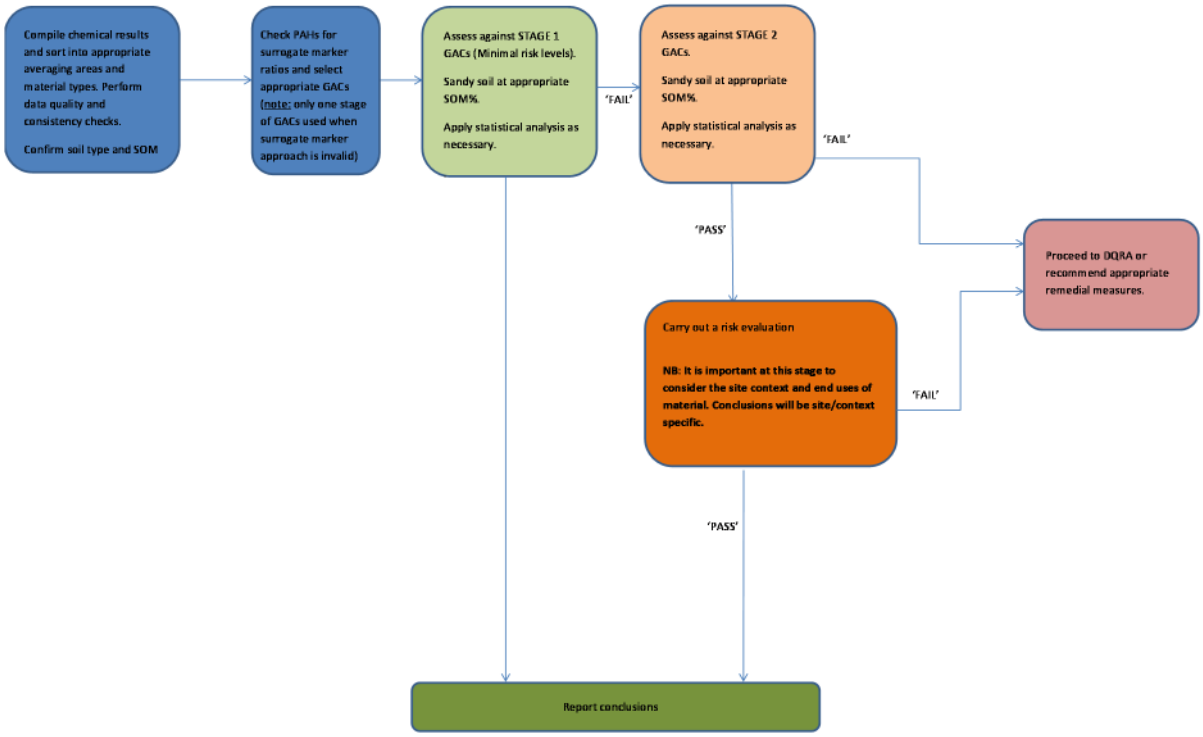
The framework for conducting site investigations, risk assessments and undertaking any necessary remedial works in the UK is provided by Environment Agency report CLR11 "Model Procedures for the Management of Contaminated Land". This presents a phased approach to risk assessment, involving: identification and qualitative assessment of potential pollutant linkages (source-pathway-receptor relationships) by means of a Conceptual Site Model; Generic Quantitative Risk Assessment (GQRA) of potentially significant pollutant links by comparing contaminant concentrations with appropriate Generic Assessment Criteria (GAC) values; and, if required, a Detailed Quantitative Risk Assessment (DQRA) based on site-specific conditions.

## Assessment of Risk to Human Health

Introduction

A staged approach to GQRA has been adopted by Sirius for the evaluation of soil concentration data, as shown schematically in Figure 1.

**Figure 1. GQRA Process.**



The first stage of GQRA comprises assessment of the data against GAC values derived using toxicological parameter values based on "minimum risk". Any contaminants exceeding their GACs at this stage are further assessed against Stage 2 GACs, which have been derived using Low Level of Toxicological Concern (LLTC) criteria, where these are available.

With appropriate justification, a contaminant concentration that does not exceed the relevant Stage 2 GAC value may be considered to indicate that the land is "suitable for use". The appropriate use of LLTC-based criteria within the planning regime is considered reasonable by government agencies, as most recently highlighted in the letter (dated 3rd September 2014) to all local authorities from Lord de Mauley, Parliamentary Under Secretary at DEFRA.

A narrative "risk evaluation" must therefore accompany any Stage 2 assessment to justify the conclusions drawn. Where appropriate, this may provide a basis for eliminating from further consideration those contaminants whose concentrations do not exceed the applicable Stage 2 GAC value.

For the specific case of lead, the Category 4 Screening Level criteria given in CL:AIRE (2014)[1] have been adopted directly as GACs, as these are considered to be based on expert interpretation of current toxicological evidence.

In some areas, background concentrations of lead, other metals and metalloids, and/or individual PAHs may exceed their respective GACs and it may be appropriate to consider relative site and background concentration data as part of a more detailed assessment of the data.

Derivation of GACs

Except where otherwise stated, GACs have been derived by Sirius using CLEA version 1.071.

The GAC values have been derived for a sandy soil type, which will be conservative for the majority of soils (including made ground) encountered on historically contaminated sites. For organic contaminants of concern, criteria have been derived for a number of Soil Organic Matter (SOM) contents.

Genotoxic PAHs are assessed by the "Surrogate Method" using benzo(a)pyrene. Further information on this approach is given below.

Unless specifically stated, chemical properties and Health Criteria Values (HCVs) were obtained from:

- Environment Agency Science Report SC050021 series;
- Nathanail *et al*. (2009) "The LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment", 2nd edition, Land Quality Press, Nottingham;
- CL:AIRE - AGS - EIC (2010) "Soil Generic Assessment Criteria for Human Health Risk Assessment". CL:AIRE, London.

GACs for arsenic, benzene, benzo(a)pyrene, cadmium and chromium (VI) have been derived using the

[1] CL:AIRE (2014) "Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination", Report SP1010, rev. 2.

Low Level of Toxicological Concern (LLTC) criteria given in CL:AIRE (2013). These criteria are considered a reasonable basis for assessment as they are still highly precautionary and definitely do not approach an intake level that could be defined as approaching Significant Possibility of Significant Harm to human health in the context of Part 2A of the Environmental Protection Act 1990. It must be further understood that the GACs derived will still incorporate a residual level of conservatism resulting from the exposure parameters used and the assumptions inherent in the model algorithms.

GACs for Genotoxic PAHs

Our approach to the assessment of genotoxic PAHs retains the use of benzo(a)pyrene as a surrogate marker. This approach for genotoxic PAHs is recommended by the HPA (2010)[2], which we consider to be the authoritative current guidance produced by a UK expert body and note that it was retained in the DEFRA Category 4 Screening Levels project (CL:AIRE, 2014).

The surrogate marker approach allows the assessment of the combined carcinogenic risk associated with all genotoxic PAHs[3] present as a mixture within soil, even though detailed toxicological information for many of the individual compounds may be lacking. The approach is based on determining the risk posed by the genotoxic PAH mixture using the concentration of benzo(a)pyrene present as an indicator.

To use the GAC for benzo(a)pyrene as a surrogate marker, a number of requirements must be met (HPA, 2010):

- Benzo(a)pyrene must be present in all soil samples containing genotoxic PAHs for which this method of assessment is being used;
- A similar profile of the genotoxic PAHs relative to benzo(a)pyrene should be present in all of the samples being assessed;
- The PAH profile of PAHs in the soil samples should be similar to that present in the pivotal toxicity study on which toxicological criterion for benzo(a)pyrene was based (Culp et al., 1998[4]). Table 1 provides the basis for defining the acceptable range.

Data indicate that contaminated soils in the UK generally meet these criteria[5] but the assessor must review their dataset before adopting this approach. If the above criteria are not met, then the surrogate marker approach must not be adopted and individual GAC or SSAC values are to be applied.

[2] HPA (2010) "Risk Assessment Approaches for Polycyclic Aromatic Hydrocarbons (PAHs)", version 5.

[3] The genotoxic PAHs included in the USEPA PAH 16 analysis reported by analytical labs are: benz[a]anthracene, benzo[b]fluoranthene, benzo[k]fluoranthene, benzo[g,h,i]perylene, benzo(a)pyrene, chrysene, dibenz[a,h]anthracene and indeno[1,2,3-c,d]pyrene.

[4] Culp, S. *et al*. (1998) Carcinogenesis, 19, 117-124.

[5] Bull, S. & Collins, C. (2013) Environ. Geochem. Health, 31, 101-109.

**Table 1. Profile of Genotoxic PAHs Relative to Benzo(a)pyrene that are Considered Acceptable for Application of Benzo(a)pyrene as a Surrogate Marker.**

| PAH | Acceptable Ratio of PAH Concentration to Benzo(a)pyrene for Application of Surrogate Marker Assessment | |
|---|---|---|
| | Lower Limit | Upper Limit |
| Benz[a]anthracene | 0.12 | 12.43 |
| Benzo[b]fluoranthene | 0.11 | 10.85 |
| Benzo[k]fluoranthene | 0.04 | 3.72 |
| Benzo[g,h,i]perylene | 0.08 | 8.22 |
| Chrysene | 0.12 | 11.61 |
| Dibenz[a,h]anthracene | 0.01 | 1.38 |
| Indeno[1,2,3-c,d]pyrene | 0.07 | 7.27 |

For further information see: HPA (2010).

Soil Criteria Set for Purposes Other Than Human Health Protection

The Sirius GACs for sulphate, total organic carbon (TOC) and calorific value are set on basis of risks other than human health and their exceedance does not indicate a potential risk to future site users:

- The GAC for sulphate content is based on potential detrimental effects on buried concrete[6] and must be assessed with reference to the soil pH;
- The GAC for TOC content is provided for indicative assessment of disposal options if off-site landfill of soil were to be considered. This GAC is set at the 'Inert' waste threshold and should be considered as being applied for information purposes only;
- The GAC for calorific value is set to assist in an initial assessment of the potential fire risk posed by made ground or natural soils containing elevated concentrations of potentially combustible organic matter.

Assessment criteria more stringent than those for human health may be set for specific purposes, for example, elimination of nuisance odours or ensuring that potentially mobile free-phase organic products are not present.

## Controlled Waters

The Environment Agency's "Remedial Targets Methodology" (2006) provides a framework for assessing the potential for pollution of controlled waters and for deriving remedial target concentrations in soil and groundwater.

There are no generic groundwater or surface water quality standards that are applicable to all sites. Drinking Water Standards and Environmental Quality Standards (EQS) are used by Sirius as assessment criteria where they are appropriate to the contaminant linkages under consideration. Given that these standards apply at the receptor point, this is a conservative approach for samples collected at a source or along a transport pathway.

[6] BRE (2005) "Concrete in Aggressive Ground", Special Digest No. 1; 3rd Edition.

## Soil Leachability

Sirius specifies that the analytical laboratory undertakes leachate preparation by BS EN 12475-2:2002. Where specific circumstances require a different method to be used, then this will be explained and justified within the report body text.

The results of leachate analysis are compared to the relevant GAC values for controlled waters.

# GAC VALUES FOR CONTROLLED WATERS IN ENGLAND AND WALES

| Parameter | GAC (µg/l, unless stated) | | | Notes |
|---|---|---|---|---|
| | Inland waters | | Coastal and transition waters | |
| | EQS | DWS | EQS | |
| **Metals and metalloids (dissolved)** | | | | |
| Arsenic | 50 | 10 | 25 | 1 |
| Cadmium | See separate table | 5 | 0.2 | 1, 2 |
| Chromium (total) | 4.7 | 50 | N.A. | 1, 3 |
| Copper | 1.0 (bioavailable) | 2000 | 3.76 | 1, 4 |
| Lead | 1.2 (bioavailable) | 10 | 1.3 | 1, 4 |
| Mercury | 0.07 | 1.0 | 0.07 | 1, 4, 5 |
| Nickel | 4.0 (bioavailable) | 20 | 8.6 | 1, 4 |
| Zinc | 10.9 (bioavailable) + background | 5000 | 6.8 + background | 1, 4, 6 |
| **Misc. inorganics** | | | | |
| Ammonia (total, as N) | See separate table | N.A. | N.A. | 7 |
| Ammonia (total, as $NH4^+$) | N.A. | 500 | N.A. | |
| Ammonia (un-ionised (NH3), as N) | N.A. | N.A. | 21 | 7 |
| Cyanide (free) | 10 | 50 | 10 | |
| Sulphate | N.A. | 250 mg/l | N.A. | 8 |
| **Petroleum hydrocarbons and related** | | | | |
| TPH (speciated analysis) *per fraction* | 10 | 10 | 10 | 9, 10 |
| Benzene | 10 | 1.0 | 8 | |
| Toluene | 74 | 700 | 74 | 11 |
| Xylenes (sum) | N.A. | 500 | N.A. | 11 |
| MTBE | 2600 | 200 | 2600 | 12, 13 |
| **PAHs** | | | | |
| Anthracene | 0.1 | N.A. | 0.1 | |
| Benzo(b)fluoranthene + Benzo(k)fluoranthene (sum) | N.A. | Sum of 4 = 0.1 | N.A. | |
| Benzo(g,h,i)perylene + indeno(1,2,3-c,d)pyrene (sum) | N.A. | | N.A. | |
| Benzo(a)pyrene | 1.7E-04 | 0.01 | 1.7E-04 | |
| Fluoranthene | 0.0063 | N.A. | 0.0063 | |
| Naphthalene | 2.0 | N.A. | 2.0 | |
| **Phenol** | | | | |
| Phenol | 7.7 | N.A. | 7.7 | |
| **Chlorinated organics** | | | | |
| Dichloromethane | 20 | N.A. | 20 | |
| Trichloromethane (chloroform) | 2.5 | 100 | 2.5 | 14 |
| Tetrachloromethane (carbon tetrachloride) | 12 | 3.0 | 12 | |
| 1,2-dichloroethane (1,2-DCA) | 10 | 3.0 | 10 | |

| Cadmium - inland waters EQS | |
|---|---|
| Hardness (as mg/l CaCO3) | EQS (µg/l) |
| <40 | 0.08 |
| 40-50 | 0.08 |
| 50-100 | 0.09 |
| 100-200 | 0.15 |
| >=200 | 0.25 |

| Ammonia - inland waters EQS | | |
|---|---|---|
| Alkalinity (as mg/l CaCO3) | Altitude | EQS (µg/l) |
| <10 | Any | 300 |
| 10-50 | Any | 300 |
| 50-100 | <80m | 600 |
| 50-100 | >80m | 300 |
| 100-200 | <80m | 600 |
| 100-200 | >80m | 300 |
| >200 | Any | 600 |

| Parameter | GAC (µg/l, unless stated) | | | Notes |
|---|---|---|---|---|
| | Inland waters | | Coastal and transition waters | |
| | EQS | DWS | EQS | |
| 1,1,1-trichloroethane (1,1,1-TCA) | 100 | N.A. | 100 | |
| 1,1,2-trichloroethane (1,1,2-TCA) | 400 | N.A. | 300 | |
| Trichloroethene (TCE) | 10 | Sum of 2 = 10 | 10 | |
| Tetrachloroethene (PCE) | 10 | | 10 | |
| Vinyl chloride | N.A. | 0.5 | N.A. | |

**Notes referenced in table:**

1. Metals and metalloid EQS relate to dissolved contamination only (i.e. analysis of filtered samples).
2. Inland waters EQS for cadmium is dependent upon hardness or alkalinity of the receiving surface water. See separate table.
3. Separate EQS standards exist for Cr III and CrVI in fresh water. The fresh water Cr III has been value adopted as the screening value for total Cr analysis as it is normally the predominant form in solution. Specific EQS for Cr VI (3.4µg/l in freshwater; 0.6µg/l in transition and coastal waters) must be applied where relevant.
4. The bioavailable concentration of copper, nickel and zinc in fresh water is dependent upon the pH, DOC and calcium data for the receiving surface water. These data should be collected whenever possible to calculate an equivalent GAC for total metal concentration using the UKTAG m-BAT spreadsheet model. Although the standard indicates that lead should be assessed on a bioavilable basis, no tool is currently avaiable and this criterion should be applied as-is for screening purposes.
5. The value for mercury is the Maximum Acceptable Concentration (MAC) as no annual average EQS is specified in the legislation.
6. The EQS for zinc may be adjusted for the ambient uncontaminated background concentration in the receiving surface water where data are available.
7. EQS for ammonia in inland waters depends on the hardness and altitude of the receiving water body - see separate table. The criteria given here are based on the attainment of "good" chemical quality in the water body.
8. No EQS for sulphate appears in the referenced legislation.
9. No concentration-based EQS values currently exist for TPH. In the absence of specific criteria, our recent discussions with the Environment Agency have led us to adopt 10µg/l *for each individual fraction* determined by speciated TPH (TPHCWG) analysis.
10. No concentration-based DWS exists for TPH. A sum TPH concentration of 200µg/l defines the DW2 Class threshold limit in the Surface Water (Abstraction for Drinking Water) (Classification) Regulations 1996; DW2 waters are generally suitable for abstraction as drinking water supplies, subject to standard filtration and chemical treatment. We therefore consider that the 10µg/l criterion *for each fraction* provides a reasonable and proportionate basis for the initial assessment of risk posed to off-site groundwater and/or surface water potable abstractions that may be impacted at a downgradient abstraction point by TPH contamination originating from the site.
11. The drinking water-based criteria are from World Health Organisation (WHO) Guidelines for Drinking Water Quality, 2008. Taint may result at lower concentrations.
12. The "EQS" given here for MTBE is the PNEC value for fresh and sea water life given in: EU Risk Assessment Report (2002) MTBE, 3rd Priority List, volume 19.
13. DWS for MTBE is a 5-fold dilution of the USEPA (1997) Drinking Water Advisory value for taint, EPA-822-F-97-009. Toxicological thresholds are significantly higher.
14. Sum trihalomethanes limit for drinking water is 100µg/l but chloroform is only compound of this class normally encountered at contaminated sites.

**Sources and general comments**

Unless otherwise stated, EQS-based GACs are annual average surface water quality criteria given in Table 1 within Part 3 (Priority Substances) or long-term average criteria given in Table 1 within Part 2 (Specific Pollutants) of The Water Framework Directive (Standards and Classification) Directions (England and Wales), 2015.
Unless otherwise stated, drinking water standard-based GACs are taken from the Water Supply (Water Quality) Regulations 2016, and relate to concentration at the supply point and/or consumers' taps.

This list presents recommended GAC values for commonly monitored analytes but is not exhaustive. See the above-referenced legislation for the full lists of criteria.

# The Sirius Group
# Stage 1 Generic Assessment Criteria for Soils

**Revision:** 24 January 2020

| Parameter | Residential (mg/kg, unless otherwise stated) | | | | | | Commercial / Industrial (mg/kg, unless otherwise stated) | | | Note |
|---|---|---|---|---|---|---|---|---|---|---|
| | With Homegrown Produce | | | Without Homegrown Produce | | | | | | |
| | 1% SOM | 2.5% SOM | 5% SOM | 1% SOM | 2.5% SOM | 5% SOM | 1% SOM | 2.5% SOM | 5% SOM | |
| **Metals/Metalloids** | | | | | | | | | | |
| Arsenic (inorganic) | 37 | | | 40 | | | 630 | | | [1] |
| Cadmium | 11 | | | 85 | | | 190 | | | [2] |
| Chromium (III) | 910 | | | 4000 | | | 8600 | | | |
| Chromium (VI) | 6.0 | | | 6.1 | | | 33 | | | [3] |
| Copper | 200 | | | 7100 | | | 68000 | | | [4] |
| Lead | 200 | | | 310 | | | 2300 | | | [5] |
| Mercury (inorganic) | 40 | | | 56 | | | 1100 | | | [6] |
| Nickel | 130 | | | 180 | | | 980 | | | [7] |
| Selenium | 250 | | | 430 | | | 12000 | | | |
| Vanadium | 410 | | | 1200 | | | 9000 | | | |
| Zinc | 450 | | | 40000 | | | 750000 | | | [4] |
| **Other Inorganics** | | | | | | | | | | |
| pH | <5 or >9 | | | <5 or >9 | | | <5 or >9 | | | |
| Total Sulphate | 2400 | | | 2400 | | | 2400 | | | [8] |
| Water-Soluble Sulphate | 0.5 g/l | | | 0.5 g/l | | | 0.5 g/l | | | [8] |
| Free Cyanide | 34 | | | 34 | | | 1400 | | | [9] |
| **Organics** | | | | | | | | | | |
| **PAHs** | | | | | | | | | | |
| Acenaphthene | 200 | 490 | 920 | 2000 | 3600 | 4900 | 75000 | 92000 | 100000 | |
| Acenaphthylene | 170 | 400 | 760 | 2000 | 3600 | 4900 | 76000 | 93000 | 100000 | |
| Anthracene | 2300 | 5300 | 9400 | 30000 | 34000 | 36000 | 520000 | 540000 | 540000 | [10] |
| Benzo(a)anthracene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Benzo(a)pyrene | 2.1 | 2.1 | 2.2 | 2.3 | 2.3 | 2.3 | 27 | 27 | 27 | [11] |
| Benzo(b)fluoranthene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Benzo(k)fluoranthene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Benzo(g,h,i)perylene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Chrysene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Dibenzo(a,h)anthracene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Fluoranthene | 280 | 560 | 820 | 1500 | 1600 | 1600 | 23000 | 23000 | 23000 | |
| Fluorene | 170 | 390 | 730 | 2200 | 3400 | 4000 | 60000 | 67000 | 70000 | |
| Indeno(1,2,3-c,d)pyrene | Assessed using benzo(a)pyrene as a surrogate marker | | | | | | | | | [10] |
| Naphthalene | 1.0 | 2.3 | 4.6 | 1.0 | 2.4 | 4.7 | 110 | 260 | 510 | |
| Phenanthrene | 95 | 220 | 380 | 1300 | 1400 | 1500 | 22000 | 22000 | 23000 | |
| Pyrene | 620 | 1200 | 1900 | 3700 | 3800 | 3800 | 54000 | 54000 | 54000 | |
| **BTEX and related** | | | | | | | | | | |
| Benzene | 0.063 | 0.13 | 0.24 | 0.16 | 0.30 | 0.38 | 15 | 28 | 49 | |
| Toluene | 100 | 240 | 460 | 370 | 830 | 1100 | 33000 | 68000 | 110000 | |
| Ethylbenzene | 26 | 62 | 120 | 34 | 81 | 110 | 3200 | 7400 | 14000 | |
| Xylenes (total) | 28 | 67 | 130 | 33 | 78 | 110 | 3200 | 7700 | 15000 | [12] |
| 1,2,4-trimethylbenzene | 0.22 | 0.53 | 1.1 | 0.24 | 0.58 | 1.2 | 39 | 93 | 170 | |
| Iso-propylbenzene | 6.6 | 16 | 32 | 6.8 | 17 | 33 | 1300 | 3100 | 6100 | |
| Propylbenzene | 21 | 51 | 100 | 23 | 57 | 110 | 3800 | 9100 | 17000 | |
| Styrene | 6.9 | 16 | 32 | 21 | 49 | 93 | 3100 | 6100 | 9500 | |
| **TPH** | | | | | | | | | | |
| Aliphatic EC 5-6 | 24 | 41 | 68 | 24 | 41 | 68 | 2400 | 4100 | 6900 | |
| Aliphatic EC >6-8 | 53 | 110 | 210 | 53 | 110 | 210 | 5300 | 11000 | 21000 | |
| Aliphatic EC >8-10 | 13 | 31 | 61 | 13 | 31 | 61 | 1300 | 3100 | 6000 | |
| Aliphatic EC >10-12 | 62 | 150 | 300 | 62 | 150 | 300 | 6100 | 15000 | 28000 | |
| Aliphatic EC >12-16 | 510 | 1200 | 2300 | 510 | 1200 | 2300 | 43000 | 72000 | 85000 | |
| Aliphatic EC >16-35 | 41000 | 70000 | 90000 | 42000 | 70000 | 90000 | >1E6 | >1E6 | >1E6 | [13] |
| Aromatic EC >5-7 | 53 | 110 | 200 | 150 | 300 | 538 | 15000 | 28000 | 48000 | |
| Aromatic EC >7-8 | 100 | 240 | 460 | 370 | 820 | 1500 | 33000 | 68000 | 110000 | |
| Aromatic EC >8-10 | 20 | 48 | 94 | 22 | 54 | 100 | 2200 | 5200 | 9800 | |
| Aromatic EC >10-12 | 63 | 150 | 290 | 120 | 290 | 560 | 11000 | 22000 | 30000 | |
| Aromatic EC >12-16 | 140 | 320 | 570 | 1100 | 1900 | 2200 | 35000 | 37000 | 37000 | |
| Aromatic EC >16-21 | 260 | 540 | 840 | 1800 | 1900 | 1900 | 28000 | 28000 | 28000 | |
| Aromatic EC >21-35 | 1100 | 1500 | 1700 | 1900 | 1900 | 1900 | 28000 | 28000 | 28000 | |
| **Chlorinated Organics** | | | | | | | | | | |
| Chlorobenzene | 0.19 | 0.44 | 0.86 | 0.19 | 0.45 | 0.87 | 31 | 71 | 140 | |
| Dichloromethane (DCM) | 0.47 | 0.78 | 1.2 | 1.2 | 1.7 | 2.4 | 250 | 340 | 470 | |
| 1,1-dichloroethane (DCA) | 1.4 | 2.4 | 4.0 | 1.4 | 2.4 | 4.1 | 260 | 420 | 690 | |
| 1,2-dichloroethane (DCA) | 0.0031 | 0.0048 | 0.0076 | 0.0035 | 0.0053 | 0.0084 | 0.34 | 0.51 | 0.81 | |
| 1,1-dichloroethene (DCE) | 0.15 | 0.26 | 0.45 | 0.15 | 0.26 | 0.46 | 24 | 43 | 74 | |
| *cis*-1,2-dichloroethene (DCE) | 0.066 | 0.12 | 0.20 | 0.069 | 0.12 | 0.21 | 14 | 23 | 38 | |
| *trans*-1,2-dichloroethene (DCE) | 0.11 | 0.21 | 0.38 | 0.12 | 0.22 | 0.39 | 21 | 37 | 65 | |
| Pentachlorophenol | 0.21 | 0.52 | 1.0 | 27 | 30 | 31 | 400 | 400 | 400 | |
| 1,1,1,2-tetrachloroethane | 0.56 | 1.3 | 2.6 | 0.63 | 1.5 | 2.9 | 59 | 140 | 270 | |

## STANDARD APPENDIX A

## NOTES ON SITE INVESTIGATION PROCEDURE (Dec 2023)

1. **GENERAL.** The ground investigation has been carried out in accordance with the requirements of BS5930: 2015 and A1: 2020 and BS10175: 2011+A1: 2017. By its very nature, any ground investigation only samples a small percentage of the ground. Consequently, changes in ground conditions and soil properties can occur between any two exploratory points, for example local features such as soft ground, pockets of contamination and faults. This is also true of the exploration of mineworkings and such features can extend beneath parts of the site not investigated. Unrecorded bell pits and shafts can also exist between exploratory points. The ground investigation is designed to minimise such risks but they cannot be eliminated.

2. **GROUND INVESTIGATION.**

2.1 **BOREHOLE AND TRIAL PIT RECORDS.** These illustrate the ground conditions only at the location of the particular borehole or trial pit. Correlation between boreholes is for guidance only and its accuracy cannot be guaranteed.

2.2 **SHELL AND AUGER BORING.** This technique uses a tripod winch and an essentially percussive action using a variety of tools. Disturbed and undisturbed samples can be taken. This is the most suitable method for soft ground investigation, enabling the maximum amount of information to be obtained. However, minor changes in lithology may be overlooked unless continuous undisturbed sampling is used.

2.3 **GROUNDWATER**. Groundwater levels vary seasonally and the details given on the borehole logs relate only to the dates and the conditions described in the borehole records. The rate of boring may not have allowed an equilibrium water level to be established and the use of casing may seal off certain seepages.

2.4 **SAMPLING.** Disturbed samples of soils are taken for identification and classification purposes. In cohesive soils 'undisturbed' samples 100mm in diameter are taken by open drive sampler for laboratory testing of strength, permeability and consolidation characteristics.

2.5 **STANDARD PENETRATION TESTS**. S.P.T tests are used in granular and cohesive materials and in soft or weathered rocks. Difficulties in obtaining true 'N' values mean they must only be used as a guide and not as an absolute value in foundation design.

2.6 **ROTARY DRILLING.** Two main types of rotary drilling are carried out in rock. Rock coring using diamond or tungsten carbide tipped core bits provides samples and information on rock types, fissuring and weathering. Openhole drilling only produces small particles for identification purposes and the information gained is therefore limited. The latter is, however, useful as a quick method for detecting major strata changes and for the location of coal seams and old workings. Water, air, foam or drilling muds may be used as the flushing medium in either case.

2.7 **PERMEABILITY TESTS.** These can be carried out in boreholes or trial pits and gives a good indication of in-situ permeability.

2.8 **TRIAL PITTING.** This enables soil conditions to be closely examined at any specific point and samples taken. It also gives useful information on the stability of excavations and ingress of water.

2.9 **WINDOW SAMPLING**. Window sampling consists of driving a series of 1m-long tubes into the ground using a dropping weight. On completion of each 1m run, the tube is withdrawn. The next tube is then inserted and the process repeated to provide a continuous profile of the ground. On each run the tube diameter is reduced in order to assist in its recovery.

2.10 **GAS MONITORING.** This is routinely carried out in trial pits or probe holes to check for elevated levels of methane and carbon dioxide or oxygen deficiency, particularly since risks can exist from natural gases, landfill sites and rising groundwater levels in mine workings below ground. Longer term monitoring is carried out with gas monitoring standpipes.

3. **SOIL DESCRIPTION.** Samples from borings or trial pits are described as specified in the standard procedure outlined in the British Standards. The description includes colour, consistency, structure, weathering, lithological type, inclusions and origin. All descriptions are based on visual and manual identification.

**Fire Soils** (Cohesive Soils)

The following field terms are used:

| Soil Type | Description |
|---|---|
| Very soft | Exudes between fingers |
| Soft | Moulded by light finger pressure |
| Firm | Cannot be moulded by the fingers but can be rolled in hand to 3mm threads. |
| Stiff | Crumbles and breaks when rolled to 3mm threads but can be remoulded to a lump. |
| Very stiff | No longer moulded but crumbles under pressure. Can be indented with thumbs. |

The following terms are used in accordance with the results of laboratory and field tests.

| Description | Undrained Shear Strength Cu (kPa) |
|---|---|
| Extremely Low | <10 |
| Very Low | 10 - 20 |
| Low | 20 - 40 |
| Medium | 40 - 75 |
| High | 75 - 150 |
| Very High | 150 - 300 |

Fine soils can also be classified according to their sensitivity, which is the ratio between undisturbed and remoulded undrained shear strength.

| Sensitivity | Ratio |
|---|---|
| Low | 8 |
| Medium | 8 - 30 |
| High | >30 |
| Quick | >50 |

**Granular Soils** (Non-Cohesive)

The following descriptions are used for granular soils.

| Description | Normalised Blow Count $(N_1)$ 60 |
|---|---|
| Very Loose | 0 - 4 |
| Loose | 4 - 10 |
| Medium | 10 - 30 |
| Dense | 30 - 50 |
| Very Dense | >50 |

4. **NATURAL OR IN-SITU MOISTURE CONTENT**. The natural or in-situ moisture content of a soil is defined as the weight of water contained in the pore space, expressed as a percentage of the dry weight of solid matter present in the soil. Soil properties are greatly affected by the moisture content and the test can help to give an indication of likely engineering behaviour.

5. **LIQUID AND PLASTIC LIMITS**. Two simple classification tests are known as the liquid and plastic limits. If a cohesive soil is remoulded with increasing amounts of water, a point will be reached at which it ceases to behave as a plastic material and becomes essentially a viscous fluid. The moisture content corresponding to this change is arbitrarily determined by the liquid limit test. 'Fat' clays, which have high contents of colloidal particles, have high liquid limits; 'lean' clays, having low colloidal particle contents have correspondingly low liquid limits. An increase in the organic content of a clay is reflected by an increase in the liquid and plastic limits.

   If a cohesive soil is allowed to dry progressively, a point is reached at which it ceases to behave as a plastic material, which can be moulded in the fingers, and it becomes friable. The moisture content of the soil at this point is known as the 'plastic limit' of the soil.

   The range of water content over which a cohesive soil behaves plastically, i.e. the range lying between the liquid and plastic limits, is defined as the plasticity index.

   A cohesive soil with a natural water content towards its liquid limit will, in general, be an extremely soft material whereas a cohesive soil with a natural water content below its plastic limit will tend to be a stiff material.

6. **PARTICLE-SIZE DISTRIBUTION.** A knowledge of particle-size distribution is used to classify soils and to indicate likely engineering behaviour. British Standards define soils in relation to their particle-size as shown below:-

| | | | |
|---|---|---|---|
| Boulders | >200mm | Coarse Sand | 2.0 to 0.63mm |
| Cobbles | 200 to 63mm | Medium Sand | 0.63 to 0.2mm |
| | | Fine Sand | 0.2 to 0.063mm |
| Coarse Gravel | 63 to 20mm | Coarse Silt | 0.063 to 0.02mm |
| Medium Gravel | 20 to 6.3mm | Medium Silt | 0.02 to 0.0063mm |
| Fine Gravel | 6.3 to 2mm | Fine Silt | 0.0063 to 0.002mm |
| | | Clay | <0.002mm |

7. **BULK DENSITY.** The bulk density of a material is the weight of that material per unit volume and includes the effects of voids whether filled with air or water. The 'dry density' of a soil is defined as the weight of solids contained in a unit volume of the soil.

8. **PERMEABILITY.** The permeability of a material is defined as the rate at which water flows through it per unit area of soil under unit hydraulic gradient.

9. **CONSOLIDATION CHARACTERISTICS.** When subjected to pressure, a soil tends to consolidate as the air or water in the pore space is forced out and the grains assume a denser state of packing. The decrease in volume per unit of pressure is defined as the 'compressibility' of the soil, and a measure of the rate at which consolidation proceeds is given by the 'coefficient of consolidation' of the soil. These two characteristics Mv and Cv are determined in the consolidation test and the results are used to determine settlement of structures or earthworks.

10. **STRENGTH CHARACTERISTICS.** The strength of geological materials is generally expressed as the maximum resistance that they offer to deformation or fracture by applied shear or compressive stress. The strength characteristics of geological materials depend to an important degree on their previous history and on the conditions under which they will be stressed in practice. Consequently, it is necessary to simulate in the laboratory tests the conditions under which the material will be stressed in the field.

In general, the only test carried out on hard rocks is the determination of their compressive strength but consideration must be given to fissuring, jointing and bedding planes.

The tests at present in use for soils and soft rocks fall into two main categories. Firstly, those in which the material is stressed under conditions of no moisture content change, and secondly those in which full opportunity is permitted for moisture content changes under the applied stresses. Tests in the first category are known as undrained (immediate or quick) tests, while those in the second category are known as drained (slow or equilibrium) tests. The tests are normally carried out in the triaxial compression apparatus but granular materials may be tested in the shear box apparatus.

The undrained triaxial test gives the apparent cohesion $C_u$ and the angle of shearing resistance $\emptyset_u$. In dry sands, $C_u = 0$ and $\emptyset_u$ is equal to the angle of internal friction whereas with saturated non-fissured clays $\emptyset u$ tends to 0 and the apparent cohesion $C_u$ is equal to one-half the unconfined compression strength qu. On site the vane test gives an approximate measure of shear strength.

For some stability problems use is made of a variant of the undrained triaxial test in which the specimen is allowed to consolidate fully under the hydrostatic pressure and is then tested to failure under conditions of no moisture content change. This is known as the consolidated undrained triaxial test. Pore water pressures may be measured during this test or a fully drained test may be carried out. In either case the effective shear strength parameters C' and $\emptyset'$ can be obtained which can be used to calculate shear strength at any given pore water pressure.

11. **COMPACTION.** The density at which any soil can be placed in an earth dam, embankment or road depends on its moisture content and on the amount of work which is used in compaction. The influence of these two factors can be studied in compaction tests, which can determine the maximum dry density (MDD) achievable at a certain optimum moisture content (OMC).

12. **CALIFORNIA BEARING RATIO TEST.** In flexible pavement design a knowledge of the bearing capacity of the subgrade is necessary to enable the thickness of pavement for any particular combination of traffic and site conditions to be determined. The quality of the subgrade can be assessed by means of the California Bearing Ratio Test or approximately by the MEXE cone penetrometer.

13. **ROCK DESCRIPTION.** This is based on;

(i) Strength

| **Term** | **Field Identification** | **Unconfined Compressive Strength (MPa)** |
|---|---|---|
| Extremely Weak[a] | Indented by thumbnail. | Less than 1 |
| Very Weak | Crumbles under firm blows with point of geological hammer, can be peeled by a pocket knife. | 1 to 5 |
| Weak | Can be peeled by a pocket knife with difficulty, shallow indentations made by firm blow with point of geological hammer. | 5 to 25 |
| Medium Strong | Cannot be scraped or peeled with a pocket knife, specimen can be fractured with single firm blow of geological hammer. | 25 to 50 |
| Strong | Specimen required more than one blow of geological hammer to fracture it. | 50 to 100 |
| Very Strong | Specimen requires many blows of geological hammer to fracture it. | 100 to 250 |
| Extremely Strong | Specimen can only be chipped with geological hammer. | Greater than 250 |

[a] Some extremely weak rocks will behave as soils and should be described as soils.

(ii) Structure

| **Thickness Term** | **Spacing Term** | **Thickness or spacing** |
|---|---|---|
| Very thickly | Extremely wide | >6m |
| Very thickly | Very wide | 2m – 6m |
| Thickly | Wide | 600mm – 2m |
| Medium | Medium | 200mm – 600mm |
| Thinly | Close | 60mm – 200mm |
| Very thinly | Very close | 20mm – 60mm |
| Thickly laminated (Sedimentary) | | |
| Narrowly (Metamorphic and Igneous | Extremely close | 6mm – 20mm |
| Thinly laminated (Sedimentary) | | |
| Very narrowly (Metamorphic and Igneous) | Extremely close | <6mm |

(iii) Colour
(iv) Texture
(v) Grain size

| Description | Predominate Grain Size (mm) |
|---|---|
| Conglomerate | >2 |
| Coarse - grained | 2 - 0.63 |
| Medium - grained | 0.63 - 0.20 |
| Fine - grained | 0.20 - 0.063 |
| Siltstone | 0.063 - 0.002 |
| Mudstone | <0.002 |

(vi) Rock Name
(vii) Stability
(viii) Weathering

| Term | Description | Grades |
|---|---|---|
| Fresh/unweathered | No visible sign of rock material weathering; perhaps slight discolouration on major discontinuity surfaces. | 0 |
| Slightly weathered | Slight discolouration indicates weathering of rock material and discontinuity surfaces. | 1 |
| Moderately weathered/Distinctly weathered | Less than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones. | 2 |
| Highly weathered/ Destructed | More than half of the rock material is decomposed or disintegrated. Fresh or discoloured rock is present either as a continuous framework or as core stones. | 3 |
| Completely weathered | All rock material is decomposed and/or disintegrated to soil. The original mass structure is still apparent. | 4 |
| Residual soil | All rock material is converted to soil. The mass structure and material fabric are destroyed. There is a large change in volume, but the soils has not been significantly transported. | 5 |

(ix) Discontinuities
(x) Weathered of Rock Mass

14. **CHEMICAL TESTS.** A knowledge of water soluble sulphate content and pH of soils and groundwater is important in determining the protection required for concrete or steel in contact with the ground. Other specialist tests may be carried out on sites suspected of being contaminated (see standard appendix B).

15. **REFERENCES**

BS5930: 2015+A1:2020 British Standard Code of Practice for Site Investigations
BS10175: 2011+A1:2017 British Standard Code of Practice for the Investigation of Potentially Contaminated Sites
BS EN ISO 14688-1: 2018 Geotechnical Investigation and Testing: Identification and Classification of Soil
BS EN ISO 14688-2: 2018 Geotechnical Investigation and Testing: Identification and Classification of Soil

## STANDARD APPENDIX B

## NOTES ON CONTAMINATION INVESTIGATION PROCEDURE (June 2021)

mdja

**1.** **GENERAL.** The desk study and/or intrusive ground investigation is typically carried out in accordance with the Environment Agency's "Land Contamination Risk Management (LCRM) documents and the requirements of BS5930: 2015 and BS10175: 2011+A1: 2020. In relation to contamination the desk study is referred to as the preliminary investigation in BS10175 and the intrusive ground investigation is referred to as the Exploratory Investigation. This appendix briefly describes the nature of the work carried out and explains the standards against which contamination data has been assessed. The nature of any contamination investigation is such that only a small percentage of the ground, and therefore potential contamination, is sampled. Consequently variations in both ground conditions and contaminant levels can occur between any two sampling positions. The contamination investigation is designed to minimise such risks, but they cannot be eliminated.

**2.** **REVIEW OF CONTAMINATION ISSUES –** The National Planning Policy Framework (NPPF) and Part 2A of the Environmental Protection Act 1990 create a new regime for the identification and remediation of contaminated land. It introduced a definition of contaminated land described in Section 78A(2) of the Act of:

"any land which appears to the local authority in whose area it is situated to be in such a condition, by reason of substances in, on or under the land, that

(a) significant harm is being caused or there is a significant possibility of such harm being caused; or

(b) significant pollution of controlled waters is being caused or there is a significant possibility of such pollution being caused:

Both Part 2A and the planning regime embrace the "suitable for use" approach. In the context of Part IIA, action is necessary only where there are unacceptable risks to health or to the environment, taking into account the current use of the land and its environmental setting.

For humans, significant harm is defined as "death, disease, serious injury ". Specifically, disease is taken to mean an unhealthy condition of the body or part of it. "Significant possibility of significant harm" is described as health effects arising from the intake of a contaminant or other direct bodily contact with the contaminant where the intake or exposure is unacceptable. The assessment should also take into account the total intake from all sources, the relative contribution of the pollutant linkage in question, and the duration of intake or exposure. The various statutory definitions are given overleaf.

The presence of unnatural substances does not automatically constitute a risk unless there is a link or pathway between the contamination (the hazard) and the receptor (the target) be it humans, the environment or property. Therefore the assessment needs to determine whether a hazard is present and whether the necessary pathway exists the so-called "pollution linkage" or "conceptual site model".

The effect of any hazard on a site depends primarily on the site use and groundwater conditions since these determine who and what may be at risk and the routes by which they may be exposed to the hazard. Site uses can include allotments, domestic gardens on residential developments, amenity and recreational areas, public open space and industrial and commercial buildings. On any site, the potential contaminants have to be identified together with the potential receptors. The pathway for that contaminant to reach its target has then to be considered.

**3.** **PRELIMINARY INVESTIGATION.** The preliminary Phase I Geoenvironmental Assessment (desk study) report normally considers the following key sections:

| | |
|---|---|
| Introduction | |
| The Site | Contaminated Land |
| Site History | Radon |
| Geology and Mining | Geoenvironmental Risk Assessment |
| Hydrogeology | Geotechnical Assessment |
| Groundsure Geo-Insight and Enviro-Insight | Ground Investigation (Recommendations) |

The report will summarise the findings and also relate our opinions to the potential for a site to be geoenvironmentally impaired, at levels likely to warrant mitigation or further consideration appropriate to the current or future use. Findings are based on information obtained and described during the desk study and site inspection without intrusive ground investigation. It is possible that further information exists. The absence of indicators of impairment does not mean that such impairment does not exist. Additional investigation including intrusive methods can reduce the risks but cannot eliminate them and may not be cost effective. We can advise on the additional research opportunities, their cost and their possible impact on mitigating risk. Recommendations are normally given based on the redevelopment proposals for the site.

| Type of Receptor | Description of harm that is to be regarded as significant harm | Conditions For There Being A Significant Possibility Of Significant Harm |
|---|---|---|
| 1. Human beings | Death, disease, serious injury, genetic mutation, birth defects or the impairment of reproductive functions.<br><br>For these purposes, disease is to be taken to mean an unhealthy condition of the body or a part of it and can include, for example, cancer, liver dysfunction or extensive skin ailments. Mental dysfunction is included only insofar as it is attributable to the effects of a pollutant on the body of the person concerned. | If the amount of the pollutant in the pollutant linkage represents an unacceptable intake or direct bodily contact, assessed on the basis of relevant information on the toxicological properties of that pollutant.<br><br>Such an assessment should take into account:<br>• the likely total intake of, or exposure to, the substance or substances which form the pollutant, from all sources including that from the pollutant linkage in question;<br>• the relative contribution of the pollutant linkage in question to the likely aggregate intake of, or exposure to, the relevant substance or substances; and<br>• the duration of intake or exposure resulting from the pollutant linkage in question.<br><br>The question of whether an intake or exposure is unacceptable is independent of the number of people who might experience or be affected by that intake or exposure.<br><br>Toxicological properties should be taken to include carcinogenic, mutagenic, teratogenic, pathogenic, endocrine-disrupting and other similar properties. |
| 2. All other human health effects (particularly by way of explosion or fire) | | If the probability, or frequency, of significant harm of that description is unacceptable. The pollutant linkage might cause "significant harm which"<br><br>• would be irreversible or incapable of being treated;<br>• would affect a substantial number of people;<br>• would result from a single incident such as a fire or an explosion; or<br>• would be likely to result from a short-term (lees than 24-hour) exposure to the pollutant. |
| 3. Any ecological system, or living organism forming part of such a system, within a location which is protected. | For any protected location:<br>• harm which results in an irreversible adverse change, or in some other substantial adverse change, in the functioning of the ecological system within any substantial part of that location; or<br>• harm which affects any species of special interest within that location and which endangers the long-term maintenance of the population of that species at that location. | If either:<br>• significant harm of that description is more likely than not to result from the pollutant linkage; or<br>• there is a reasonable possibility of significant harm of that description being caused, and if that harm were to occur, it would result in such a degree of damage to features of special interest at the location in question that they would be beyond any practicable possibility of restoration. |
| 4. Property in the form of:<br>• crops, including timber;<br>• produce grown domestically, or on allotments, for consumption;<br>• livestock;<br>• other owned or domesticated animals;<br>• wild animals which are the subject of shooting or fishing rights. | For crops, a substantial diminution in yield or other substantial loss in the value resulting from death, disease or other physical damage. For domestic pets, death, serious disease or serious physical damage. For other property in this category, a substantial loss in its value resulting from death, disease or other serious physical damage. | If significant harm of that description is more likely than not to result from the pollutant linkage in question. |
| 5. Property in the form of buildings. | Structural failure, substantial damage or substantial interference with any right of occupation. | If significant harm of that description is more likely than not to result from the pollutant linkage in question during the expected economic life of the building. |
| 6. Controlled waters. | | |

**4.** **INTRUSIVE INVESTIGATION.** BS10175 describes this as an exploratory investigation. Intrusive ground investigation is described in Standard Appendix A. During the investigation representative or indicative samples are obtained for testing by an accredited laboratory. The aim is to determine (with a degree of confidence appropriate to the objectives), the presence, concentration and distribution of contaminants in respect of those points investigated. The extent of any necessary intrusive investigation will depend on the size of the site and any hazards, either known or suspected.

**5.** **ASSESSMENT OF CONTAMINATION.** The assessment of contaminated land under the terms of Part II A of the Environmental Protection Act 1990 is based upon pollution linkage (source - pathway - receptor model) and the principles of the Environment Agency's "Contamination Land Risk Management" documentation.

DEFRA previously issued "Outcome of the Way Forward Exercise on Soil Guideline Values". This document was intended to provide guidance to determine if there is a Significant Possibility of Significant Harm (SPOSH) i.e. whether land meets the legal trigger of being contaminated land.

In the context of Part 2A, a risk assessor using an SGV would conclude the following (DEFRA, 2008).

- At a representative average soil concentration at or below an SGV, it is very unlikely that there will be a *significant possibility of significant harm (SPOSH)*.

- At a representative average soil concentration above an SGV, there *might* be a *significant possibility of significant harm* with the significance linked to the margin of exceedance, the duration and frequency of exposure, and other site-specific factors that the enforcing authority may wish to take into account. Further investigation and/or detailed evaluation will usually be required.

It should be stressed that where there is any uncertainty as to whether or not there is a SPOSH, it was the policy of this practice to adopt a conservative approach, particularly in the adoption of clean cover systems.

In April 2012, Defra both published new Statutory Guidance which forms a major part of their contaminated land regimes under Part 2A of the Environment Protection Act 1990. The regime provides a means of dealing with contaminated land which poses a significant risk to human health or the environment where there is no alternative solution. It also works alongside planning rules and building regulations to help ensure that affected land is made suitable for use when it is redeveloped.

Since the regime was introduced in 2000 there has been considerable uncertainty over how to decide when land is, and is not contaminated land on grounds of the legal test of *significant possibility of significant harm to human health or the environment*.

To help address this, one of the main changes set out in the new Statutory Guidance, is the introduction of a new four category test to help decide when land is, and is not, contaminated land on grounds of *significant possibility of significant harm to human health*. Under the new four category test:

- Category 1 describes land that is clearly contaminated land, for example because similar land is known to have caused significant harm in the past.

- Categories 2 and 3 cover less straightforward land where more detailed consideration is needed before the regulator can decide either: (a) that there is a strong case for regulatory action, in which case the land would be in Category 2 and be classified as contaminated land under Part 2A; or (b) that such a case does not exist, in which case the land would be in Category 3 and not be classified as contaminated land under Part 2A.

- Category 4 describes land that is clearly not contaminated land, as discussed below.

One of the main purposes of including the Categories in the Statutory Guidance is to provide a legal framework against which new technical tools can be developed by the land contamination sector to describe the Categories in more detail with regard to specific substances and/or situations.

The new Category 4 test is particularly important in terms of reducing uncertainty over when land is definitely not caught by the regime.

The new Statutory Guidance makes clear what land should be placed into Category 4, for example:

(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 the guidance), unless there is a particular reason to consider otherwise. In other words land with normal background concentrations in the soil.

(c) Land that has been excluded from the need for further inspection and assessment under Part 2A because contaminant levels do not exceed relevant generic assessment criteria in accordance with Section 3 of the guidance, or relevant technical tools or advice that may be developed in accordance with paragraph 3.30 of the guidance, e.g. Category 4 Screening Levels.

(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 to in the normal course of their lives).

The guidance clarifies how generic assessment criteria (including the currently available SGVs/GACs) should and should not be used. It states that:

*3.27 It is common practice in contaminated land risk assessment to use "generic assessment criteria" (GACs) as screening tools in generic quantitative human health risk assessment to help assessors decide when land can be excluded from the need for further inspection and assessment, or when further work may be warranted.*

*3.28 Local authorities may use GACs and other technical tools to inform certain decisions under the Part 2A regime, provided: (i) they understand how they were derived and how they can be used appropriately; (ii) they have been produced in an objective, scientifically robust and expert manner by reputable organizations; and (iii) they are only used in a manner that is in accordance with Part 2A and this Guidance.*

*3.29 GACs relating to human health risk assessment represent cautious estimates of levels of contaminants in soil at which there is considered to be no risk to health or, at most, a minimal risk to health. With regard to such GACs:*

(a) They may be used to indicate when land is very unlikely to pose a significant possibility of significant harm to human health. This is on the basis that they are designed to estimate levels of contamination at which risks are likely to be negligible or minimal and far from posing a significant possibility of significant harm to human health.

(b) They should not be used as direct indicators of whether a significant possibility of significant harm to human health may exist. Also, the local authority should not view the degree by which GACs are exceeded (in itself) as being particularly relevant to this consideration, given that the degree of risk posed by land would normally depend on many factors other than simply the amount of contaminants in soil.

(c) They should not be seen as screening levels which describe the boundary between Categories 3 and 4 in terms of Section 4 (i.e. the two Categories in which land would not be contaminated land on grounds of risks to human health). In the very large majority of cases, these SGVs/GACs describe levels of contamination from which risks should be considered to be comfortably within Category 4.

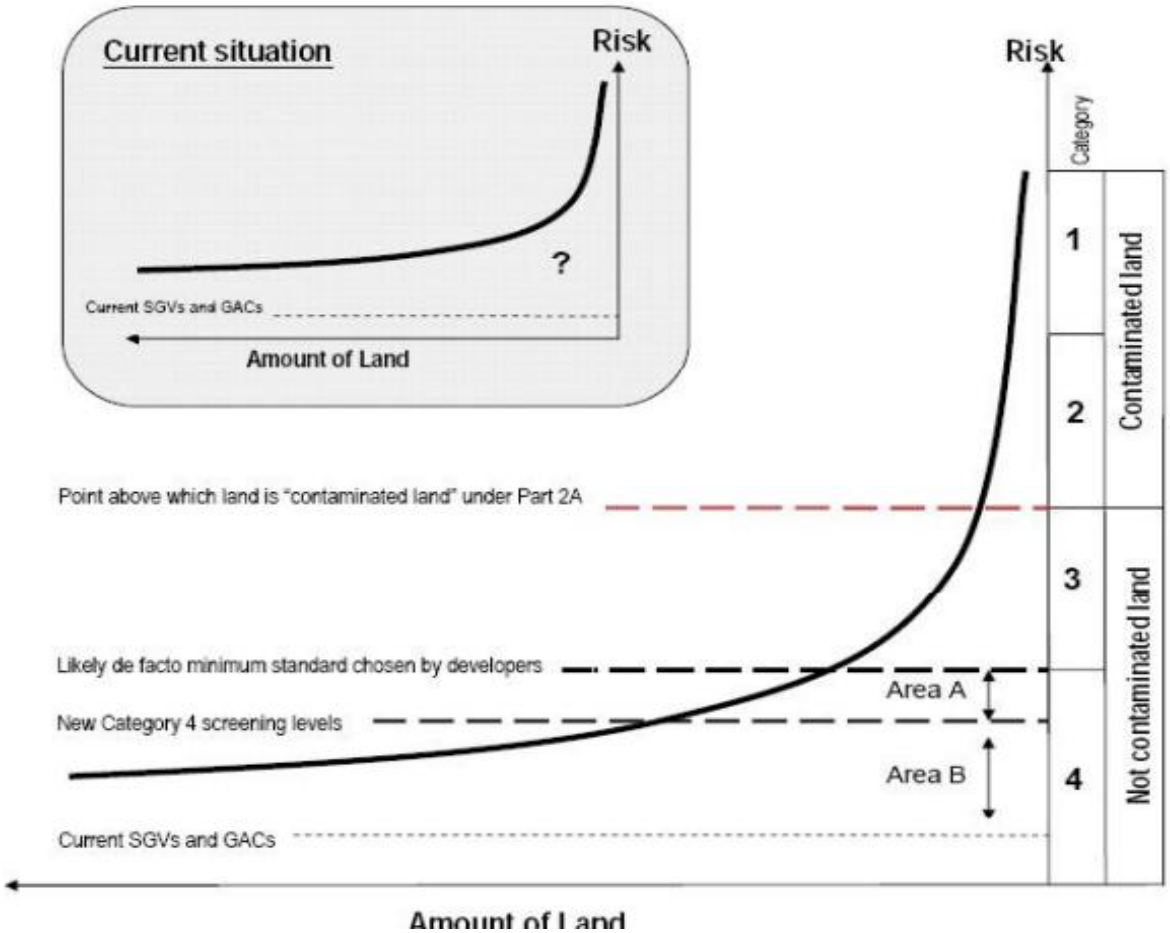
(d) They should not be viewed as indicators of levels of contamination above which detailed risk assessment would automatically be required under Part 2A.

(e) They should not be used as generic remediation targets under the Part 2A regime. Nor should they be used in this way under the planning system, for example in relation to ensuring that land affected by contamination does not meet the Part 2A definition of contaminated land after it has been developed.

The way in which the new four category system is intended to operate and the place of the C4SLs within that system, was explained in detail in the Impact Assessment which accompanied the Statutory Guidance. Please note that although the detail of the Impact Assessment is included here to provide clarity on the job expected of C4SLs, the Statutory Guidance, itself, sets out the regime that needs to be delivered under Part 2A.

Paragraph 47 of the Impact Assessment describes the diagram in detail. Of particular relevance to this project is the description of the overall diagram (sub-paragraph a), description of category 4 (sub-paragraphs c (part iv) and h) and the description of how the monetised benefits of the new system will be realised (sub-paragraph h). These sub-paragraphs are reproduced below.

**Diagram showing the new Category 1-4 system (compared to current situation)**




The diagram above seeks to illustrate, in a simplified manner, broadly what the changes to the statutory guidance on significant possibility of significant harm to human health are intended to achieve. To explain:

(a) The curved line and axes illustrate the spectrum of risk presented by land contamination. The idea is to show that a very large amount of land is low risk, and only a small amount of land would pose sufficient risk to be contaminated land in the legal sense. The axes and lines in the diagrams are not to scale, and they have been compressed for the purposes of illustration (in reality the risks on Category 1 land would probably be orders of magnitude above Category 4 risks, and vastly more land would be in Category 4 compared to the other Categories).

(b) The smaller diagram summarizes the current situation. In the area below the SGV/GACs there is near certainty that land is not contaminated land, however, above the line there is increasing uncertainty. As explained above, currently remediation usually occurs to just below the SGV/GAC level because they are perceived as offering the only cast-iron guarantee of when land is definitely not contaminated land. Sometimes consultants are employed to justify remediating to levels above the SGV/GACs, however the further they go away from the SGV/GACs the more legal risk they and their clients are exposed to.

(c) The new statutory guidance will end the current situation, and it would not be legally possible e.g. for individual regulators to ignore the changes being made. For example, as explained above, the new statutory guidance will specifically say:

(i) that Part 2A cannot be used to force remediation to below a point where it ceases to be contaminated land in the legal sense i.e. the Category 2/3 border in terms of the diagram), although responsible parties can choose to go further;

(ii) that SGV/GACs cannot be used as one size fits all remediation thresholds under either Part 2A of the planning system;

(iii) that normal background levels of contamination are not caught by Part 2A; and

(iv) that SGV/GACs are well into Category 4, sometimes by only a few times and sometimes by orders of magnitude. These changes and others also provide the legal backing for the development e.g. of Category 4 screening levels, as discussed below.

(d) The new Category 1-4 system divides the spectrum of risk posed by contaminated land into four different categories, and the statutory guidance will explain how to decide when land falls into each Category. This is more sophisticated than the current statutory guidance, which in effect has only two categories (contaminated land or not) and does not explain how to decide which category land falls into. The new Category 1-4 system

reflects what assessors find when they investigate real sites i.e. some are clearly contaminated land (Category 1) ; some clearly are not (Category 4) and some are less-straightforward and need some level of detailed assessment before a decision can be taken as to whether or not they are contaminated land (Categories 2 and 3).

(e) In the case of Category 2 and 3 sites, the regulator will have flexibility to take decisions within the parameters set by the new Guidance. There would be less flexibility for Category 2 and 3 sites that clearly pose either a high or low risk. However, the regulator will have considerable flexibility for sites closer to the Category 2/3 border to judge which side of the border a site would fall (e.g. taking account of their understanding of the risks, uncertainties and the interests of the local community). These are often complex decisions which need to be taken case-by-case given the many factors involved.

(f) In the case of Categories 1 and 4 the regulator will have far less flexibility. For example, if a regulator claimed that a site matching the Category 1 description was not contaminated land, or that a site matching the Category 4 description was contaminated land, they would be acting directly against the statutory guidance which the Act requires that they follow, and decisions could be challenged (e.g. in a law court) with a high chance that the challenge would be successful. Among other things, the intention of doing this is to create far more legal certainty around when land is definitely not contaminated land in the legal sense. With the specific wording of the new statutory guidance, and the supporting tools such as the new Category 4 screening levels, it would be very difficult for a regulator e.g. to threaten landowners with the Part 2A regime, and if they tried to determine land as contaminated land they would be operating in direct opposition to the statutory guidance.

(g) In the many consultation meetings held in developing the Category 1-4 system, all the developers, landowners and consultants we spoke to were strongly of the view that they would want the ensure their land is safely within Category 4 (even though in theory they could remediate to a level within Category 3 and still satisfy Part 2A and planning rules). They would do this for various reasons, including the fact that the flexibility granted to regulators in Categories 2 and 3 means that the further into Category 3 a site gets, the greater the risk that the regulator might decide it is in Category 2. Also they would want to be in Category 4 for reasons of marketability, future proofing etc. So developers and others would have a strong incentive to seek the regulatory certainty of being safely within Category 4. Thus, as far as development taking place under the planning system is concerned, Category 3 would, in effect, normally be a buffer which provides added reassurance that development falling within Category 4 will not be caught by the Part 2A regime.

(h) The new statutory guidance will bring about a situation where the current SGV/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. Above the C4SLs, in Area A on the diagram, there will be much stronger legal backing for experts to use their judgement to make sensible and precautionary decisions on when land should be considered to be towards the top end of Category 4, without fear that land may be caught as contaminated land. This recognizes that the generic C4SLs will not be able to describe the Category 3/4 border itself because they are generic and would therefore have to err on the side of caution whilst a detailed site specific assessment would be able to push further by looking at specific circumstances relating to a specific site.

(i) The very large majority of the monetized benefits of the changes to the regime discussed in this Impact Assessment manifest themselves in Category 4, and in particular in Areas A and B on the diagram. The main effects of moving to the new system would include Low risk land falling within Area B (pre-development) on the diagram would no longer have to be remediated because it would fall below the new C4SLs. Similarly land which is in Area A pre-development would no longer need to be remediated if justified by a detailed site-specific assessment. For these sites the cost of remediation would be removed altogether. The cost of remediating land which is initially in Categories 3, 2 or 1 would fall because it would be remediated to the new C4SL levels (or somewhere within Area A if there has been a detailed assessment) rather than the SGV/GAC level. This will have the overall effect of reducing the cost of remediation, with the effect varying according to specific site circumstances, the type of remediation etc. Generally the cost of remediation would fall for many affected brownfield land sites. This would have the general effect of making such land more economically viable for development. It would also mean that some land that is not currently economically viable to develop becomes reduce pressure to develop Greenfield land in some cases. The C4SLs will also speed up regulatory decisions on the reuse of brownfield land by providing a simple remediation standard.

The C4SLs are intended as "*relevant technical tools*" (in relation to Paragraph 4.2.1(c)) provides 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 with 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 soils that, unless stated otherwise, are tolerable or pose a minimal risk to human health".*

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.

CL:AIRE (Contaminated Land: Application in Real Environments) has published "*Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination*". In it a series of C4SLs were proposed as follows;

| Analyte | Residential (with home grown produce) (mg/kg) | Residential (without home grown produce) (mg/kg) | Allotments (mg/kg) | Commercial (mg/kg) | POS (mg/kg) |
|---|---|---|---|---|---|
| Arsenic | 37 | 40 | 49 | 640 | 79 |
| Benzene | 0.87 | 3.3 | 0.18 | 98 | 140 |
| Benzo(a)Pyrene | 5 | 5.3 | 5.7 | 77 | 10 |
| Cadmium | 22 | 150 | 3.9 | 410 | 880 |
| Chromium (vi) | 21 | 21 | 170 | 49 | 21 |
| Lead | 200 | 310 | 80 | 2300 | 630 |

Where C4SL's are not available, Generic Assessment Criteria have been used as follows;

## Generic Assessment Criteria for Human Health Risk Assessment Comparison
## METALS/CYANIDE

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and based on 6% soil organic matter (SOM)**
**Values are expressed in mg/kg**

| | S4UL | | | | | | C4SL | | | | | | EA SGV | | | EIC/AGS/CL:AIRE or *ATRISKSOIL | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| | Residential with homegrown produce | Residential without homegrown produce | Allotment | Commercial | POSresi | POSpark | Residential with homegrown produce | Residential without homegrown produce | Allotment | Commercial | POSresi | POSpark | Residential | Allotment | Commercial | Residential without consumption of homegrown produce | Allotment | Commercial |
| Antimony[1] | | | | | | | | | | | | | | | | 550 | ND | 7500 |
| Arsenic (6% SOM) | 37 | 40 | 43 | 640 | 79 | 170 | 37 | 40 | 49 | 640 | 79 | 170 | 32 | 43 | 640 | | | |
| Barium[1] | | | | | | | | | | | | | | | | 1300 | ND | 22000 |
| Beryllium (6% SOM) | 1.7 | 1.7 | 35 | 12 | 2.2 | 63 | | | | | | | | | | | | |
| Boron (6% SOM) | 290 | 11000 | 45 | 240000 | 21000 | 46000 | | | | | | | | | | | | |
| Cadmium (6% SOM) | 11 | 85 | 1.9 | 190 | 120 | 560 | 22 | 150 | 3.9 | 410 | 220 | 880 | 10 | 1.8 | 230 | | | |
| Chromium (III) (6% SOM) | 910 | 910 | 18000 | 8600 | 1500 | 33000 | | | | | | | | | | | | |
| Chromium (VI) (6% SOM) | 6 | 6 | 1.8 | 33 | 7.7 | 220 | 21 | 21 | 170 | 49 | 21 | 250 | | | | | | |
| Copper (6% SOM) | 2400 | 7100 | 520 | 68000 | 12000 | 44000 | | | | | | | | | | | | |
| Cyanide (AtriskSoil) | | | | | | | | | | | | | | | | 34* | 34* | 34* |
| Lead (6% SOM) | | | | | | | 200 | 310 | 80 | 2300 | 630 | 1300 | | | | | | |
| Nickel (6%SOM) | 130 | 180 | 53 | 980 | 230 | 800 | | | | | | | | | | | | |
| Mercury (Elemental) (6% SOM) | 1.2 | 1.2 | 21 | 58 | 16 | 30 | | | | | | | 1.0 | 26 | 26 | | | |
| Mercury (Inorganic) (6% SOM) | 40 | 56 | 19 | 1100 | 120 | 240 | | | | | | | 170 | 80 | 3600 | | | |
| Mercury (Methyl) (6% SOM) | 11 | 15 | 6 | 320 | 40 | 68 | | | | | | | 11 | 8 | 410 | | | |
| Molybdbenum[1] | | | | | | | | | | | | | | | | 670 | ND | 17000 |
| Selenium (6% SOM) | 250 | 430 | 88 | 12000 | 1100 | 1800 | | | | | | | 350 | 120 | 13000 | | | |
| Vanadium (6% SOM) | 410 | 1200 | 91 | 9000 | 2000 | 5000 | | | | | | | | | | | | |
| Zinc (6% SOM) | 3700 | 40000 | 620 | 730000 | 81000 | 170000 | | | | | | | | | | | | |

**Additional notes for EIC/AGS/CL:AIRE GAC**

1 Due to the limitations in time and scope of the EIC/AGS/CL:AIRE project, plant uptake factors were not derived for metals and therefore the metals GAC have only been produced for residential without consumption of homegrown produce and commercial land-uses. Note that the derived GAC are not dependent on SOM.

## PETROLEUM HYDROCARBONS

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM).**
**SGVs based on 6% SOM, at a lower SOM the SGV may not be sufficiently protective.**
**Generic assessment criteria for Petroleum Hydrocarbons will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 10**

| | S4UL | | | | | | C4SL | | | | | | EA SGV | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with homegrown produce** | **Residential without homegrown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with homegrown produce** | **Residential without homegrown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential** | **Allotment** | **Commercial** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| Aliphatic EC 5-6 (1% SOM) | 42 | 42 | 730 | 3200 (340) | 570000 (304) | 95000 (304) | | | | | | | | | | | | | |
| Aliphatic EC 5-6 (2.5% SOM) | 78 | 78 | 1700 | 5900 (558) | 590000 | 130000 (558) | | | | | | | | | | | | | |
| Aliphatic EC 5-6 (6% SOM) | 160 | 160 | 3900 | 12000 (1150) | 600000 | 18000 (1550) | | | | | | | | | | | | | |
| Aliphatic EC>6-8 (1% SOM) | 100 | 100 | 2300 | 7800 (144) | 600000 | 150000 (144) | | | | | | | | | | | | | |
| Aliphatic EC>6-8 (2.5% SOM) | 230 | 230 | 5600 | 17000 (322) | 610000 | 220000 (322) | | | | | | | | | | | | | |
| Aliphatic EC>6-8 (6% SOM) | 530 | 530 | 13000 | 40000 (736) | 620000 | 320000 (736) | | | | | | | | | | | | | |
| Aliphatic EC>8-10 (1% SOM) | 27 | 27 | 320 | 2000 (78) | 13000 | 14000 (78) | | | | | | | | | | | | | |
| Aliphatic EC>8-10 (2.5% SOM) | 65 | 65 | 770 | 4800 (190) | 13000 | 18000 (190) | | | | | | | | | | | | | |
| Aliphatic EC>8-10 (6% SOM) | 150 | 150 | 1700 | 11000 (451) | 13000 | 21000 (451) | | | | | | | | | | | | | |
| Aliphatic EC>10-12 (1% SOM) | 130 (48) | 130 (48) | 2200 | 9700 (48) | 13000 | 21000 (48) | | | | | | | | | | | | | |
| Aliphatic EC>10-12 (2.5% SOM) | 330 (118) | 330 (118) | 4400 | 23000 (118) | 13000 | 23000 (118) | | | | | | | | | | | | | |
| Aliphatic EC>10-12 (6%SOM) | 760 (283) | 770 (283) | 7300 | 47000 (283) | 13000 | 24000 (283) | | | | | | | | | | | | | |
| Aliphatic EC>12-16 (1% SOM) | 1100 (24) | 1100 (24) | 11000 | 59000 (24) | 13000 | 25000 (24) | | | | | | | | | | | | | |
| Aliphatic EC>12-16 (2.5% SOM) | 2400 (59) | 2400 (59) | 13000 | 82000 (59) | 13000 | 25000 (59) | | | | | | | | | | | | | |
| Aliphatic EC>12-16 (6% SOM) | 4300 (142) | 4300 (142) | 13000 | 90000 (142) | 13000 | 26000 (142) | | | | | | | | | | | | | |
| Aliphatic EC>16-35 (1% SOM) | 65000 (8.48) | 65000 (8.48) | 260000 | 1600000 | 250000 | 450000 | | | | | | | | | | | | | |
| Aliphatic EC>16-35 (2.5% SOM) | 92000 (21) | 92000 (21) | 270000 | 1700000 | 250000 | 480000 | | | | | | | | | | | | | |
| Aliphatic EC>16-35 (6% SOM) | 110000 | 110000 | 270000 | 1800000 | 250000 | 490000 | | | | | | | | | | | | | |
| Aliphatic EC>35-44 (1% SOM) | 65000 (8.48) | 65000 (8.48) | 260000 | 1600000 | 250000 | 450000 | | | | | | | | | | | | | |
| Aliphatic EC>35-44 (2.5% SOM) | 92000 (21) | 92000 (21) | 270000 | 1700000 | 250000 | 480000 | | | | | | | | | | | | | |
| Aliphatic EC>35-44 (6% SOM) | 110000 | 110000 | 270000 | 1800000 | 250000 | 490000 | | | | | | | | | | | | | |
| Aromatic EC 5-7 (1% SOM) | 70 | 370 | 13 | 26000 (1220) | 56000 | 76000 (1220) | | | | | | | | | | | | | |
| Aromatic EC 5-7 (2.5% SOM) | 140 | 690 | 27 | 46000 (2260) | 56000 | 84000 (2260) | | | | | | | | | | | | | |
| Aromatic EC 5-7 (6% SOM) | 300 | 1400 | 57 | 86000 (4710) | 56000 | 92000 (4710) | | | | | | | | | | | | | |
| Aromatic EC>7-8 (1% SOM) | 130 | 860 | 22 | 56000 (869) | 56000 | 87000 (869) | | | | | | | | | | | | | |
| Aromatic EC>7-8 (2.5% SOM) | 290 | 1800 | 51 | 110000 (1920) | 56000 | 95000 (1920) | | | | | | | | | | | | | |
| Aromatic EC>7-8 (6% SOM) | 660 | 3900 | 120 | 180000 (4360) | 56000 | 100000 (4360) | | | | | | | | | | | | | |
| Aromatic EC>8-10 (1% SOM) | 34 | 47 | 8.6 | 3500 (613) | 5000 | 7200 (613) | | | | | | | | | | | | | |
| Aromatic EC>8-10 (2.5% SOM) | 83 | 110 | 21 | 8100 (1500) | 5000 | 8500 (1500) | | | | | | | | | | | | | |
| Aromatic EC>8-10 (6% SOM) | 190 | 270 | 51 | 17000 (3580) | 5000 | 9300 (3580) | | | | | | | | | | | | | |
| Aromatic EC>10-12 (1% SOM) | 74 | 250 | 13 | 16000 (364) | 5000 | 9200 (364) | | | | | | | | | | | | | |
| Aromatic EC>10-12 (2.5% SOM) | 180 | 590 | 31 | 28000 (899) | 5000 | 9700 (899) | | | | | | | | | | | | | |
| Aromatic EC>10-12 (6% SOM) | 380 | 1200 | 74 | 34000 (2150) | 5000 | 10000 | | | | | | | | | | | | | |
| Aromatic EC>12-16 (1% SOM) | 140 | 1800 | 23 | 36000 (169) | 5100 | 10000 | | | | | | | | | | | | | |
| Aromatic EC>12-16 (2.5% SOM) | 330 | 2300 (419) | 57 | 37000 | 5100 | 10000 | | | | | | | | | | | | | |
| Aromatic EC>12-16 (6% SOM) | 660 | 2500 | 130 | 38000 | 5000 | 10000 | | | | | | | | | | | | | |
| Aromatic EC>16-21 (1% SOM) | 260 | 1900 | 46 | 28000 | 3800 | 7600 | | | | | | | | | | | | | |
| Aromatic EC>16-21 (2.5% SOM) | 540 | 1900 | 110 | 28000 | 3800 | 7700 | | | | | | | | | | | | | |
| Aromatic EC>16-21 (6% SOM) | 930 | 1900 | 260 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aromatic EC>21-35 (1% SOM) | 1100 | 1900 | 370 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aromatic EC>21-35 (2.5% SOM) | 1500 | 1900 | 820 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aromatic EC>21-35 (6% SOM) | 1700 | 1900 | 1600 | 28000 | 3800 | 7900 | | | | | | | | | | | | | |
| Aromatic EC>35-44 (1% SOM) | 1100 | 1900 | 370 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aromatic EC>35-44 (2.5% SOM) | 1500 | 1900 | 820 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aromatic EC>35-44 (6% SOM) | 1700 | 1900 | 1600 | 28000 | 3800 | 7900 | | | | | | | | | | | | | |
| Aliphatic + Aromatic EC>44-70 ( | 1600 | 1900 | 1200 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aliphatic + Aromatic EC>44-70 ( | 1800 | 1900 | 2100 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |
| Aliphatic + Aromatic EC>44-70 ( | 1900 | 1900 | 3000 | 28000 | 3800 | 7800 | | | | | | | | | | | | | |

| | S4UL | | | | | | C4SL | | | | | | EA SGV | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with homegrown produce** | **Residential without homegrown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with homegrown produce** | **Residential without homegrown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential** | **Allotment** | **Commercial** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| Benzene (1% SOM) | 0.087 | 0.38 | 0.017 | 27 | 72 | 90 | | | | | | | | | | | | | |
| Benzene (2.5% SOM) | 0.17 | 0.7 | 0.034 | 47 | 72 | 100 | | | | | | | | | | | | | |
| Benzene (6% SOM) | 0.37 | 1.4 | 0.075 | 90 | 73 | 110 | 0.87 | 3.3 | 0.18 | 98 | 140 | 230 | 0.33 | 0.07 | 95 | | | | |
| Toluene (1% SOM) | 130 | 880 (869) | 22 | 56000 (869) | 56000 | 87000 (869) | | | | | | | | | | | | | |
| Toluene (2.5% SOM) | 290 | 1900 | 51 | 110000 (1920) | 56000 | 95000 (1920) | | | | | | | | | | | | | |
| Toluene (6% SOM) | 660 | 3900 | 120 | 180000 (4360) | 56000 | 100000 (4360) | | | | | | | 610 | 120 | $4.4x10^3$ | | | | |
| Ethyl benzene (1% SOM) | 47 | 83 | 16 | 5700 (518) | 24000 | 17000 (518) | | | | | | | | | | | | | |
| Ethyl benzene (2.5% SOM) | 110 | 190 | 39 | 13000 (1220) | 24000 | 22000 (1220) | | | | | | | | | | | | | |
| Ethyl benzene (6% SOM) | 260 | 440 | 91 | 27000 (2840) | 25000 | 27000 (2840) | | | | | | | 350 | 90 | $2.8x10^3$ | | | | |
| o-xylene (1%SOM) | 60 | 88 | 28 | 6600 (478) | 41000 | 17000 (478) | | | | | | | | | | | | | |
| o-xylene (2.5% SOM) | 140 | 210 | 67 | 15000 (1120) | 42000 | 24000 (1120) | | | | | | | | | | | | | |
| o-xylene (6% SOM) | 330 | 480 | 160 | 33000 (2620) | 43000 | 33000 (2620) | | | | | | | 250 | 160 | $2.6x10^3$ | | | | |
| m-xylene (1% SOM) | 59 | 82 | 31 | 6200 (625) | 41000 | 17000 (625) | | | | | | | | | | | | | |
| m-xylene (2.5% SOM) | 140 | 190 | 74 | 14000 (1470) | 42000 | 24000 (1470) | | | | | | | | | | | | | |
| m-xylene (6% SOM) | 320 | 450 | 170 | 31000 (3460) | 43000 | 32000 (3469) | | | | | | | 240 | 180 | $3.5x10^3$ | | | | |
| p-xylene (1% SOM) | 56 | 79 | 29 | 5900 (576) | 41000 | 17000 (478) | | | | | | | | | | | | | |
| p-xylene (2.5% SOM) | 130 | 180 | 69 | 14000 (1350) | 42000 | 23000 (1350) | | | | | | | | | | | | | |
| p-xylene (6% SOM) | 310 | 430 | 160 | 30000 (3170) | 43000 | 31000 (3170) | | | | | | | 230 | 160 | $3.2x10^3$ | | | | |
| Methyl tert-butyl ether (1% SOM) | | | | | | | | | | | | | | | | 49 | 73 | 23 | 7900 |
| Methyl tert-butyl ether (2.5% SOM) | | | | | | | | | | | | | | | | 84 | 120 | 44 | 13000 |
| Methyl tert-butyl ether (6% SOM) | | | | | | | | | | | | | | | | 160 | 220 | 90 | 24000 |

**Additional Notes for LQM/CIEH Generic Assessment Criteria**

1 For residential land use the inhalation of vapours indoors exposure pathway is the most significant exposure pathway for the lighter end aliphatic and aromatic fractions (up to aliphatic EC>12-16 and aromatic EC>10-12). The ingestion of soil and indoor dust and consumption of homegrown produce exposure pathways are the most significant for the higher end fractions (aliphatics EC>16-35 and EC>35-44; aromatics EC>12-16, EC16-21, EC>21-35, EC>35-44 and EC44-70).

2 For the allotment land use the consumption of homegrown produce exposure pathway is the most significant for the aromatic and lighter end aliphatic fractions. The ingestion of soil and and indoor dust is the most significant exposure pathway for the higher end aliphatics EC>12-16, EC>16-35 and EC35-44.

3 For the commercial land use the indoor inhalation of vapour exposure pathway is a significant exposure pathway for the lighter end aliphatic and aromatic fractions (up to aliphatic EC>12-16 and aromatic EC>10-12.

4 Background exposure represents a significant proportion of the total exposure for all fractions expect aromatic fractions EC>5-7 and EC>7-8 in all land uses.

**Notes for SGVs**

1 Based on a sandy loam as defined in Environment Agency (2009b) and 6% SOM. At a lower SOM, SGVs may not be sufficient protective.
2 Generic assessment criteria will vary according to SOM for all land uses.
3 SGVs assume that free phase contamination is not present.
4 SGVs based on a sub-surface soil to indoor air correction air correction factor of 10.
5 SGV presented for Toluene Commercial based on the vapour saturation limit.
6 SGV presented for Ethylbenzene Allotment and Xylene Allotment - in applying the rules for non-soil background, the inhalation background ADE is limited to being no larger than the contribution of the inhalation soil ADE.
7 Exposure of all isomers of xylene should be considered together, because the HCV applied is based on intake of total xylene and not an individual isomer in isolation.

**Notes for EIC/AGS/CL:AIRE Generic Assessment Criteria**

1 GAC have been derived for 4 generic land uses; residential with consumption of homegrown produce, residential without consumption of homegrown produce, allotments and commercial land-use.

## POLYAROMATIC HYDROCARBONS

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria for Polycyclic Aromatic Hydrocarbons will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | LQM/CIEH | | | | | | C4SL | | | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** |
| Acenaphthene (1% SOM) | 210 | 3000 (57) | 34 | 84000 (57) | 15000 | 29000 | | | | | | |
| Acenaphthene (2.5% SOM) | 510 | 4700 (141) | 85 | 97000 (141) | 15000 | 30000 | | | | | | |
| Acenaphthene (6% SOM) | 1100 | 6000 (336) | 200 | 100000 | 15000 | 30000 | | | | | | |
| Acenaphthylene (1% SOM) | 170 | 2900 (86.1) | 28 | 83000 (86.1) | 15000 | 29000 | | | | | | |
| Acenaphthylene (2.5% SOM) | 420 | 4600 (212) | 69 | 97000 (212) | 15000 | 30000 | | | | | | |
| Acenaphthylene (6% SOM) | 920 | 6000 (506) | 160 | 100000 | 15000 | 30000 | | | | | | |
| Anthracene (1% SOM) | 2400 | 31000 (1.17) | 380 | 520000 | 74000 | 150000 | | | | | | |
| Anthracene (2.5% SOM) | 5400 | 35000 | 950 | 540000 | 74000 | 150000 | | | | | | |
| Anthracene (6% SOM) | 11000 | 37000 | 2200 | 540000 | 74000 | 150000 | | | | | | |
| Benz(a)anthracene (1% SOM) | 7.2 | 11 | 2.9 | 170 | 29 | 49 | | | | | | |
| Benz(a)anthracene (2.5% SOM) | 11 | 14 | 6.5 | 170 | 29 | 56 | | | | | | |
| Benz(a)anthracene (6% SOM) | 13 | 15 | 13 | 180 | 29 | 62 | | | | | | |
| Benzo(a)pyrene (1% SOM) | 2.2 | 3.2 | 0.97 | 35 | 5.7 | 11 | | | | | | |
| Benzo(a)pyrene (2.5% SOM) | 2.7 | 3.2 | 2.0 | 35 | 5.7 | 12 | | | | | | |
| Benzo(a)pyrene (6% SOM) | 3.0 | 3.2 | 3.5 | 36 | 5.7 | 13 | 5.0 | 5.3 | 5.7 | 77 | 10 | 21 |
| Benzo(b)fluoranthene (1% SOM) | 2.6 | 3.9 | 0.99 | 44 | 7.1 | 13 | | | | | | |
| Benzo(b)fluoranthene (2.5% SOI | 3.3 | 4.0 | 2.1 | 44 | 7.2 | 15 | | | | | | |
| Benzo(b)fluoranthene (6% SOM) | 3.7 | 4.0 | 3.9 | 45 | 7.2 | 16 | | | | | | |
| Benzo(ghi)perylene (1% SOM) | 320 | 360 | 290 | 3900 | 640 | 1400 | | | | | | |
| Benzo(ghi)perylene (2.5% SOM) | 340 | 360 | 470 | 4000 | 640 | 1500 | | | | | | |
| Benzo(ghi)perylene (6% SOM) | 350 | 360 | 640 | 4000 | 640 | 1600 | | | | | | |
| Benzo(k)fluoranthene (1% SOM) | 77 | 110 | 37 | 1200 | 190 | 370 | | | | | | |
| Benzo(k)fluoranthene (2.5% SOI | 93 | 110 | 75 | 1200 | 190 | 410 | | | | | | |
| Benzo(k)fluoranthene (6% SOM) | 100 | 110 | 130 | 1200 | 190 | 440 | | | | | | |
| Chrysene (1% SOM) | 15 | 30 | 4.1 | 350 | 57 | 93 | | | | | | |
| Chrysene (2.5% SOM) | 22 | 31 | 9.4 | 350 | 57 | 110 | | | | | | |
| Chrysene (6% SOM) | 27 | 32 | 19 | 350 | 57 | 120 | | | | | | |
| Dibenzo(ah)anthracene (1% SOI | 0.24 | 0.31 | 0.14 | 3.5 | 0.57 | 1.1 | | | | | | |
| Dibenzo(ah)anthracene (2.5% S | 0.28 | 0.32 | 0.27 | 3.6 | 0.57 | 1.3 | | | | | | |
| Dibenzo(ah)anthracene (6% SOI | 0.3 | 0.32 | 0.43 | 3.6 | 0.58 | 1.4 | | | | | | |
| Fluoranthene (1% SOM) | 280 | 1500 | 52 | 23000 | 3100 | 6300 | | | | | | |
| Fluoranthene (2.5% SOM) | 560 | 1600 | 130 | 23000 | 3100 | 6300 | | | | | | |
| Fluoranthene (6% SOM) | 890 | 1600 | 290 | 23000 | 3100 | 6400 | | | | | | |
| Fluorene (1% SOM) | 170 | 2800 (30.9) | 27 | 63000 (30.9) | 9900 | 20000 | | | | | | |
| Fluorene (2.5% SOM) | 400 | 3800 (76.5) | 67 | 68000 | 9900 | 20000 | | | | | | |
| Fluorene (6% SOM) | 860 | 4500 (183) | 160 | 71000 | 9900 | 20000 | | | | | | |
| Indeno(123cd)pyrene (1% SOM) | 27 | 45 | 9.5 | 500 | 82 | 150 | | | | | | |
| Indeno(123cd)pyrene (2.5% SOI | 36 | 46 | 21 | 510 | 82 | 170 | | | | | | |
| Indeno(123cd)pyrene (6% SOM) | 41 | 46 | 39 | 510 | 82 | 180 | | | | | | |
| Naphthalene (1% SOM) | 2.3 | 2.3 | 4.1 | 190 (76.4) | 4900 | 1200 (76.4) | | | | | | |
| Naphthalene (2.5% SOM) | 5.6 | 5.6 | 10 | 460 (183) | 4900 | 1900 (183) | | | | | | |
| Naphthalene (6% SOM) | 13 | 13 | 24 | 1100 (432) | 4900 | 3000 | | | | | | |
| Phenanthrene (1% SOM) | 95 | 1300 (36) | 15 | 22000 | 3100 | 6200 | | | | | | |
| Phenanthrene (2.5% SOM) | 220 | 1500 | 38 | 22000 | 3100 | 6200 | | | | | | |
| Phenanthrene (6% SOM) | 440 | 1500 | 90 | 22000 | 3100 | 6300 | | | | | | |
| Pyrene (1% SOM) | 620 | 3700 | 110 | 54000 | 7400 | 15000 | | | | | | |
| Pyrene (2.5% SOM) | 1200 | 3800 | 270 | 54000 | 7400 | 15000 | | | | | | |
| Pyrene (6% SOM) | 2000 | 3800 | 620 | 54000 | 7400 | 15000 | | | | | | |
| Coal Tar (BaP as surrogate marl | 0.79 | 1.2 | 0.32 | 15 | 2.2 | 4.4 | | | | | | |
| Coal Tar (BaP as surrogate marl | 0.98 | 1.2 | 0.67 | 15 | 2.2 | 4.7 | | | | | | |
| Coal Tar (BaP as surrogate marl | 1.1 | 1.2 | 1.2 | 15 | 2.2 | 4.9 | | | | | | |

## CHLOROALCANES AND ALKANES

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | S4UL | | | | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| 1,1-Dichloroethane (1% SOM) | | | | | | | 2.4 | 2.5 | 9.2 | 280 |
| 1,1-Dichloroethane (2.5% SOM) | | | | | | | 3.9 | 4.1 | 17 | 450 |
| 1,1-Dichloroethane (6% SOM) | | | | | | | 7.4 | 7.7 | 35 | 850 |
| 1,2-Dichloroethane (1% SOM) | 0.0071 | 0.0092 | 0.0046 | 0.67 | 29 | 21 | | | | |
| 1,2-Dichloroethane (2.5% SOM) | 0.011 | 0.013 | 0.0083 | 0.97 | 29 | 24 | | | | |
| 1,2-Dichloroethane (6% SOM) | 0.019 | 0.023 | 0.016 | 1.7 | 29 | 28 | | | | |
| 1,1,1-Trichloroethane (1% SOM) | 8.8 | 9 | 48 | 660 | 140000 | 57000 (1425) | | | | |
| 1,1,1-Trichloroethane (2.5% SOI | 18 | 18 | 110 | 1300 | 140000 | 76000 (2915) | | | | |
| 1,1,1-Trichloroethane (6% SOM) | 39 | 40 | 240 | 3000 | 140000 | 100000 (6392) | | | | |
| 1,1,2-Trichloroethane (1% SOM) | | | | | | | 0.6 | 0.88 | 0.28 | 94 |
| 1,1,2-Trichloroethane (2.5% SOM) | | | | | | | 1.2 | 1.8 | 0.61 | 190 |
| 1,1,2-Trichloroethane (6% SOM) | | | | | | | 2.7 | 3.9 | 1.4 | 400 |
| 1,1,1,2-Tetrachloroethane (1% S | 1.2 | 1.5 | 0.79 | 110 | 1400 | 1500 | | | | |
| 1,1,1,2-Tetrachloroethane (2.5% | 2.8 | 3.5 | 1.9 | 250 | 1400 | 1800 | | | | |
| 1,1,1,2-Tetrachloroethane (6% S | 6.4 | 8.2 | 4.4 | 560 | 1400 | 2100 | | | | |
| 1,1,2,2-Tetrachloroethane (1%SI | 1.6 | 3.9 | 0.41 | 270 | 1400 | 1800 | | | | |
| 1,1,2,2-Tetrachloroethane (2.5% | 3.4 | 8.0 | 0.89 | 550 | 1400 | 2100 | | | | |
| 1,1,2,2-Tetrachloroethane (6%SI | 7.5 | 17 | 2.0 | 1100 | 1400 | 2300 | | | | |
| 1,1-Dichloroethene (1% SOM) | | | | | | | 0.23 | 0.23 | 2.8 | 26 |
| 1,1-Dichloroethene (2.5% SOM) | | | | | | | 0.40 | 0.41 | 5.6 | 46 |
| 1,1-Dichloroethene (6% SOM) | | | | | | | 0.82 | 0.82 | 12 | 92 |
| Tetrachloroethene (1% SOM) | 0.18 | 0.18 | 0.65 | 19 | 1400 | 810 (424) | | | | |
| Tetrachloroethene (2.5% SOM) | 0.39 | 0.40 | 1.5 | 42 | 1400 | 1100 (951) | | | | |
| Tetrachloroethene (6% SOM) | 0.9 | 0.92 | 3.6 | 95 | 1400 | 1500 | | | | |
| Tetrachloromethane (1% SOM) | 0.026 | 0.026 | 0.45 | 2.9 | 890 | 190 | | | | |
| Tetrachloromethane (2.5% SOM | 0.056 | 0.056 | 1.0 | 6.3 | 920 | 270 | | | | |
| Tetrachloromethane (6% SOM) | 0.13 | 0.13 | 2.4 | 14 | 950 | 400 | | | | |
| Trichloroethene (1% SOM) | 0.016 | 0.017 | 0.041 | 1.2 | 120 | 70 | | | | |
| Trichloroethene (2.5% SOM) | 0.034 | 0.036 | 0.091 | 2.6 | 120 | 91 | | | | |
| Trichloroethene (6% SOM) | 0.075 | 0.080 | 0.21 | 5.7 | 120 | 120 | | | | |
| Trichloromethane (1% SOM) | 0.91 | 1.2 | 0.42 | 99 | 2500 | 2600 | | | | |
| Trichloromethane (2.5% SOM) | 1.7 | 2.1 | 0.83 | 170 | 2500 | 2800 | | | | |
| Trichloromethane (6% SOM) | 3.4 | 4.3 | 1.7 | 350 | 2500 | 3100 | | | | |
| Vinyl Chloride (1% SOM) | 0.00064 | 0.00077 | 0.00055 | 0.059 | 3.5 | 4.8 | | | | |
| Vinyl Chloride (2.5% SOM) | 0.00087 | 0.0010 | 0.0010 | 0.077 | 3.5 | 5.0 | | | | |
| Vinyl Chloride (6% SOM) | 0.0014 | 0.0015 | 0.0018 | 0.12 | 3.5 | 5.4 | | | | |
| Chloroethane (1% SOM) | | | | | | | 8.3 | 8.4 | 110 | 960 |
| Chloroethane (2.5% SOM) | | | | | | | 11 | 11 | 200 | 1300 |
| Chloroethane (6% SOM) | | | | | | | 18 | 18 | 380 | 2100 |
| 1,2-Dichloropropane (1% SOM) | | | | | | | 0.024 | 0.024 | 0.62 | 3.3 |
| 1,2-Dichloropropane (2.5% SOM) | | | | | | | 0.042 | 0.042 | 1.2 | 5.9 |
| 1,2-Dichloropropane (6% SOM) | | | | | | | 0.084 | 0.085 | 2.6 | 12 |
| 2-Chloronaphthalene (1% SOM) | | | | | | | 3.7 | 3.8 | 40 | 390 |
| 2-Chloronaphthalene (2.5% SOM) | | | | | | | 9.2 | 9.3 | 98 | 960 |
| 2-Chloronaphthalene (6% SOM) | | | | | | | 22 | 22 | 230 | 2200 |
| Bromodichloromethane (1% SOM) | | | | | | | 0.016 | 0.019 | 0.016 | 2.1 |
| Bromodichloromethane (2.5% SOM) | | | | | | | 0.030 | 0.034 | 0.032 | 3.7 |
| Bromodichloromethane (6% SOM) | | | | | | | 0.061 | 0.07 | 0.068 | 7.6 |
| Chloromethane (1% SOM) | | | | | | | 0.0083 | 0.0085 | 0.066 | 1 |
| Chloromethane (2.5% SOM) | | | | | | | 0.0098 | 0.0099 | 0.13 | 1.2 |
| Chloromethane (6% SOM) | | | | | | | 18 | 18 | 380 | 2100 |

| | S4UL | | | | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| *cis* -1,2 Dichloroethene (2.5% SOM) | | | | | | | 0.19 | 0.20 | 0.50 | 24 |
| *cis* -1,2 Dichloroethene (6% SOM) | | | | | | | 0.37 | 0.39 | 1.0 | 47 |
| *trans* -1,2 Dichloroethene (1% SOM) | | | | | | | 0.19 | 0.19 | 0.93 | 22 |
| *trans* -1,2 Dichloroethene (2.5% SOM) | | | | | | | 0.34 | 0.35 | 1.9 | 40 |
| *trans* -1,2 Dichloroethene (6% SOM) | | | | | | | 0.70 | 0.71 | 4.0 | 81 |
| Dichloromethane (1% SOM) | | | | | | | 0.58 | 2.1 | 0.1 | 270 |
| Dichloromethane (2.5% SOM) | | | | | | | 0.98 | 2.8 | 0.19 | 360 |
| Dichloromethane (6% SOM) | | | | | | | 1.7 | 4.5 | 0.34 | 560 |
| Hexachloroethane (1% SOM) | | | | | | | 0.2 | 0.22 | 0.27 | 22 |
| Hexachloroethane (2.5% SOM) | | | | | | | 0.48 | 0.54 | 0.67 | 53 |
| Hexachloroethane (6% SOM) | | | | | | | 1.1 | 1.3 | 1.6 | 120 |

**Notes for EIC/AGS/CL:AIRE Generic Assessment Criteria**

1 GAC have been derived for 4 generic land uses; residential with consumption of homegrown produce, residential without consumption of homegrown produce, allotments and commercial land-use.

## EXPLOSIVES

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | S4UL | | | | | |
|---|---|---|---|---|---|---|
| **Compound** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** |
| RDX (1% SOM) | 120 | 13000 | 17 | 210000 | 210000 | 210000 |
| RDX (2.5% SOM) | 250 | 13000 | 38 | 210000 | 26000 | 49000 (18.7) |
| RDX (6% SOM) | 540 | 13000 | 85.0 | 210000 | 27000 | 53000 |
| HMX (1% SOM) | 5.7 | 6700 | 0.86 | 110000 | 13000 | 23000 (0.35) |
| HMX (2.5% SOM) | 13 | 6700 | 1.9 | 110000 | 13000 | 23000 (0.39) |
| HMX (6% SOM) | 26 | 6700 | 3.9 | 110000 | 13000 | 24000 (0.48) |

## PESTICIDES

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| Compound | S4UL Residential with home grown produce | Residential without home grown produce | Allotment | Commercial | POSresi | POSpark |
|---|---|---|---|---|---|---|
| Aldrin (1% SOM) | 5.7 | 7.3 | 3.2 | 170 | 18 | 30 |
| Aldrin (2.5% SOM) | 6.6 | 7.4 | 6.1 | 170 | 18 | 31 |
| Aldrin (6% SOM) | 7.1 | 7.5 | 9.6 | 170 | 18 | 31 |
| | | | | | | |
| Dieldrin (1% SOM) | 0.97 | 7 | 0.17 | 170 | 18 | 30 |
| Dieldrin (2.5% SOM) | 2 | 7.3 | 0.41 | 170 | 18 | 30 |
| Dieldrin (6% SOM) | 3.5 | 7.4 | 0.96 | 170 | 18 | 31 |
| | | | | | | |
| Atrazine (1% SOM) | 3.3 | 610 | 0.5 | 9300 | 1200 | 2300 |
| Atrazine (2.5% SOM) | 7.6 | 620 | 1.2 | 9400 | 1200 | 2400 |
| Atrazine (6% SOM) | 17.4 | 620 | 2.7 | 9400 | 1200 | 2400 |
| | | | | | | |
| Dichlorovos (1% SOM) | 0.032 | 6.4 | 0.0049 | 140 | 16 | 26 |
| Dichlorovos (2.5% SOM) | 0.066 | 6.5 | 0.010 | 140 | 16 | 26 |
| Dichlorovos (6% SOM) | 0.14 | 6.6 | 0.022 | 140 | 16 | 27 |
| | | | | | | |
| Alpha-Endosulfan (1% SOM) | 7.4 | 160 (0.003) | 1.2 | 5600 (0.003) | 1200 | 2400 |
| Alpha-Endosulfan (2.5% SOM) | 18 | 280 (0.007) | 2.9 | 7400 (0.007) | 1200 | 2400 |
| Alpha-Endosulfan (6% SOM) | 41 | 410 (0.016) | 6.8 | 8400 (0.016) | 1200 | 2500 |
| | | | | | | |
| Beta-Endosulfan (1% SOM) | 7 | 190 (0.00007) | 1.1 | 6300 (0.00007) | 1200 | 2400 |
| Beta-Endosulfan (2.5% SOM) | 17 | 320 (0.0002) | 2.7 | 7800 (0.0002) | 1200 | 2400 |
| Beta-Endosulfan (6% SOM) | 39 | 440 (0.0004) | 6.4 | 8700 | 1200 | 2500 |
| | | | | | | |
| Alpha-Hexachlorocyclohexanes ( | 0.23 | 6.9 | 0.035 | 170 | 24 | 47 |
| Alpha-Hexachlorocyclohexanes ( | 0.55 | 9.2 | 0.087 | 180 | 24 | 48 |
| Alpha-Hexachlorocyclohexanes ( | 1.2 | 11 | 0.21 | 180 | 24 | 48 |
| | | | | | | |
| Beta-Hexachlorocyclohexanes (1 | 0.085 | 3.7 | 0.013 | 65 | 8.1 | 15 |
| Beta-Hexachlorocyclohexanes (2 | 0.2 | 3.8 | 0.032 | 65 | 8.1 | 15 |
| Beta-Hexachlorocyclohexanes (6 | 0.46 | 3.8 | 0.077 | 65 | 8.1 | 16 |
| | | | | | | |
| Gamma-Hexachlorocyclohexane | 0.06 | 2.9 | 0.0092 | 67 | 8.2 | 14 |
| Gamma-Hexachlorocyclohexane | 0.14 | 3.3 | 0.023 | 69 | 8.2 | 15 |
| Gamma-Hexachlorocyclohexane | 0.33 | 3.5 | 0.054 | 70 | 8.2 | 15 |

## CHLOROBENZENES & METHYLBENZENES

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | S4UL | | | | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with homegrown produce** | **Residential without homegrown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| Chlorobenzene (1% SOM) | 0.46 | 0.46 | 5.9 | 56 | 11000 | 1300 (675) | | | | |
| Chlorobenzene (2.5% SOM) | 1.0 | 1.0 | 14 | 130 | 13000 | 2000 (1520) | | | | |
| Chlorobenzene (6% SOM) | 2.4 | 2.4 | 32 | 290 | 14000 | 2900 | | | | |
| 1,2-Dichlorobenzene (1% SOM) | 23 | 24 | 94 | 2000 (571) | 90000 | 24000 (571) | | | | |
| 1,2-Dichlorobenzene (2.5% SOM | 55 | 57 | 230 | 4800 (1370) | 95000 | 36000 (1370) | | | | |
| 1,2-Dichlorobenzene (6% SOM) | 130 | 130 | 540 | 11000 (3240) | 98000 | 51000 (3270) | | | | |
| 1,3-Dichlorobenzene (1% SOM) | 0.40 | 0.44 | 0.25 | 30 | 300 | 390 | | | | |
| 1,3-Dichlorobenzene (2.5% SOM | 1.0 | 1.1 | 0.6 | 73 | 300 | 440 | | | | |
| 1,3-Dichlorobenzene (6% SOM) | 2.3 | 2.5 | 1.5 | 170 | 300 | 470 | | | | |
| 1,4-Dichlorobenzene (1% SOM) | 61 | 61 | 15 | 4400 (224) | 17000 | 36000 (224) | | | | |
| 1,4-Dichlorobenzene (2.5% SOM | 150 | 150 | 37 | 10000 (540) | 17000 | 36000 (540) | | | | |
| 1,4-Dichlorobenzene (6% SOM) | 350 | 350 | 88 | 25000 (1280) | 17000 | 36000 (1280) | | | | |
| 1,2,3-Trichlorobenzene (1% SOI | 1.5 | 1.5 | 4.7 | 102 | 1800 | 770 (134) | | | | |
| 1,2,3-Trichlorobenzene (2.5% S( | 3.6 | 3.7 | 12 | 250 | 1800 | 110 (330) | | | | |
| 1,2,3-Trichlorobenzene (6% SOI | 8.6 | 8.8 | 28 | 590 | 1800 | 1600 (789) | | | | |
| 1,2,4-Trichlorobenzene (1% SOI | 2.6 | 2.6 | 55 | 220 | 15000 | 1700 (318) | | | | |
| 1,2,4-Trichlorobenzene (2.5% S( | 6.4 | 6.4 | 140 | 530 | 17000 | 2600 (786) | | | | |
| 1,2,4-Trichlorobenzene (6% SOI | 15 | 15 | 320 | 1300 | 19000 | 400 (1880) | | | | |
| 1,3,5-Trichlorobenzene (1% SOI | 0.33 | 0.33 | 4.7 | 23 | 1700 | 380 (36.7) | | | | |
| 1,3,5-Trichlorobenzene (2.5% S( | 0.81 | 0.81 | 12 | 55 | 1700 | 580 (90.8) | | | | |
| 1,3,5-Trichlorobenzene (6% SOI | 1.9 | 1.9 | 28 | 130 | 1800 | 860 (217) | | | | |
| 1,2,3,4-Tetrachlorobenzene (1% | 15 | 24 | 4.4 | 1700 (122) | 830 | 1500 (122) | | | | |
| 1,2,3,4-Tetrachlorobenzene (2.5 | 36 | 56 | 11 | 3080 (304) | 830 | 1600 | | | | |
| 1,2,3,4-Tetrachlorobenzene (6% | 78 | 120 | 26 | 4400 (728) | 830 | 1600 | | | | |
| 1,2,3,5-Tetrachlorobenzene (1% | 0.66 | 0.75 | 0.38 | 49 (39.4) | 78 | 110 (39) | | | | |
| 1,2,3,5-Tetrachlorobenzene (2.5 | 1.6 | 1.9 | 0.90 | 120 (98.1) | 79 | 120 | | | | |
| 1,2,3,5-Tetrachlorobenzene (6% | 3.7 | 4.3 | 2.2 | 240 (235) | 79 | 130 | | | | |
| 1,2,4,5-Tetrachlorobenzene (1% | 0.33 | 0.73 | 0.06 | 42 (19.7) | 13 | 25 | | | | |
| 1,2,4,5-Tetrachlorobenzene (2.5 | 0.77 | 1.7 | 0.16 | 72 (49.1) | 13 | 26 | | | | |
| 1,2,4,5-Tetrachlorobenzene (6% | 1.6 | 3.5 | 0.37 | 96 | 13 | 26 | | | | |
| Pentachlorobenzene (1% SOM) | 5.8 | 19 | 1.2 | 640 (43.0) | 100 | 190 | | | | |
| Pentachlorobenzene (2.5% SOM | 12 | 30 | 3.1 | 770 (107) | 100 | 190 | | | | |
| Pentachlorobenzene (6% SOM) | 22 | 38 | 7.0 | 830 | 100 | 190 | | | | |
| Hexachlorobenzene (1% SOM) | 1.8 (0.20) | 4.1 (0.20) | 0.47 | 110 (0.20) | 16 | 30 | | | | |
| Hexachlorobenzene (2.5% SOM) | 3.3 (0.50) | 5.7 (0.50) | 1.1 | 120 | 16 | 30 | | | | |
| Hexachlorobenzene (6% SOM) | 4.9 | 6.7 (1.2) | 2.5 | 120 | 16 | 30 | | | | |
| 1,2,4-Trimethylbenzene (1% SOM) | | | | | | | 0.35 | 0.41 | 0.38 | 42 |
| 1,2,4-Trimethylbenzene (2.5% SOM) | | | | | | | 0.85 | 0.99 | 0.93 | 99 |
| 1,2,4-Trimethylbenzene (6% SOM) | | | | | | | 2 | 2.3 | 2.2 | 220 |
| Isopropyl benzene (1% SOM) | | | | | | | 11 | 12 | 32 | 1400 |
| Isopropyl benzene (2.5% SOM) | | | | | | | 27 | 28 | 79 | 3300 |
| Isopropyl benzene (6% SOM) | | | | | | | 64 | 67 | 190 | 7700 |
| Propylbenzene (1% SOM) | | | | | | | 34 | 40 | 34 | 4100 |
| Propylbenzene (2.5% SOM) | | | | | | | 82 | 97 | 83 | 9700 |
| Propylbenzene (6% SOM) | | | | | | | 190 | 230 | 200 | 21000 |
| Styrene (1% SOM) | | | | | | | 8.1 | 35 | 1.6 | 3300 |
| Styrene (2.5% SOM) | | | | | | | 19 | 78 | 3.7 | 6500 |
| Styrene (6% SOM) | | | | | | | 43 | 170 | 8.7 | 11000 |

## PHENOLS AND CHLOROPHENOLS

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | LQM/CIEH | | | | | | EA SGV | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential** | **Allotment** | **Commercial** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **otm** | **Commercial** |
| Phenol (1% SOM) | 120 | 440 (460) | 23 | 440 (26000) | 440 (10000) | 440 (7600) | | | | | | | |
| Phenol (2.5% SOM) | 200 | 690 | 42 | 690 (30000) | 690 (10000) | 690 (8300) | | | | | | | |
| Phenol (6% SOM) | 380 | 1200 | 83 | 1300 (34000) | 1300 (10000) | 1300 (9300) | 420 | 280 | 3200 (38000) | | | | |
| Chlorophenol (1% SOM) | 0.87 | 94 | 0.13 | 3500 | 620 | 1100 | | | | | | | |
| Chlorophenol (2.5% SOM) | 2.0 | 150 | 0.30 | 4000 | 620 | 1100 | | | | | | | |
| Chlorophenol (6% SOM) | 4.5 | 210 | 0.70 | 4300 | 620 | 1100 | | | | | | | |
| Pentachlorophenol (1% SOM) | 0.22 | 27 (16.7) | 0.03 | 400 | 60 | 110 | | | | | | | |
| Pentachlorophenol (2.5% SOM) | 0.52 | 29 | 0.08 | 400 | 60 | 120 | | | | | | | |
| Pentachlorophenol (6% SOM) | 1.2 | 31 | 0.19 | 400 | 60 | 120 | | | | | | | |
| 2,4-Dimethylphenol (1% SOM) | | | | | | | | | | 19 | 210 | 3 | 16000 |
| 2,4-Dimethylphenol (2.5% SOM) | | | | | | | | | | 43 | 410 | 7 | 24000 |
| 2,4-Dimethylphenol (6%SOM) | | | | | | | | | | 97 | 730 | 17 | 30000 |
| Total Cresols (2-Methylphenol, 3-methylphenol, 4-methylphenol) (1%SOM) | | | | | | | | | | 80 | 3700 | 12 | 160000 |
| Total Cresols (2-Methylphenol, 3-methylphenol, 4-methylphenol) (2.5%SOM) | | | | | | | | | | 180 | 5400 | 27 | 180000 |
| Total Cresols (2-Methylphenol, 3-methylphenol, 4-methylphenol) (6%SOM) | | | | | | | | | | 400 | 6900 | 63 | 180000 |

## PHTHALATES

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|
| **Compound** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| Bis (2-ethylhexyl) phthalate (1% | 280 | 2700 | 47 | 85000 |
| Bis (2-ethylhexyl) phthalate (2.5 | 610 | 2800 | 120 | 86000 |
| Bis (2-ethylhexyl) phthalate (6% | 1100 | 2800 | 280 | 86000 |
| Butyl benzyl phthalate (1% SOM | 1400 | 42000 | 220 | 940000 |
| Butyl benzyl phthalate (2.5% SO | 3300 | 44000 | 550 | 940000 |
| Butyl benzyl phthalate (6% SOM | 7200 | 44000 | 1300 | 950000 |
| Diethyl Phthalate (1% SOM) | 120 | 1800 | 19 | 1500000 |
| Diethyl Phthalate (2.5% SOM) | 260 | 3500 | 41 | 220000 |
| Diethyl Phthalate (6% SOM) | 570 | 6300 | 94 | 290000 |
| Di-*n*-butyl phthalate (1% SOM) | 13 | 450 | 2 | 15000 |
| Di-*n*-butyl phthalate (2.5% SOM | 31 | 450 | 5 | 15000 |
| Di-*n*-butyl phthalate (6% SOM) | 67 | 450 | 12 | 15000 |
| Di-*n*-octyl phthalate (1% SOM) | 2300 | 3400 | 940 | 89000 |
| Di-*n*-octyl phthalate (2.5% SOM | 2800 | 3400 | 2100 | 89000 |
| Di-*n*-octyl phthalate (6% SOM) | 3100 | 3400 | 3900 | 89000 |

# OTHER ORGANICS

**Based on sandy loam soil as defined in SR3 (Environment Agency, 2009) and 1%, 2.5% and 6% soil organic matter (SOM)**
**Generic assessment criteria will vary according to SOM for all land values**
**Values are expressed in mg/kg**
**GACs assume that free phase contamination is not present**
**GACs are based on sub-surface soil to indoor air correction factor of 1**

| | S4UL | | | | | | EIC/AGS/CL:AIRE | | | |
|---|---|---|---|---|---|---|---|---|---|---|
| **Compound** | **Residential with home grown produce** | **Residential without home grown produce** | **Allotment** | **Commercial** | **POSresi** | **POSpark** | **Residential with consumption of homegrown produce** | **Residential without consumption of homegrown produce** | **Allotment** | **Commercial** |
| Carbon disulphide (1% SOM) | 0.14 | 0.14 | 4.8 | 11 | 11000 | 1300 | | | | |
| Carbon disulphide (2.5% SOM) | 0.29 | 0.29 | 10 | 22 | 11000 | 1900 | | | | |
| Carbon disulphide (6% SOM) | 0.62 | 0.62 | 23 | 47 | 12000 | 2700 | | | | |
| Hexachloro-1,3-butadiene (1% S | 0.29 | 0.32 | 0.25 | 31 | 25 | 48 | | | | |
| Hexachloro-1,3-butadiene (2.5% | 0.70 | 0.78 | 0.61 | 66 | 25 | 50 | | | | |
| Hexachloro-1,3-butadiene (6% S | 1.6 | 1.8 | 1.4 | 120 | 25 | 51 | | | | |
| Tributyl tin oxide (1% SOM) | | | | | | | 0.25 | 1.4 | 0.042 | 130 |
| Tributyl tin oxide (2.5% SOM) | | | | | | | 0.59 | 3.1 | 0.1 | 180 |
| Tributyl tin oxide (6% SOM) | | | | | | | 1.3 | 5.7 | 0.24 | 200 |
| Biphenyl (1% SOM) | | | | | | | 66 | 220 | 14 | 18000 |
| Biphenyl (2.5% SOM) | | | | | | | 160 | 500 | 35 | 33000 |
| Biphenyl (6% SOM) | | | | | | | 360 | 980 | 83 | 48000 |
| 2,4-Dinitrotoluene (1% SOM) | | | | | | | 1.5 | 170 | 0.22 | 3700 |
| 2,4-Dinitrotoluene (2.5% SOM) | | | | | | | 3.2 | 170 | 0.49 | 3700 |
| 2,4-Dinitrotoluene (6% SOM) | | | | | | | 7.2 | 170 | 1.1 | 3800 |
| 2,6-Dintrotoluene (1% SOM) | | | | | | | 0.78 | 78 | 0.12 | 1900 |
| 2,6-Dintrotoluene (2.5% SOM) | | | | | | | 1.7 | 84 | 0.27 | 1900 |
| 2,6-Dintrotoluene (6% SOM) | | | | | | | 3.9 | 87 | 0.61 | 1900 |
| Bromoform (1% SOM) | | | | | | | 2.8 | 5.2 | 0.95 | 760 |
| Bromoform (2.5% SOM) | | | | | | | 5.9 | 11 | 2.1 | 1500 |
| Bromoform (6% SOM) | | | | | | | 13 | 23 | 4.6 | 3100 |

## 6. GEOENVIRONMENTAL RISK ASSESSMENT

6.1 **Potential Hazard Sources.** Ground contamination can occur through several causes, particularly from historical use of the site and is often linked to the processes of waste disposal, underground storage, open storage, process pipework, leaks, spillages, tanks, site filling and various other reasons. The contamination can either arise from site sources or be the result of migration from other sources off site.

6.2 **Potential Migratory Pathways.** The primary pathways are considered to be laterally or vertically downward through underlying strata or upward to the ground surface. Such pathways also provide the potential for contaminants to migrate towards local watercourses and groundwater.

6.3 **Potential Targets At Risk.** Potential environmental liabilities related to current legislation associated with contaminated land with regard to existing ownership and redevelopment are summarised.

The probability of a hazard, linked with its consequences, can be used to assess risk in accordance with the tables below for use in decision making.

**Consequence of Pollution Linkage**

| | |
|---|---|
| **Severe** | Damage to human health.<br>Substantial pollution of controlled waters.<br>Significant change in ecosystem population.<br>Irreparable damage to property. |
| **Moderate** | Non-permanent damage to human health.<br>Minor pollution of controlled waters.<br>Change in ecosystem.<br>Damage to property. |
| **Mild** | Short term health effects.<br>Slight pollution of controlled waters.<br>Slight effect on ecosystem.<br>Minor repairable damage to property. |
| **Near Zero** | No noticeable effect on human health.<br>No significant pollution to controlled waters.<br>No measurable effect on ecosystem densities.<br>Non-structural cosmetic damage to property. |

**Decision Making**

| **Probability of a hazard and an associated linkage** | **Consequences of a pollution linkage (hazard-pathway-target)** | | | |
|---|---|---|---|---|
| | Severe | Moderate | Mild | Near Zero |
| High | High | High | Medium/low | Negligible |
| Medium | High | Medium | Low | Negligible |
| Low | High/medium | Medium/low | Low | Negligible |
| Unlikely | High/medium/low | Medium/low | Low | Negligible |

Final overall risk is based on an assessment of probability of a hazard and its consequences. Risk categories are shown shaded in the table above and defined below.

| **Risk** | **Description** |
|---|---|
| High | Site probably or certainly unsuitable for present use or environmental setting. Contamination probably or certainly present and likely to have an unacceptable impact on key targets. Urgent action needed. |
| Medium/ Moderate | Site may not be suitable for present use or environmental setting. Contamination may be present, and likely to have unacceptable impact on key targets. Action may be needed on the medium term. |
| Low | Site considered suitable for present use and environmental setting. Contamination may be present but unlikely to have unacceptable impacts on key targets. Action unlikely to be needed in present use. |
| Negligible | Site considered suitable for present use and environmental setting. Contamination may be present but unlikely to have unacceptable impacts on key targets. No action needed while site remains in present use. |

The review of the information from the exploratory investigation may be such that a decision is made that there is no need for further investigation. Alternatively, it may be necessary to carry out a further main investigation.

The Environment Agency has set out guidance as to the classification of waste arising from construction sites in its document "The Definition of Waste" dated April 2006. This document outlines how waste is to be handled

The following activities are not regarded as a waste management activity requiring licencing.

1) Construction activities carried out for the purpose of producing a suitably engineered soil e.g. lime stabilisation, vibro-replacement and piling.

2) Uncontaminated materials produced on site (including excavated soils and materials from demolition) which can be reused without further treatment. Examples include site regrading and footing excavations.

   These must be done in accordance with the Planning Permission. Demolition material must be used in accordance with the quality protocols for the production of aggregates from inert waste, subject to appropriate testing and the lack of any harmful constituents. Uses include pipe bedding, backfill and sub-base.

3) Contaminated soils can be moved on-site providing they do not require treatment or containment. There should be no risk to the environment i.e. non-leachable and in accordance with Planning Permission. Relevant activities can include site regarding and use of materials below clean cover systems, capping, buildings and hardstanding.

Where contaminated materials have to be placed in an engineered cell to prevent pollution, then this would be classed as landfilling and require PPC permits. Any material taken off site is considered to be waste. However, this is under review. If material is waste, then there is a duty of care including ensuring material is transported by a registered carrier. The destination of material leaving the site should be regularly checked and Waste Transfer Notes kept.

**Clean Cover Systems**

According to the Environment Agency's Remediation Position Statements of May 2006, the placement of a cover system using "clean" material is not treatment of waste. Consequently, no licensing/permitting position statements are applicable to this type of remediation. If the cover system uses 'waste materials' in its construction, waste management licensing exemption paragraph 9A may be applicable to its installation. If the installation of the proposed cover system does not meet the criteria for registration of this exemption, the activity may be regulated through a waste management site license.

## 7. WASTE ACCEPTANCE CRITERIA (WAC)

The main objective of the Landfill Directive is to prevent or reduce as far as possible the negative effects of landfilling waste on the environment and on human health. It is intended to reduce the disposal of waste materials to landfills and to encourage more sustainable approaches to dealing with wastes. It bans the landfill of liquids and certain solid wastes, introduces requirements for the treatment of wastes prior to landfill and provides for the classification of landfills as sites for inert, hazardous or non-hazardous waste and prohibits co-disposal.

It sets out procedures for waste acceptance at landfills and the types of waste for each class of landfill as specified by Waste Acceptance Criteria (WAC). The WAC are predominantly lists of "limit values" for certain parameters obtained from standard leaching tests of wastes going to landfills. WAC are set out in the Landfill Directive itself. Full details can be found in the Environment Agency document "Waste Classification – Guidance on the classification and Assessment of Waste " Technical Guidance WM3 - 2015

## 8. MAIN REFERENCES


| | |
|---|---|
| British Standards | BS3882: 2015 British Standard Specification for Topsoil<br>BS5930: 2015+A1:2020 British Standard Code of Practice for Site Investigations<br>BS8485: 2015 British Standard Code of Practice for the design and protective measures from methane and carbon dioxide ground gases for new buildings<br>BS10175: 2011+A2:2017 British Standard Code of Practice for the Investigation of Potentially Contaminated Sites |
| BRE | Radon: Guidance on protective measures for new dwellings, BR211, 2015<br>Protective measures for housing on gas-contaminated land, BR414, 2015<br>Cover systems for land regeneration, 2004<br>Concrete in aggressive ground. Special Digest SD1, 3rd Edition, 2005<br>Soakaway Design (DG365) |
| CIEH | The LQM / CIEH Generic Assessment Criteria for Human Health Risk Assessment (2nd Edition) |
| CIRIA | Assessing risks posed by hazardous ground gases to buildings, CIRIA C665<br>Asbestos in Soil and Made Ground: a guide to understanding and managing risks, CIRIAC733, 2014<br>Good Practice on the testing and verification of protection systems for buildings against hazardous ground gases. C735:2014 |
| CL:AIRE | Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination, SP1010, 2013 |
| DEFRA | Contaminated Land Report CLR 11, 2002 (7-10 withdrawn)<br>R & D Publications TOX 1 – 12, 14, 16 – 25<br>R & D Publications SGV 1, 3, 4, 5, 7, 8, 9, 10, 15 and 16 (withdrawn)<br>Improvements to Contaminated Land Guidance - "Outcome of the "Way Forward", 2008<br>Exercise on Soil Guideline Values. July 2008<br>Guidance on the Legal Definition of Contaminated Land. July 2008<br>Simplification of the Contaminated Land Regime Impact Assessment No: Defra 1133 |
| DETR | Circular 02/2000. Contaminated Land, 2000<br>Guidelines for Environmental Risk Assessment and Management, 2000 |
| Environment Agency | Guidance for the Safe Development of Housing on Land Affected by Contamination, 2000<br><br>Protective measures for housing on gas-contaminated land<br>Remediation Position Statements, May 2006<br>Guidance and monitoring of landfill leachate, groundwater and surface water<br>Human health toxicological assessment of contaminants in soil (Science Report SC050021/SR2) 2008<br>Updated technical background in the CLEA model (Science Report SC0520021/SR3)<br>Waste Classification – Guidance on the classification and Assessment of Waste - Technical Guidance WM3 (2015)<br>Contaminated Land Risk Management (2021) |
| HMSO | Part 2A of the Environmental Protection Act<br>Part 2A Statutory Guidance – April 2012<br>Contaminated Land (England) Regulations 2006<br>The Contaminated Land (England) (Amendment) Regulations 2012<br>The Water Act 2003 (Commencement No. 11) Order 2012 |
| Institution of Civil Engineers | Contaminated Land: Investigation, Assessment and Remediation, 2nd Edition |
| NHBC | Guidance on evaluation of development proposals on sites where methane and carbon dioxide are present, 2007 |


This list is not intended to be exhaustive.