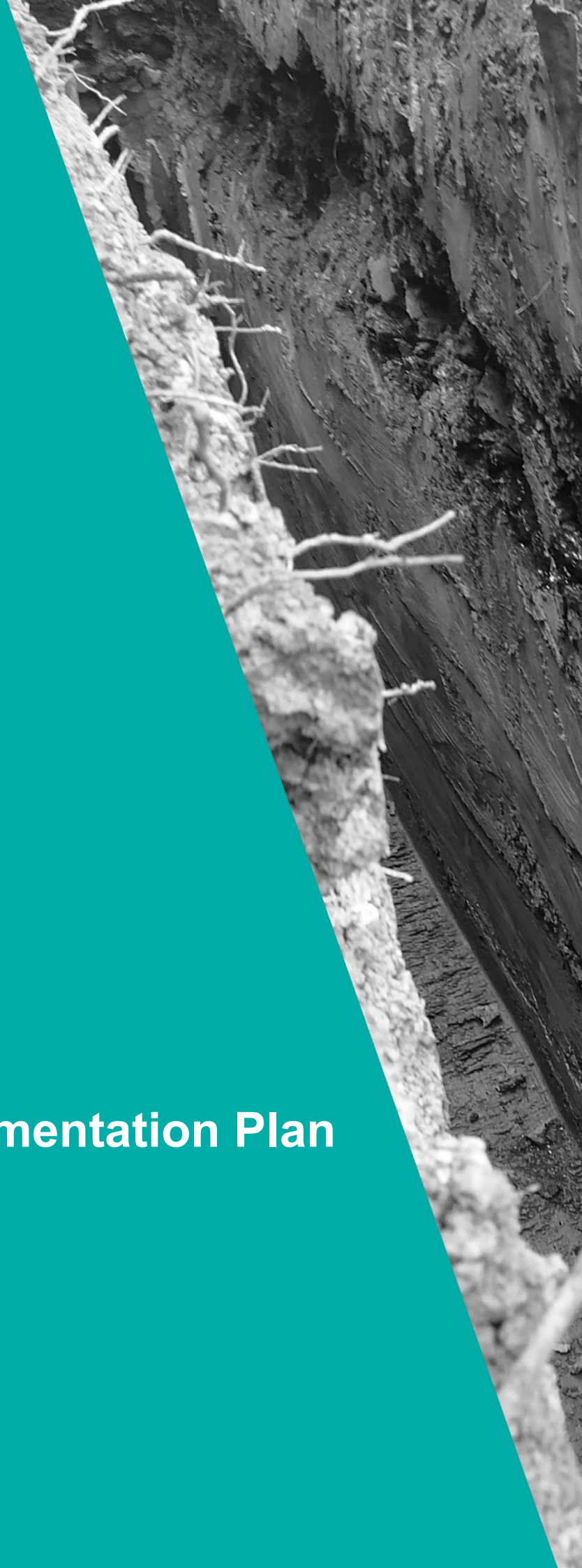
Eastwood
CONSULTING ENGINEERS



Remediation Implementation Plan

HAY GREEN LANE, BIRDWELL

AVANT HOMES

3 MARCH 2023

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REMEDIATION IMPLEMENTATION PLAN

HAY GREEN LANE, BIRDWELL

FOR

AVANT HOMES



46384-001 **3 March 2023**

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REMEDIATION IMPLEMENTATION PLAN

HAY GREEN LANE, BIRDWELL

FOR

AVANT HOMES

Job No.	:	46384
Report Status	:	Issue 1
Document Date	:	3 March 2023

Approved : Kate Edwards

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(including ECE mark up of approximate extent of unsuitable topsoil)

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Table of Assessment Values – Residential with Home-grown Produce

1.0 INTRODUCTION

This Implementation Plan has been produced by Eastwood & Partners Limited, trading as Eastwood Consulting Engineers (ECE), on behalf of Avant Homes, for the site at Hay Green Lane in Birdwell, South Yorkshire. The purpose of this document is to detail the procedure for the implementation and subsequent verification of remedial works to deal with contaminants found within the ground at the site.

This is to ensure that upon completion of the proposed residential development, the site can be shown to be suitable for its intended use and that it will not pose unacceptable risks to future receptors. This therefore covers the protective measures to be installed during the construction phases of the redevelopment for a residential end use.

This document is a working publication and may need to be updated, in agreement with the relevant regulatory bodies, at any stage during development dependent on what is encountered. This document is also subject to the approval of the regulatory parties; the Local Authority and your warranty provider. This version constitutes Issue 1. Please contact Eastwood Consulting Engineers if you are unsure of the current issue.

2.0 RATIONALE FOR REMEDIAL WORKS

ECE have been provided with the following reports prepared by RSK for the site, which we understand Avant Homes have reliance upon:

- A ‘Preliminary Risk Assessment and Coal Mining Risk Assessment’, referenced 350283-R1(00) and dated November 2019;
- A ‘Phase 2 Geo-Environmental Site Investigation’, referenced 350283-R02(00) and dated September 2020; and
- A ‘Ground Gas Risk Assessment’, referenced 350283/L03/jh and dated 26 April 2021.

The above reports are to be read in conjunction with this Implementation Plan.

The Site

The approximately 4.0 hectare site is located to the south of Hay Green Lane in Birdwell, South Yorkshire. The eastern ~70% of the site comprises pastoral land used for grazing horses. In the western ~30% of the site, allotment gardens (which appear to be disused on the satellite

imagery) and associated sheds in varying condition are located in the north and east of this area, pastoral fields are located in the west, and unoccupied land covered with dense vegetation is located in the south.

Two garages are located in the south west of the site and have possible asbestos cement sheet roofs. In addition, asbestos cement fragments were noted at the surface in localised areas within the allotments in the west of the site.

Historically, no significant development has previously taken place on the site. A well was previously indicated close to the southern boundary in the east of the site on 1855 map but is not shown on any subsequent maps. The allotment gardens in the west were first labelled in 1931, and previously occupied the whole of the western ~30%.

It is proposed that the site will be developed with low-rise residential properties with private gardens, areas of hardstanding and soft landscaping.

Ground Conditions

The solid geology beneath the site comprises the Pennine Middle Coal Measures Formation. A fault orientated north east to south west is shown to cross the north west of the site, and the geology is downthrown to the north west.

No superficial deposits are shown to underlie the site.

The Swallow Wood coal seam is conjectured to outcrop in the south west of the site (to the south of the fault).

During RSK's ground investigation, topsoil between 0.1 to 0.3 m thick was encountered across the majority of the site. Topsoil made ground (between 0.15 and 0.3 m thick) was frequently recorded at the surface in the south and west of the western ~30% of the site (in the pastoral fields and heavily vegetated area).

Predominantly granular made ground was locally encountered in three trial pits in the eastern fields in TP4, TP5 and TP8 to between 0.95 and 1.9 m bgl. In TP4 and TP5, the made ground was generally described as sandy gravel (and cobbles in TP4) of sandstone with occasional brick. In TP8, the made ground comprises cobbles and occasional boulders of sandstone with a clay matrix.

Below the topsoil and made ground (where present), the natural ground is predominantly cohesive (firm to stiff clay). Granular natural ground was recorded directly below the topsoil in TP1 in the north of the site and TP201 and TP202 in the centre. Sandstone bedrock was recorded below the eastern fields between 0.7 and 1.9 m bgl, and mudstone was recorded below the west between 1.5 and 3.6 m bgl.

An in-tact coal seam (interpreted to be the Swallow Wood) was occasionally recorded from as shallow as 0.7 m depth and thickness of between 0.1 and 1.3 m. No evidence of surface mine features (e.g. bell pits) were identified during the investigation, and there are no recorded mine entries present on the site; however, it is recommended that, during the topsoil surface strip, an inspection of the ground surface is undertaken to look for evidence of mining features.

Groundwater ingresses were recorded in two trial pits (TP4 and TP8) between 1.0 and 2.0 m depth. In the rotary boreholes, groundwater strikes were recorded between 7.5 and 12.5 m bgl. During groundwater monitoring, groundwater was typically recorded between 2.7 and 3.8 m depth. Groundwater was occasionally recorded in the upper 1.0 m in wells installed to 1.5 m depth, and as shallow as 0.34 m in WS110.

Chemical Testing Assessment

Topsoil (Eastern Fields)

Eight samples of topsoil were collected from the eastern fields and submitted for testing.

None of the samples recorded any elevated concentrations of contaminants with respect to the relevant human health assessment criteria. The topsoil from the fields area is therefore considered to be suitable for re-use within the development.

Topsoil & Topsoil Made Ground (Western 30% / Allotments)

Eight samples of topsoil and five samples of topsoil made ground were collected from the western ~30% and submitted for testing.

In the samples of topsoil made ground, lead was recorded above its human health assessment value of 200 mg/kg in two samples (WS107 at 0.0-0.1 m and WS110 at 0.0-0.1 m) which recorded elevated concentrations of 205 and 354 mg/kg respectively. The concentration in WS110 also exceeds the lower assessment value for POS near housing end-use of 270 mg/kg.

A corrected mean value for lead of 167 mg/kg is calculated across all the samples, which falls below the assessment value.

None of the samples of topsoil recorded any elevated concentration of contaminants.

RSK conclude that the topsoil / made ground from the allotments will require a minimum 600 mm clean capping layer where this material is to remain in place below gardens and landscaped areas, or removed from the site.

Given the presence of ACM at surface of this topsoil, ECE concur with this conclusion. However, should the ACM removal be undertaken in a satisfactory manner, ECE consider that with further chemical testing, the topsoil and topsoil made ground from the western 30% of the site may all be suitable for re-use, as only two of thirteen samples tested recorded elevated lead concentrations.

During the site strip, any potentially harmful extraneous materials (e.g. glass) should be removed from the topsoil. Since this area comprised former allotment gardens, there is also a potential for asbestos fragments / fibres to be present (asbestos fragments were identified at the surface in localised areas during the ground investigation). Any **asbestos fragments** will need to be **removed** by a specialist contractor. Additional testing will then need to be undertaken to ensure the topsoil is suitable for re-use, for placement in gardens and POS areas.

If it is determined that the topsoil not suitable for re-use, to minimise material removed from the site ECE consider that the material may be placed below **gardens** in a layer no more than 300 mm thick below a minimum **600 mm thick clean capping** layer. This capping can reduce to **300 mm thick** below **POS areas**.

Made Ground (Eastern Fields)

Two samples of made ground were submitted for testing. Neither of the samples recorded any elevated concentrations of contaminants compared to their respective assessment criteria.

RSK do not state that any remedial measures are required for this made ground. However, ECE consider that it to be prudent for Avant to provide a **300 mm thick growing medium** where these localised areas of made ground underlie gardens and soft landscaped areas due to the made ground's granular consistency (sandy gravel and cobbles).

Based on the latest proposed layout, ground levels in the vicinity of TP4 are expected to be raised by at least 0.5 m compared to existing ground levels, and TP8 is located in the footprint of the proposed attenuation basin. No additional remedial measures are therefore considered to be required for these areas. However, in the vicinity of TP5 sections of the surrounding front gardens will be raised by less than 0.3 m, therefore Avant may wish to consider placing a thicker layer of topsoil in this area.

Asbestos

Multiple fragments of asbestos sheeting were noted at the surface of the western 30% of the site, concentrated in two zones within the east of this area (between WS112 and HP6 and adjacent to the south east of HP4).

Five samples of the surface soils were collected from the vicinity of where asbestos fragments were noted and submitted for asbestos screens. No asbestos fibres were recorded in any of these samples.

Any asbestos fragments identified on the site will need to be removed by a suitable contractor.

Natural Ground (Including Coal)

Five samples of natural ground were submitted for a full suite of environmental testing during RSK's investigation.

Arsenic exceeded its assessment value of 37 mg/kg in sample WS111 0.5 m, completed in the centre of the western 30%, which recorded an elevated concentration of 50 mg/kg. No elevated contaminants were recorded in the remaining samples, which recorded very low concentrations ranging between 1 and 7 mg/kg.

RSK state that since the elevated arsenic concentration is only slightly above its assessment value, it will not present a significant risk to human health.

ECE consider that the elevated concentration could be erroneous, as no made ground was encountered above the natural ground in WS111. A modified mean of 33 mg/kg and an arithmetic mean of 13 mg/kg is calculated across the samples of natural ground, both below the assessment value of 37 mg/kg. In addition, the top of the natural clay in WS111 lies at around 130.65 m AOD, which is 0.95 m below the proposed finished ground level of the closest

plot. On this basis, ECE concur with RSK's conclusion that the natural ground does not present a significant risk to human health, and arisings would be considered suitable for re-use on the site.

The Swallow Wood coal was recorded in the upper 1.0 m in WS107 (0.7 to 1.1 m) in the south west, although the seam is expected to be at least 1.0 m below the closest plots in this section of the site. A 100 mm thick coal seam was also encountered in WS102 (0.7 to 0.8 m) in the east of the site, although it is proposed to raise ground levels by approximately 1.0 m in this area. If coal seams or coal-rich strata are encountered less than 1.0 m below the surface of gardens or soft landscaped areas, a minimum 1.0 m thick capping will be required to reduce the potential for combustion. Similarly, coal or coal rich strata surrounding electricity cables should be removed to a distance of 1.0 m from the service in all directions and replaced with appropriate, non-combustible, fill.

Construction Materials Assessment

The site has been taken as a Greenfield location in relation to the Aggressive Chemical Environment for concrete classifications and groundwater is assumed to be mobile.

The chemical results indicate that a Design Sulphate class of DS-1 and an ACEC class of AC-1 (i.e. no sulphate precautions) are appropriate for sub-surface concrete in contact with the natural ground.

Where sub-surface concrete will be in contact with coal or coal-rich strata, it would be prudent to allow for a minimum of DS-2 AC-2 sulphate precautions.

RSK do not comment on the level of sulphate precautions required for concrete in contact with made ground. ECE consider that it would be prudent to allow for a minimum of **DS-2 AC-2** precautions where subsurface concrete is in contact with made ground and coal-rich strata.

The results of the chemical testing will need to be forwarded to the water company so that appropriate water supply pipes can be selected.

Radon and Ground Gas

ECE obtained a radon report in February 2023 from the British Geological Survey. No radon protective measures are considered to be required.

RSK installed eleven gas monitoring wells across the site to target shallow coal seams, and the adjacent opencast coal workings to the south. Twelve rounds of gas monitoring were undertaken. A summary of the results is provided below:

- No detectable concentrations of methane;
- A maximum carbon dioxide concentration of 6.0% was recorded in BH107 (also the deepest well, installed to 9 m depth) during the final round of monitoring. The same well also recorded a concentration 5.4% during the 5th round, but concentrations were below 5% during the remaining rounds. In the other wells, concentrations typically ranged between 2 and 4%;
- Zero flow.

Although carbon dioxide was recorded above 5% on two occasions in BH107, since concentrations were recorded below 5% during the remaining rounds it is considered appropriate to classify the site a Characteristic Situation 1, or 'Green' (i.e. no gas precautions required) in accordance with the NHBC traffic light system.

3.0 REMEDIATION OBJECTIVES

The remedial objectives for this site are therefore:

1. Removal of asbestos fragments identified within the allotment area by a specialist contractor*;
2. To ensure the topsoil and topsoil made ground in the western 30% has a **600 mm thick capping** where it remains below gardens and **300 mm thick capping** below POS and other landscaped areas. An alternative approach is to segregate this material and undertake further chemical testing to determine if the material is suitable for re-use;
3. Install a **300 mm thick growing medium** where localised made ground in the east of the site underlies gardens and landscaped areas*;
4. To ensure that appropriate sulphate precautions and water supply pipes are installed*;

5. To reduce the risks to construction workers, they should be made aware of the presence of elevated levels of contaminants within the materials to be excavated and ensure that the requisite working practices are adhered to*; and

6. Upon identification of any additional or unexpected contamination, a suitable strategy to determine any remedial action is to be in place.

*No further guidance with regards to this is considered necessary as part of this document.

4.0 WORKING METHOD

During the works, procedures to protect site neighbours, the environment and amenity, and to control dust, noise and odours should be put in place by the contractor, in addition to the required site health and safety procedures that apply. Control of surface runoff over areas of potentially contaminated ground should also be taken into consideration.

To reduce any risk to construction workers, they should be made aware of the presence of and risks from any unexpected contamination. The following precautions should be adopted by site workers when coming into contact with any areas of impacted ground:

- Normal site hygiene precautions should be maintained, including washing hands before eating; and
- Protective gloves should be worn when handling any impacted ground

The procedures for implementation of the mitigation measures identified in Section 2, to ensure that the objectives detailed in Section 3 are met, are outlined in Sections 5 to 8. All remediation works are to be overseen by suitably experienced site staff.

Periodic visits will be made by a suitably qualified independent consulting Engineer, to undertake the necessary verification works detailed.

5.0 CAPPING MATERIALS

5.1 Sourcing of Material

The site-won topsoil across the fields (eastern 70% of the site) and natural ground arisings are considered to be suitable for re-use within the development.

Should additional material (topsoil or subsoil) be imported to site for use in gardens and landscaped areas, it should comply with the below guidance.

Any topsoil and subsoil considered for importation should be from a source not expected to be contaminated and meet both physical and chemical criteria as detailed in Sections 5.2 and 5.3. Testing will need to be carried out in accordance with the guidance given in the Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) document "Verification Requirements for Cover Systems", a copy of which can be found in the Appendix.

Prior to importation, certification should be obtained from the supplier detailing the source site, its previous and current land use and relevant test results. A copy of this information should also be forwarded to the Engineer.

If no such information is available, the Engineer will need to visit the source and collect samples which will be submitted for testing to determine the suitability of the material for use within the development. Material which does not hold the relevant certification should not be brought to site.

For imported materials, copies of the carrier's consignment notes should be retained with the documentation detailed in Section 5.4 and a copy forwarded to the Engineer. The soil should be stockpiled separately and away from areas designated for storing other materials or potential sources of contamination. Separate stockpiles should also be created for each different source. All stockpiles should be suitably quarantined and identified as such until deemed suitable for use.

The following soil handling procedures should also be adhered to:

- Topsoil and subsoil should not become mixed;
- Capping should not be laid during or immediately following heavy rain;
- Double handling of material should be avoided;
- Stockpiles of topsoil should be shaped to shed water;
- Topsoil stockpiles should be low and narrow to ensure that the core is within 1 m of the surface; and

- Over tracking by machinery used to place soils should be avoided.

Imported and site-won stockpiles should not be mixed. Site-won stockpiles considered as suitable for reuse in gardens and site won stockpiles considered to be impacted with contaminants must not be mixed.

5.2 Physical Requirements

Topsoil and subsoil should comprise clay or sand and should have a maximum of 65% of fragments in excess of 2 mm, a maximum of 60% in excess of 20 mm, a maximum of 40% in excess of 50 mm and only occasional pieces in excess of 100 mm. This is to be confirmed by visual inspection of the material by the Engineer.

Any material imported for placement in conjunction with the raising of levels across the site should also comply with the requirements of the relevant Earthworks Specification.

Material should be free of fragments of glass and wire or other potentially hazardous foreign material which could cause traumatic injury. Significant quantities of extraneous material such as brick and concrete should also not be present. In addition, all materials should be free from propagules of aggressive weeds and bulk vegetative growth, in order to ensure negligible risk of subsequent weed problems.

5.3 Chemical Requirements

Testing should be carried out for the following general suite of contaminants:

Type of Material	Frequency of Testing	Testing Schedule
Greenfield / Manufactured Soils	Minimum 3 Dependent on source and receptor, between 1 per 50 m^3 and 1 per 250 m^3	Standard metals/metalloids PAHs (16 USEPA speciation) Asbestos pH Soil organic matter/Total organic carbon
Brownfield Soils / Screened Soils	Minimum 6 Dependent on source and receptor, between 1 per 50 m^3 and 1 per 100 m^3	Standard metals/metalloids PAHs (16 USEPA speciation) Asbestos TPH (CWG banded) pH Soil organic matter/Total organic carbon Any additional analysis dependant on the history of the donor site.

The sampling is to be undertaken by a suitably qualified Geo-environmental Engineer and depending on the source or variability of imported material, the Engineer may, at their discretion, request additional testing to be undertaken.

A table of assessment values is included in the Appendix. If any of the assessment values are exceeded, the material shall be considered to be unsuitable unless further testing and risk assessment shows it to be satisfactory.

5.4 Documentation

Each stockpile of imported material should be given a clear reference number and designated sheet recording the following:

- Identification reference (e.g. Stockpile A, B, C etc.);
- Material type (e.g. Topsoil);
- Source site;
- The carrier's consignment note reference numbers;
- The approximate volume (or number of loads); and
- Which plots the material is to be used on and where (i.e. Plot number and landscaped area to the front or rear garden);

Each entry shall be signed and dated by the Site Manager or their assistant. These sheets should be available for inspection by the Engineer, Warranty Inspectors, Local Authority staff and others involved with this development. A copy should also be given to the Engineer when verification visits are made.

6.0 INSTALLATION AND VERIFICATION OF CAPPING

6.1 Capping Installation

If the western 30%'s topsoil and made ground is to be placed below gardens, it will require a 600 mm thick capping, decreasing to 300 mm thick where placed below POS and landscaped areas. The capping should include a minimum 100 mm of clean topsoil. The material below the capping should not exceed 300 mm in thickness.

The installation of the capping should be undertaken by site staff in the following steps:

1. Establish the finished ground levels over gardens or landscaped areas and from this determine the required level of the underside of the capping.
2. Where present ground levels are above the level of the underside of the capping, re-grading of the ground is to be undertaken. This excavated material may be placed in areas where ground levels are to be raised, such as beneath hard-standing or used to raise levels beneath other capped areas (see 3 below). Failing this the material can be removed from site (see 4 below).
3. Where the present ground levels are below the underside of the capping, the ground level may be made up to the underside of the capping using material from 2 (above) or imported material where no suitable fill exists.
4. All arisings should be regarded as contaminated until proven otherwise. If they cannot be used on site, they are to be removed to a licensed waste management facility. The waste is to be taken by a registered waste carrier in accordance with the Waste Management Duty of Care Code of Practice. Copies of all waste transfer notices are to be retained.
5. Check the level of the ground surface to ensure that it is at the correct level for the underside of the capping.
6. Install subsoil.
7. Install private services, where applicable. Where materials from above and below the capping/growing medium are excavated these should be kept separate. Capping materials can be reused but the material below the cap should be placed as detailed in 3 or removed from site following the procedures set out in 4.
8. Place a minimum of 100 mm topsoil.

6.2 Verification of the Capping Installation

Upon completion of the capping, verification pits shall be dug by an independent Engineer to measure the thickness of topsoil and, if used, subsoil. Verification pits shall be dug at a rate of 1 pit per 3 plots, and 1 pit per 300 m^2 of soft landscaping.

Each verification pit and competed garden or landscaped area shall be photographed. The photograph will include reference of depth and location of the pit.

If the capping is deemed to be insufficient, the Site Manager will be informed and advised on how much more material is needed for the capping to be adequate. Verification of capping can only be carried out on areas where the capping has been completed.

A verification report is to be produced by the Engineer, which includes:

- The documentation detailed in Section 5.4;
- The chemical test results for imported subsoil and topsoil;
- Confirmation of the capping thicknesses, including photographs of the verification pits with a scaled marker; and
- Confirmation of the physical suitability of the material.

The submission of verification reports is covered in Section 9.

The growing medium placement does not require verification.

7.0 UNEXPECTED CONTAMINATION

There is the potential for areas of unexpected contamination, as is the case with any site. Any unusual, brightly coloured, oily or odorous material should be considered in this category. Significant amounts of material suspected of containing asbestos should also be included.

If unexpected contamination is found the following procedures should be adhered to:

1. All site works at the position of the suspected contamination should stop, and visual and olfactory observations of the condition of the ground and the extent of contamination should be made. Notification shall be given to an independent consultant and the Local Authority not later than 24 hours after discovery. Should the contamination be likely to affect controlled waters the Environment Agency should also be informed.
2. During the presence of a suitably qualified Engineer, investigation works shall commence to recover samples for testing and, using visual and olfactory observations

of the condition of the ground, accurately delineate the area over which contaminated materials are present.

3. Should the Consultant deem it appropriate, the affected material may be excavated and placed in a stockpile on a suitable impermeable surface. This should be suitably quarantined with no addition to or removal of the stockpile while chemical analysis is being undertaken. Alternatively, the material should remain in-situ until laboratory test results have been obtained.
4. The testing suite will be determined by the Consultant on the basis of visual and olfactory observations.
5. Test results will be compared against current assessment criteria suitable for the future use of the area of the site affected.
6. If after testing the ground is found to be contaminated, the Local Authority shall be informed. After consultation with the Local Authority, and if necessary, the Environment Agency, materials should either be removed for disposal to a licensed waste management facility or remediated to agreed clean-up criteria.

A report will be prepared by the Engineer and submitted to the Local Authority and where groundwater may potentially have been impacted, the Environment Agency.

8.0 COMPLETION DOCUMENTATION

On completion of the verification works the appropriate verification documentation, detailing the works that have been completed in accordance with the agreed Implementation Plan, will be forwarded to the Local Authority and warranty provider.

Should any remediation affecting controlled waters have been required and consequently undertaken, verification documentation will also need to be issued to the Environment Agency for their approval.

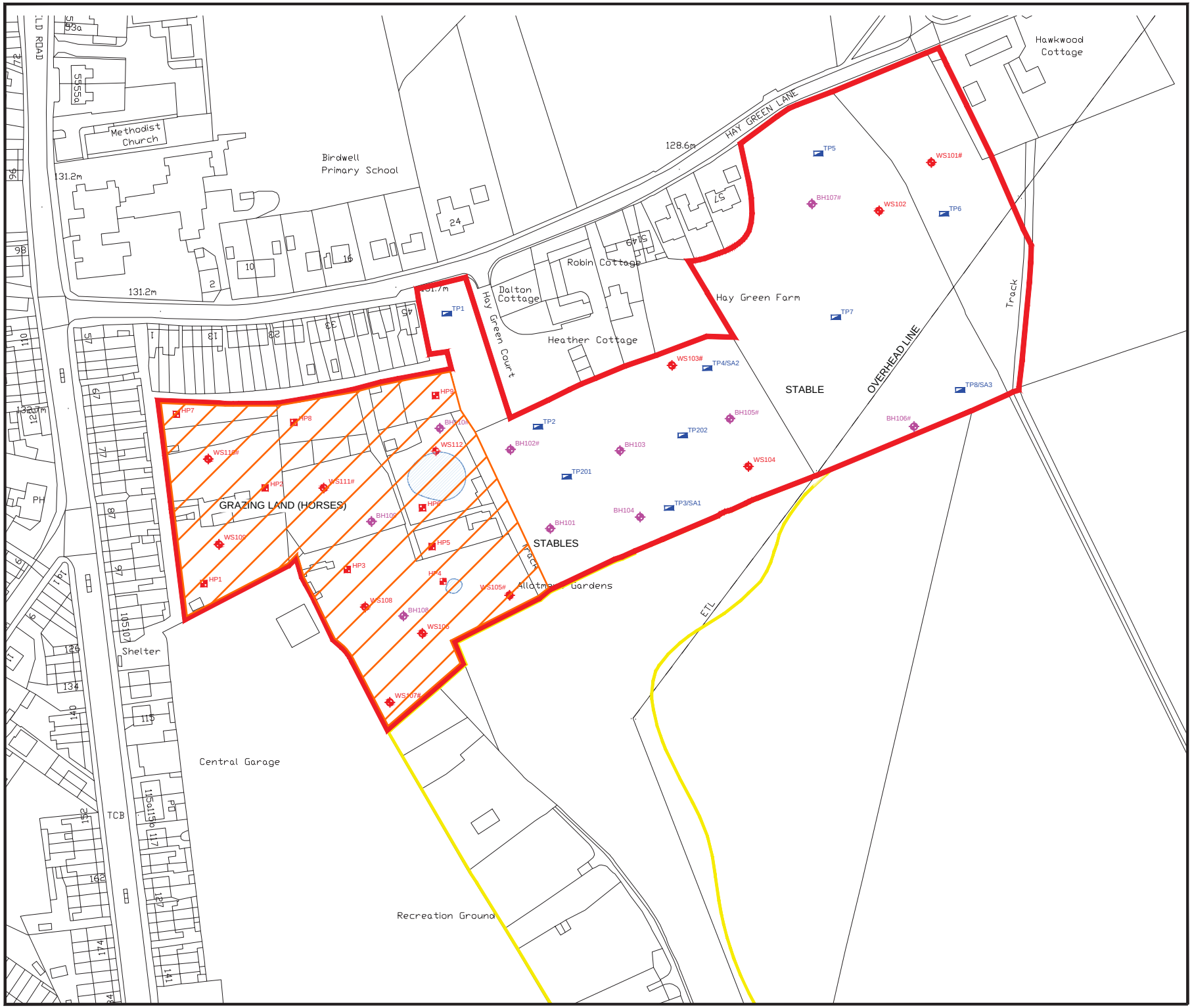
Necessary changes to the agreed Implementation Plan, arising during the course of the works, are to be agreed in writing with the Local Authority and warranty provider prior to being undertaken on site.

APPENDIX

RSK's Exploratory Hole Plan (referenced 350283-R01(00)-FIG4)
(including ECE mark up of approximate extent of unsuitable topsoil)

Yorkshire and Lincolnshire Pollution Advisory Group (YALPAG) document "Verification Requirements for Cover Systems"

Table of Assessment Values – Residential with Home-grown Produce



LEGEND:

- Site boundary
- Asbestos fragments
- Trial pit (SA - Soakaway test)
- Window sample borehole
- Rotary open hole
- Hand dug trial pit
- # Gas well installed
- Approximate extent of potentially unsuitable topsoil

Notes

Base plan from Gladman Development, Drawing No. 001, Dated 17.10.17

REV.	DATE	DESCRIPTION	BY	CHD.	APR.
A	21.08.20	FIRST ISSUE	NP	LA	LA

Dimensions	Projection	Scale	Orig Size
m		1:1500	A3

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CLIENT: HARWORTH GROUP

PROJECT: BIRDWELL

TITLE: EXPLORATORY HOLE PLAN

JOB No.:	DRAWING FILE:
350283	350283-R01(00)-FIG 4

BY:	DATE:	CONTRACT NO.		REV:
HD	21.08.20		FIGURE 4	A

Scale 1 : 1500

0 15 30 45 60 75m











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:

















































































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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.

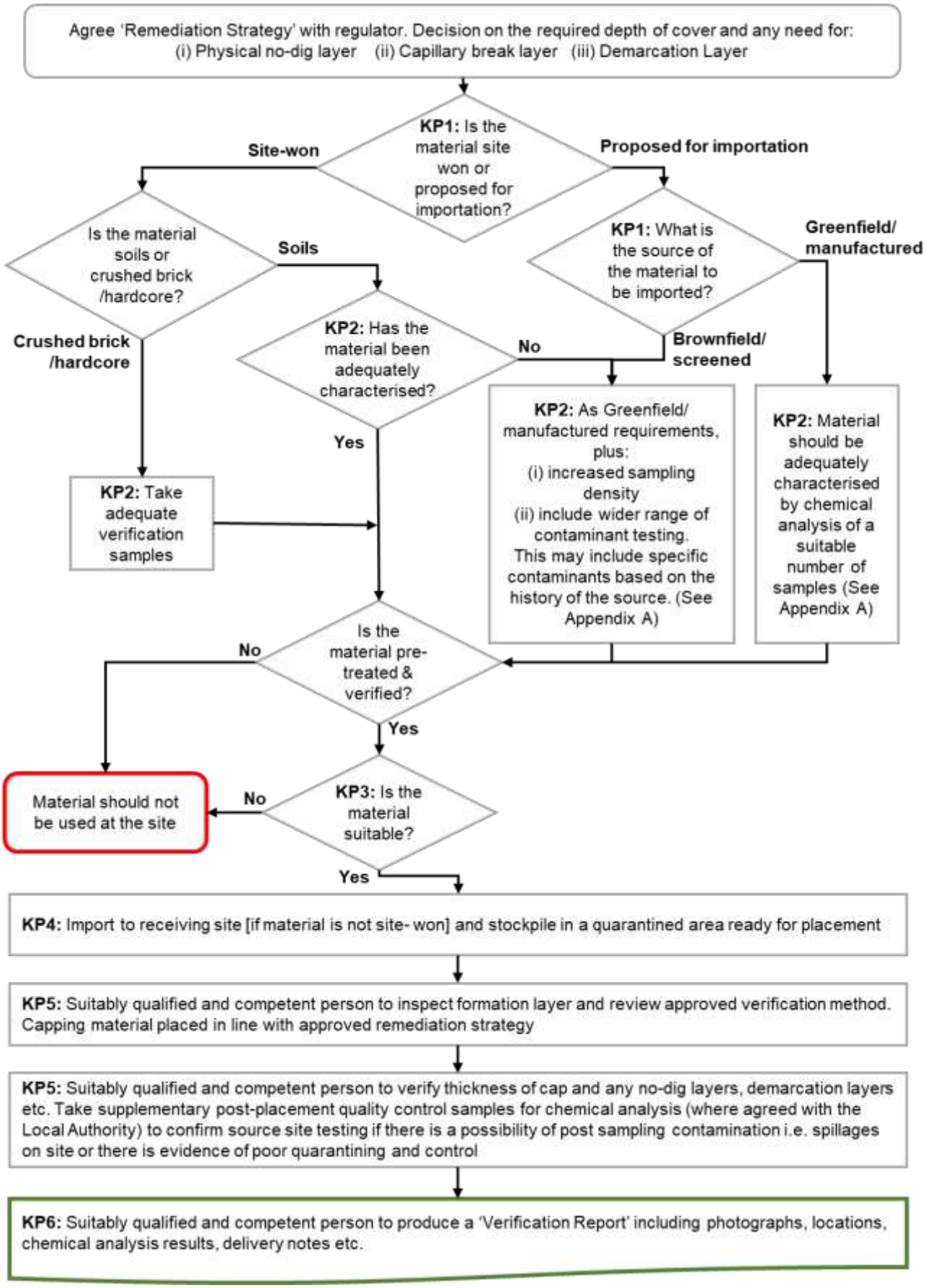
For cover and containment systems, verification will normally depend upon the provision of defensible measurements, observations and records. Critical factors to be considered are:

- 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 500m^3	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	Minimum 3 Dependent on source and receptor, between 1 per 50m^3 and 1 per 250m^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 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).	

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



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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.



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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.



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



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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.



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



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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).



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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



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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.

Inorganic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)
Arsenic	37
Cadmium	11
Chromium (III)	910
Chromium (VI)	6
Lead	200
Mercury	1.2
Nickel	180
Selenium	250
Copper	2400
Zinc	3700

Organic Compounds	Human Health - Residential with Homegrown Produce (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Naphthalene	2.3	5.6	13
Acenaphthene	210	510	1100
Acenaphthylene	170	420	920
Fluorene	170	400	860
Phenanthrene	95	220	440
Anthracene	2400	5400	11000
Fluoranthene	280	560	890
Pyrene	620	1200	2000
Benzo(a)anthracene	7.2	11	13
Chrysene	15	22	27
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(k)fluoranthene	77	93	100
Benzo(a)pyrene	2.2	2.7	3.0
Dibenz(a,h)anthracene	0.24	0.28	0.3
Indeno(1,2,3-cd)pyrene	27	36	41
Benzo(g,h,i)perylene	320	340	350
Benzene	0.087	0.17	0.37
Toluene	130	290	660
Ethylbenzene	47	110	260
o-Xylene	60	140	330
m-Xylene	59	140	320
p-Xylene	56	130	310

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AVANT HOMES

ASSESSMENT CRITERIA – RESIDENTIAL WITH HOMEGROWN PRODUCE

Contaminant	Phytotoxicity			
	pH 5.0 to 5.5	pH 5.5 to 6.0	pH 6.0 to 7.0	pH >7.0
Arsenic	50			
Cadmium	3			
Chromium	400			
Lead	300			
Mercury	1			
Nickel	50	60	75	110
Copper	80	100	135	200
Zinc	200	200	200	300

The assessment concentration for lead is the Category 4 Screening Level produced by Contaminated Land: Applications in Real Environments (CL:AIRE) and outlined in Appendix H of their report SP1010. The others have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. The metals/metalloids are based on a sandy loam soil and 6% soil organic matter. The assessment values are not intended to be applied to individual sample results where materials are similar, as the levels of contaminants will have a natural variability across the site. Instead, the modified mean value should be compared with the assessment concentration.

The assessment values for phytotoxicity are the levels at which plant growth is thought to be affected. They are taken from the maximum permissible and advisable concentrations in soil after application of soil sludge given in the *'The Code of Good Agricultural Practice for the Protection of Soil*', MAFF, 1998.

The assessment of sulphate, water soluble sulphate, elemental sulphur and sulphide is to determine the aggressive nature of the ground with respect to concrete and consequently the results are compared with BRE Special Digest 1:2005 '*Concrete in Aggressive Ground*'.

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ASSESSMENT CRITERIA – RESIDENTIAL WITH HOMEGROWN PRODUCE

TPH Fraction	Intended Land Use Residential (mg/kg)		
	1% SOM	2.5% SOM	6% SOM
Aliphatic EC 5-6	42	78	160
Aliphatic EC >6-8	100	230	530
Aliphatic EC >8-10	27	65	150
Aliphatic EC >10-12	130 (48)[vap]	330 (118)[vap]	760 (283)[vap]
Aliphatic EC >12-16	1100 (24)[sol]	2400 (59)[sol]	4,300 (142)[sol]
Aliphatic EC >16-35	65,000 (8.48)[f,sol]	92,000 (21)[f,sol]	110,000[f]
Aliphatic EC >35-44	65,000 (8.48)[f, sol]	92,000 (21)[f,sol]	110,000[f]
Aromatic EC 5-7	70	140	300
Aromatic EC >7-8	130	290	660
Aromatic EC>8-10	34	83	190
Aromatic EC >10-12	74	180	380
Aromatic EC >12-16	140	330	660
Aromatic EC >16-21	260[f]	540[f]	930[f]
Aromatic EC >21-35	1,100[f]	1,500[f]	1,700[f]
Aromatic EC >35-44	1,100[f]	1,500[f]	1,700[f]

[f] oral, dermal, and inhalation exposure compared with oral HCV

[sol] S4UL presented exceeds the solubility saturation limit, which is presented in brackets

[vap] S4UL presented exceed the vapour saturation limit, which is presented in brackets

The assessment criteria for each of the petroleum hydrocarbon fractions have been taken from Nathanail, C. P., McCaffrey, C., Gillett, A., Ogden, R., and Nathanail, J., 2015, *'The LQM/CIEH S4ULs for Human Health Risk Assessment'*, Land Quality Press, Nottingham. These are also all based on a sandy loam soil.

Within the Environment Agency Science Report P5-080/TR3, Askari, K. & Pollard, S., 2005 *'The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils'* it is stated that the assessment values should not be considered individually; instead the potential additive effects should be calculated. This is achieved by calculating an individual Hazard Quotient (HQ) for each fraction. The HQ is the proportion of the assessment concentration represented by the recorded concentration. The HQs are then added together to form a Hazard Index (HI) and where this exceeds unity a potential significant risk to human health may exist.

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ASSESSMENT CRITERIA – RESIDENTIAL WITH HOMEGROWN PRODUCE



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