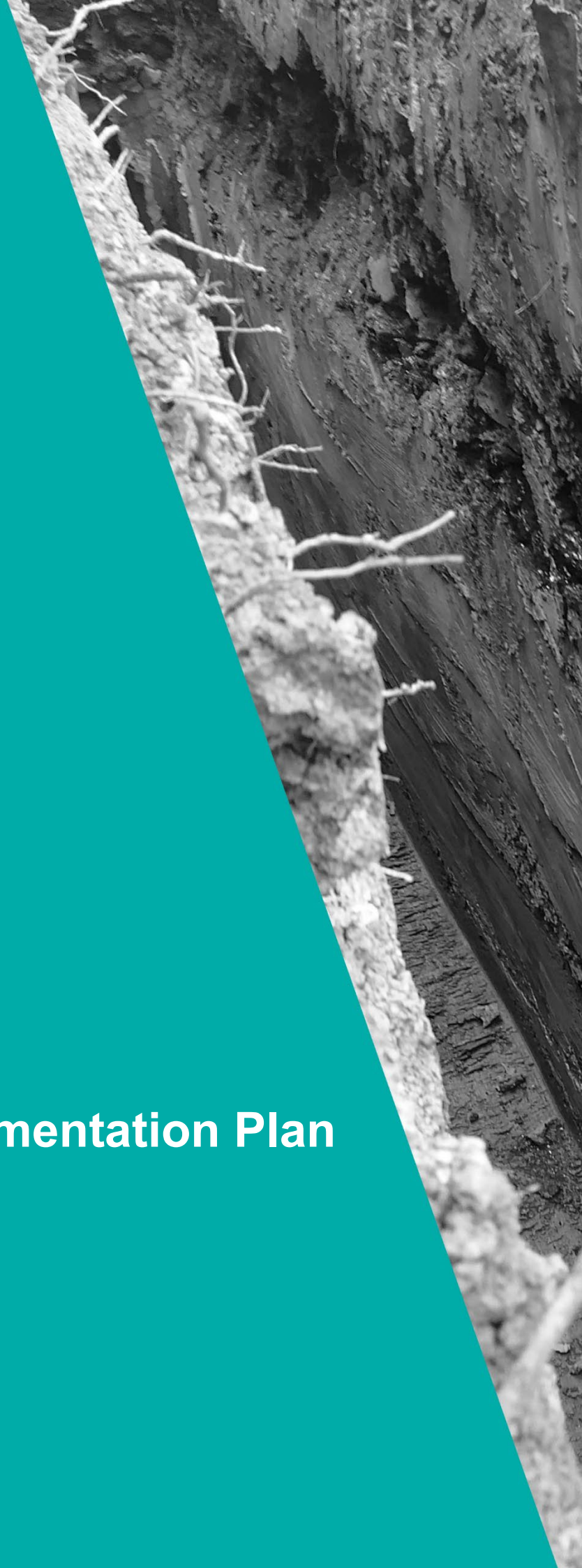
Eastwood
CONSULTING ENGINEERS



Remediation Implementation Plan

Lockwood Road, Goldthorpe

Gleeson Developments Ltd

19 June 2023

Eastwood
CONSULTING ENGINEERS

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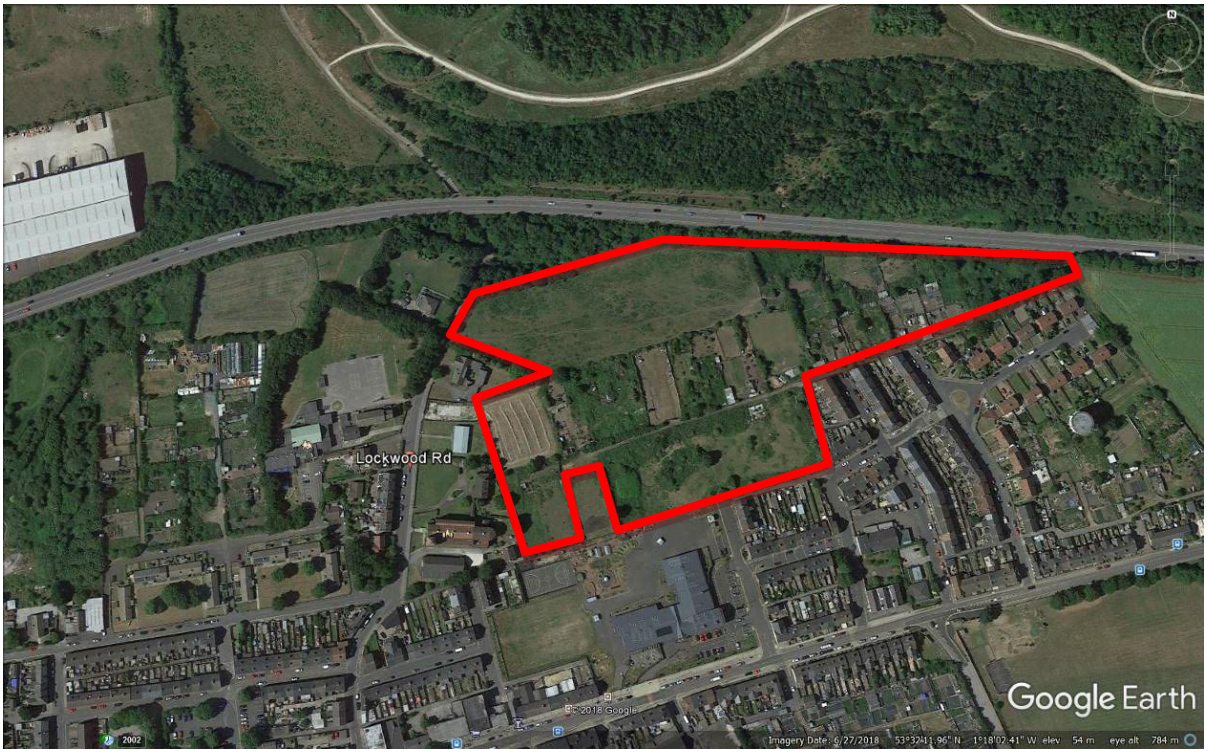
REMEDIATION IMPLEMENTATION PLAN

LOCKWOOD ROAD, GOLDTHORPE

FOR

GLEESON DEVELOPMENTS LTD



44271-004 **19 June 2023**

REMEDIATION IMPLEMENTATION PLAN

LOCKWOOD ROAD, GOLDTHORPE

FOR

GLEESON DEVELOPMENTS LTD

Job No.	:	44271
Report Status	:	Issue 1
Document Date	:	19 June 2023
Approved	:	Kate Edwards

Kate Edwards

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1.0 INTRODUCTION

This Implementation Plan has been produced by Eastwood Consulting Engineers Limited, on behalf of Gleeson Developments Ltd, for the site at Lockwood Road, Goldthorpe. The purpose of this document is to detail the procedure for the implementation and subsequent verification of remedial works to deal with contamination 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

Eastwood Consulting Engineers (as Eastwood & Partners) have undertaken the following reports:

- *Phase 1 Geotechnical and Geo-environmental* (reference 44271-001, dated August 2019)
- *Phase 2 Geotechnical and Geo-environmental Site Investigation* (Issue 2, reference 44271-003, dated 20 May 2021),

These reports are therefore to be read in conjunction with this Implementation Plan.

The Site

The site has an area of 5.3 hectares and is centred on grid reference 446540, 404680.

The site comprises a grassed field to the north and partially overgrown fields in the south used for grazing. The central part of the site is formed by a complex of allotment gardens with associated sheds, outbuildings and caravans. Small localised stockpiles of suspected

asbestos containing roofing materials were noted during the investigation at surface within the allotment area.

A stand of suspected Japanese Knotweed was identified in the southern field during the site walkover. The location of which is shown on the Exploratory Hole Location Plan (Reference 44271/001) in the Appendix. The presence of invasive plant species should be confirmed by a suitably qualified ecologist or invasive plant specialist.

The site was undeveloped until the start of the 20th century when the southern half was used for allotment gardens. Residential development has extended up to the southern boundary of the site and three collieries (Hickleton Main, Highgate, and Goldthorpe Colliery) and an associated brick works are present around 700 m north, west and south of the site. A spoil heap associated with the Hickleton Main Colliery extended up to the northern boundary of the site by around the 1980s, disused by the 1990s.

It is proposed that the site will be developed with low-rise residential properties with private gardens and associated areas of hardstanding. It is assumed that existing ground levels will not alter significantly.

Ground Conditions

During our visits to site in December 2020 and March 2021, trial pits TP01 to TP13, SA1 to Sa4 and TP101 to T111 were excavated. Seven gas and groundwater monitoring wells, BH1 to BH7, were also installed.

Topsoil covers the majority of the site to depths of between 0.2 and 0.4 m.

Below the centre west of the site and the hardstanding where present, made ground comprising either a 100 mm thick concrete slab with a similar thickness of sub-base below or a slightly silty slightly clayey gravelly sand with low cobble content is present to depths of between 0.2 and 0.8 m.

The shallow natural ground typically comprises slightly gravelly silty sand, overlying sandstone from depths of between 1.0 and 2.2 m. An upper band of slightly silty slightly clayey sand was encountered in approximately half of the exploratory hole positions, typically not extending below 1.0 m.

Groundwater was not typically encountered, with the exception of four trial pits in the centre-east of the site where slow ingress was noted at around 2.0 m bgl. The monitoring wells were often noted to be 'wet at base' with only two wells in the second round recording perched water at around 1.0 to 1.4 m depth.

Chemical Testing Assessment

Topsoil

Northern Field

Seven samples of topsoil were tested from across the northern field. No elevated concentrations were recorded in respect to human health or phytotoxicity. No asbestos fibres were recorded.

Central and Southern Areas (current and former allotment gardens)

Thirteen samples of topsoil were recovered from the central and southern areas. Elevated concentrations in respect to human health and phytotoxicity are presented in the following table:

Determinand	Assessment Value (mg/kg) 2.5% SOM*		Range of Concentrations (mg / kg)	Exceedances (mg/kg)		Modified/ Corrected Mean (mg/kg)
	Resi	Phytotoxicity		Resi	Phytotoxicity	
Arsenic	37	50	15 to 44	42 (TP02 at 0.3 m) 44 (TP03 at 0.1 m) 44 (TP105 at 0.2 m) 38 (TP109 at 0.2 m)	-	32.86
Lead	200	300	42 to 470	470 (TP105 at 0.2 m) 300 (TP106 at 0.3 m)	470 (TP105 at 0.2 m)	151
Cadmium	11	3	0.29 to 3.7	-	3.7 (TP106 at 0.3 m)	Outlier
Zinc	3700	300**	100 to 630	-	480 (TP03 at 0.1 m) 630 (TP105 at 0.2 m) 520 (TP106 at 0.3 m) 400 (TP109 at 0.2 m)	393.5
Benzo(b) fluoranthene	3.3	-	<0.1 to 6.2	6.2 (TP01 at 0.2 m)	-	2.37
Benzo(a) pyrene	2.7	-	<0.1 to 5.5	5.5 (TP01 at 0.2 m)	-	1.98
Dibenz(a,h) anthracene	0.28	-	<0.1 to 0.28	0.26 (TP02 at 0.3 m) 0.28 (TP105 at 0.2 m)	-	0.18

The modified mean for arsenic and the three PAH determinants, and the corrected mean for lead, do not exceed the human health assessment value, the original concentrations are not considered to pose a significant risk to human health.

The modified mean for zinc still marginally exceeds the phytotoxic assessment value. The elevated phytotoxic concentration of cadmium of 3.7 mg/kg recorded in TP106 at 0.3 m is indicated to be a statistical outlier.

No other determinants or asbestos fibres were recorded in excess of their relevant assessment criteria.

Stockpiles of suspected asbestos containing cement bound roofing product were noted locally at surface within the allotment area. Any significant visible pieces of asbestos containing material should be handpicked and removed by a specialist contractor prior to clearance of vegetation. Further assessment of the allotment topsoil will be required following removal of the asbestos containing materials prior to determine if the topsoil is suitable for re-use.

Made Ground

Two samples of made ground were tested. One sample (TP110 at 0.4 m) recorded the following elevated concentrations:

Contaminant	Assessment Value (mg/kg)		Elevated Concentration (mg/kg)
	Resi	Phytotoxicity	
Lead	200	300	320
Zinc	-	300	350
Benzo(b)fluoranthene	2.6	-	3.1
Dibenz(a,h)anthracene	0.24	-	0.36

No asbestos fibres were identified in any of the samples of made ground analysed.

Where made ground is to remain below proposed gardens and landscaped areas, a minimum 600 mm thick capping layer, including at least 100 mm clean topsoil, is considered to be required. Alternatively, the made ground could be excavated and placed below hardstanding.

Natural Ground

Twelve samples of natural ground were tested. None of the samples recorded elevated concentrations above their respective human health or phytotoxicity assessment values.

Construction Materials Assessment

DS-1 AC-1 sulphate measures are required for concrete in contact with the natural ground. Where concrete is in contact with made ground, this should be increased to DS-2 AC-2.

The test results will need to be submitted to the water supplier for review.

Radon and Ground Gas

A site specific radon report has been obtained. No radon protective measures are necessary.

Six rounds of gas monitoring have been completed. BH1 recorded one elevated carbon dioxide concentration; plots within 50 m of BH1 should be installed with PCV floors and an underlying ventilated void. This should apply to plots 46 to 54.

The gassing regime for the remainder of the site can be classed as Green or Characteristic Situation 1.

3.0 REMEDIATION OBJECTIVES

The remedial objectives for this site are therefore:

1. To determine if the allotment topsoil is suitable for re-use following the removal of ACM;
2. To ensure that 600 mm of clean inert physically suitable material, including at least 100 mm of topsoil, is present within gardens and areas of soft landscaping where made ground or topsoil with low asbestos fibre content remains;
3. To ensure that a minimum 150 mm high ventilated void is provided in plots 46 to 54;
4. To ensure that appropriate sulphate precautions and water supply pipes are installed*;
5. To ensure invasive weeds are treated appropriately;*

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

7. 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*.

*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.

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 9. 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 SITE CLEARANCE & TOPSOIL ASSESSMENT

Field Area

The northern field area is defined by hedgerows and sections of brick walls. To prevent mixing the field topsoil with the topsoil from the adjacent allotment area, the following methodology is proposed:

1. A suitably qualified Geo-environmental Engineer will visit site and witness the excavation of the topsoil within the field area, paying particular attention to the boundary of the field with the adjacent allotments;

2. The stripped topsoil should be placed in a stockpile and labelled as ‘northern field topsoil’. There should be no mixing of this topsoil with any other site-won materials;

3. Photographs should be taken to record the works.

Allotment Area

Within the allotment area, Gleesons will engage a suitably qualified contractor to remove visible fragments of ACM from the topsoil.

Following this removal, a suitably qualified geo-environmental/geotechnical engineer will visit site, inspect the allotment topsoil for evidence of visible ACM and if no significantly sized fragments are identified, undertake a grid pattern of testing. A suggested 1 sample per 25 by 25 m grid square should be allowed for at this stage, with each sample to be tested for an asbestos screen.

Should any fibres be encountered, additional testing may be required to delineate potential fibre 'hotspots'. Topsoil containing asbestos fibres can be placed in a maximum 300 mm thick layer below a 600 mm thick permeable capping layer in gardens and POS areas. Should a significant fibre content be recorded, an alternative method of placement may be required.

Made Ground

During the excavation of the allotment topsoil, a suitably qualified geo-environmental/geotechnical engineer will visit site to inspect the underside of the topsoil and determine the extent of any made ground. This made ground extent will be recorded on a plan and discussed with Gleesons as to whether the material will remain in place and capped, or excavated and placed below areas of hardstanding.

Should the material require excavation, this work shall be witnessed by a suitably qualified geo-environmental/geotechnical engineer who take a photographic record of the works. A report will be compiled detailing the volume of material excavated and where it has been placed to cut off the pathway between the material and site end users.

6.0 CAPPING MATERIALS

6.1 Sourcing of Material

It is anticipated that the site won topsoil from the field area will be re-used for this development. The natural ground is considered suitable for re-use on site, as long as the material is kept segregated from any made ground. However, subsoil (and potentially topsoil) may also need to be imported to the site.

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 the Sections 6.2 and 6.3. 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: Technical Guidance for Developers, Landowners and Consultants'. A copy is attached 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.

For imported materials, copies of the carrier's consignment notes should be retained with the documentation detailed in Section 6.4 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.

6.2 Physical Requirements

Topsoil and subsoil should comprise clay or sand. Topsoil should have a maximum of 30% of fragments in excess of 2 mm, a maximum of 10% in excess of 20 mm and nothing greater than 50 mm. 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.

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 within the topsoil. Reasonable judgement should be taken with respect to their presence in subsoil. 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.

6.3 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.

6.4 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.

7.0 INSTALLATION AND VERIFICATION OF CAPPING

7.1 Installation

Where made ground is to remain or be placed below gardens and landscaped areas, a minimum 600 mm thick capping, including at least 100 mm of topsoil will be required.

Where no made ground is present, a minimum 100 mm topsoil growing medium is required.

Topsoil with a low asbestos fibre content could be placed in a maximum 300 mm thick layer below a 600 mm thick permeable capping in gardens and landscaped areas.

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

1. Establish the finished ground levels over each garden or landscaped area 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 to accommodate the capping. 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 layer 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 the subsoil, if required.
7. Install private services, where applicable. Where materials from above and below the capping 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.

7.2 Verification of the Capping

Upon completion of the capping, verification pits shall be dug by an independent Engineer in order to measure the thickness of topsoil and subsoil, where present. Verification pits will be dug at a rate of 1 pit per 3 plots.

Verification pits shall be dug by an independent Engineer in order to measure the thickness of the capping.

Each verification pit 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. All gardens and landscaped areas which have had the capping layer completed will be photographed by the Engineer.

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

- The documentation detailed in Section 6.4;
- 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 10.

No verification of the growing medium thickness is considered necessary.

8.0 GAS PROTECTIVE MEASURES

Plots within 50 m of BH1 should be installed with PCV floors and an underlying minimum 150 mm ventilated void. This applies to plots 46 to 54. The foundation schedule stipulates that these plots require a precast concrete floor with an underlying ventilated void. There is therefore no requirement to verify the void height.

The gassing regime for the remainder of the site can be classed as Green or Characteristic Situation 1.

9.0 UNEXPECTED CONTAMINATION FOUND DURING THE COURSE OF THE WORKS

There is the potential for areas of unexpected contamination, as is the case with any ‘Brownfield’ site. Any unusual, brightly coloured, oily or odorous material should be considered

in this category. Significant amounts of material suspected of containing asbestos or potential tanks 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.

10.0 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.

The verification report for the capping will include photographs of the capping materials within validation pits and of the garden and landscaped areas, as well as the pertinent chemical test results.

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

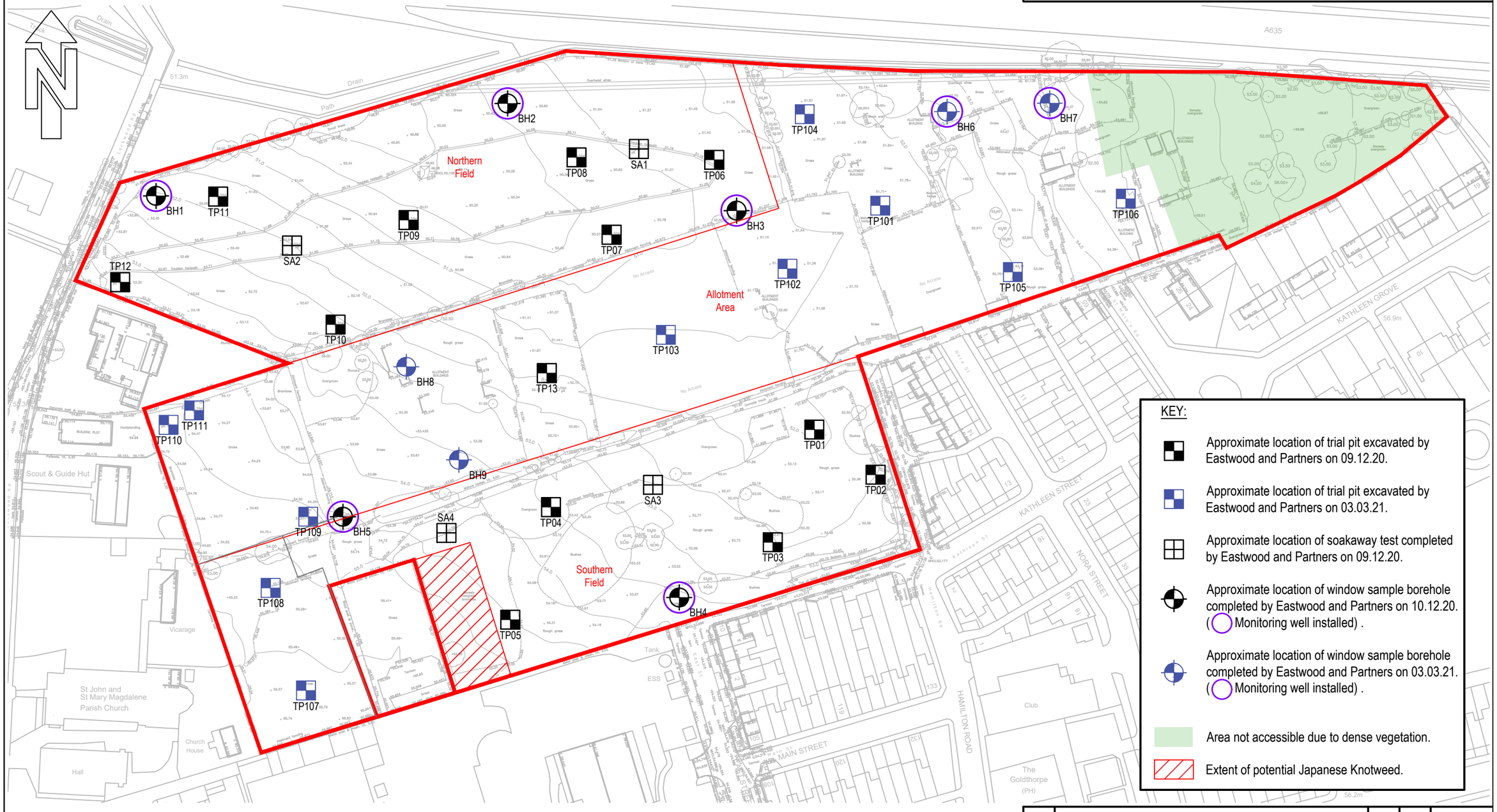
Exploratory Hole Location Plan – Drawing Number 44271/001B

BGS Radon Report (June 2023)

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

Table of Assessment Values

INFORMATION WITHIN THIS DRAWING IS NOT NECESSARILY PRODUCED TO SCALE.
ALWAYS USE FIGURED DIMENSIONS AND CO-ORDINATES - IF IN DOUBT, ASK.



KEY:

- Approximate location of trial pit excavated by Eastwood and Partners on 09.12.20.
- Approximate location of trial pit excavated by Eastwood and Partners on 03.03.21.
- Approximate location of soakaway test completed by Eastwood and Partners on 09.12.20.
- Approximate location of window sample borehole completed by Eastwood and Partners on 10.12.20. (◯ Monitoring well installed) .
- Approximate location of window sample borehole completed by Eastwood and Partners on 03.03.21. (◯ Monitoring well installed) .
- Area not accessible due to dense vegetation.
- Extent of potential Japanese Knotweed.

REV	DESCRIPTION	SIG	CHK	DATE
B	Trial pit positions updated to suit topographical survey.	JL	KE	20.05.21
A	First Issue.			

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GLEESON DEVELOPMENTS LTD

LOCKWOOD ROAD, GOLDTHORPE

EXPLORATORY HOLE LOCATION PLAN

SCALE WHEN PLOTTED AT A3	DRAWING STATUS
1:1250	INFORMATION

DRAWN	CHECKED	DATE	DRAWING NUMBER	REV
JRB	LW	06.04.21	44271/001	B

GeoReports

British Geological Survey

KATE EDWARDS
EASTWOOD & PARTNERS (CONSULTING ENGINEERS) LTD
ST. ANDREWS HOUSE
23 KINGFIELD ROAD
SHEFFIELD
S11 9AS

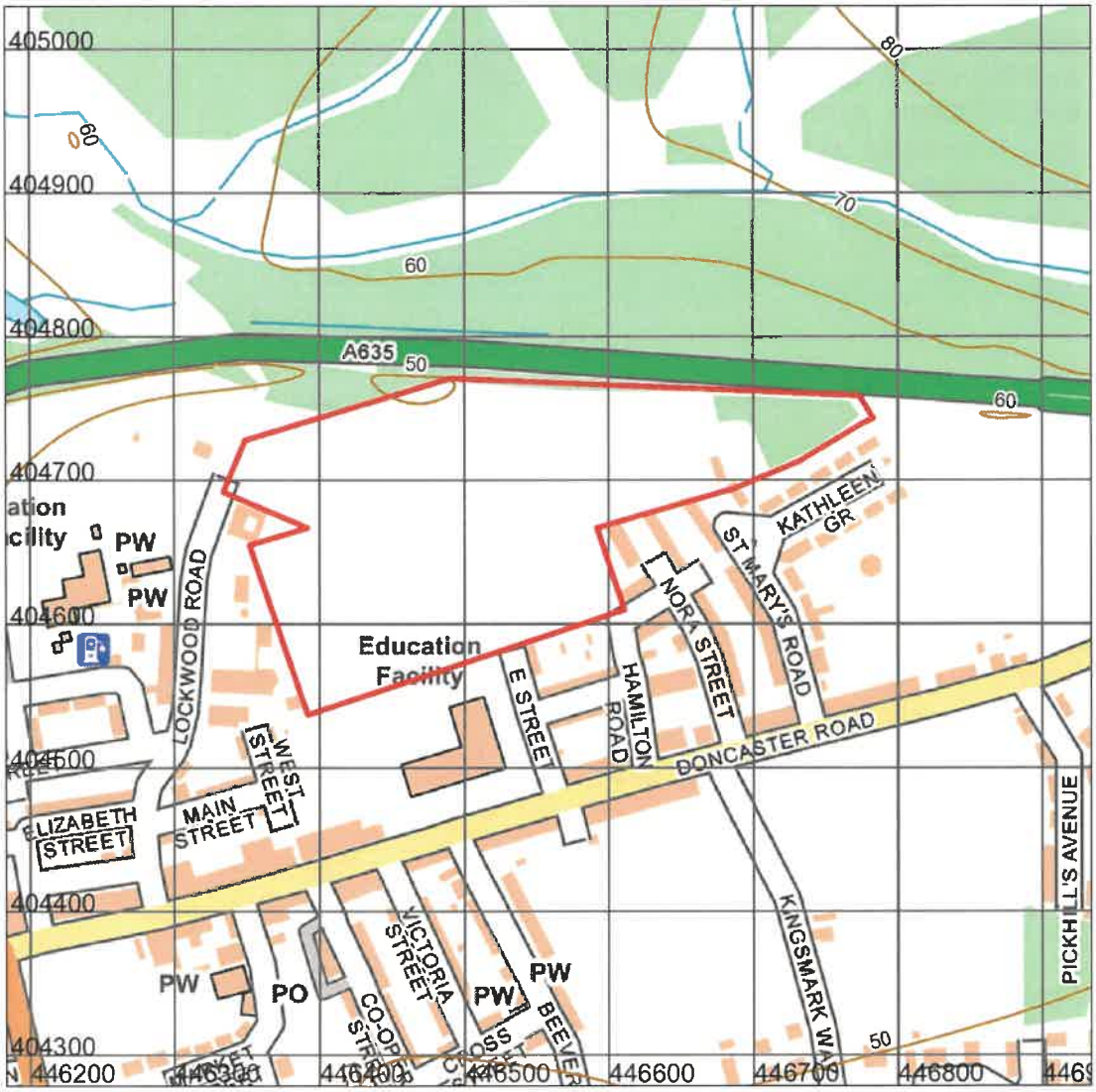
Radon Report

Advisory report on the requirement for radon protective measures in new buildings, conversions and extensions to existing buildings. The report also indicates whether a site is located within a radon Affected Area

Report Id: *BGS_333353/45741*

Client reference: 44271

Search location



Contains OS data © Crown Copyright and database right 2023. OS OpenMap Local: Scale: 1:5 000 (1cm = 50 m)
Search location indicated in red

This report describes a site located at National Grid Reference 446558, 404654. Note that for sites of irregular shape, this point may lie outside the site boundary. Where the client has submitted a site plan the assessment will be based on the area given.

Radon Report: UK

When extensions are made to existing buildings in high radon areas, or new buildings are constructed in these areas, the Building Regulations for England, Wales, Scotland and Northern Ireland require that protective measures are taken against radon entering the building.

This report provides information on whether radon protective measures are required. Depending on the probability of buildings having high radon levels, the Regulations may require either:

1. No protective measures
2. Basic protective measures
3. Full protective measures

This is an advisory report on the requirement for radon protective measures in new buildings, conversions and extensions. The report also indicates whether a site is located within a radon Affected Area

Requirement for radon protective measures

The determination below follows advice in *BR211 Radon: Guidance on protective measures for new buildings (2015 edition), which also provides guidance on what to do if the* result *indicates that protective measures are required.*

Is the property in an area where radon protective measures are required for new buildings or extensions to existing ones as described in publication BR211 (2015 edition) Radon: Guidance on protective measures for new buildings?

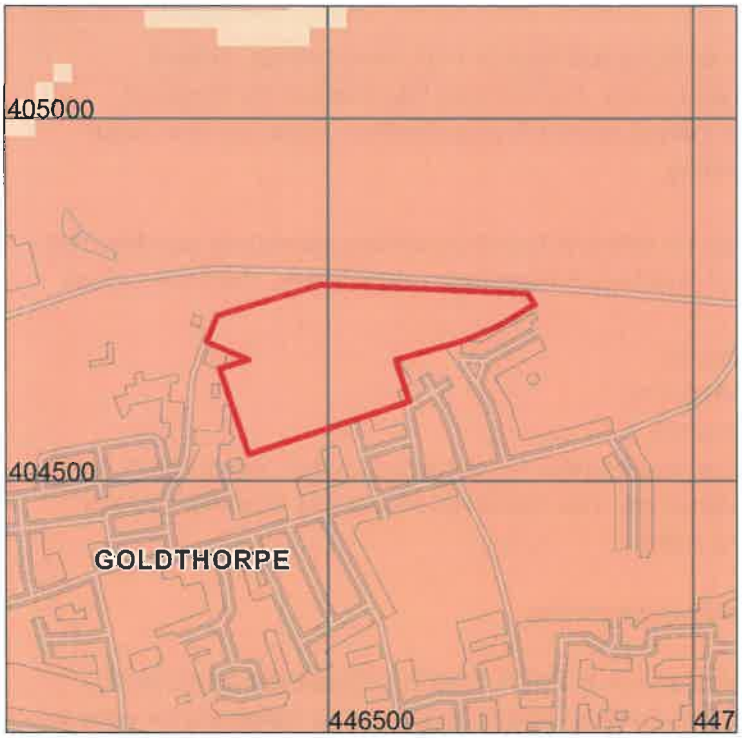
NO RADON PROTECTIVE MEASURES ARE REQUIRED FOR THE REPORT AREA.

More details of the protective measures required are available in *BR211 Radon: Guidance on protective measures for new buildings (2015 Edition)*. Additional information and guidance is available from the Building Research Establishment website (http://www.bre.co.uk/radon/).

Whether or not the radon level in a building is above or below the radon Action Level can only be established by having the building tested. The UKHSA provides a radon testing service which can be accessed at www.ukradon.org or by telephone (01235 822622).

If you require further information or guidance, you should contact your local authority building control officer or approved inspector.

Radon Affected Area



	% Homes estimated to be at or above the action level
	0-1%
	1-3%
	3-5%
	5-10%
	10-30%
	30-100%

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Scale: 1:10 000 (1cm = 100 m)
Search area indicated in red

Is the property in a radon Affected Area as defined by the UK Health Security Agency (UKHSA) and if so what percentage of homes are estimated to be at or above the Action Level? YES

Additional Information

THE PROPERTY IS IN A RADON AFFECTED AREAS WHERE 1 TO 3% OF HOMES ARE ESTIMATED TO BE AT OR ABOVE THE ACTION LEVEL.

The UKHSA recommends a radon 'Action Level' of 200 Becquerels per cubic metre of air (Bq m^{-3}) for the annual average of the radon gas concentration in a home. Where 1% or more of homes are estimated to be at or above the Action Level the area should be regarded as a radon Affected Area.

This report informs you whether the property is in a radon Affected Area and the percentage of homes that are estimated to be at or above the radon Action Level at this location. Being in an Affected Area does not necessarily mean there is a high radon level within the property; the only way to determine the radon level is to carry out a radon measurement.

The UKHSA advises that radon gas should be measured in all properties within radon Affected Areas and that homes with radon levels at or above the Action Level (200 Bq m^{-3}) should be remediated. Householders with levels between the Target Level (100 Bq m^{-3}) and Action Level should seriously consider reducing their radon level, especially if they are at greater risk, such as if they are current or ex smokers. Whether or not a home is in fact above or below the Action Level or Target Level can only be established by having the building tested. The UKHSA provides a validated radon testing service which can be accessed at www.ukradon.org.

The information in this report provides an answer to one of the standard legal enquiries on house purchase in England and Wales, known as Law Society CON29 Enquiries of the Local Authority (2016); 3.14 Radon Gas: Do records indicate that the property is in a "Radon Affected Area" as identified by the UKHSA. The data can also be used to advise house buyers and sellers in Scotland and Northern Ireland.

If you are buying a new build property in a Radon Affected Area, you should ask the builder whether radon protective measures were incorporated in the construction of the property.

If you are buying a currently occupied property in a radon Affected Area, you should ask the present owner whether radon levels have been measured in the property. If they have, ask whether the results were at or above the radon Action Level and if so, whether remedial measures were installed, radon levels were re-tested, and if the results of re-testing confirmed the effectiveness of the measures.

Further information on radon is available from the UKHSA at www.ukradon.org.

What is radon?

Radon is a naturally occurring radioactive gas, which is produced by the radioactive decay of radium which, in turn, is derived from the radioactive decay of uranium. Uranium is found in small quantities in all soils and rocks, although the amount varies from place to place. Radon released from rocks and soils is quickly diluted in the atmosphere. Concentrations in the open air are normally very low and do not present a hazard. Radon that enters enclosed spaces such as some buildings (particularly basements), caves, mines, and tunnels may reach high concentrations in some circumstances. The construction method and degree of ventilation will influence radon levels in individual buildings. A person's exposure to radon will also vary according to how particular buildings and spaces are used.
Inhalation of the radioactive decay products of radon gas increases the chance of developing lung cancer. If individuals are exposed to high concentrations for significant periods of time, there may be cause for concern. In order to limit the risk to individuals, the Government has adopted an Action Level for radon in homes of 200 becquerels per cubic metre (Bq m^{-3}). The Government advises householders that, where the radon level is at or above the Action Level, measures should be taken to reduce the concentration.

Radon in workplaces

The Ionising Radiation Regulations 2017 require employers to take action when radon is present above a defined level in the workplace. Advice may be obtained from your local Health and Safety Executive Area Office or the Environmental Health Department of your local authority. The BRE publishes a guide (BR293)**: Radon in the workplace.** BRE publications may be obtained from the BRE Bookshop, Tel: 01923 664262, email: bookshop@bre.co.ukwebsite: www.brebookshop.com

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- Geological observations and interpretations are made according to the prevailing understanding of the subject at the time. The quality of such observations and interpretations may be affected by the availability of new data, by subsequent advances in knowledge, improved methods of interpretation, and better access to sampling locations.
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- Although samples and records are maintained with all reasonable care, there may be some deterioration in the long term.
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- The topography shown on any map extracts is based on the latest OS mapping and is not necessarily the same as that used in the original compilation of the BGS geological map, and to which the geological linework available at that time was fitted.
- Note that for some sites, the latest available records may be historical in nature, and while every effort is made to place the analysis in a modern geological context, it is possible in some cases that the detailed geology at a site may differ from that described.

Report issued by
BGS Enquiry Service

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.

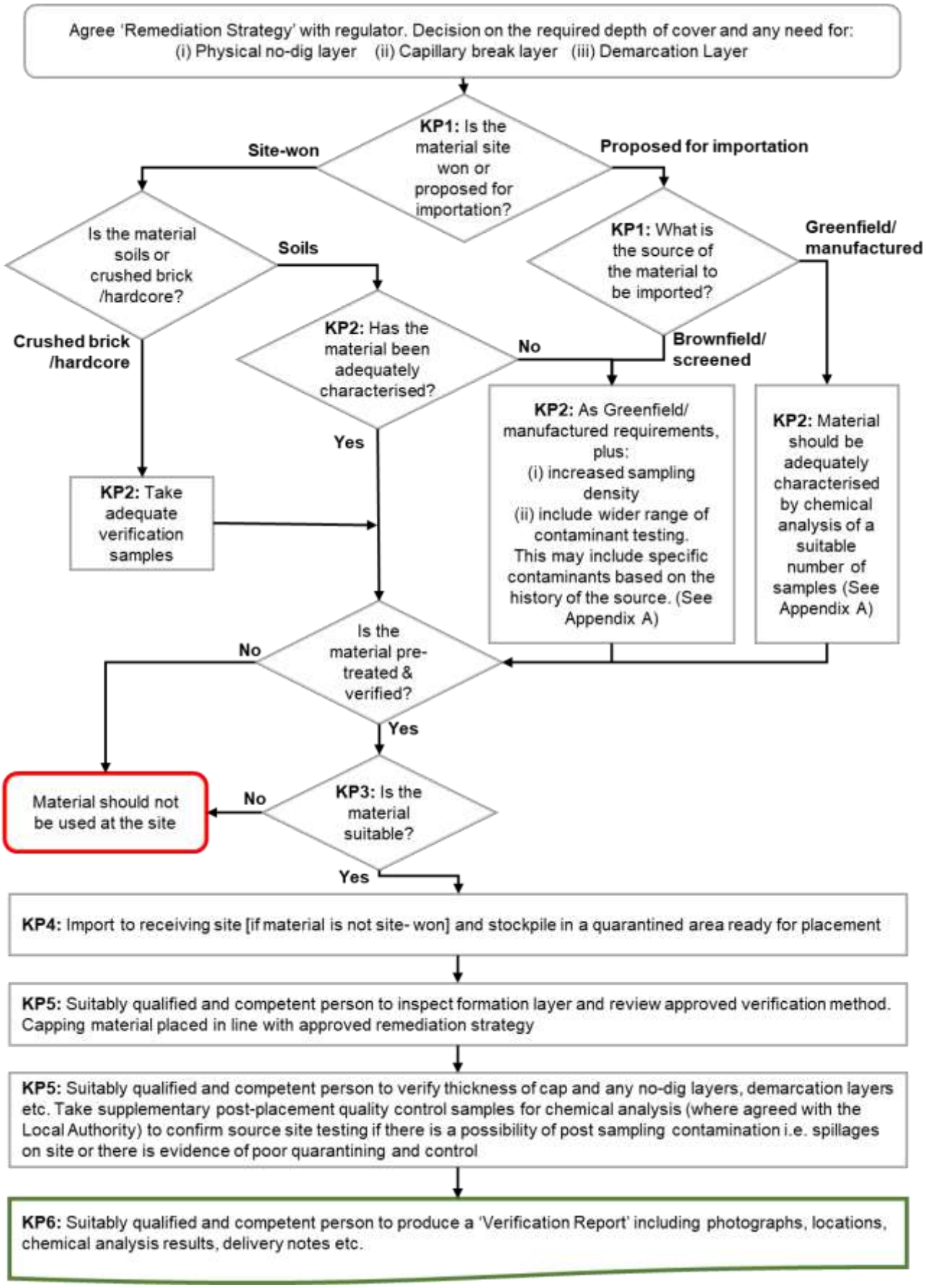
For cover and containment systems, verification will normally depend upon the provision of defensible measurements, observations and records. Critical factors to be considered are:

- 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 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

© 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.

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

Prepared	KB	Checked	KE	Date	19.06.23	Job No	44271

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LOCKWOOD ROAD, GOLDTHORPE

GLEESON DEVELOPMENTS LTD

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*'.

Prepared	KB	Checked	KE	Date	19.06.23	Job No	44271

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LOCKWOOD ROAD, GOLDTHORPE

GLEESON DEVELOPMENTS LTD

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.

Prepared	KB	Checked	KE	Date	19.06.23	Job No	44271

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