

Harworth Estates

J36 Phase 2A, Phase 2B and Phase 3 Rockingham

Remediation Strategy

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RSK GENERAL NOTES

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Title: Remediation Strategy: J36 Phase 2a, Phase 2b and Phase 3 Rockingham

Client: Harworth Estates Investments Limited

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Status: **Final**

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Where field investigations have been carried out, these have been restricted to a level of detail required to achieve the stated objectives of the work.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd.

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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by Harworth Estates (the client) to prepare a remediation strategy (RS) document specific to supporting reuse of materials under CL:AIRE Definition of Waste (DoW) Code of Practice (CoP) arrangements for the proposed redevelopment of land located at the former Rockingham Colliery in Barnsley, South Yorkshire.

A planning application (reference: 2019/1573) for the proposed development was submitted on 17 December 2020 to Barnsley Metropolitan Borough Council (BMBC) with outline planning permission granted on 10 August 2020.

This report is subject to RSK's Service Constraints, a copy of which is included as Appendix A.

1.1 Background

The site is located at Rockingham, Hoyland, South Yorkshire, at National Grid reference 434810, 401210, as shown on Figure 1.

Historical mapping indicates a legacy of mining operations at the site with Phase 3 used as a colliery from at least 1855 and extensive opencast operations carried out across the entire site from the late 1980's. Restoration was completed by 2002 using a combination of backfilling and planting though it is unclear if the backfilling was controlled. The proposed redevelopment work for the site divides it into three development areas termed 'Phases 2A, 2B and 3'. Phase 2A lies to the immediate south of the Dearne Valley Parkway, with Phase 2B located adjacent and further to the south. Phase 3 is located to the north of the Dearne Valley Parkway between two existing commercial developments; Shortwood Business Park to the east, and Rockingham 1 (a Harworth development plot) to the west. The Phase 2 site lies on a hill with the lower elevations to the north and west. The Phase 3 site is predominantly relatively flat with a general slight fall to the north. In the south eastern corner of the eastern site area the ground levels rise toward the adjacent road (A6195

The site is being considered for redevelopment for commercial purposes, comprising several light industrial units with associated roads and infrastructure. A planning application has been submitted to Barnsley Metropolitan Borough Council (BMBC) for the proposed development with a decision due to be made at a planning committee meeting in mid-June 2020. In order to bring the site forward, a scheme of cut/ fill earthworks is required comprising excavation of backfilled spoil and controlled redeposition of the material to meet an engineering specification. The current cut and fill models are included in Appendix B. A copy of the proposed redevelopment layout is included as Appendix C.

Information to compile this remediation strategy has been taken from existing site investigation reports, earthworks specifications and material volumetric information pertaining to the site carried out by RSK and third parties.

1.2 Legislation

Environmental Protection Act 1990 (EPA) – Part IIa

The regime for contaminated land is set out in Part IIA (ss.78A-78YC) of the Environmental Protection Act 1990 (EPA), as inserted by S.57 of The Environment Act 1995 and came into effect in England on 1st April 2000 as The Contaminated Land (England) Regulations 2000 (SI 2000/227). These regulations were subsequently revoked with the provision of The Contaminated Land (England) Regulations 2006 (SI 2006/1380), which consolidated the previous regulations and amendments. Subsequently, these were amended in April 2012 and new statutory guidance issued at the same time. They also provide for land which is contaminated as a result of radioactive substances to be designated as special sites, and for appeals against remediation notices to be heard by the Secretary of State. These regulations came into force on 4th August 2006. The Radioactive Contaminated Land (Modification of Enactments) (England) Regulations 2006 (SI 2006/1379), (subsequently updated and amended in 2018) modified the wording of the EPA 1990 to extend controls on contaminated land to radioactive contaminated land. These were As a result, contaminated land, under Part IIA of the EPA Section 78A(2), is defined as "land which appears… to be in such a condition, by reason of substances in, on or under the land, that:

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

(b) "pollution of controlled waters is being, or is likely to be, caused".

"Significant harm" is defined in the Guidance on risk-based criteria and must be the result of a significant "pollutant linkage". The presence of a pollutant linkage relies on the Source-Pathway-Receptor concept, where all three factors must be present and potentially or actually linked for a potential risk to exist. An initial assessment of pollutant linkage can be made qualitatively (i.e. through identifying these factors).

Local Authorities have a duty to assess all land in their areas and identify any sites that may be considered to be contaminated under Part IIA. If there is a proven pollutant linkage, then the Local Authority may issue a Determination Notice (and ultimately a Remediation Notice) requiring the site to be cleaned up to the extent necessary to remove the pollutant linkage.

1.3 Objective

The objective of this RS document is to clearly set out that the material reuse proposals for the site will be compliant with the requirements of the CL:AIRE DoW CoP.

1.4 Previous reports

Information in the following documents containing pertinent information relating to the site have been reviewed in support of production of this remediation strategy:

- RSK Report Reference 321393 – R1 (01), dated July 2013: Rockingham, South Yorkshire: Appraisal of Ground Conditions and Coal Mining Review

- RSK Report Reference 321393 – R5 (00), dated June 2014: Rockingham, South Yorkshire: Appraisal of Wentworth Estates Land
- RSK Report Reference 321393 – R3 (01), dated April 2015: Geo-environmental Site Assessment: Rockingham 2 East
- RSK Report Reference 321393 – R4 (01), dated April 2015: Geo-environmental Site Assessment: Rockingham 3
- RSK Report Reference 321393 – R6 (01), dated April 2015: Geo-environmental Site Assessment: Rockingham 2 West
- RSK Report Reference 322494-R1 (00), dated February 2019; Preliminary Risk Assessment and Coal Mining Risk Assessment: J36 Phase 2, Rockingham.
- Phase 2 Geo-environmental and Geotechnical Site Investigation: J36 Phase 2 and Phase 3, Rockingham Report no. 322638-R02 (00)
- JPG report reference 4652-JPG-XX-XX-SP-G-0401-S1-P01, dated April 2020 version P01: Site Specification – Earthworks, Phase 2 Rockingham
- JPG report reference 4652-2-JPG-XX-XX-SP-G-0402-S1-P01, dated April 2020 version P01: Site Specification – Earthworks, Phase 2 Rockingham
- JPG drawing reference: 4652-2-JPG-SW-00-DR-C-1200-S4-P07_Proposed_Earthwork_Levels
- JPG drawing reference: 4652-2-JPG-SW-00-DR-C-1201-S4-P08_Cut_Fill_Analysis
- JPG drawing reference: 4652-2-JPG-SW-00-DR-C-1202-S4-P04_Phase_3_Proposed_Earthwork_Levels
- JPG drawing reference: 4652-2-JPG-SW-00-DR-C-1203-S4-P06_Phase_3_Cut_Fill_Analysis
- JPG drawing reference: 4652-2-JPG-SW-00-DR-C-1212-S4-P01_Topsoil_Strategy

The data from the above documents are considered in detail in Section 2.

1.5 Limitations

This RS has been produced specifically to support reuse of material under the CL:AIRE DoW COP and is presented to a level of detail considered sufficient for this purpose. Whilst it is considered sufficient for this purpose the report on its own does not present a remedial design or specification to the level of detail that will be required for contractual negotiations, quantity surveying, or remediation tendering purposes. The RS can be relied upon for those areas of the site where ground investigation data has been provided. Extrapolation of data to cover areas where no data are available has not been adopted.

It is possible that the RS may require refinement as and when additional information becomes available and this can be done once new data are available. A revised document (if required) will be produced based on the site data already available and any subsequent revisions or new data including:

- information obtained as part of supplementary investigation

- revision of existing cut and fill plans and volumetric calculations
- details of proposed foundation design with limits of excavations proposed for foundations, storm tanks, drainage, etc.

2 SUMMARY OF CONCEPTUAL MODEL AND RISK ASSESSMENT

2.1 Introduction

This section provides a review of existing information for the site contained within the documents listed in Section 1.4 lists the reports pertaining to previous works undertaken at the site that have been provided to RSK for review. A conceptual site model (CSM) was developed and refined during earlier phases of investigation undertaken by RSK

2.2 Conceptual site model

This section summarises the CSM as developed and refined during preceding site investigation and risk assessment stages of work undertaken by RSK. The CSM is a key tool to enable linkages between contaminant sources, pathways, and receptors to be assessed in accordance with the EA publication the Model Procedures for the Management of Land Contamination (CLR11[(1)]). Exploratory locations targeted as part of previous investigations at the site are presented on Figure 2.

2.2.1 Geology and groundwater

2.2.1.1 Made ground

The made ground generally comprised a cohesive soil with a significant proportion of granular material (gravel, cobbles and boulders) within the matrix. In the existing grassed areas of the site (see Figure 2), a surface layer of organic made ground (similar to topsoil) acting as a growing media was present between 0.10m and 0.55m thick This layer exhibited properties resembling that of topsoil in terms of appearance and structure and should be considered as a soft compressible layer across the site surface. Below this a second distinct layer of made ground was present ranging between 0.80m and 69m in thickness, with the latter extent found in RBH405, located in an area of deep opencast extraction albeit in a higher areas of the site where topographical levels had been raised as part of the historical restoration works. The made ground largely comprised reworked natural materials including mudstone, sandstone, siltstone with occasional coal fragments typically representative of colliery-type spoil backfill often found at former opencast mining sites. Other materials encountered included rare brick fragments and burnt shale, which are consistent with the former use of the site as a colliery.

2.2.1.2 Superficial soils

Superficial soils were not encountered during previous investigations and this is largely due to the likelihood that these soils were removed to access the underlying coal measures as part of historical mining operations at the site.

2.2.1.3 *Bedrock*

This stratum comprised an interbedded series of dark brown to dark grey mudstones, siltstones and sandstones with coal seams (usually weathered at the upper surface) of the Pennine Middle Coal Measures (PMCM) and was encountered at a depth of between 1.5m and 69m below ground level.

2.2.1.4 *Groundwater encountered during intrusive works*

Where water entries occurred, these were generally recorded as sporadic seepages within the made ground, possibly representing perched water moving through interconnected pathways between more granular horizons of the made ground. Deeper water strikes were also recorded and are thought to represent perched water at the interface between the made ground and bedrock at the base of the former open cast pit. Given the largely unsurfaced nature of the site it is not considered surprising that pockets of perched water are present.

2.2.1.5 *Groundwater encountered during monitoring*

The most recent monitoring undertaken as part of RSK's 2019 recorded groundwater at elevations between 91.64m AOD (above ordnance datum) and 101.82m AOD in the west of the site within the larger former opencast pit in the Phase 3 area, and between 141.59m AOD and 151.16m AOD within the shallower eastern pit in the Phase 2B area.

For context, the ground levels across the site range from ~119m AOD in the far north to ~148m AOD in the south (western pit) to ~138m AOD in the north to ~160m AOD in the south for the eastern pit.

Response zones of the groundwater monitoring wells installed in WS102-105 generally targeted the deeper part of the made ground present above the interface with the underlying bedrock. Follow-on monitoring generally recorded the wells as 'dry' at some point during the monitoring period apart from WS102 where water levels were consistently recorded around 3.0m bgl. Where water was measured in the other wells this was typically <0.1m from the base of the well. RSK considers it likely that the shallow groundwater regime at the site comprises perched water at the interface of the made ground and the underlying bedrock.

2.2.1.6 *Hydrogeology and Hydrology*

The bedrock underlying the site is classified as a secondary A aquifer. However, there are no licensed groundwater abstractions within 1km of the site. Several linear surface water features are shown on the eastern site area in the environmental database report reviewed as part of the 2019 PRA, but these do not connect to any other features. The stream on the western site area connects to the pond off-site to the south, though no further connection from this is shown. The nearest named surface water course is Blacker Dyke around 1km to the north.

2.2.1.7 *Contamination observations*

No visual or olfactory evidence of contamination was identified within made ground deposits aside from a fragment of timber noted to exhibit a 'creosote odour' in TP525

located in the area of Plot 5 in Phase 2A. No visual and/ or olfactory evidence of contamination was identified in any of the other exploratory holes.

No visual evidence of asbestos was encountered.

There was an absence of visual or olfactory evidence of contamination in groundwater during monitoring well development.

2.2.2 Pollutant linkages

Potentially complete pollutant linkages that were identified following RSK's 2019 intrusive investigation works were assessed by risk assessment. Visual or olfactory evidence of contamination was limited to a single observation of treated timber fragment with a potential creosote odour with no other evidence of contamination encountered during the intrusive investigation works. Ground conditions and groundwater encountered were as anticipated from the CSM and potential risks to controlled water receptors were considered to be acceptable based on the absence of a continuous groundwater body (i.e. pathway), the general absence of a significant contamination (i.e. source) and the relative low sensitivity of the water environment. Therefore, risks to human health from direct contact with contaminants and controlled water risks continued to be identified as incomplete linkages therefore did not require risk assessment with the following two pollutant linkages identified as the only linkages requiring assessment:

1. **moderate/low risk** - permeation of water supply pipes by contaminants in soils and subsequent ingestion by workers in the proposed on-site commercial buildings
2. **moderate risk -** vertical and lateral migration of ground gas into enclosed spaces which would affect future workers on-site (and possibly workers/residents on could potentially pose asphyxiation and/or explosion risks to occupants of future site buildings.

2.3 Quantitative risk assessment

This section summarises the stages of quantitative risk assessment presented in the RSK 2019 SI report.

2.3.1 Linkage 1 - human health – permeation of water supply pipes by contaminants in soils and subsequent ingestion by workers in the proposed on-site commercial buildings.

For initial assessment purposes, the results of RSK's 2020 report were compared with GAC specific for this linkage, which are reproduced from UKWIR Report 10/WM/03/21. Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites (UKWIR, 2010). The results indicated that a relevant linkage is unlikely to exist associated with organic contaminants and therefore pollutant polyethylene (PE) and/or polyvinyl chloride (PVC) water supply pipes are expected to be suitable for use on the development.

2.3.2 Linkage 2 - human health - vertical and lateral migration of ground gas into enclosed spaces which would affect future workers on-site (and possibly workers/residents on adjacent sites)

Between 2019 and 2020, 1-3 gas monitoring visits were completed at 29 monitoring wells installed at the site. A maximum methane concentration of 1.7% v/v was recorded in BH516 with concentrations in all other wells reported at or below the instrument detection limit of 0.1% v/v. Detectable carbon dioxide concentrations were recorded in all monitoring wells with the exception of BH520 with concentrations ranging from 0.1% v/v to 24.6% v/v (BH506). A maximum flow rate of 1.8l/hr was recorded in BH302.

RSK calculated gas screening values (GSV) in accordance with CIRIA publication C665(3). Maximum GSVs for carbon dioxide and methane were calculated as 0.44 and 0.02 l/hr, respectively. Based on this the gas regime underlying the site was provisionally assigned as characteristic situation 2 gas under CIRIA C655 guidance meaning low basic gas protection measures are required in the proposed buildings.

On this basis, potential risks associated with the pollutant linkage can be adequately mitigated by incorporation of gas protection measures within the design of the built development rather than requiring source removal which would potentially affect material reuse suitability and options under an MMP. Notwithstanding this, materials proposed for placement under or near to structures should no contain quantities of degradable and/ or putrescible material capable of generating significant concentrations of hazardous ground gases.

2.4 Assessment of laboratory results

Chemical data for 78 samples collected at the site by RSK between 2013 and 2020, as presented in the reports listed in Section 1.4, were assessed against RSK's GAC designed to be protective of human health under a commercial end-use. All of the chemical concentrations were compliant when assessed against the GAC.

Potential risks to controlled water receptors from reused materials are considered to be at acceptable levels based on the absence of a continuous groundwater body (i.e. pathway) and the general absence of a significant contamination (i.e. source).

Based solely on the chemical quality of material, it is considered unlikely that there will be any restrictions for reusing excavated soils under an MMP. However, it is recognised that the site has a history of mining therefore the potential exists that areas of previously undisclosed contamination may be encountered during bulk earthworks. In respect of this and in accordance with the CL:AIRE DoW CoP, the site has been classified as 'Route A (land affected by contamination or suspected of being affected by contamination)' and this remediation strategy has been prepared in support of reuse of materials under this route.

3 REMEDIAL AND DEVELOPMENT OBJECTIVES

3.1 Remedial objectives

The objective of the remedial works is to support compliant reuse of materials at the site under the CLAIRE DoW CoP to render the site suitable for commercial end-use. The following remedial objectives are considered in formulating this strategy:

- comply with regulatory environmental protection requirements
- reduce to acceptable levels the potential risks that are associated with contaminants by either removing the source from the site or breaking the pathway that links the source to the receptor
- limit the removal of soil from site for disposal to that necessary to achieve required development levels – Government policy is to encourage sustainable methods of remediation.

3.2 Development objectives

The following development objectives are considered in formulating this strategy:

- economy of development by maximising use of development form (e.g. hard surfacing, building construction) in arriving at a remedial solution
- minimise delay to development programme
- minimise long-term maintenance requirements.

4 REMEDIATION STRATEGY

4.1 Introduction

The general principles underpinning the proposed remediation are presented in the following section. As discussed earlier, specific remedial actions to break potentially complete pollutant linkages associated with material reuse have not been identified at the site rather a remediation strategy is required due to the site being classified as 'Route A' (land affected by contamination or suspected of being affected by contamination) in accordance with the CL:AIRE DoW CoP. Therefore, the objective of the remediation strategy detailed in this section is to set out the steps to be followed to support compliant reuse of materials in the event areas of previously undisclosed contamination are encountered during earthworks.

4.2 Primary and secondary source removal

With the exception of a single instance where treated timber with a potential creosote odour was encountered in TP525 at 4.10m bgl in the central area of Phase 2A, primary sources of contamination (e.g. buried tanks, chemical drums etc.) requiring removal have not been identified at the site. Should primary sources of contamination be encountered during the redevelopment earthworks the source should be removed and disposed from site by an appropriate method and, if required, by a suitably qualified contractor. An environmental specialist shall undertake assessment of the chemical status of the surrounding soils.

Evidence of secondary sources of contamination in soil and groundwater were not recorded during the various phases on investigation. Should visual and/or olfactory evidence of secondary sources of contamination be encountered in further areas during earthworks then the contamination shall be assessed by an environmental specialist and, if necessary, samples of the impacted materials submitted for chemical analysis. In addition to this, all material streams proposed for reuse at the site will be subject to a physical inspection and chemical testing programme (as detailed in Section 4.6) to demonstrate chemical suitability for reuse. It is possible that chemical testing may identify contaminated materials. Reuse of contaminated materials under an MMP may still be possible; however, it will need to be robustly demonstrated that contaminated materials do not pose an unacceptable risk to receptors when placed in their final location on site. Dependent on the results of chemical testing and assessment it may be necessary to remove contaminated soils from the site that do not meet suitability for reuse criteria. Removal of any unanticipated sources of contamination will be documented and form part of the verification report.

In the event that removal of any unanticipated primary sources or significant secondary sources of contamination is required, the local authority shall be notified and details of the proposed methodology for dealing with the identified contaminant sources provided for comment.

4.3 Asbestos containing materials

Asbestos either visible or at microscopic level has not been identified at the site and this includes laboratory asbestos screening of ten samples. In the event visible asbestos fragments are encountered during earthworks, work in this area will be suspended, and the advice of an environmental consultant and/ or asbestos specialist sought. Further investigation may be required to delineate the extent of any asbestos should this be encountered. Where excavated materials potentially impacted by asbestos are proposed for reuse these should be stockpiled separately pending inspection by an asbestos specialist so any visible asbestos can be removed as far as is reasonably practicable prior to re-use on site. Any visible ACM that is removed will require disposal off-site under waste Duty of Care (DoC) arrangements.

On completion of the project the majority of the built development will comprise of hard cover materials or buildings. Where present, these will be sufficient to provide an engineered break in the contaminant linkage thus protecting end-users of the site from inhalation of asbestos fibres. Where landscaping is proposed, potential risks associated with asbestos may be mitigated by placing asbestos-impacted materials at a depth greater than >300mm below the surface.

4.4 Re-use of material

Re-use of materials will be undertaken in accordance with the provision of an approved materials management plan (MMP). Information on the cut/ fill drawings produced by JPG as listed in Section 1.4 and provided as Appendix B indicate the below material mass balance for the site. Topsoil volumes are independent of the cut/fill volumes and have been derived from the JPG Topsoil Strategy Plan as included as Appendix B based on the total strip volumes for the site.

4.4.1 Phase 2

- 332,520m^3 of cut and 324,957m^3 of fill is proposed, with a net surplus material of 7,563m^3. A 5% bulking factor has been allowed in the volumetric calculations
- the projected total volume of topsoil on-site is approximately 72,817m^3. Based on current proposals there is a requirement to retain 9,888m^3 within future landscaping, and therefore, an excess of approximately 62,929m^3 may be generated and require removal from site.

4.4.2 Phase 3

- 112,674m^3 of cut and 112,157m^3 of fill is proposed, with a net surplus material of 517m^3. A 5% bulking factor has been allowed in the volumetric calculations
- the projected total volume of topsoil on-site is approximately 27,668m^3. Based on current proposals there is a requirement to retain 2,387m^3 within future landscaping, and therefore, an excess of approximately 25,281m^3 may be generated and require removal from site.

4.5 Offsite disposal

It is possible that excess soils or soils unsuitable to remain on site will be generated during the development. Where this occurs, chemical testing to inform waste classification of the material may be undertaken although chemical test data is already available from the previous site investigations may be sufficient for this purpose.

Waste soils will be taken to an appropriately licensed treatment or disposal facility and transported by an appropriately licensed carrier. Duty of care information to demonstrate this will be collected and maintained on site for inspection.

4.6 Requirements for remediation/ material reuse verification

Soft landscaping areas shall comprise a 150mm minimum thickness of topsoil, overlying up to 150mm of subsoil. All materials present within 300mm of the final finish level in soft landscaping area shall be tested and certified as chemically clean and suitable for the intended end-use.

The subsoil element of the cover may comprise either undisturbed in situ soil or stockpiled soil reused under the MMP subject to an appropriate testing scope and frequency to confirm chemical suitably of the material. It may be possible for made ground (either stockpiled or undisturbed in situ) to be present/ reused within 300mm of the surface in soft landscaping areas; however, where this is proposed made ground will be subject to a robust testing and assessment programme in order to demonstrate that the material does not pose an unacceptable risk to end users.

Any materials (either site-derived or imported) proposed for reuse within 300mm of the surface in soft landscaping areas will be assessed for compliance against RSK's Generic Assessment Criteria (GAC) protective of Human Health for a commercial end-use scenario (provided as Appendix B).

4.7 General fill

The potential presence of volatile contaminants or leachate risks to controlled water receptors was not disclosed during previous investigations therefore further chemical testing of materials to support reuse as general fill at the site is not anticipated at this stage. This approach may require revision should previously undisclosed evidence of contamination be encountered during the development works. Therefore it is considered that verification of general fill will in the first instance be carried out via visual inspection by an environmental consultant to assess chemical quality and, where material is proposed for reuse as general fill below buildings, confirmation that organic (e.g. peat) and/ or degradable (e.g. timber) materials are not present at quantities capable of generating significant volumes of hazardous ground gases. In addition, where made ground is proposed for reuse as general fill, if visible ACM is suspected or confirmed by laboratory analysis it will be necessary to remove the ACM prior to reuse of the material.

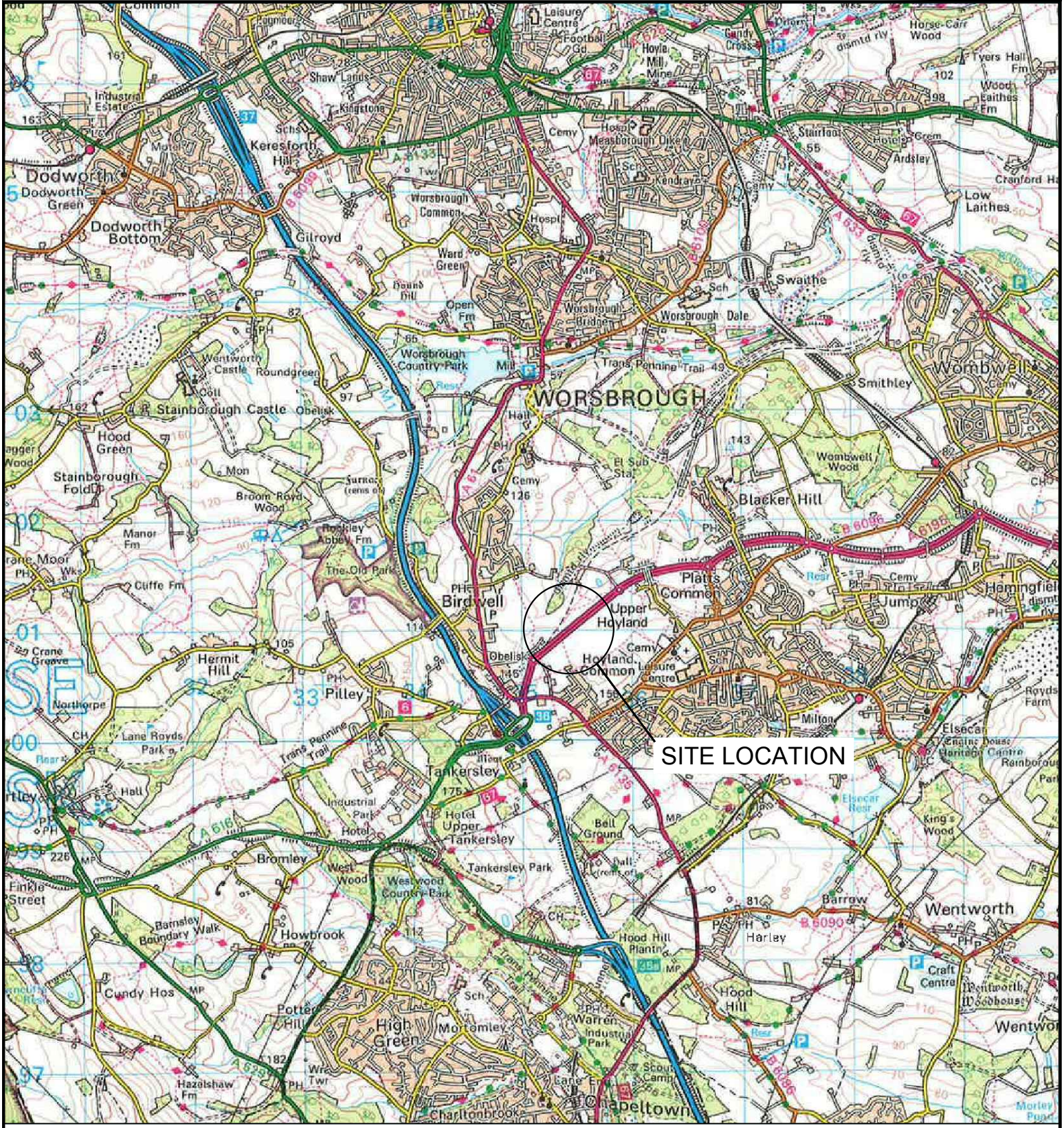
4.8 Inspection and testing frequency

Table 1: Sampling and Testing Requirements

	Number of samples	Testing schedule
Site-derived soils destined for reuse within 300mm of soft cover	Stockpiled: minimum 3 per source, or 1 per 500m^3 (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, pH, PAH (16 USEPA speciation), TPH (CWG banded), asbestos screen
	Undisturbed in situ: 1 per 500m^3 equivalent	

Site records will be maintained so that sufficient data are available for the purpose of compiling a robust verification report. Further specific information on the verification requirements will be included in the verification plan prepared in support of the MMP. In addition, where any contamination is being further investigated or where any proposed mitigation is required, details of this will be retained for inclusion in the site health and safety file.

FIGURES



Ordnance Survey © Crown copyright 2010 of the Ordnance Survey paper map.
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Client	HARWORTH ESTATES INVESTMENTS LIMITED
Project Title	J36 PHASE 2a, PHASE 2b AND PHASE 3, ROCKINGHAM
Drawing Title	SITE LOCATION PLAN

Drawn	Date	Checked	Date	Approved	Date	Project No.	Drawing File
HD	19.05.20	KH	19.05.20	KH	19.05.20	322638	322638-R04(00)D001A

Scale	Orig Size	Dimensions	Drawing No.	Rev.
NTS	A4	—	FIGURE 1	A

LEGEND:

- Site boundary for Rockingham 4
- RSK cable percussive borehole
- RSK trial pit
- RSK rotary borehole

Previous RSK Site investigation locations

- Window sample location
- Trial pit location
- Borehole location
- Rotary borehole location

N

REV	DATE	DESCRIPTION	BY	CHD.	APR.
A	19.05.20	FIRST ISSUE	HD	KH	KH

Dimensions	Projection	Scale	Orig Size
m		AS SHOWN	A3

RSK
Spring Lodge
172 Chester Road
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Fax: +44 1928 725633
Web: www.rsk.co.uk

CLIENT
HARWORTH ESTATES INVESTMENTS LIMITED

PROJECT
J36 PHASE 2a, PHASE 2b AND PHASE 3, ROCKINGHAM

TITLE
EXPLORATORY HOLE LOCATION PLAN

JOB No.:	DRAWING FILE:
322638	322638-R04(00)D002A

BY:	DATE:	CONTRACT NO.		REV:
HD	19.05.20		FIGURE 2	A

Scale bar
0 40 80 120 160 200m

APPENDIX A
RSK ENVIRONMENT LTD SERVICE CONSTRAINTS

1. This report and the site investigation carried out in connection with the report (together the "Services") were compiled and carried out by RSK Environment Limited (RSK) for Harworth Estates Investments Limited (the "Client") in accordance with the terms of the contract between RSK and the Client. The Services were performed by RSK with the reasonable skill and care ordinarily exercised by an environmental consultant at the time the Services were performed. Further, and in particular, the Services were performed by RSK taking into account the limits of the scope of works required by the client, the time scale involved and the resources, including financial and manpower resources, agreed between RSK and the Client.
2. Other than that, expressly contained in paragraph 1 above, RSK provides no other representation or warranty whether express or implied, in relation to the Services.
3. Unless otherwise agreed in writing, the Services were performed by RSK exclusively for the purposes of the Client. RSK is not aware of any interest of or reliance by any party other than the Client in or on the Services. Unless expressly provided in writing, RSK does not authorise, consent or condone any party other than the client relying upon the Services. Should this report or any part of this report, or otherwise details of the Services or any part of the Services be made known to any such party, and such party relies thereon that party does so wholly at its own and sole risk and RSK disclaims any liability to such parties. **Any such party would be well advised to seek independent advice from a competent environmental consultant and/or lawyer.**
4. It is RSK's understanding that this report is to be used for the purpose described in the introduction to the report. That purpose was a significant factor in determining the scope and level of the Services. Should the purpose for which the report is used, or the proposed use of the site change, this report may no longer be valid and any further use of or reliance upon the report in those circumstances by the client without RSK 's review and advice shall be at the client's sole and own risk. Should RSK be requested to review the report after the date of this report, RSK shall be entitled to additional payment at the then existing rates or such other terms as agreed between RSK and the client.
5. The passage of time may result in changes in site conditions, regulatory or other legal provisions, technology or economic conditions which could render the report inaccurate or unreliable. The information and conclusions contained in this report should not be relied upon in the future without the written advice of RSK. In the absence of such written advice of RSK, reliance on the report in the future shall be at the Client's own and sole risk. Should RSK be requested to review the report in the future, RSK shall be entitled to additional payment at the then existing rate or such other terms as may be agreed between RSK and the client.
6. The observations and conclusions described in this report are based solely upon the Services which were provided pursuant to the agreement between the Client and RSK. RSK has not performed any observations, investigations, studies or testing not specifically set out or required by the contract between the client and RSK. RSK is not liable for the existence of any condition, the discovery of which would require performance of services not otherwise contained in the Services. For the avoidance of doubt, unless otherwise expressly referred to in the introduction to this report, RSK did not seek to evaluate the presence on or off the site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas or other radioactive or hazardous materials, unless specifically identified in the Services.
7. The Services are based upon RSK's observations of existing physical conditions at the Site gained from a visual inspection of the site together with RSK's interpretation of information, including documentation, obtained from third parties and from the Client on the history and usage

of the site, unless specifically identified in the Services or accreditation system (such as UKAS ISO 17020:2012 clause 7.1.6):

a. The Services were based on information and/or analysis provided by independent testing and information services or laboratories upon which RSK was reasonably entitled to rely.

b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.

c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials received from the client or third parties, including laboratories and information services, during the performance of the Services.

RSK is not liable for any inaccurate information or conclusions, the discovery of which inaccuracies required the doing of any act including the gathering of any information which was not reasonably available to RSK and including the doing of any independent investigation of the information provided to RSK save as otherwise provided in the terms of the contract between the Client and RSK.

8. The intrusive environmental site investigation aspects of the Services are a limited sampling of the site at pre-determined locations based on the known historic / operational configuration of the site. The conclusions given in this report are based on information gathered at the specific test locations and can only be extrapolated to an undefined limited area around those locations. The extent of the limited area depends on the properties of the materials adjacent and local conditions, together with the position of any current structures and underground utilities and facilities, and natural and other activities on site. In addition, chemical analysis was carried out for a limited number of parameters (as stipulated in the scope between the client and RSK, based on an understanding of the available operational and historical information) and it should not be inferred that other chemical species are not present.

9. Any site drawing(s) provided in this report is (are) not meant to be an accurate base plan but is (are) used to present the general relative locations of features on, and surrounding, the site. Features (intrusive and sample locations etc) annotated on site plans are not drawn to scale but are centred over the approximate location. Such features should not be used for setting out and should be considered indicative only.

10. The comments given in this report and the opinions expressed are based on the ground conditions encountered during the site work and on the results of tests made in the field and in the laboratory. However, there may be conditions pertaining to the site that have not been disclosed by the investigation and therefore could not be taken into account. In particular, it should be noted that there may be areas of made ground not detected due to the limited nature of the investigation or the thickness and quality of made ground across the site may be variable. In addition, groundwater levels and ground gas concentrations and flows, may vary from those reported due to seasonal, or other, effects and the limitations stated in the data should be recognised.

11. Asbestos is often observed to be present in soils in discrete areas. Whilst asbestos-containing materials may have been locally encountered during the fieldworks or supporting laboratory analysis, the history of brownfield and demolition sites indicates that asbestos fibres may be present more widely in soils and aggregates, which could be encountered during more extensive ground works.

12. Unless stated otherwise, only preliminary geotechnical recommendations are presented in this report and these should be verified in a Geotechnical Design Report, once proposed construction and structural design proposals are confirmed.

APPENDIX B
JPG CUT / FILL AND TOPSOIL STRATEGY DRAWINGS

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DO NOT SCALE

NOTES

Cut/Fill Depth By Colour Banding			
Number	Minimum Elevation	Maximum Elevation	Colour
1	-12.00	-10.00	
2	-10.00	-8.00	
3	-8.00	-6.00	
4	-6.00	-4.00	
5	-4.00	-2.00	
6	-2.00	0.00	
7	0.00	2.00	
8	2.00	4.00	
9	4.00	6.00	
10	6.00	8.00	
11	8.00	10.00	
12	10.00	12.00	

Site Specific
Maximum Cut Depth: -7.58m
Maximum Fill Build-Up: 7.58m

PROPOSED LEVELS

Cut/Fill In Brief
Cut: 332520.11 Cu. M.
Fill: 324956.83 Cu. M.
Net Surplus: 7563.28 Cu. M.

Site Perimeter Has Battered To Existing Levels At 1:3.

Gradients And Spot Elevations Displayed Reflect The Proposed Finished Plateau Levels.

Highway Levels Displayed Reflect Highway Formation Levels.

A 300mm Site Strip Was Calculated And Removed Prior To The Cut/Fill Analysis.

A Site Strip Volume of 72816.88 Cu. M. Has Been Calculated.

A 5% Bulking Factor Has Been Accounted For In The Cut/Fill Analysis.

Areas Not Shaded With The Cut/Fill Colour Banding Have Not Been Included In The Cut/Fill Analysis.

The Topography Used In The Cut/Fill Analsis Has Been Generated From Combining 'Greenhatch Group, Topographical Survey, Drawing No. 20379_OGL_Rev_3, Date 05-06.06.14'

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Cut/Fill Analysis	1.000	1.000	242722.93 sq.m	316685.82 Cu. M.	324956.83 Cu. M.	8271.01 Cu. M.<Fill>
Bulking Factor (5%)				15834.29 Cu. M.	0000.00 Cu. M.	15834.29 Cu. M.<Cut>
Total				332520.11 Cu. M.	324956.83 Cu. M.	7563.28 Cu. M.<Cut>

Analysis has been performed using topographical surface generated from 'Greenhatch Group, Topographical Survey, Drawing No. 20379_OGL_Rev_3, Date 05-06.06.14'.

Analysis has incorporated a 300mm site strip, and so site strip volume is not included in the calculation above.

The total site strip volume calculated is 72816.879Cu. M.

Analysis has included a 5% bulking factor.

TENDER ISSUE

THIS DRAWING HAS BEEN PREPARED TO ASSIST THE CONTRACTOR IN PREPARING A DESIGN AND BUILD TENDER AND IS NOT INTENDED TO BE A FINAL DRAWING FROM WHICH ACCURATE QUANTITIES CAN BE TAKEN. ALL DETAILS SHOWN ARE SUBJECT TO DESIGN DEVELOPMENT.

REV	DESCRIPTION	DATE	BY
P08	NOTE ALTERATION.	12.05.20	OLT
P07	ALTERATION TO S38 ATTENUATION LAYOUT.	15.04.20	OLT
P06	TENDER ISSUE.	11.03.2020	OLT
P05	ARCHITECT LAYOUT ALTERATION.	29.11.2019	OLT
P04	LAYOUT ALTERATION IN LINE WITH HARWORTH COMMENTS.	25.11.2019	OLT
P03	PROPOSED LEVELS ALTERATION IN LINE WITH LINK ROAD ADJUSTMENTS.	07.11.2019	OLT
P02	ALTERATIONS TO LEVELS IN LINE WITH ARCHITECTS COMMENTS.	26.09.2019	OLT
P01	FIRST ISSUE.	09.09.2019	OLT

Project
ROCKINGHAM PHASE 2A & 2B,
ROCKINGHAM 2&3,
HOYLAND

Drawing Title
CUT/FILL ANALYSIS

TENDER ISSUE

Architect
THE HARRIS PARTNERSHIP

JPG
www.jpg.group
Leeds London Birmingham 0113 263 1155

JPG Project Ref	Scale at A0	Date	Checked	Drawn
4652-2	1:1000	SEP19		OLT

4652-2 - JPG - SW - 00 - DR - C - 1201 | S4 | P08

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NOTES

Cut/Fill Depth By Colour Banding			
Number	Minimum Elevation	Maximum Elevation	Colour
1	-12.00	-10.00	
2	-10.00	-8.00	
3	-8.00	-6.00	
4	-6.00	-4.00	
5	-4.00	-2.00	
6	-2.00	0.00	
7	0.00	2.00	
8	2.00	4.00	
9	4.00	6.00	
10	6.00	8.00	
11	8.00	10.00	
12	10.00	12.00	

Site Specific
Maximum Cut Depth: -4.93m
Maximum Fill Build-Up: 7.49m

PROPOSED LEVELS

MINE SHAFT LOCATION

Cut/Fill In Brief
Cut: 112673.55 Cu. M.
Fill: 112156.89 Cu. M.
Net Surplus: 516.66Cu. M.

Site Perimeter Has Battered To Existing Levels At 1:3.

Gradients And Spot Elevations Displayed Reflect The Proposed Finished Floor Levels.

A 300mm Site Strip Was Calculated And Removed Prior To The Cut/Fill Analysis.

A Site Strip Volume of 27668.33 Cu. M. Has Been Calculated.

Attenuation Volume Has Been Accounted For In The Cut/Fill Analysis.

A 5% Bulking Factor Has Been Accounted For In The Cut/Fill Analysis.

Areas Not Shaded With The Cut/Fill Colour Banding Have Not Been Included In The Cut/Fill Analysis.

The Topography Used In The Cut/Fill Analysis Has Been Generated From 'Greenhatch Group, Topographical Survey, Drawing No. 20379_OGL_Rev_3, Date 05-06.06.14'

Approximate Location Of Existing Surcharge Stockpile.
Volume: Approx. 10,000 Cu. M.

Stockpile To Be Moved And Reused For Surcharging Post-Cut/Fill Earthworks.

Mine Shaft
CA Ref. 435401-002

Mine Shaft
CA Ref. 435401-003

Existing Pond

Existing Unit

Car Park

Service Yard

Proposed Roundabout

Deane Valley Parkway

Existing Footpath to be retained

Cut/Fill Summary

Name	Cut Factor	Fill Factor	2d Area	Cut	Fill	Net
Cut/Fill Analysis	1.000	1.000	92227.78sq.m	107308.14 Cu. M.	112156.89 Cu. M.	4848.75 Cu. M.<Fill>
Bulking Factor (5%)				5365.41 Cu. M.	0000.00 Cu. M.	5365.41 Cu. M.<Cut>
Total				112673.55 Cu. M.	112156.89 Cu. M.	516.66 Cu. M.<Cut>

Analysis has been performed using topographical surface generated from 'Greenhatch Group, Topographical Survey, Drawing No. 20379_OGL_Rev_3, Date 05-06.06.14'.

Analysis has incorporated a 300mm site strip, and so site strip volume is not included in the calculation above.

The total site strip volume calculated is 27668.33 Cu. M.

Analysis has included attenuation volume.

Analysis has included a 5% bulking factor.

REV	DESCRIPTION	DATE	BY
P05	NOTE ALTERATION.	12.05.20	OLT
P04	APPROXIMATE POSITION OF SURCHARGE STOCKPILE ADDED.	22.04.20	OLT
P03	UPDATED ATTENUATION LAYOUT. TENDER ISSUE.	15.04.20	OLT
P02	ARCHITECT LAYOUT ALTERATION.	29.11.19	OLT
P01	FIRST ISSUE.	10.10.19	OLT

Project
ROCKINGHAM PHASE 3,
ROCKINGHAM 2&3,
HOYLAND

Drawing Title
PHASE 3 CUT/FILL ANALYSIS

TENDER ISSUE

Architect
THE HARRIS PARTNERSHIP

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Leeds London Birmingham 0113 263 1155

JPG Project Ref	Scale at A0	Date	Checked	Drawn
4652-2	1:1000	OCT19		OLT

4652-2 - JPG - SW - 00 - DR - C - 1203 | S4 | P05

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NOTES

Extent Of Topsoil Placement

Proposed Topsoil Mounds

Earthwork Levels

This is an indicative layout and should be read inconjunction with the detailed surcharging strategy and landscaping design.

Attenuation Basin and Highway Verge topsoil thickness: 300mm

Topsoil Mounds Formed With 1:2 Batters.

Phase 3 Mound Volumes Include Existing Surcharge Stockpile (approx. 10,000 Cu. M.).

Attenuation Basin,
Topsoil Requirement:
2386.50 Cu. M.

Topsoil Mound, 5.0m Height,
Topsoil Volume:
17961.94 Cu. M.

Topsoil Mound, 5.0m Height,
Topsoil Volume:
16470.29 Cu. M.

Approximate Location Of Existing Surcharge Stockpile.
Volume: Approx. 10,000 Cu. M.

Stockpile To Be Moved And Reused For Surcharging Post-Cut/Fill Earthworks.

Attenuation Basin,
Topsoil Requirement:
1096.09 Cu. M.

Topsoil Mound, 3.0m Height,
Topsoil Volume:
53514.03 Cu. M.

Topsoil Mound, 5.0m Height,
Topsoil Volume:
8542.61 Cu. M.

Highway Verges,
Topsoil Requirement:
1728.30 Cu. M.

Attenuation Basin,
Topsoil Requirement:
7064.24 Cu. M.

Existing Footpath to be retained

Existing Pond

Existing Unit

Car Park

Service Yard

Proposed Roundabout

Deane Valley Parkway

Playing Field

TENDER ISSUE

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REV	DESCRIPTION	DATE	BY
P01	FIRST ISSUE.	13.05.20	OLT

Project
ROCKINGHAM 2 & 3,
HOYLAND

Drawing Title
TOPSOIL STRATEGY

TENDER ISSUE

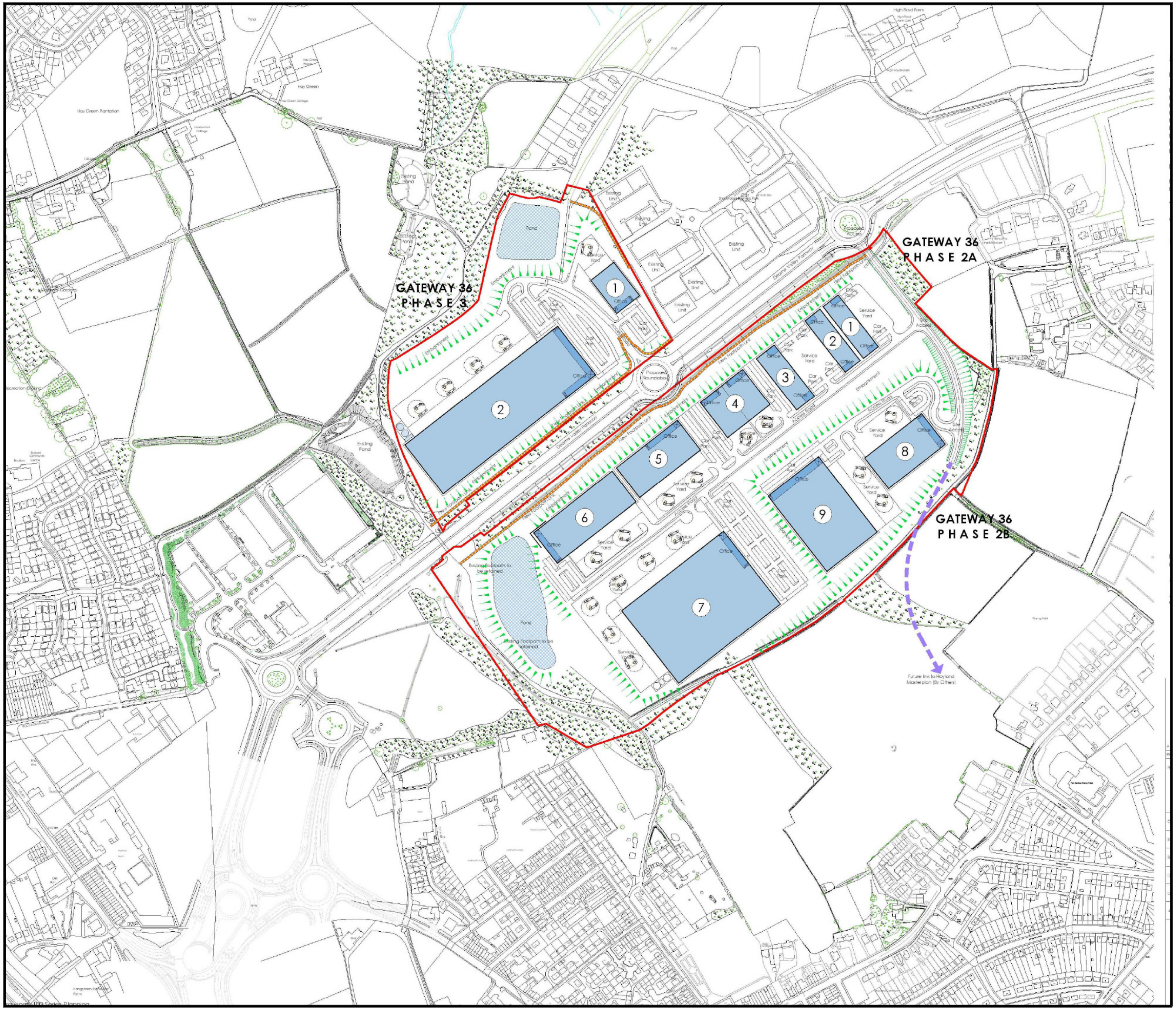
Architect
THE HARRIS PARTNERSHIP

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Leeds London Birmingham 0113 263 1155

JPG Project Ref	Scale at A0	Date	Checked	Drawn
4652-2	1:1000	MAY'20		OLT

4652-2 - JPG - SW - 00 - DR - C - 1212 | S4 | P01

APPENDIX C
PROPOSED DEVELOPMENT LAYOUT



LEGEND:

Site boundary

N

A	20.02.20	FIRST ISSUE	HD	AC	GMG
REV	DATE	DESCRIPTION	BY	CHD.	APR.

Dimensions	Projection	Scale	Orig Size
m		NTS	A3

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CLIENT
HARWORTH ESTATES INVESTMENTS LTD

PROJECT
ROCKINGHAM 2 AND 3

TITLE
SITE BOUNDARY PLAN

JOB No.:	DRAWING FILE:
322638	322638-R02(00)D002A

BY:	DATE:	CONTRACT NO.		REV:
HD	20.02.20		FIGURE 2	A

APPENDIX D
RSK HUMAN HEALTH GENERIC ASSESSMENT CRITERIA FOR COMMERCIAL END-USE

Generic assessment criteria for human health: commercial scenario

Background

RSK's generic assessment criteria (GAC) were initially prepared following the publication by the Environment Agency (EA) of soil guideline value (SGV) and toxicological (TOX) reports, and associated publications in 2009[1]. RSK GAC were updated following the publication of GAC by LQM/CIEH in 2009[2]. RSK GAC are periodically revised when updated information on toxicological, land use or receptor parameters is published.

Updates to the RSK GAC

In 2014, the publication of Category 4 Screening Levels (C4SL)[3,4], as part of the Defra-funded research project SP1010, included modifications to certain exposure assumptions documented within EA Science Report SC050221/SR3 (herein after referred to as SR3)[5] used in the generation of SGVs.

C4SL were published for six substances (cadmium, arsenic, benzene, benzo(a)pyrene, chromium VI and lead) for a sandy loam soil type with 6% soil organic matter, based on a low level of toxicological concern (LLTC; see Section 2.3 of research project report SP1010[3]). Where a C4SL has been published, the RSK GAC duplicates the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and adopts them as GAC for these six substances.

For all other substances the only C4SL exposure modification relevant to a commercial end use are daily inhalation rates.

The RSK GAC have also been revised with updated toxicology published by LQM/CIEH in 2015[7] or by the USEPA[14], where a C4SL has not been published.

RSK GAC derivation for metals and organic compounds

Model selection

Soil assessment criteria (SAC) were calculated using the Contaminated Land Exposure Assessment (CLEA) tool v1.071, supporting EA guidance[5,8,9] and revised exposure scenarios published for the C4SL[3]. The SAC are also termed GAC.

Pathway selection

In accordance with SR3[5] the commercial scenario considers risks to a female worker who works from the age of 16 to 65 years. It should be noted that this end use is not suitable for a workplace nursery but may be appropriate for a sports centre or shopping centre where children are present. In accordance with Box 3.5, SR3[5] the pathways considered for production of the SAC in the commercial scenario are

- direct soil and dust ingestion
- dermal contact with soil both indoors and outdoors
- indoor air inhalation from soil and vapour and outdoor inhalation of soil and vapour.

With respect to volatilisation, the CLEA model assumes a simple linear partitioning of a chemical in the soil between the sorbed, dissolved and vapour phase[9]. The upper boundaries of this partitioning are represented by the maximum aqueous solubility and pure saturated vapour concentration of the chemical. The CLEA model estimates saturated soil concentrations where these limits are reached[9]. The CLEA software uses a traffic light system to identify when individual and/or combined assessment criteria exceed the lower of either the aqueous- or vapour-based soil saturation limits. Model output cells are flagged red where the saturated soil concentration has been exceeded and the contribution of the indoor and outdoor vapour pathway to total exposure is greater than 10%. In this case, further consideration of the following is required[9]:

- Free phase contamination may be present.
- Exposure from the vapour pathways will be over-predicted by the model, as in reality the vapour phase concentration will not increase at concentrations above saturation limits
- Where the vapour pathway contribution is greater than 90%, it is unlikely the relevant health criteria value (HCV) will be exceeded at soil concentrations at least a factor of ten higher than the relevant HCV.

Where the vapour pathway is the predominant pathway (contributes greater than 90% of exposure) or the only exposure route considered and the cell is highlighted red (SAC exceeds saturation limit), the risk based on the assumed conceptual model is likely to be negligible as the vapour risk is assumed to be tolerable at maximum possible soil concentrations. In such circumstances, the vapour pathway exposure should be considered based on the presence of free phase or non-aqueous phase liquid sources and the measured concentrations of volatile organic compounds (VOC) in the vapour phase. Screening could be considered based on setting the SAC as the modelled soil saturation limits. However, as stated within the CLEA handbook[9], this is likely to not be practical in many cases because of the very low saturation limits and, in any case, is highly conservative.

It should also be noted that for mixtures of compounds, free phase may be present where soil (or groundwater) concentrations are well below saturation limits for individual compounds.

Where the vapour pathway is only one of the exposure pathways considered, an additional approach can then be utilised as detailed within Section 4.12 of the CLEA model handbook[9], which explains how to calculate an effective assessment criterion manually.

SR3[5] states that, as a general rule of thumb, it is recognised that estimating vapour phase concentrations from dissolved and sorbed phase contamination by petroleum hydrocarbons are at least a factor of ten higher than those likely to be measured on-site. RSK has therefore applied an empirical subsurface to indoor air correction factor of 10 into the CLEA model chemical database for all petroleum hydrocarbon fractions (including BTEX, trimethylbenzenes and the polycyclic aromatic hydrocarbons (PAH) naphthalene, acenaphthene and acenaphthylene) to reduce this conservatism.

Input selection

The most up-to-date published chemical and toxicological data was obtained from EA Report SC050021/SR7[10], the EA TOX[1] reports, the C4SL SP1010 project report and associated appendices[3,6], the 2015 LQM/CIEH report[7] or the USEPA IRIS database[14]. Where a C4SL has been published, the RSK GAC have duplicated the C4SL published values using all input parameters within the SP1010 final project report[3] and associated appendices[6], and has

adopted them as GAC for these six substances. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium and methyl tertiary-butyl ether (MTBE) were obtained from the CL:AIRE Soil Generic Assessment Criteria report[11].

For TPH, aromatic hydrocarbons C_5–C_8 were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the commercial end use, the CLEA default pre-1970s three-storey office building was used. SR3[5] notes this commercial building type to be the most conservative in terms of protection from vapour intrusion. The default input building parameters presented in Table 3.10 of SR3[5] have been used.

The parameters for a sandy loam soil type were used in line with Table 4.4 of SR3[5]. This includes a value of 6% for the percentage of soil organic matter (SOM) within the soil. In RSK's experience, this is rather high for many sites. To avoid undertaking site-specific risk assessments for this SOM, RSK has produced an additional set of GAC for SOM of 1% and 2.5% for all substances using the CLEA tool.

Summary of modifications to the default CLEA SR3[5] input parameters for a commercial land use

In summary, the RSK commercial GAC were produced using the default input parameters for soil properties, the air dispersion model, building properties and the vapour model detailed in SR3[5]. Modifications to the default SR3[5] exposure scenarios based on the C4SL exposure scenarios[3] are presented in Table 2 below. The sole modification to the default commercial input parameters is the updated inhalation rate.

The final selected GAC are presented by pathway in Table 3 with the combined GAC in Table 4.

Figure 1: Conceptual model for CLEA commercial scenario

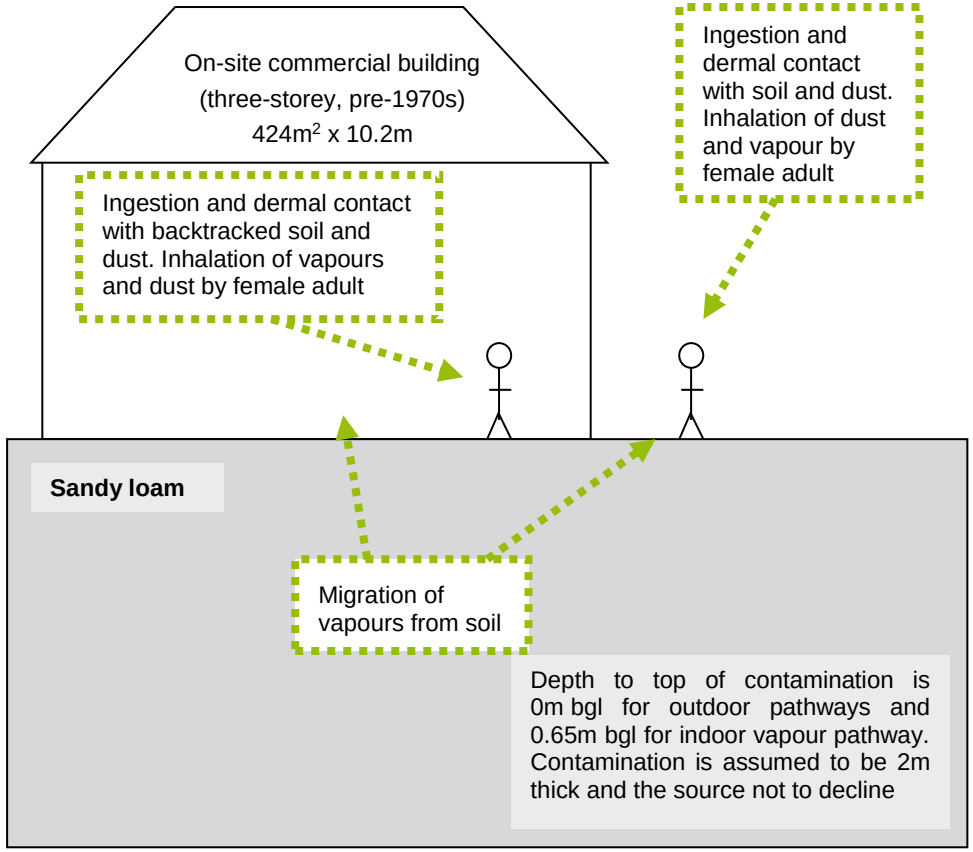


Table 1: Exposure assessment parameters for commercial scenario – inputs for CLEA model

Parameter	Value	Justification
Land use	Commercial	Chosen land use
Receptor	Female worker	Taken as female adult exposed over 49 years from age 16 to 65 years, Box 3.5, SR3[5]
Building	Office (pre-1970)	Key generic assumption given in Box 3.5, SR3[5]. Pre-1970s three-storey office building chosen as it is the most conservative in terms of protection from vapour intrusion (Section 3.4.6, SR3[5])
Soil type	Sandy loam	Most common UK soil type (Section 4.3.1, Table 4.4, SR3[5])
Start age class (AC)	17	AC corresponding to key generic assumption that the critical receptor is a working female adult exposed over a 49-year period from age 16 to 65 years. Assumption given in Box 3.5, SR3[5]
End AC	17	
SOM (%)	6	Representative of sandy loam according to EA guidance note dated January 2009 entitled 'Changes We Have Made to the CLEA Framework Documents'[13]
	1	To provide SAC for sites where SOM < 6% as often observed by RSK
	2.5	
pH	7	Model default

Table 2: Commercial – modified receptor inputs

Parameter	Unit	Value	Justification
Inhalation rate (AC17)	m^3 day^{-1}	15.7	Mean value USEPA, 2011[12]; Table 3.2, SP1010[3]

References

1. Environment Agency (2009), 'Science Reports SC050021 - SGV and TOX reports for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'; 'Supplementary information for the derivation of SGV for: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs', and 'Contaminants in soil: updated collation of toxicological data and intake values for humans: benzene, toluene, ethylbenzene, xylene, mercury, selenium, nickel, arsenic, cadmium, phenol, dioxins, furans and dioxin-like PCBs'. Available at: https://www.gov.uk/government/publications/contaminants-in-soil-updated-collation-of-toxicological-data-and-intake-values-for-humans and https://www.gov.uk/government/publications/land-contamination-soil-guideline-values-sgvs (accessed 4 February 2015)

2. Nathanial, C. P., McCaffrey, C., Ashmore, M., Cheng, Y., Gillet, A. G., Ogden, R. C. and Scott, D. (2009), *LQM/CIEH Generic Assessment Criteria for Human Health Risk Assessment*, second edition (Nottingham: Land Quality Press).

3. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Development of Category 4 Screening Levels for Assessment of Land Affected by Contamination', Revision 2, DEFRA research project SP1010.

4. Department for Environment, Food and Rural Affairs (Defra) (2014), 'SP1010: Development of Category 4 Screening Levels for assessment of land affected by contamination – Policy Companion Document', Revision 2.

5. Environment Agency (2009), *Science Report – SC050021/SR3. Updated technical background to the CLEA model* (Bristol: Environment Agency).

6. Contaminated Land: Applications in Real Environment (CL:AIRE) (2014). 'Appendices C to H). DEFRA research project SP1010'.

7. Nathanial, C. P., McCaffrey, C., Gillet, A. G., Ogden, R. C. and Nathanial, J. F. (2015), *The LQM/CIEH S4ULs for Human Health Risk Assessment* (Nottingham: Land Quality Press).

8. Environment Agency (2009), *Human health toxicological assessment of contaminants in soil. Science Report – Final SC050021/SR2* (Bristol: Environment Agency).

9. Environment Agency (2009), *Science Report – SC050021/SR4 CLEA Software (version 1.05) Handbook* (Bristol: Environment Agency).

10. Environment Agency (2008), *Science Report SC050021/SR7. Compilation of Data for Priority Organic Pollutants for Derivation of Soil Guideline Values* (Bristol: Environment Agency).

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 3

Human health generic assessment criteria by pathway for commercial scenario

Compound	Notes	SAC appropriate to pathway SOM 1% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 2.5% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 6% (mg/kg)			Soil saturation limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Metals													
Arsenic	(a,b)	6.35E+02	1.25E+03	NR	NR	6.35E+02	1.25E+03	NR	NR	6.35E+02	1.25E+03	NR	NR
Barium	(b)	2.21E+04	NR	NR	NR	2.21E+04	NR	NR	NR	2.21E+04	NR	NR	NR
Beryllium		3.97E+03	1.17E+01	NR	NR	3.97E+03	1.17E+01	NR	NR	3.97E+03	1.17E+01	NR	NR
Boron		2.38E+05	2.82E+07	NR	NR	2.38E+05	2.82E+07	NR	NR	2.38E+05	2.82E+07	NR	NR
Cadmium	(a)	7.73E+02	8.57E+02	4.10E+02	NR	7.73E+02	8.57E+02	4.10E+02	NR	7.73E+02	8.57E+02	4.10E+02	NR
Chromium (III) - trivalent	(c)	3.31E+05	8.57E+03	NR	NR	3.31E+05	8.57E+03	NR	NR	3.31E+05	8.57E+03	NR	NR
Chromium (VI) - hexavalent	(a,d)	9.62E+02	4.91E+01	NR	NR	9.62E+02	4.91E+01	NR	NR	9.62E+02	4.91E+01	NR	NR
Copper		1.89E+05	8.96E+04	6.83E+04	NR	1.89E+05	8.96E+04	6.83E+04	NR	1.89E+05	8.96E+04	6.83E+04	NR
Lead	(a)	2.32E+03	NR	NR	NR	2.32E+03	NR	NR	NR	2.32E+03	NR	NR	NR
Elemental Mercury (Hg^0)	(d)	NR	1.54E+01	NR	4.31E+00	NR	3.26E+01	NR	1.07E+01	NR	5.80E+01	NR	2.58E+01
Inorganic Mercury (Hg^{2+})		1.18E+03	1.97E+04	1.12E+03	NR	1.18E+03	1.97E+04	1.12E+03	NR	1.18E+03	1.97E+04	1.12E+03	NR
Methyl Mercury (Hg^{4+})		3.38E+02	2.13E+03	2.92E+02	7.33E+01	3.38E+02	3.87E+03	3.11E+02	1.42E+02	3.38E+02	7.33E+03	3.23E+02	3.04E+02
Nickel	(d)	3.06E+03	9.83E+02	NR	NR	3.06E+03	9.83E+02	NR	NR	3.06E+03	9.83E+02	NR	NR
Selenium	(b)	1.23E+04	NR	NR	NR	1.23E+04	NR	NR	NR	1.23E+04	NR	NR	NR
Vanadium		2.15E+04	9.03E+03	NR	NR	2.15E+04	9.03E+03	NR	NR	2.15E+04	9.03E+03	NR	NR
Zinc	(b)	7.35E+05	1.97E+08	NR	NR	7.35E+05	1.97E+08	NR	NR	7.35E+05	1.97E+08	NR	NR
Cyanide (free)		6.56E+02	7.51E+04	6.53E+02	NR	6.56E+02	7.51E+04	6.53E+02	NR	6.56E+02	7.51E+04	6.53E+02	NR
Volatile Organic Compounds													
Benzene	(a)	1.09E+03	2.79E+01	2.72E+01	1.22E+03	1.09E+03	5.19E+01	4.96E+01	2.26E+03	1.09E+03	1.08E+02	9.80E+01	4.71E+03
Toluene		4.24E+05	6.49E+04	5.63E+04	8.69E+02	4.24E+05	1.43E+05	1.07E+05	1.92E+03	4.24E+05	3.24E+05	1.84E+05	4.36E+03
Ethylbenzene		1.91E+05	5.89E+03	5.71E+03	5.18E+02	1.91E+05	1.38E+04	1.28E+04	1.22E+03	1.91E+05	3.21E+04	2.75E+04	2.84E+03
Xylene - m		3.43E+05	6.26E+03	6.15E+03	6.25E+02	3.43E+05	1.47E+04	1.41E+04	1.47E+03	3.43E+05	3.44E+04	3.12E+04	3.46E+03
Xylene - o		3.43E+05	6.73E+03	6.60E+03	4.78E+02	3.43E+05	1.57E+04	1.50E+04	1.12E+03	3.43E+05	3.65E+04	3.30E+04	2.62E+03
Xylene - p		3.43E+05	6.03E+03	5.92E+03	5.76E+02	3.43E+05	1.41E+04	1.36E+04	1.35E+03	3.43E+05	3.28E+04	3.00E+04	3.17E+03
Total xylene		3.43E+05	6.03E+03	5.92E+03	6.25E+02	3.43E+05	1.41E+04	1.36E+04	1.47E+03	3.43E+05	3.28E+04	3.00E+04	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		5.72E+05	7.58E+03	7.48E+03	2.04E+04	5.72E+05	1.23E+04	1.21E+04	3.31E+04	5.72E+05	2.34E+04	2.24E+04	6.27E+04
1,1,1,2 Tetrachloroethane		1.10E+04	1.09E+02	1.08E+02	2.60E+03	1.10E+04	2.53E+02	2.47E+02	6.02E+03	1.10E+04	5.88E+02	5.59E+02	1.40E+04
1,1,2,2-Tetrachloroethane		1.10E+04	2.81E+02	2.74E+02	2.67E+03	1.10E+04	5.75E+02	5.46E+02	5.46E+03	1.10E+04	1.26E+03	1.13E+03	1.20E+04
1,1,1-Trichloroethane		1.14E+06	6.60E+02	6.60E+02	1.43E+03	1.14E+06	1.35E+03	1.35E+03	2.92E+03	1.14E+06	2.96E+03	2.95E+03	6.39E+03
1,1,2 Trichloroethane		7.62E+03	9.02E+01	8.91E+01	4.03E+03	7.62E+03	1.84E+02	1.80E+02	8.21E+03	7.62E+03	4.02E+02	3.82E+02	1.80E+04
1,1-Dichloroethene		8.76E+04	2.43E+01	2.43E+01	2.23E+03	8.76E+04	4.30E+01	4.30E+01	3.94E+03	8.76E+04	8.68E+01	8.67E+01	7.94E+03
1,2-Dichloroethane		2.29E+02	6.73E-01	6.71E-01	3.41E+03	2.29E+02	9.71E-01	9.67E-01	4.91E+03	2.29E+02	1.67E+00	1.65E+00	8.43E+03
1,2,4-Trimethylbenzene		NR	3.29E+02	NR	4.74E+02	NR	6.41E+02	NR	1.16E+03	NR	1.04E+03	NR	2.76E+03
1,3,5-Trimethylbenzene	(e)	NR	NR	NR	2.30E+02	NR	NR	NR	5.52E+02	NR	NR	NR	1.30E+03
1,2-Dichloropropane		2.57E+04	3.14E+00	3.13E+00	1.19E+03	2.57E+04	5.54E+00	5.54E+00	2.11E+03	2.57E+04	1.11E+01	1.11E+01	4.24E+03
Carbon Tetrachloride (tetrachloromethane)		7.62E+03	2.87E+00	2.87E+00	1.52E+03	7.62E+03	6.29E+00	6.28E+00	3.32E+03	7.62E+03	1.43E+01	1.42E+01	7.54E+03
Chloroethane		NR	9.01E+02	NR	2.61E+03	NR	1.22E+03	NR	3.54E+03	NR	1.97E+03	NR	5.71E+03
Chloromethane		NR	9.54E-01	NR	1.91E+03	NR	1.11E+00	NR	2.24E+03	NR	1.49E+00	NR	2.99E+03
Cis 1,2 Dichloroethene		1.36E+01	NR	NR	3.94E+03	2.29E+01	NR	NR	6.61E+03	4.44E+01	NR	NR	1.29E+04
Dichloromethane		9.04E+03	2.63E+02	2.57E+02	7.27E+03	9.04E+03	3.50E+02	3.39E+02	9.68E+03	9.04E+03	5.53E+02	5.26E+02	1.53E+04
Tetrachloroethene		1.12E+04	1.86E+01	1.86E+01	4.24E+02	1.12E+04	4.17E+01	4.16E+01	9.51E+02	1.12E+04	9.57E+01	9.49E+01	2.18E+03
Trans 1,2 Dichloroethene		3.23E+04	2.07E+01	NR	3.42E+03	3.23E+04	3.74E+01	NR	6.17E+03	3.23E+04	7.63E+01	NR	1.26E+04
Trichloroethene		9.53E+02	1.23E+00	1.23E+00	1.54E+03	9.53E+02	2.58E+00	2.57E+00	3.22E+03	9.53E+02	5.72E+00	5.69E+00	7.14E+03
Vinyl Chloride (chloroethene)		2.67E+01	5.95E-02	5.94E-02	1.36E+03	2.67E+01	7.70E-02	7.67E-02	1.76E+03	2.67E+01	1.18E-01	1.17E-01	2.69E+03
Semi-Volatile Organic Compounds													
2-Chloronaphthalene		1.53E+05	3.71E+02	3.70E+02	1.14E+02	1.53E+05	9.07E+02	9.02E+02	2.80E+02	1.53E+05	2.13E+03	2.10E+03	6.69E+02
Acenaphthene		1.10E+05	2.75E+06	1.06E+05	5.70E+01	1.10E+05	5.36E+06	1.08E+05	1.41E+02	1.10E+05	8.83E+06	1.08E+05	3.36E+02
Acenaphthylene		1.10E+05	2.68E+06	1.05E+05	8.61E+01	1.10E+05	5.23E+06	1.07E+05	2.12E+02	1.10E+05	8.65E+06	1.08E+05	5.06E+02
Anthracene		5.49E+05	1.13E+07	5.23E+05	1.17E+00	5.49E+05	2.35E+07	5.36E+05	2.91E+00	5.49E+05	4.13E+07	5.42E+05	6.96E+00
Benzo(a)anthracene		2.84E+02	4.08E+02	1.67E+02	1.71E+00	2.84E+02	4.47E+02	1.74E+02	4.28E+00	2.84E+02	4.67E+02	1.76E+02	1.03E+01
Benzo(a)pyrene	(a)	7.68E+01	2.04E+02	5.58E+01	9.11E-01	7.68E+01	2.09E+02	5.61E+01	2.28E+00	7.68E+01	2.11E+02	5.63E+01	5.46E+00

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 3

Human health generic assessment criteria by pathway for commercial scenario

Compound	Notes	SAC appropriate to pathway SOM 1% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 2.5% (mg/kg)			Soil saturation limit (mg/kg)	SAC appropriate to pathway SOM 6% (mg/kg)			Soil saturation limit (mg/kg)
		Oral	Inhalation	Combined		Oral	Inhalation	Combined		Oral	Inhalation	Combined	
Benzo(b)fluoranthene		7.13E+01	1.17E+02	4.43E+01	1.22E+00	7.13E+01	1.20E+02	4.47E+01	3.04E+00	7.13E+01	1.21E+02	4.49E+01	7.29E+00
Benzo(g,h,i)perylene		6.29E+03	1.05E+04	3.93E+03	1.54E-02	6.29E+03	1.06E+04	3.95E+03	3.85E-02	6.29E+03	1.07E+04	3.96E+03	9.23E-02
Benzo(k)fluoranthene		1.88E+03	3.11E+03	1.17E+03	6.87E-01	1.88E+03	3.17E+03	1.18E+03	1.72E+00	1.88E+03	3.21E+03	1.19E+03	4.12E+00
Chrysene		5.67E+02	8.89E+02	3.46E+02	4.40E-01	5.67E+02	9.25E+02	3.52E+02	1.10E+00	5.67E+02	9.47E+02	3.55E+02	2.64E+00
Dibenzo(a,h)anthracene		5.67E+00	9.32E+00	3.53E+00	3.93E-03	5.67E+00	9.52E+00	3.55E+00	9.82E-03	5.67E+00	9.64E+00	3.57E+00	2.36E-02
Fluoranthene		2.29E+04	1.89E+06	2.26E+04	1.89E+01	2.29E+04	2.72E+06	2.27E+04	4.73E+01	2.29E+04	3.32E+06	2.27E+04	1.13E+02
Fluorene		7.31E+04	4.55E+05	6.30E+04	3.09E+01	7.31E+04	1.06E+06	6.84E+04	7.65E+01	7.31E+04	2.24E+06	7.08E+04	1.83E+02
Hexachloroethane		2.09E+01	NR	NR	8.17E+00	4.98E+01	NR	NR	2.01E+01	1.11E+02	NR	NR	4.81E+01
Indeno(1,2,3-cd)pyrene		8.10E+02	1.31E+03	5.01E+02	6.13E-02	8.10E+02	1.35E+03	5.06E+02	1.53E-01	8.10E+02	1.37E+03	5.09E+02	3.68E-01
Naphthalene		3.64E+04	1.87E+03	1.78E+03	7.64E+01	3.64E+04	4.39E+03	3.92E+03	1.83E+02	3.64E+04	9.94E+03	7.81E+03	4.32E+02
Phenanthrene		2.28E+04	5.35E+05	2.19E+04	3.60E+01	2.28E+04	1.09E+06	2.24E+04	8.96E+01	2.28E+04	1.86E+06	2.25E+04	2.14E+02
Pyrene		5.49E+04	4.47E+06	5.42E+04	2.20E+00	5.49E+04	6.46E+06	5.44E+04	5.49E+00	5.49E+04	7.91E+06	5.45E+04	1.32E+01
Phenol		1.10E+06	2.65E+04	2.59E+04	2.42E+04	1.10E+06	3.04E+04	2.96E+04	3.81E+04	1.10E+06	3.46E+04	3.35E+04	7.03E+04
Total petroleum hydrocarbons													
Aliphatic hydrocarbons EC5-EC6		4.77E+06	3.19E+03	3.19E+03	3.04E+02	4.77E+06	5.86E+03	5.86E+03	5.58E+02	4.77E+06	1.21E+04	1.21E+04	1.15E+03
Aliphatic hydrocarbons >EC6-EC8		4.77E+06	7.79E+03	7.78E+03	1.44E+02	4.77E+06	1.74E+04	1.74E+04	3.22E+02	4.77E+06	3.97E+04	3.96E+04	7.36E+02
Aliphatic hydrocarbons >EC8-EC10		9.53E+04	2.02E+03	2.00E+03	7.77E+01	9.53E+04	4.91E+03	4.85E+03	1.90E+02	9.53E+04	1.17E+04	1.13E+04	4.51E+02
Aliphatic hydrocarbons >EC10-EC12		9.53E+04	9.97E+03	9.69E+03	4.75E+01	9.53E+04	2.47E+04	2.29E+04	1.18E+02	9.53E+04	5.89E+04	4.73E+04	2.83E+02
Aliphatic hydrocarbons >EC12-EC16		9.53E+04	8.26E+04	5.88E+04	2.37E+01	9.53E+04	2.04E+05	8.17E+04	5.91E+01	9.53E+04	4.81E+05	9.02E+04	1.42E+02
Aliphatic hydrocarbons >EC16-EC35	(b)	1.58E+06	NR	NR	8.48E+00	1.75E+06	NR	NR	2.12E+01	1.83E+06	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC35-EC44	(b)	1.58E+06	NR	NR	8.48E+00	1.75E+06	NR	NR	2.12E+01	1.83E+06	NR	NR	5.09E+01
Aromatic hydrocarbons >EC8-EC10		3.81E+04	3.55E+03	3.46E+03	6.13E+02	3.81E+04	8.66E+03	8.11E+03	1.50E+03	3.81E+04	2.05E+04	1.70E+04	3.58E+03
Aromatic hydrocarbons >EC10-EC12		3.81E+04	1.92E+04	1.62E+04	3.64E+02	3.81E+04	4.69E+04	2.79E+04	8.99E+02	3.81E+04	1.10E+05	3.42E+04	2.15E+03
Aromatic hydrocarbons >EC12-EC16		3.81E+04	2.02E+05	3.62E+04	1.69E+02	3.81E+04	4.76E+05	3.73E+04	4.19E+02	3.81E+04	1.03E+06	3.78E+04	1.00E+03
Aromatic hydrocarbons >EC16-EC21	(b)	2.82E+04	NR	NR	5.37E+01	2.83E+04	NR	NR	1.34E+02	2.84E+04	NR	NR	3.21E+02
Aromatic hydrocarbons >EC21-EC35	(b)	2.84E+04	NR	NR	4.83E+00	2.84E+04	NR	NR	1.21E+01	2.84E+04	NR	NR	2.90E+01
Aromatic hydrocarbons >EC35-EC44	(b)	2.84E+04	NR	NR	4.83E+00	2.84E+04	NR	NR	1.21E+01	2.84E+04	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. GrAC - groundwater screening value. SAC - soil screening value.

The CLEA model output is colour coded depending upon whether the soil saturation limit has been exceeded.

Calculated SAC exceeds soil saturation limit and may significantly affect the interpretation of any exceedances as the contribution of the indoor and outdoor vapour pathway to total exposure is >10%.

Calculated SAC exceeds soil saturation limit but the exceedance will not affect the SAC significantly as the contribution of the indoor and outdoor vapour pathway to total exposure is <10%.

Calculated SAC does not exceed the soil saturation limit.

The SAC for organic compounds are dependant upon soil organic matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58. 1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway (Section 10.1.1, SR3)

(a) SAC for arsenic, benzene, benzo(a)pyrene, cadmium, chromium VI and lead are derived using the C4SL toxicology data.

(b) SAC for barium and selenium should not include the inhalation pathway as no expert group HCV has been derived; aliphatic and aromatic hydrocarbons >EC16 should not include inhalation pathway due to their non-volatile nature and inhalation exposure being minimal (oral, dermal and inhalation exposure is compared to the oral HCV); arsenic should only be based on oral contribution (rather than combined) owing to the relative small contribution from inhalation in accordance with the SGV report. The Oral SAC should be adopted for zinc and benzo(a)pyrene.

(c) SAC for CrIII should be based on the lower of the oral and inhalation SAC (see LQM/CIEH 2015 Section 6.8)

(d) SAC for elemental mercury, chromium VI and nickel should be based on the inhalation pathway only.

(e) SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used.

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - COMMERCIAL

Table 4
Human Health Generic Assessment Criteria for Commercial Scenario

Compound	SAC for Soil SOM 1% (mg/kg)	SAC for Soil SOM 2.5% (mg/kg)	SAC for Soil SOM 6% (mg/kg)
Metals			
Arsenic	640	640	640
Barium	22,000	22,000	22,000
Beryllium	12	12	12
Boron	240,000	240,000	240,000
Cadmium	410	410	410
Chromium (III) - trivalent	8,600	8,600	8,600
Chromium (VI) - hexavalent	49	49	49
Copper	68,000	68,000	68,000
Lead	2,300	2,300	2,300
Elemental Mercury (Hg^0)	15 (4)	33 (11)	58 (26)
Inorganic Mercury (Hg^{2+})	1,120	1,120	1,120
Methyl Mercury (Hg^{4+})	290 (73)	310 (142)	320
Nickel	980	980	980
Selenium	12,000	12,000	12,000
Vanadium	9,000	9,000	9,000
Zinc	740,000	740,000	740,000
Cyanide (free)	650	650	650
Volatile Organic Compounds			
Benzene	27	50	98
Toluene	56,000 (869)	107,000 (1,916)	184,000 (4,357)
Ethylbenzene	6,000 (518)	13,000 (1,216)	27,000 (2,844)
Xylene - m	6,200 (625)	14,100 (1,474)	31,200 (3,457)
Xylene - o	6,600 (478)	15,000 (1,120)	33,000 (2,618)
Xylene - p	5,900 (576)	13,600 (1,353)	30,000 (3,167)
Total xylene	5,900 (625)	13,600 (1,474)	30,000 (3,457)
Methyl tertiary-Butyl ether (MTBE)	7,500	12,100	22,400
1,1,1,2 Tetrachloroethane	110	250	560
1,1,2,2-Tetrachloroethane	270	550	1,130
1,1,1-Trichloroethane	700	1,300	3,000
1,1,2 Trichloroethane	89	180	382
1,1-Dichloroethene	24	43	87
1,2-Dichloroethane	0.67	0.97	1.65
1,2,4-Trimethylbenzene	330	640	1,040
1,3,5-Trimethylbenzene	NR	NR	NR
1,2-Dichloropropane	3	6	11
Carbon Tetrachloride (tetrachloromethane)	2.9	6.3	14.2
Chloroethane	901	1,223	1,972
Chloromethane	1.0	1.1	1.5
Cis 1,2 Dichloroethene	14	23	44
Dichloromethane	257	339	526
Tetrachloroethene	20	40	90
Trichloroethene	1	3	6
Trans 1,2 Dichloroethene	21	37	76
Trichloroethene	1	3	6
Vinyl Chloride (chloroethene)	0.06	0.08	0.12
Semi-Volatile Organic Compounds			
2-Chloronaphthalene	370 (114)	902 (280)	2,098 (669)
Acenaphthene	110,000	110,000	110,000
Acenaphthylene	110,000	110,000	110,000
Anthracene	520,000	540,000	540,000
Benzo(a)anthracene	170	170	180
Benzo(a)pyrene	77	77	77
Benzo(b)fluoranthene	44	45	45
Benzo(g,h,i)perylene	3,900	3,900	4,000
Benzo(k)fluoranthene	1,200	1,200	1,200
Chrysene	350	350	350
Dibenzo(a,h)anthracene	3.5	3.6	3.6
Fluoranthene	23,000	23,000	23,000
Fluorene	63,000 (31)	68,000	71,000
Hexachloroethane	21 (8)	50 (20)	111 (48)
Indeno(1,2,3-cd)pyrene	500	510	510
Naphthalene	1,800 (76)	3,900 (183)	7,800 (432)
Phenanthrene	22,000	22,000	23,000
Pyrene	54,000	54,000	54,000
Phenol	440*	690*	1,300*
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC_5-EC_6	3,200 (304)	5,900 (558)	12,100 (1,150)
Aliphatic hydrocarbons >EC_6-EC_8	7,800 (144)	17,400 (322)	39,600 (736)
Aliphatic hydrocarbons >EC_8-EC_{10}	2,000 (78)	4,800 (190)	11,300 (451)
Aliphatic hydrocarbons >EC_{10}-EC_{12}	9,700 (48)	22,900 (118)	47,300 (283)
Aliphatic hydrocarbons >EC_{12}-EC_{16}	59,000 (24)	82,000 (59)	90,000 (142)
Aliphatic hydrocarbons >EC_{16}-EC_{35}	1,000,000**	1,000,000**	1,000,000**
Aliphatic hydrocarbons >EC_{35}-EC_{44}	1,000,000**	1,000,000**	1,000,000**
Aromatic hydrocarbons >EC_8-EC_{10}	3,500 (613)	8,100 (1,503)	17,000 (3,580)
Aromatic hydrocarbons >EC_{10}-EC_{12}	16,000 (364)	28,000 (899)	34,000 (2,150)
Aromatic hydrocarbons >EC_{12}-EC_{16}	36,000 (169)	37,000	38,000
Aromatic hydrocarbons >EC_{16}-EC_{21}	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{21}-EC_{35}	28,000	28,000	28,000
Aromatic hydrocarbons >EC_{35}-EC_{44}	28,000	28,000	28,000
Minerals			
Asbestos	Stage 1 test – No asbestos detected with ID; Stage 2 test - <0.001% dry weight (exceedance of either equates to an exceedance of the GAC)[1]		

Notes:

'-' Generic assessment criteria not calculated owing to low volatility of substance and therefore no pathway, or an absence of toxicological data.

NR - SAC for 1,3,5-trimethylbenzene is not recorded owing to the lack of toxicological data, SAC for 1,2,4 trimethylbenzene may be used

EC - equivalent carbon. GrAC - groundwater assessment criteria. SAC - soil assessment criteria.

* The GAC for Phenol is based on a threshold which is protective of direct contact (SC050021/Phenol SGV report)

** Denoted SAC calculated exceeds 100% contaminant, hence 100% (1,000,000mg/kg) has been taken as SAC

The SAC for organic compounds are dependent on Soil Organic Matter (SOM) (%) content. To obtain SOM from total organic carbon (TOC) (%) divide by 0.58.
1% SOM is 0.58% TOC. DL Rowell Soil Science: Methods and Applications, Longmans, 1994.

SAC for TPH fractions, PAHs napthalene, acenaphthene and acenaphthylene, BTEX and trimethylbenzene compounds were produced using an attenuation factor for the indoor air inhalation pathway of 10 to reduce conservatism associated with the vapour inhalation pathway, section 10.1.1, SR3.

(VALUE IN BRACKETS)

RSK has adopted an approach for petroleum hydrocarbons in accordance with LQM/CIEH whereby the concentration modelled for each petroleum hydrocarbon fraction has been tabulated as the SAC with the corresponding solubility or vapour saturation limits given in brackets.