



John Southworth Builders Ltd

Fernhill Caravan Park, Every Street, Bury

REMEDIATION VERIFICATION REPORT

11752 R05 (00)

RSK GENERAL NOTES

Project No.: 11752

Title: Remediation Verification Report: Fernhill Caravan Park, Every Street, Bury

Client: John Southworth Builders Ltd

Date: August 2023

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Figure 1 Plot Validation Site Plan

APPENDICES

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1. INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) was commissioned by John Southworth Builders Ltd (herein referred to as 'the Client') to prepare a remediation verification report to support discharge of land contamination related planning conditions.

The project was carried out to an agreed brief as set out in RSK tender 11752 TL01 (01) dated 15 September 2022.

RSK's service constraints are shown in **Appendix A**.

The Site in question is being developed as a residential caravan park.

The client John Southworth Builders Ltd commissioned RSK to act as their client representative on a part-time basis for duration of the remedial works.

1.2 Site Background

The Site boundary and current site layout are shown in **Figure 1** (ref: 11752-MA-112-SS-D-C-11201-P01). The Site covers an area of approximately 0.69 hectares. It was formerly occupied by Fernhill Caravan Park, a residential site for travellers with 17 plots and six facility blocks.

The site is roughly rectangular in shape and access is gained via Every Street, along the central northern boundary.

The Site is subject to planning application 67596 dated 01/11/2021 with Bury Council. Planning conditions 3 and 4 relate to contaminated land matters.

Historical records show that the site was part of a large gravel pit, shown to be completely infilled by 1930. A rail line is shown cutting through the site in the early 20th century. The site was used as a council depot since 1978. Adjacent historic land uses were predominantly industrial, with maps showing the presence of woollen mills, hat/textile works, an iron foundry, chemical works and a sawmill. A refuse incinerator is shown from the late 19th century; it is considered possible that some or much of the former gravel pit may have been infilled using material generated by the incinerator.

The site has been subject to several phases of previous investigation which identified made ground noted to contain elevated concentrations of metals and polycyclic aromatic hydrocarbons. Asbestos was also encountered within the recent made ground.

The report recommends that a 0.6m thick inert cover system would be required in areas of proposed gardens, the details of which should be set out within a remediation strategy. The requirement for a remediation strategy is outlined in planning condition 3 which states that 'Where remediation/protection measures is/are required, a detailed Remediation Strategy shall be submitted to, and approved in writing by, the Local Planning Authority'.

RSK produced the following Remediation Strategy in respect of condition 3 of the planning application:

- Remediation Strategy (ref: 11752-01 R00), dated October 2022, prepared by RSK Environment Ltd;

Following on from the Remediation Strategy, condition 4 of the planning application states:

Following the provisions of Condition 3 of this planning permission, where remediation is required, the approved Remediation Strategy must be carried out to the satisfaction of the Local Planning Authority within agreed timescales; and A Site Verification Report detailing the actions taken and conclusions at each stage of the remediation works, including substantiating evidence, shall be submitted to and approved in writing by the Local Planning Authority prior to the development being brought into use.

This report documents the verification report stipulated in condition, as above.

1.3 Objectives

The objective of this verification report is to demonstrate that remedial works have been undertaken in line with the remedial strategy (RS), reference 11752 R01 (00), to demonstrate the site is suitable for end use as a residential caravan park.

1.4 Proposed Development

The proposed layout of the site, at the time of preparing this report, is included in **Appendix B**.

Proposed development plans show that the entire site is to be demolished and the 17 individual plots are to be reduced to 12, including six single-storey double-facilities blocks, around the margins of the site, with each block to be shared between two plots. There will still be an office building to the east of the site entrance in the northeastern corner of the site. Each plot will contain sufficient space for either one or two touring caravans, which will be used for sleeping and it will also have private soft landscaped areas.

Details from LK Remediate indicate an initial removal of hardstanding and obstructions up to 2m below existing ground level (mbegl). At this stage, allowance for a 1.50 m turnover of shallow material is to be excavated and re-engineered, if chemically and geotechnically suitable, for construction platforms. Approximately 9,750 m³ of soil will be excavated to be taken from the perimeter bunds and made ground beneath the site surface.

Cut and fill calculations performed by LK Remediate indicate a surplus of material in the region of 3,700 m³ requiring removal from the site without any value engineering. Approximately 650 m³ of recycled aggregates is proposed to be won from crush for the construction of piling mats and 1,000m³ of validated clean soils proposed to be won for reuse as subsoil in the clean cover layer gardens. This could reduce the surplus to circa 2,100 m³. Surplus material is to be removed from the site by a registered waste carrier to a suitably licenced facility.

1.5 Pertinent Reports

The following reports detailing previous works by third parties at the site were available to RSK and should be read in conjunction with this report:

- Tergeo Ltd, Travellers Site, Every Street, Bury, BL9 5BE, Ref: 0293_01, March 2017.
- LK Remediate, Verification Report for the Remediation and Enabling Works at Fernhill Caravan Park, Every Street, Bury Report ref: LKR221029VR Rev 0

The following reports pertaining to the site have been completed by RSK:

- Geo-environmental and geotechnical site investigation: Fernhill Caravan Park, Every Street, Bury 11542-R02 (00) dated August 2021, prepared by RSK Environment Ltd;
- Preliminary Risk Assessment (ref: 11542-01 {R00}, dated December 2020), prepared by RSK Environment Ltd;
- Remediation Strategy (ref: 11752-01 R00), dated October 2022, prepared by RSK Environment Ltd;
- Materials Management Plan (ref: 11752 MMP (R Final), dated November 2022, prepared by RSK Environment Ltd; and
- RSK Review of LK Remediate MMP Verification Report (ref: 11752 L01 (00), dated March 2023, prepared by RSK Environment Ltd.

1.6 Limitations

This report is subject to the RSK service constraints given in Appendix A and limitations that may be described through this document.

2. PROPOSED REMEDIATION

2.1 Introduction

The general principles underpinning the proposed remediation are presented in the following section.

Following evidence provided in RSK remediation strategy (11752-R01(00)) and LK Remediation Strategy and Enabling Works (LKR221029VR Rev 1) in **Appendix B**, it is considered that the remediation works are split into 'pre-construction' (or enabling works) phase and the 'build phase' i.e., during the development works) phase.

2.2 Contamination Source Removal

It was concluded that made ground present both underlying the site and contained within the bund was not suitable to be present at the surface and accessible to residents for the proposed end use as a caravan park as well as maintenance workers who may be required to excavate where services are installed.

Proposed remediation included earthworks segregation, all areas of hardstanding comprising buried floor slabs, historical foundations, roadways, and former car-parking areas to be broken out and excavated to stockpile. Reductant private drainage pipes and manholes to be broken out and excavated to stockpile.

Soils that are excavated are planned to be split into temporary stockpiles and tested, where appropriate to confirm suitability for the following categories of use:

- Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials.
- Material suitable for inclusion within 600 mm of surface in soft landscaping areas.
- Material suitable for placing beneath car parks and roadways.

2.2.1 Watching Brief

A general watching brief was recommended to be maintained throughout earthworks looking for visual and/or olfactory evidence of contamination to be identified and assessed.

If unexpected horizons of contaminated soils were identified during excavation works, the contractor was to inform the site manager and/or contact the environmental consultant immediately. Work was to be postponed around discovery and the work area cordoned off. The soils were to be inspected, sampled, and or/analysed to assess the potential risk. The environmental consultant was to document any findings.

Stockpiled materials were to be clearly marked and referenced on site to minimise the risk of materials that either not validated, unsuitable or destined for off-site disposal being refused in error.

2.3 Off-site/Waste Disposal

All material to be disposed off-site was to be sampled, tested, assessed and classified in accordance with WM3. Where appropriate, further Waste Acceptance Criteria (WAC) analysis was to be undertaken to identify the suitability of material for disposal at a specific class of landfill where WAC limits apply.

Where material was anticipated to be removed from site, chemical testing to inform waste classification of the material was to be undertaken although chemical test data is already available from the previous bund investigation in 2018 and the August 2021 investigation. Two samples (HP8 and HP10) from the analysis undertaken by RSK of the bund were noted to have a concentration of hydrocarbon compounds which exceeded 1,000 mg/kg and are considered to exceed the hazardous threshold for carcinogenic risk HP7, and mutagenic risk HP11. Three samples (BH2 at 0.40 m, BH2 at 1.55 m and BH6 at 0.60 m) from the analysis undertaken by RSK from boreholes drilled across the site are considered to be hazardous waste for the same risk factors. It is anticipated that zinc also fails the threshold within BH2 at 1.55 m.

Daily records were to be kept of all material movements at the site with periodic visits by a John Southworth Builders Ltd appointed geo-environmental engineer to inspect and test stockpiles of material proposed for re-use with written confirmation that material may be re-used provided. Annotated plans of excavations, stockpile locations and reuse areas will be maintained on-site for subsequent inclusion with the MMP Verification Report. Soils found unsuitable for any of the above purposes were to be consigned for offsite disposal.

2.4 Asbestos Management

RSK considers the works are not licensable and that notification of the works to the Health and Safety Executive (HSE) is not required.

Before excavation works at the site commence, air monitoring was recommended to be undertaken by a specialist asbestos consultant comprising:

- Air monitoring and fibre counting on one occasion at locations along the site boundary where nearby commercial sites are present (this may require multiple locations to be monitored).

2.5 Use of Materials as General Fill

In line with cut/fill calculation outlined by LK Remediate, estimates initially showed there could be approximately 1885.95 m³ of material re-used at the site to reduce site levels to those stated in approved level drawings.

Given the soil turnover to be used as a construction development platform, soil materials are to be re-used on site and additional chemical testing was requested to be undertaken to inform suitability for re-use.

Soils that were excavated were anticipated to be temporarily stockpiled and tested, where appropriate, to confirm suitability for the following categories of use:

- Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials.

- Material suitable for inclusion within 600 mm of surface in soft landscaping areas.
- Material suitable for placing beneath car parks and roadways.

2.5.1 Site-Won Materials

By design, placement of site won soil >600mm below the final restoration level in soft cover areas or below hard surfacing (buildings, hardstanding etc.) is sufficient to protect end-users from direct contact with soil contaminants. Thus, a remedial criterion for contaminants, including asbestos in soil, are not applicable to soils destined for re-use as general fill.

2.5.2 Imported Materials Suitable for Use

The sampling and testing frequency for the validation of chemical suitability of imported recycled aggregate/imported soil/site-won made ground for use as general fill is minimum 3, or 1 per 250 m³ (whichever is the greater).

Additionally, where materials are intended to be brought onto site from elsewhere, chemical testing of material at the source should reduce the likelihood that unsuitable material will be delivered to site. Records for all soil imports should include the following:

- Certificates of quality - material imported under the WRAP protocol will be accompanied by certificates of conformity that are less than two months old and relating to the material being imported.
- Invoices and lorry tickets – importation tickets should be completed in full and legible so the origin of the soil can be traced to the specific donor site.
- Chemical test data – all data obtained from the donor site or from site initiated chemical testing.
- Storage – the location of temporary storage or quarantine areas will be identified, and plans/photographs retained to show where the position and movement of stockpile at the site.

2.6 Criteria for Simple Soil Cover System

2.6.1 Imported Materials Suitable for Use

To demonstrate the suitability of a soil brought to site, the type and frequency of confirmatory soil analysis will be in line with that in Table 1 of the Remediation Strategy. Where appropriate chemical test data is not available, additional sampling will be undertaken once the material is received at site.

Table 1 Sampling and testing frequency requirements for cover system validation

	Number of samples	Testing schedule
Greenfield soils	Minimum 3, or 1 per 250 m ³ (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), asbestos
Brownfield / screened soils	Minimum 6 or 1 per 100 m ³ (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), TPH (CWG banded), asbestos and any additional analysis depending on the history of the donor site

2.6.2 Soft Cover System

Where a clean soil cover system is proposed for garden and landscaping areas where these are situated on made ground, system shall be a minimum of 600 mm thick and comprise a 150 mm minimum thickness of topsoil, overlying a suitable thickness of subsoil.

A marker layer of Terram shall be placed between the cover system and underlying made ground soils. The marker layer of Terram will not be required if natural in situ soils form part of the cover system.

Following placement of the cover system the resulting thickness should be checked by excavation and measurement, including confirmatory photographic records at a frequency of 1 per 2 plots/gardens and 4 in total for landscaped areas. It is proposed that the Principal Contractor will provide the environmental consultant with photographic evidence confirming that the physical thickness of installed cover systems are in accordance with the provisions of this document. The environmental consultant shall undertake 'spot checks' of the physical thickness of installed cover systems at a frequency not less than 1 in 10 plots in order to verify the records provided by the Contractor.

Any soils that are present within 0.6 m of ground level in gardens and 0.30 m of ground level in other landscaped areas are assessed using Human Health Generic Assessment Criteria, shown in **Appendix B** (ref: 11752 R01 (00), Appendix C: Table 4) and adopted for the assessment of potential risks.

3. REMEDIAL ACTIONS – PRE-CONSTRUCTION

Site remediation works were completed by LK Remediate and were documented in the following report:

- LK Remediate. Verification Report for the Remediation and Enabling Works at Fernhill Caravan Park, Every Street, Bury LKR221029VR Rev 1. April 2023

This section provides an indication of remedial actions undertaken with reference to the above.

3.1 Contamination Source Removal

LK Remediate undertook the remediation and enabling works at the site at Fernhill Caravan Park. The enabling and pre-construction works were supervised on a full-time basis on behalf of RSK by a suitably qualified LKR remediation site manager with additional support and part time supervision by a geo-environmental engineer.

A watching brief for any unusual ground conditions or visual or olfactory evidence of contamination (including asbestos containing material) was maintained by a suitably qualified LKR remediation site engineer and briefed site personnel. No evidence of significant unexpected visual or olfactory contamination was identified.

As part of the enabling worked, previous contamination hotpots were outlined in perimeter bunds, this material was quarantined and then taken to suitable hazardous waste management facility.

A 75 mm diameter asbestos cement duct was encountered in made ground in the centre of the site during the course of LKR's works. It was noted to be intact and in good condition with no evidence of significant deterioration.

No groundwater was encountered during the enabling works.

3.2 LKR Assessment of Site Generated Aggregates

Material classification testing was undertaken on site generated aggregates. Four samples of site generated aggregate (CR01-CR04) were collected and sent for geotechnical laboratory testing. Samples were scheduled for the following suites of testing:

- Metals / metalloids, pH, Water soluble sulphate, speciated PAH's, TPHCWG, BTEX, MTBE, SOM and asbestos screen (including identification and type, if present).

Whilst exceedances were noted, the testing indicates the site generated 6f2 is suitable for use where no direct contact pathway exists, such as beneath plots, roadways are beneath clean cover soils. Based on the above information, the site generated aggregates are considered suitable for use beneath clean cover soils.

3.3 LKR Assessment of Site-won Materials

Site-won subsoil was categorised as being from a greenfield source on the basis that it was generated from natural strata >2.00 m below ground level and has not been subjected to what could be considered 'brownfield activity'. Several samples of site generated natural subsoils were collected for laboratory testing and results were compared to the nearest appropriate SOM based on residential with plant uptake land use.

Samples were scheduled for the following suites of testing:

- Metals/metalloids, pH, water soluble sulphate, speciated PAH's, TPHCWG, BTEX, MTBE, SOM and asbestos (including identification and type, if present).

There were no exceedances of generic assessment criteria for site generated subsoil for use in private garden and therefore this material is considered suitable for use.

At the time of the testing, site won subsoils were suitable for use as part of clean cover in gardens and soft landscaping. Steps should be made to continue segregation through the construction phase of works to avoid cross contamination of clean site own material.

3.4 Management of Asbestos-containing Material

The remediation strategy required a watching brief throughout the remedial works. Evidence of this is provided in Verification Report (ref: LKR221029VR Rev 1) included in **Appendix B** shows ongoing supervision of a component geo-environmental engineer throughout the works.

RSK were informed that Asbestos chrysotile (<0.001%) were identified on site in locations TP503e and CR08. A 75 mm piece of ACM was observed during works and was removed by a licensed contractor. Following this an asbestos cement pipe was removed in removal works in January 2023.

Analyses of the site-won crush indicates the presence of very small quantities of asbestos fibres in one of eight samples tested (sample CR08 <0.001%). All the site-won crush has been placed in area which will be below hardstanding or within building footprints, so the long-term potential risk from these fibres becoming airborne is negligible. During the remainder of the construction period, construction should be aware of the potential risk, particularly in dry conditions, when any particles have a potential to become airborne if disturbed. In such conditions, when any particle have a potential to become airborne if disturbed spray misting with water would be sufficient to ensure any such particles remain bound within the crush material.

RSK agrees with assessment of crush material and that it is suitable for reuse below hardstanding. Asbestos impacted material should be included in an Asbestos Management Plan for future groundworkers and utilities engineers.

As part of this ongoing plan, background air monitoring was conducted during the first week as a requirement of the remedial strategy. As part of the Verification Report (ref: LKR221029VR Rev 1, Appendix 13: Air Monitoring) provided in **Appendix B**, boundary air monitoring was shown to be undertaken on 15 November 2022, site air test certificates are provided as evidence.

Air monitoring carried out in accordance with all current Health and Safety Executive (HSE) regulations and by the Control of Asbestos Regulations (CAR, 2012).

3.5 Re-use of Materials

Based on the site investigation and risk assessment, the Made Ground in-situ was considered suitable for use beneath hardstanding and clean cover soils. The majority of made ground encountered during the remediation works comprised varying degrees of rubble, ash and reworked natural strata, as described in the site investigation report. There was significant variation in the type of made ground encountered across the site therefore segregation of made ground material for re-use was not required.

The MMP anticipates that the turnover of made ground and cut/fill to level estimated to generate a surplus of approximately 3,698 m³, comprising 650 m³ of suitable aggregates for re-use in road capping and pile mats, 1050 m³ of subsoil and 1998 m³ surplus for disposal during enabling works phase. Quantity of material used below:

Table 2 Quantities of Material Used - Verification Report (ref: LKR221029VR Rev 1)

Item	Anticipated Volumes (m3)	Actual Volumes (m3)
Surplus material for disposal	1,998	2,525
Clean subsoil for use in capping gardens	1,050	602
Clean MOT for use hard to dig part of subsoil capping in gardens	N/A	556
Suitable aggregates for use in pile mats and road capping	650	606

Volumes of materials re-used under the MMP, although variations to original declaration were undertaken, are similar to those submitted and LKR consider the four guiding principles of the MMP have been adhered to and materials can be considered non-waste.

3.6 Waste Disposal

To facilitate removal of surplus soils to an appropriate waste stream, a soil segregation plan was produced which outlined sources of surplus material to be removed from site.

The LK remediate report was sent to waste hauliers for consideration prior to start of material being removed from site. The objective was to ensure that surplus materials generated from site were adequately classified and managed to identify a suitable disposal route.

A Material Management Plan was prepared by RSK Environmental Ltd (ref: 11752 MMP (00)), prior to start of site to cover re-use of materials on site. The reuse of materials under DoW CoP was agreed with regulators (Bury Council and Environment Agency) and declaration was made, included in MMP report in **Appendix B**.

Waste material (including general demolition waste and quantities of fly-tipped general waste) were segregated into appropriate waste types and removed from the site by registered waste carriers to suitably licensed facilities. Surplus soils were managed with recourse to the soil segregation plan and disposed of off-site to licensed facilities.

During remediation waste was transferred off site in the form of lorry loads. Waste transfer sheets and collection delivery notes were provided by John Southworth Limited as part of record keeping. Total volumes are provided within the Verification Report (ref: LKR221029VR Rev 1), included in **Appendix B**.

4. REMEDIAL ACTIONS – BUILT DEVELOPMENT

4.1 Implementation of a Cover System Soil

The Remediation Strategy included for the provision of a simple cover system in areas of soft scraping that overlies made ground. The cover system has been designed to comprise a minimum of 600 mm soil capping layer that includes a minimum 150mm thickness of suitable topsoil underlain by subsoil.

4.2 Source Information of Material Used Within a Cover System

4.2.1 Imported Topsoil

John Southworth Builders Limited imported topsoil from Cheshire Soils and Aggregates LTD from Altrincham Business Park, Altrincham.

The following document was provided to RSK for review detailing chemical analysis, shown of the material at source:

- I2 Analytical Report Number: 22-41097, dated 4 March 2022

The report included the soil testing of 1 soil samples of topsoil undertaken on 22 February 2022 with the chemical test data indicating that topsoil is suitable for use in residential development. A copy of the chemical analysis report is presented in **Appendix D** for reference.

4.2.2 Subsoil

John Southworth Builders Limited re-used crushed 'site-won' aggregate for capping within gardens, with anticipated volume roughly 1,050 m³. Most of this material was used from areas of relict foundations and hard materials that were grubbed out and processed for re-use on site in accordance with the declared MMP under recourse to the WoW COP.

All retained stockpiled subsoils for use in build phase remediation were clearly demarcated on site. At the time of the testing, site-won subsoils were suitable for use as part of clean cover in gardens and soft landscaping, as part of ongoing construction

4.3 Physical Validation of Cover System Soils

During the visit on 11 August 2023, RSK carried out the physical inspection of the soil cover system in the areas of soft landscaping across the site. In addition, John Southworth Builders Limited provided RSK with photographic evidence confirming 600 mm of cover system in remaining plots.

VP02 was situated on an area of soft landscaping in close proximity to the access road in the centre of the site. Locations VP03, VP04, VP08 and VP10 were all situated in the long narrow strip of soft landscaping close to proposed back gardens. The following ground conditions were observed:

Table 3 – RSK (ref: RSK Photographic Log, in Appendix C)

Location (ID)	Topsoil thickness (m) / Description of material	Subsoil Thickness (m) / Description of material	Terram layer (Y/N)
VC02	0.16 m Light brown slightly sandy Clay with occasional rootlets.	0.44 m Dark brown to grey and slightly red sandy Clay.	Y
VC03	0.25 m Light brown slightly sandy Clay with occasional rootlets.	0.40 m Dark grey slightly sandy gravelly Clay	Y
VC04	0.15 m Light brown slightly silty sandy Clay with fine gravels and rootlets.	0.45 m Dark brown slightly red sandy gravelly Clay	Y
VC08	0.15 m Light brown slightly silty Clay with occasional rootlets.	0.50 m Dark brown to black very slightly sandy gravelly Clay.	Y
VC10	0.15 m Light brown slightly silty Clay with occasional rootlets.	0.60 m Light to dark brown slightly sandy CLAY	Y

The areas of the site which were inspected by RSK are indicated on **Figure 1**.

The thickness of the cover system was physically validated in total of five plots out of 12 locations (as shown on Figure 1). RSK can confirm that the topsoil was generally described as dark brown slightly silty clay with rootlets, was measured between 0.11 m and 0.25 m thick. Subsoil described as light brown to grey slightly sandy gravelly clay was present below the topsoil and measured between 0.39 m and 0.49 m thick. It was confirmed by the RSK Engineer that in soft scraping validated the total thickness of cover system was in excess of 600 mm in accordance with the RS.

Photographic evidence of the physical validation of the soil cover system in communal landscaping areas across the site is presented in **Appendix C**.

5 CONCLUSIONS

In line with the RVS, RSK has undertaken a watching brief and conduct soil thickness validation tests. RSK verified the implementation of the required cover system in soft-scaping areas.

Five number of plots out of twelve were complete during the inspection on 11 August 2023. Following this report, a further seven validation checks from the contractor will be provided to RSK to be added into the report findings.

In conclusion, based on the information to date, the remedial strategy and implementation on site has been successful in attaining the objectives set for site development.

FIGURES



DO NOT SCALE FROM THIS DRAWING



LEGEND

- Site boundary
- Existing plot locations

Notes:

Base plan provided by Client
No.Ref: 'Proposed Site Layout - 19144-101H'

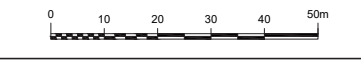
P01	16.08.23	First Issue	LS	##	##
Rev	Date	Amendment	Drawn	Chkd	Appd



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Client		
John Southworth Builder Ltd		
Project Name		
Fernhill Caravan Park		
Description		
Plot Validation Site Plan		
Project ID	Drawing no.	Revision
11752	11201	P01
File name		
11752-MA-112-SS-D-C-11201-P01		
Dimensions	Scale	Size
m	1:1000	A3
		

PRELIMINARY REVISION
TO BE REVISED

APPENDIX A

RSK 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 John Southworth Builders Limited (the "client") in accordance with the terms of a contract [RSK Environment Limited Standard Terms and Conditions] amend if work not done under RSK standard terms between RSK and the "client", dated February 2021. The Services were performed by RSK with the skill and care ordinarily exercised by a reasonable 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.
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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 site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS and related compounds) 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

PREVIOUS REPORTS



John Southworth Builders Ltd

Fernhill Caravan Park, Every Street, Bury

Remediation Strategy

11752 R01 (00)

RSK GENERAL NOTES

Project No.: 11752

Title: Remediation Strategy: Fernhill Caravan Park, Every Street, Bury

Client: John Southworth Builders Ltd

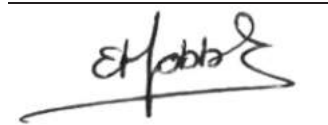
Date: October 2022

Office: RSK Environment Limited, Fourways House, 57 Hilton Street, Manchester, M1 2EJ. Tel 0161 2362757

Status: Rev 00

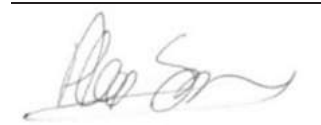
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Revision control sheet				
Revision ref.	Date	Reason for revision	Amended by:	Approved by:
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1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by John Southworth Builders Ltd on behalf of Bury Council to prepare a remediation strategy (RS) document for the proposed development of the Fernhill Caravan Park located at Every Steet, Bury. The requirement to produce a Remediation Strategy is in line with pre-commencement planning conditions (planning conditions 3 and 4) in planning application 67596 dated 01/11/2021 with Bury Council.

1.1 Background

The Site boundary and current site layout are shown on [Figure 2](#). The Site covers an area of approximately 0.69 hectares. It is currently occupied by Fernhill Caravan Park, a residential site for travellers with 17 plots and six facility blocks.

The site is roughly rectangular in shape and access is gained via Every Street, along the central northern boundary.

Each individual plot was separated by wooden fencing secured with concrete posts, approximately 1.20 m high, and occupied plots contain a mobile caravan, which have a lounge and bedrooms that are used by the occupants. The facility blocks include a food preparation area with plumbing for washing, cleaning, and toilets.

RSK completed an intrusive investigation at the site in March 2021 which included 5no. window sample boreholes to a maximum depth of 6.45mbgl. Ground conditions encountered comprised recent made ground of clay and silty sand with much brick and gravel, and varied in thickness from 0.50m to up to 2.00m. Pre 1930's made ground comprised almost exclusively of ash and clinker and was encountered within borehole BH2 underlying the recent made ground. Underlying the made ground was medium dense silty sand and silt (alluvium). Groundwater was noted to be confined to sand lenses within the silt and was deep during the ground gas monitoring programme.

The made ground was noted to contain elevated concentrations of metals and polycyclic aromatic hydrocarbons. Asbestos was also encountered within the recent made ground.

Given the presence of hydrocarbons within made ground, it was recommended that barrier pipes, in the form of Protectorline or similar, be utilised on site to reduce the risk of contamination permeating potable water supply pipes and impacting drinking water. If inert service corridors are installed during the significant 'turnover' of the site, the requirement for barrier pipes may be removed to PE piping.

The report recommends that a 0.6m thick inert cover system would be required in areas of proposed gardens, the details of which should be set out within a remediation strategy. The requirement for a remediation strategy is outlined in planning condition 3 which states that 'Where remediation/protection measures is/are required, a detailed Remediation Strategy shall be submitted to, and approved in writing by, the Local Planning Authority'.

1.2 Objective

The objective of this RS document is to clearly set out the present site condition and state the objectives of the remediation work to be carried out in order to address pre-commencement planning conditions (planning conditions 3 and 4) in planning application 67596 dated 01/11/2021 with Bury Council.

1.3 Scope of report

The scope of this report is to present a RS, the function of which is to demonstrate to the regulatory and planning authorities that the full details of required remedial actions have been considered and documented. The following details are included for approval by the regulatory and planning authorities before works commence:

- remediation objectives with details of proposed remediation and verification works
- mitigation measures
- licenses and consents
- contingency measures.

Given that the development form will be adequate to achieve a remediation solution for the site by providing an engineered break in the pathway of potentially complete contaminant linkages, completion of a remediation options appraisal was not considered necessary.

In addition to the RS, there remains a requirement in a condition of the extant planning permission for a verification report to be completed once the remediation works have been finished, and for formal approval of this document to be confirmed in writing by the local planning authority before the site is occupied.

1.4 Limitations

The RS is presented to a level of detail considered sufficient for the purposes of planning and regulatory authorities. 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 should be noted any change to the development layout, proposed end uses, or other significant amendment will impact on the findings and recommendations of this strategy and may require its full or partial reinterpretation.

This report is subject to the RSK service constraints given in [Appendix A](#).

1.5 Proposed development

The proposed development will include construction of a number of green/blue-roofed The proposed layout of the site, at the time of preparing this report, is shown in [Appendix B](#).

Proposed development plans show that the entire site is to be demolished and the 17 individual plots are to be reduced to 12, including six single-storey double-facilities blocks, around the margins of the site, with each block to be shared between two plots. There will still be an office building to the east of the site entrance in the north eastern corner of the site. Each plot will contain sufficient space for either one or two touring caravans, which will be used for sleeping and it will also have private soft landscaped areas.

Details from LK Remediate indicate an initial removal of hardstanding and obstructions up to 2m below existing ground level (mbegl). At this stage, allowance for a 1.5m turnover of shallow material is to be excavated and re-engineered, if chemically and geotechnically suitable, for construction platforms. Approximately 9,750m³ of soil will be excavated to be taken from the perimeter bunds and made ground beneath the site surface.

Cut and fill calculations performed by LK Remediate indicate a surplus of material in the region of 3,700m³ requiring removal from the site without any value engineering. Approximately 650m³ of recycled aggregates is proposed to be won from crush for the construction of piling mats and 1,000m³ of validated clean soils proposed to be won for reuse as subsoil in the clean cover layer gardens. This could reduce the surplus to circa 2,100m³. Surplus material is to be removed from the site by a registered waste carrier to a suitably licenced facility.

2 SUMMARY OF CONCEPTUAL MODEL AND RISK ASSESSMENT

2.1 Introduction

This section of the report lists the previous reports provided to RSK for review and produced by RSK as part of the various stages of investigation. A conceptual site model (CSM) was developed and refined during the earlier phases of investigation 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 Environment Agency publication the Land Contamination Risk Management (LCRM) guidance. Where exploratory hole locations from the preceding phases of the RSK work are referenced, their locations on site are presented on [Figure 2](#).

2.2 Previous investigations

2.2.1 RSK reports

The following reports detailing investigation and assessment undertaken at the site by RSK have been produced:

- Soil Assessment – Generic Quantitative Risk Assessment: Traveller Site (Fernhill Caravan Park), Bury 11151-R01(01), dated October 2018.
- Soil Assessment – Detailed Quantitative Risk Assessment: Traveller Site (Fernhill Caravan Park), Bury 11151-R02(00), dated October 2018.
- Preliminary Risk Assessment (PRA): Fernhill Caravan Park, Every Street, Bury. 11542-R01(00) dated December 2020.
- Geo-environmental and geotechnical site investigation: Fernhill Caravan Park, Every Street, Bury 11542-R02(00) dated August 2021.

2.2.2 Reports produced by Third Parties

The following report detailing an assessment of the soil mounds around the perimeter of the site was made available to RSK for review. A detailed review of this report was presented in the Geo-environmental and geotechnical report completed by RSK in August 2021.

- Tergeo Ltd, Travellers Site, Every Street, Bury, BL9 5BE, Ref: 0293_01, March 2017.

2.3 Findings of the RSK investigation (August 2021)

RSK carried out intrusive investigation works with subsequent monitoring and sampling of ground gases and groundwaters between March and June 2021 as reported in the RSK report 11542-R02 (00), dated August 2021. A summary of the findings of the investigations is provided in the below sections.

2.3.1 Geology and groundwater

2.3.1.1 *Surface construction*

Current ground surface across the site comprises a gravel stratum comparable to MOT road stone beneath a bitumen surface. In BH4, the thickness of bitumen was noted to be 0.55 m and was underlain by a significant thickness of gravel (0.50 m).

2.3.1.2 *Made ground*

The made ground which is considered relatively recently deposited was generally encountered beneath hardstanding and either comprised a very sandy clay or a silty sand. Both were noted to contain fragmented concrete, brick, bitumen and tar, glass, wood, and clinker. Where the bitumen was encountered, there was a slight hydrocarbon odour. The maximum depth of recent made ground from existing ground level ranged from 0.50 m to 1.90 m.

Deeper seated made ground encountered within borehole BH2 was distinctly different from the recent deposits and comprised principally ash and clinker with steel fragments and was conjectured to be waste bi-product deposited within the former gravel pit from the refuse destructor (incinerator) that was present beyond the north western boundary.

2.3.1.3 *Variable cohesive and granular unit*

The natural strata were encountered at a depth of between 0.50 and 1.90 below existing ground levels over the majority of the site; however, where the gravel pit was encountered within borehole BH2, the depth to natural stratum was 5.40 m. The strata were noted to comprise a soft and soft to firm / loose laminated clayey, very sandy silt or very silty sand. The units were highly variable in thickness and it is anticipated that there is likely to be more discrete variability with these strata than had been recorded within the visual assessment of the cores.

2.3.1.4 *Bedrock*

Bedrock was not encountered during the site investigation.

2.3.1.5 *Hydrogeology*

Site is underlain by superficial deposits comprising Till (an undifferentiated aquifer). Beneath the Till is bedrock of the Pennine Lower Coal Measures (a secondary A aquifer). The Till is a Secondary (undifferentiated) aquifer, and therefore low sensitivity.

The majority of groundwater strikes recorded during the investigation were situated within the silt. Borehole BH3 encountered groundwater perched within the made ground overlying natural clay. Resting groundwater levels were measured between 1.9m below existing ground level (begl), and 5.39m begl. For the duration of the monitoring programme, the groundwater within all the wells remained static. The greatest variation in groundwater level was noted in borehole BH3 in Round 5, with the first 4 visits having 0.27 m variability.

Shallow groundwater in the site area is anticipated to flow in a south westerly direction, i.e., towards and in the direction of flow of the River Irwell.

2.3.1.6 Observed contamination

The only odours recorded were associated within the recent made ground where bituminous materials were encountered. The odours are anticipated to be remnant diesel and polycyclic aromatic hydrocarbons associated with its use as a hardstanding but will be relatively immobile.

2.3.2 Contaminant linkages

Potentially complete contaminant linkages were identified following the intrusive investigation works and were assessed by risk assessment where appropriate. The contaminant linkages identified before a quantitative risk assessment was completed comprised:

- Linkage (1) – Plausible contaminant linkage to future residents via oral, dermal and inhalation exposure with impacted soil and soil vapour inhalation.
- Linkage (2) – Plausible contaminant linkage to future site residents by inhalation of airborne asbestos fibres from impacted soil.
- Linkage (3) – Plausible contaminant linkage to plant growth by vegetation uptake of contaminants
- Linkage (4) – Plausible contaminant linkage to water supply pipes via permeation of plastic by organic soil contaminants (with implications for human health).
- Linkage (5) – Plausible contaminant linkage to groundwater in the underlying aquifer via leaching of soil contaminants and dissolved phase migration from potentially impacted Made ground soil.
- Linkage (6) – Plausible contaminant linkage to future site residents from migration of onsite ground gasses and vapours into indoor areas via preferential pathways (such as backfill around services or compromised drainage) with subsequent risk of inhalation, asphyxiation or explosion.

2.4 Quantitative risk assessment (August 2021)

This section summarises the stages of quantitative risk assessment carried out during the project and is subdivided into human health and controlled waters receptors.

2.4.1 Human Health (Linkage 1)

All soil results in each dataset were directly compared against the GAC for residential with home-grown produce / residential without home-grown produce with a soil organic matter of 1%.

Recent, shallower made ground was noted to have slight contamination associated with lead and zinc (phytotoxic threshold), asbestos (loose fibres and cement of chrysotile), polycyclic aromatic hydrocarbon (PAH) compounds (principally benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(ah)anthracene), with the shallow sample of BH6 encountering additional PAH compounds (indeno(123-cd)pyrene, naphthalene and phenanthrene). Total petroleum hydrocarbon (TPH) compounds were encountered elevated above threshold concentrations also with the same samples with elevated concentrations of PAH compounds.

Deeper made ground within borehole BH2 was conjectured to comprise the bi-product of the waste destructor (ash and clinker). This stratum was noted to contain significant concentrations of arsenic (194 mg/kg), copper (1,440 mg/kg), lead (2,110 mg/kg), nickel (137 mg/kg) and zinc (1,100 mg/kg), although all concentrations of compounds within the TPH CWG and US EPA 16 suites were all negligible.

Two samples of natural strata were uncontaminated.

There was also a bund within the boundary of the site. This was sampled by both Tergeo and RSK during 2017 and 2018. Several samples in both investigations reported soil contaminants above the threshold for selected metals (zinc and lead), PAHs and total petroleum hydrocarbons bands, particularly between the chain lengths C12 to C16, C16 to C21 and C21 to C35. It was determined that rather being fuel derived, these were associated with the combustion of organic based materials, most likely in the form of ash and clinkers.

The report concluded that made ground present on site, both underlying the site and contained within the bund around the site boundary is not suitable to be present at the surface and accessible to residents for the proposed end use as a caravan park, as well as maintenance workers who may be required to excavate where services are located.

2.4.2 Asbestos (Linkage 2)

Asbestos was encountered within both the made ground underlying the site, as well as the bund surrounding the site. The analysis of the soils has identified the asbestos to be chrysotile and present as both fibres and clumps, with one sample of chrysotile board.

The bund was noted to contain loose fibres/clumps between 0.006% and 0.062% by weight.

A potential linkage therefore exists between asbestos that has been identified on site for the future site users, and for construction workers and users of adjacent sites during development works.

2.4.3 Phytotoxic risk (Linkage 3)

Phytotoxic metals were noted to be above threshold concentrations within the made ground, although below human health threshold concentrations. As the made ground requires remediation and mitigation due to other compounds and elements, the phytotoxic assessment becomes irrelevant and is addressed within the mitigation requirements.

2.4.4 Potable water supply pipes (linkage 4)

For initial assessment purposes, the results from the investigation were compared against the GAC 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 indicate that a relevant linkage is likely to exist associated with organic contaminants due to polycyclic aromatic hydrocarbon compounds within the TPH CWG analysis. We anticipate that Protectorline or similar barrier pipework will be required for the potable water supply for this site. The site is to undergo a significant 'turnover' and hence the materials will be completely disturbed. As the site is to have an inert service corridor, the requirement for this form of potable protection maybe removed to standard

PE piping; however, the threshold values as stated on the risk assessment must be achieved with imported aggregate.

2.4.5 Controlled waters (Linkage 5)

Groundwater analysis of samples obtained from the boreholes did not indicate that mobile contamination is present.

2.4.6 Ground gas (Linkage 6)

Six ground gas monitoring visits were undertaken between May and June 2021. Based on the results of the six monitoring rounds the maximum concentration of methane and carbon dioxide encountered across the site was 0.1% by volume and 7.4% by volume respectively. Methane was only encountered at this trace level within boreholes BH3 and BH5 on one occasion, with all other readings being zero. Carbon dioxide was only encountered above the initial assessment threshold of 5% on one occasion (BH2 third visit) with the next highest concentration of 4.1% by volume within BH2 (fifth visit).

Based on the current understanding of the conceptual site model and the assessment undertaken, the site has been classified as CS1. In accordance with BS8485, ground gas protective measures are not considered necessary within proposed buildings.

The NHBC Guidance for ground gas is not relevant to this form of development as this risk assessment is only to be used where ground floor slabs comprise a screed, block and beam/pre-cast concrete ground floor slab system. These structures will not be constructed in this manner.

2.5 Contaminant linkages requiring remedial action

Following the quantitative risk assessment, the following contaminant linkage was identified as still being potentially complete and requiring remediation or mitigation measures to be incorporated into the redevelopment planned for the site:

- Linkage (1) – Plausible contaminant linkage to future residents via oral, dermal and inhalation exposure with impacted soil and soil vapour inhalation.
- Linkage (2) – Plausible contaminant linkage to future site residents by inhalation of airborne asbestos fibres from impacted soil.
- Linkage (4) – Plausible contaminant linkage to water supply pipes via permeation of plastic by organic soil contaminants (with implications for human health).

3 REMEDIAL AND DEVELOPMENT OBJECTIVES

3.1 Remedial objectives

The objective of the remedial works is to address the relevant contaminant linkages identified in [Section 2.5](#), to render the site suitable for the proposed end use. The following remedial objectives are taken into account 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 taken into account in formulating this strategy:

- Subject to space restrictions, minimise off-site disposal of soil by re-using chemically and geotechnically suitable soil where possible and selecting materials as suitable for a particular purpose, e.g., some soils may be suitable beneath hard standing but unsuitable in open space (maintained landscape areas)
- 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.

4.2 Primary source removal

Primary sources of contamination (e.g. below ground storage tanks, area of landfilling waste, immediate risks to controlled waters) have not been identified at the site. Should primary sources of contamination be encountered during the redevelopment earthworks advice should be sought from RSK and the risks / implications considered in the context of this strategy.

Where required, the contamination shall be assessed by an environmental specialist and samples of the impacted materials submitted for chemical analysis. Dependent on the results of chemical testing and assessment it may be necessary to remove contaminated soils from the site. Removal of any unanticipated sources contamination will be documented and form part of the verification report.

In the event that removal of any unanticipated primary 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 Secondary source removal

Secondary sources identified at the site typical relate to the presence of elevated PAH compounds, heavy metals and asbestos in made ground beneath the site and within the perimeter bunds. For the purposes of this definition, made ground does not include engineering fill materials which have been recycled on site from demolition materials or any imported soils, aggregates which have been otherwise validated as suitable for the use to which it is intended.

4.3.1 Secondary sources - Contaminant Linkages 1 & 2

Based on the findings of the previous site investigations, the identified risks to human health receptors from direct contact / fibre inhalation from soils impacted by heavy metals, PAH compounds and asbestos can be managed by incorporation of engineered measures into the built development that isolate the end-user from potential exposure to these contaminants.

Engineered methods may include, but are not limited to, floor slabs, hard surfacing of areas (roads etc) and soil cover system in areas of soft landscaping or gardens where made ground materials are present (thus removing the pathway).

It should be noted that groundworks contractors working within the highways and paved areas are considered at risk of exposure to these contaminants and the adoption of adequate PPE and good site hygiene practices are recommended.

Where gardens and areas of soft landscaping are proposed and located over made ground materials, a clean soil cover system will be necessary. Cover systems should be at least 0.6m thick in gardens and 0.3m in other soft landscaped area (e.g. public open space areas) and comprise a minimum 0.15m thickness of suitable topsoil underlain by subsoil. A layer of marker Terram or 0.1m thick layer of inert hard to dig aggregate shall be placed between the cover system and underlying made ground soils.

Where made ground is currently present within 0.6m of the final ground levels in gardens or 0.3m in other soft landscaping areas, the made ground shall be removed to the requisite depth to allow installation of the cover system. Should in situ natural soils be present within 0.6m of ground level in gardens or 0.3m of ground level in other soft landscaping areas, these soils may be retained providing they are considered to be a suitable growing medium for vegetation and chemical testing is undertaken to demonstrate the soils are chemically suitable.

Any imported soils used in these areas should be subject to chemical validation testing of material imported and compared against the range of determinants and requirements for a simple soil cover system presented in [Section 5](#) (and in accordance with validation requirements outlined in [Section 5](#)). In addition, any material used as capping in these areas will need to possess sufficient infiltration characteristics to allow site drainage networks to function.

Photographic records showing the soil capping depth has been achieved will be required once completed along with information on the source for any imported clean soils. Photographs should include a survey staff for measurement as evidence the 600 mm capping requirements have been achieved. This information will be required for completion of the Phase 3b Site Validation Report for the project.

4.3.2 General Watching brief

Extrapolation between site data is undertaken to assume ground conditions between points of data collection. Therefore, it is possible the contamination that has not been identified could be encountered during development works.

A general watching brief should be maintained by construction site staff throughout earthworks looking for visual and/or olfactory evidence of contamination. This will allow any unexpected areas of contamination to be identified and assessed. In the event that unanticipated contamination (e.g. ACM, hydrocarbon impact) is encountered during earthworks, construction activities should be temporarily suspended in this area and the advice of an environmental specialist sought.

A methodology and/or appropriate measures for dealing with contamination can then be put into place before work continues (e.g. revised remediation strategy, production of a specific asbestos in soil management plan and during construction activities). It may also be necessary to inform the local authority where any unanticipated contamination is encountered to obtain their agreement with any proposals for dealing with the contamination, which in accordance with planning conditions, may require a revised remediation strategy to be prepared.

4.4 Management of asbestos in soil during redevelopment (Linkage 2)

Asbestos was encountered within both the made ground underlying the site, as well as the bund surrounding the site. The analysis of the soils has identified the asbestos to be chrysotile and present as both fibres and clumps, with one sample of chrysotile board. The bund was noted to contain loose fibres/clumps between 0.006% and 0.062% by weight.

The exploratory holes where asbestos in soil has been detected suggests that the asbestos is likely to be consistently present throughout the made ground soils that underlie and form the perimeter bunds of the site. As such it will be necessary to employ asbestos mitigation measures during the redevelopment work to safeguard the health and safety of site staff and users of adjacent sites (further details of which are provided in this section).

4.4.1 Safety of construction workers during ground works

Asbestos fibres are released more readily from granular soil. Exploratory hole records for previous investigations at the site indicate that a significant portion of made ground is granular, either silty sand within shallow made ground or ashy gravel in deeper historic made ground. Fibres are also released more readily during dry and windy conditions with fibre release reduced when soil moisture contents are maintained greater than 10%. Asbestos fibre concentrations in the soil range between <0.001% and 0.062%. To prevent, where practicable, exposure and spreading of asbestos fibres in line with the Control of Asbestos Regulations (2012) mitigation measures are recommended (see Section 4.4.4).

4.4.2 Users of adjacent sites during the earthworks

The area around the site primarily consists of industrial and commercial developments with a waste transfer facility to the west and other industrial units to the west and south. Of higher sensitivity is a primary school and residential area within 50m of the north of the site. Given the potential close proximity of the general public to the proposed works, this linkage will require mitigation measures to prevent, where practicable, exposure to adjacent occupants in line with the Control of Asbestos Regulations (2012) (see [Section 4.4.4](#)).

4.4.3 Mitigation measures for dealing with asbestos

It is likely that the asbestos that has been identified relates to asbestos containing materials which has become entrained within made ground from various historic sources prior to placement, likely from the site's historic development and subsequent demolition of a railway and two buildings of unknown use. From onsite testing, made ground present beneath the site and contained within the perimeter bunds have been found to contain chrysotile loose fibres and board.

In addition to the above, the moisture content of the soil samples is not known but it is likely that the potential may be variable across the site as the made ground can vary

considerably and their moisture content (linked to the ease of fibre liberation) can also be very variable. It will be necessary to control the release of nuisance dust from the site during the works and such control will also limit the release of asbestos. RSK considers the works are unlikely to require licensing but it is recommended to be notifiable to the HSE.

To manage spreading and exposure risks RSK recommends:

- Excavations within the made ground and perimeter bunds comprising made ground be dampened down.
- Stockpiles of the made ground and perimeter bunds comprising made ground to be covered.
- All site staff to receive training on the identification of ACM and an understanding of actions to be implemented if ACM is identified.
- Implement stop work procedures if potential unforeseen ACM is identified.

To demonstrate these mitigation works are adequate and because of the potentially close proximity of sensitive land uses to the north (primary school and residential area), RSK recommends boundary monitoring be undertaken during periods when excavating, handling and transporting the made ground. Further details of the boundary monitoring are provided in the following subsections.

4.4.4 Mitigation measures to manage spreading and exposure

The asbestos contamination within made ground presents a potential risk to site personnel and the general public during the development of the site. Disturbance of the made ground on site by vehicles and excavation activity has the potential to cause airborne fibre release. Fibre release is generally considered to be greatest from granular material with a low moisture content. This shall be minimised by the implementation of the following control measures:

- The exposed made ground soil should be dampened down to reduce the potential for asbestos fibre release. The moisture content at the surface of the area being excavated and in any uncovered stockpiles of excavated made ground material should be maintained at >10%.
- To prevent spreading of potential asbestos contamination to 'clean' soils, where excavated made ground should, if possible, be stored on impacted areas that are later to be excavated and removed or on hard standing. If this is not possible, stockpiles should be placed on plastic sheeting.
- If stockpiles are to be left in place for more than 12 hours, leading to possible drying out (or sooner if the weather conditions dictate), they shall be covered to prevent the possible release of fibres.
- When impacted soils are required to remain on site outside of working hours then appropriate fencing and signage should be present to secure the area.
- Vehicle movements need to be managed to avoid spreading of asbestos fibres. To minimise the potential for affecting natural soils within the site, vehicular movement routes should be signed and where possible loading areas will be restricted either to

hard standing, or to haul roads constructed of 'clean' imported fill or natural clean soils from site.

- Should the exterior or wheels of any tipper lorry be affected by potentially contaminated material, a vehicle jet-wash will be used to clean the vehicle, with the wash water directed into the contaminated area.

4.4.5 Health and safety of site personnel

It is the responsibility of the principal contractor and any appointed sub-contractors to enforce an appropriate health and safety regime for all site personnel. Full details regarding the proposed working practices in connection with the remediation works shall be agreed in advance of the commencement of the works with the Principal Designer.

A project health and safety plan will be produced before site works commence. This will detail the anticipated hazards associated with the site work, for example asbestos, machinery and open excavation. It will also detail the control measures that will be put in place to reduce these risks to an acceptable level. This plan will also document emergency procedures and include the address and location of the nearest hospital with an A&E department. A copy of this will be made available to principal contractor before commencement and also kept on site and made available on request.

Measures will be necessary to protect the health and safety of site workers during the site works. The contractors will be under a statutory obligation to take reasonable care to protect the health and safety of their employees. The following measures are suggested to provide a minimum level of protection:

- All site staff should undergo asbestos awareness training as part of the site induction.
- All ground workers on-site should be issued with protective clothing, respiratory protective equipment to FFP3 standard, footwear and gloves. These should not be removed from site, and advice should be given on when and how they are to be used.
- Care should be taken to minimise the amount of dust and mud generated on-site.
- Good practices relating to personal hygiene should be adhered to on-site, i.e., food and drink should only be consumed within designated areas on the site and smoking should be prohibited in all working areas.

Reference should also be made to the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Development of Contaminated Land".

4.4.6 Mitigation measures to manage unforeseen ACM

Owing to the potential for unforeseen concentrations of ACM throughout excavation of made ground, RSK recommends a watching brief be maintained by a suitably experienced engineer. The engineer should carefully inspect the soil for the presence of previously unidentified ACM, such as clumps of fibrous asbestos, material that may contain asbestos such as board, rope, textile, vinyl or ceramics. Should the engineer suspect ACM from their visual observations, works should cease, and the situation re-evaluated. The duration and frequency of the watching brief can be reviewed during the works to allow certainty that an engineer is present during the higher risk operations.

Re-evaluation may require wetting of soil, additional monitoring, risk assessment and personal protective equipment to be adopted. Should it be necessary to obtain samples for bulk analysis or quantification of asbestos, samples will be taken in a controlled manner and utilising appropriate dust suppression techniques. Samples will be double bagged at the sampling location and uniquely labelled. The approximate location will be recorded on the site plan for future reference.

4.4.7 Monitoring and analysis

Upon commencement of excavation works at the site, air sampling and counting of asbestos fibres should be undertaken.

The air monitoring should be undertaken during the first week of the excavation works and reviewed after this time. If the fibre levels are above the limit of quantification (0.01 f/ml), additional air monitoring should be undertaken until the clearance levels are satisfied (0.01 fibres/ml).

The specific location of air monitoring will depend upon wind direction and the extent of the excavation works. Therefore, it will be determined upon arrival at the site on the day of monitoring. The monitoring location will be recorded by the engineer undertaking the 'watching brief'.

Where power is available on site, the results of air sampling will be determined on site following completion of the tests. Should power not be available, then fibre levels would need to be determined back at RSK's laboratories with results reported later the same day or first thing on the following day.

4.5 Water supply and drainage (linkage 4)

An initial screen of chemical testing results from previous Phase 2 site investigation works indicates potentially chemically aggressive ground conditions may be present on site such that the integrity of new potable water supply pipework may be at risk of damage. It is noted from discussions with contractors there is an aspiration to adopt a clean trench fill system for water pipe runs.

This will entail the excavation of water supply pipe runs to required depth and width, installation of infrastructure, and backfill with clean granular engineered fill. It is considered that, assuming all water supply runs are constructed using this method and adequate validation records, photographs and other evidential records are collected, the exposure linkage will be broken.

Once completed validation testing of soils used as backfill within trench excavations will be required to allow the completion of a United Utilities risk assessment. Further details as to the validation requirements to confirm this element of groundworks have met the remedial requirements.

4.6 Re-use of materials

Current estimates show there could be approximately 9,750m³ of material excavated and re-engineered assuming a conservative estimate of 1.5m soil turnover. It is assumed the units will be either situated on a semi-stiff integral raft or ground beams supported on piles.

The process of turning over this site will require a temporary mobile plant licence to undertake the works. Given the type and form of asbestos identified within the investigations, has been identified as chrysotile in both fibres and clumps, with one sample of chrysotile board with the bund containing loose fibres/clumps between 0.006% and 0.062% by weight, is unlikely to require licensing but is recommended to be notifiable to the HSE.

It will be for a competent contractor to obtain all the required licenses and permits to ensure that the proposed works are undertaken within the current legal and regulatory frameworks.

It will be for the contractor to prove that through the process of sorting the made ground, all unacceptable materials have been removed and those materials remaining on site are suitable for reuse and hence no longer should be considered waste.

The processing of the soils will create a geotectonically suitable development platform, with sterile corridors (within a Terram wrap) to mitigate the risk of service contractors coming into contact with soils which may contain asbestos fibres.

The proposed foundation option (piles or semi-stiff raft foundation) will require confirming prior to the turnover being undertaken as there are different requirements for proposed ground levels during these operations with the different build types. Typically for piling projects a piling blanket will be required, although the turnover may create a surface suitable for lower loaded piling rigs. A specific pile blanket calculation will be required depending upon the plant to be used and the ground conditions.

Given the proposed soil turnover to be used a construction development platform, soil materials will be re-used on site and additional chemical testing should be undertaken to inform suitability for re-use.

Soils that are excavated are anticipated to be temporarily stockpiled and tested, where appropriate, to confirm suitability for the following categories of use:

- Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials.
- Material suitable for inclusion within 600 mm of surface in soft landscaping areas.
- Material suitable for placing beneath car parks and roadways.

Soils found unsuitable for any of the above purposes will be consigned for offsite disposal. It is possible that soils will be disposed off-site despite suitability for re-use if stockpiling is impracticable or a surplus volume of material is present. In addition to general excavations, aggregate may also be generated from processing of concrete slabs and old foundations to a suitable granular fill material though at this stage likely volumes derived from these sources are considered to be small and it may be impractical to mobilise suitable equipment for small volumes of material.

Re-use of materials on site shall be subject to the provisions of an MMP.

4.7 Off-site disposal

Current cut/fill estimates indicate a surplus of material in the region of 3,700m³ requiring removal from the site without any value engineering. It is proposed to win 650m³ of

recycled aggregates for the construction of piling mats and 1,000m³ of validated clean soil for reuse as subsoil in the clean cover layer gardens; potentially reducing the surplus to 2100m³.

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 bund investigation in 2018 and the August 2021 investigation. Two samples (HP8 and HP10) from the analysis undertaken by RSK of the bund were noted to have a concentration of hydrocarbon compounds which exceeded 1,000 mg/kg and are considered to exceed the hazardous threshold for carcinogenic risk HP7, and mutagenic risk HP11. Three samples (BH2 at 0.40 m, BH2 at 1.55 m and BH6 at 0.60 m) from the analysis undertaken by RSK from boreholes drilled across the site are considered to be hazardous waste for the same risk factors. It is anticipated that zinc also fails the threshold within BH2 at 1.55 m.

WAC Analysis should be undertaken on any surplus soils on site for disposal.

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.

5 REQUIREMENTS FOR REMEDIATION VERIFICATION

5.1 Introduction

This section identifies the proposed form of verification and reporting that will be undertaken to demonstrate that the mitigation measures that are considered necessary have been implemented on site.

The source of any imported material for the provision of soft landscaped areas will be presented to the local authority for their comment and approval before it is brought to site.

5.2 Frequency and Records

Record Keeping

A record of all soil imports to site for will be maintained. This will include:

- certificates of quality - material imported under the WRAP protocol will be accompanied by certificates of conformity that are less than two months old and relating to the material being imported
- invoices and lorry tickets – importation tickets should be completed in full and legible so the origin of the soil can be traced to the specific donor site
- chemical test data – all data obtained from the donor site or from site initiated chemical testing
- storage – the location of temporary storage or quarantine areas will be identified, and plans/photographs retained to show where the position and movement of stockpile at the site
- verification reports – reports that are generated following visits for the purpose of verification will be retained on site.
- “As built” drawing information and records should be collated detailing information of completed earthworks and remedial operations.

Site records will be maintained so that sufficient data are available for the purpose of compiling a robust verification report. 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 as previously discussed. Records of any environmental monitoring (for asbestos, dust etc.), if undertaken, during the remediation programme shall also be retained so they can be included in the final verification report.

Excavations and capping systems

Along proposed water supply pipe work run it will be necessary to excavate trenches to the required depth and alignment to suit design requirements. The “as built” alignment of these trenches should be recorded along with their dimensions (e.g. width, depth); photographic records should also be obtained at regular intervals during water supply construction as evidence of their excavation and backfill with clean imported soils.

Where a clean soil cover system is proposed for garden and landscaping areas where these are situated on made ground, system shall be a minimum of 600mm thick and comprise a 150mm minimum thickness of topsoil, overlying a suitable thickness of subsoil.

A marker layer of Terram shall be placed between the cover system and underlying made ground soils. The marker layer of Terram will not be required should natural in situ soils form part of the cover system.

Following placement of the cover system the resulting thickness should be checked by excavation and measurement, including confirmatory photographic records at a frequency of 1 per 2 plots/gardens and 4 in total for landscaped areas. It is proposed that the Principal Contractor will provide the environmental consultant with photographic evidence confirming that the physical thickness of installed cover systems are in accordance with the provisions of this document. The environmental consultant shall undertake 'spot checks' of the physical thickness of installed cover systems at a frequency not less than 1 in 10 plots in order to verify the records provided by the Contractor.

Chemical Validation Testing

Chemical test data and visual confirmation of suitability will be recorded prior to confirming the imported soils as being suitable. As detailed in earlier sections of this report, verification records of the remedial works will be collated in a verification report on completion of all site works. There is a risk that soils may need to be removed from site if the chemical test data shows they are not suitable. Therefore, any imported materials should be clearly demarcated as awaiting clearance until suitable data are available and acceptance confirmed by the environmental specialist.

The frequency of chemical testing of imported soils utilised in soil capping systems (either in landscaping zones or as part of clean fill potable water supply pipe runs) should be completed at a frequency of 1/250m³ used. Details of the range of determinants and the associated "suitable for use" values are provided in Table 1.

Table 1: Sampling and Testing Requirements

	Number of samples	Testing schedule
Greenfield soils	Minimum 3, or 1 per 250m ³ (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), asbestos
Brownfield / screened soils	Minimum 6 or 1 per 100m ³ (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), TPH (CWG banded), asbestos and any additional analysis depending on the history of the donor site

5.3 Remedial criteria

5.4 Growing Media (<0.6m in gardens and <0.3m in landscaped areas)

Any soils that are present within 0.6m of ground level in gardens and 0.3m of ground level in other landscaped areas will be assessed are the HH GAC in Table 4 of Appendix C will be adopted for assessment of potential risks.

5.4.1 General fill (>0.6m from surface of soft cover or directly under areas of hard cover buildings)

For the purpose of this report the definition of general fill relates to any material placed >0.6m below ground level in garden areas and >0.3m below ground level in other soft landscaped areas and includes engineered fill used as base materials for road and pavement construction.

5.4.1.1 Site-won materials

By design, placement of site won soil >600mm below the final restoration level in soft cover areas or below hard surfacing (buildings, hardstanding etc.) is sufficient to protect end-users from direct contact with soil contaminants. Thus, a remedial criterion for contaminants, including asbestos in soil, are not applicable to soils destined for re-use as general fill.

5.4.1.2 Imported materials

For imported materials, much of the required testing may be undertaken at source and provided by the supplier; however, verification analysis will be required upon arrival to site in accordance with the requirements for Table 1. The GAC in Table 4 of Appendix D will be adopted for assessment of potential risks to future site users from materials placed as general fill. However, any materials containing detectable concentrations of asbestos must not be imported onto the site.

It is not anticipated that chemical testing will be required to validate the chemical suitability of imported aggregate derived from natural sources (e.g. quarry stone) provided an appropriate level of information confirming the provenance of such material is provided in support of it being imported.

However, where such materials are being used within clean fill water supply pipe work runs it will be necessary to obtain samples for chemical validation against United Utilities Pipe Work Risk Assessment criteria (and thus allow completion of the pipework RA form to support their adoption by United Utilities). A copy of the validation testing criteria has been included within Appendix D and is reproduced below.

Extract from United Utilities PSRAS backfill material chemical testing criteria.

Test Group	Testing Required?	PE threshold	Metal Pipes/ Barrier Pipe	Laboratory Detection Limit	Testing UKAS accredited Y/N	Maximum concentration at proposed pipeline depth See Note [2]	Maximum site concentration See Note [3]	Locations and depths where concentrations exceed proposed pipeline threshold
Total VOCs	Where Preliminary Risk Assessment (PRA) has identified land potentially affected by contamination	0.5	Pass					
Total BTEX & MTBE		0.1	Pass					
Total SVOCs (excluding PAHs and those substances marked with an *)		2	Pass					
EC5-EC10 aliphatic and aromatic hydrocarbons		2	Pass					
EC10-EC16 aliphatic and aromatic hydrocarbons		10	Pass					
EC16-EC40 aliphatic and aromatic hydrocarbons		500	Pass					
Phenols* (from SVOC analysis)		2	Pass					
Cresols and chlorinated phenols* (from SVOC analysis)		2	Pass					
Ethers*	Only where identified	0.5	Pass					
Nitrobenzene*		0.5	Pass					
Ketones*		0.5	Pass					
Aldehydes*		0.5	Pass					
Amines		Fail	Pass					
Corrosive	Conductivity, Redox and pH	Pass	See Note [1]					

Note [1] Threshold: For wrapped steel, corrosive if pH<7 and conductivity > 400µS/cm. For wrapped ductile iron corrosive if pH<5, Eh not neutral and conductivity > 400µS/cm. For copper, corrosive if pH<5 or >8 and Eh positive.

Note [2] Water pipes are normally laid at 0.75-1.35m below finished ground level.

As previously discussed, the frequency of chemical testing of imported soils utilised in soil capping systems (either in landscaping zones or as part of clean fill potable water supply pipe runs) should be completed at a frequency of 1/250m³ used.

5.4.1.3 Road and Pavement Aggregate

All imported aggregate for use within road corridors, beneath pavements and driveways must be free of asbestos. All sources of reclaimed/recycled aggregate (including 'scalpings') must have the matrix/dusts/fine content analysed for asbestos prior to acceptance on site. If stockpiled temporarily awaiting testing/return of results, this must be covered and damped down.

This is the most prevalent way sites become impacted by asbestos. Site Managers have a responsibility to inform RSK with each load of this material for analysis. Should loads not be disclosed, there is a high chance that asbestos may be distributed across the site, and fibres maybe wicked from stockpiles or placed aggregates impacting soils which are being controlled and managed through the material management process.

6 CONSTRAINTS AND ADDITIONAL ASSESSMENT

6.1 Potential constraints

The availability of suitable storage areas on site to quarantine soils that are awaiting confirmation testing may be insufficient or unavailable, depending on the nature of the work being undertaken. If storage is unavailable, it may be necessary to place the cover system soils directly into place as they are received and schedule chemical testing from samples taken in-situ. In the event that the chemical test data shows an exceedance of the assessment criteria, there is a risk this soil would need to be excavated and removed from site or used in another location where it will be suitable.

6.2 Unanticipated contamination

Extrapolation between site data is undertaken to assume ground conditions between points of data collection. Therefore, it is possible the contamination that has not been identified could be encountered during development works. A general watching brief should be maintained throughout earthworks looking for visual and/or olfactory evidence of contamination. This will allow any unexpected areas of contamination to be identified and assessed.

In the event that unexpected horizons of contaminated soils are identified during excavation works, the contractor will inform the site manager and/or contact the environmental consultant immediately. Work will be postponed in the area of discovery and the work area cordoned off. The soils will be inspected, sampled and/or analysed to assess the potential risks. The environmental consultant will document any findings.

6.3 Asbestos containing material

The potential risk to site end-users from asbestos contamination is considered appropriately mitigated through the placement of the proposed hard and soft barrier systems. The potential risk to on-site workers and to the surrounding residents and site users during site development will be controlled by the mitigation measures detailed in [Section 4](#).

6.4 Waste disposal

Disposal of general waste will be managed under a site waste management plan the development of which is outside the scope of this report.

The off-site disposal of soils (including made ground) may be required to break contaminant linkages and/or to facilitate the site development. Disposal soils to off-site waste receiving/treatment facilities will also be covered under the site waste management plan. This will require a sufficient frequency and scope of chemical and physical testing to be undertaken to allow suitable waste characterisation to be completed.

REFERENCES

British Standards Institution (2013), BS8576:2013. Guidance on investigations for ground gas – permanent gases and volatile organic compounds (VOCs)

CIRIA C665. Assessing risks posed by hazardous ground gases to buildings. 2007.

BS3882: 2015. Specification for topsoil and requirements for use. British Standards Institution, 2007.

Environment Agency (2018), 'Technical Guidance WM3. Guidance on the classification of and assessment of waste, 1st Edition, v.1.1, May 2018.

Environment Agency (2020), Land contamination risk management, <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>, 8 October 2020

FIGURES

FIGURE 1 SITE LAYOUT PLAN



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Tel: +44 (0)117 947 1006
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Client

Bury Council

Project Title

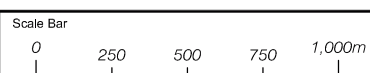
Fernhill Caravan Park, Every Street, Bury

Drawing Title

SITE LOCATION MAP

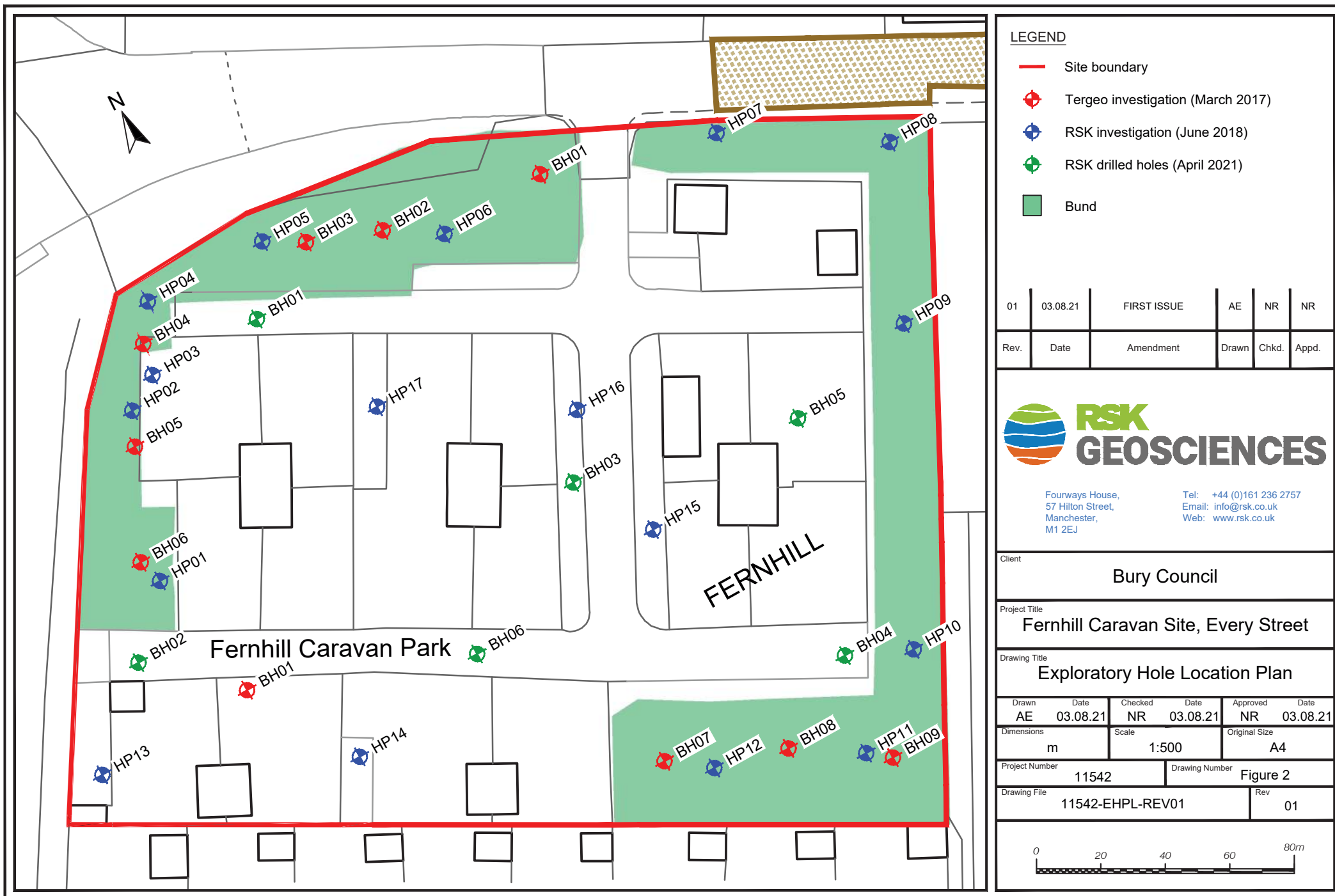
Rev	Drawn	Date	Checked	Date	Approved	Date
00	NP	09.12.20	LB	09.12.20	-	-
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Project Number	Grid Ref
11542	SD 804 117



Drawing Number
FIGURE 1

FIGURE 2 EXPLORATORY LOCATION PLAN



APPENDICES

APPENDIX A

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 John Southworth Builders Ltd in accordance with the terms of a contract [RSK Environment Standard Terms and Conditions] 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 site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS/ PFOS) 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

DEVELOPMENT DRAWINGS



This drawing is the copyright of Paddock Johnson Partnership Limited and may not be used without their prior written consent. Written dimensions to be taken in preference to scaled dimensions. Due to the inaccuracies of scanning, scanned images should not be scaled.

REV: DATE: DESCRIPTION: MK
+ A 25.01.21. Static caravan and touring units, adjusted MK
B 15.02.21. Pitches 1 & 2 amended, static added MK
C 30.03.21. Pitches renumbered, plots 11 & 12 amended MK
D 14.05.21. Static indicated plots 11 & 12 amended MK
E 22.06.21. Dropped kerbs indicated adj. site access MK
F 15.10.21. Fence boundary notes updated MK
G 30.11.21. Red line amended MK
H 17.08.22. Static & touring positions switched pitch 1 MK

CLIENT:	Bury Council	PROJECT:	Fernhill Gypsy and Traveller Site Re-development	DRAWING TITLE:	Proposed Site Layout	DRAWING NUMBER:	19144-101H	SCALE:	1:500@A3	DATE:	22.10.20.
STATUS:			BY: MK			CHECKED: SH			PADDOCK JOHNSON		
Studio 2, The Lyceum, Bath Street, Port Sunlight, Merseyside, CH42 4UJ info@paddockjohnson.com www.paddockjohnson.com Paddock Johnson Partnership Limited. Registered in England and Wales. No. 06684275											

APPENDIX C

GENERIC ASSESSMENT CRITERIA – RESIDENTIAL WITH HOME GROWN PRODUCE

Generic assessment criteria for human health: residential scenario with home-grown produce

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 initially 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⁾). Further C4SL were published in 2021 for vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE). Where a C4SL has been published, the RSK GAC duplicates the C4SL using all input parameters within the SP1010 final project report⁽³⁾ and associated chemical specific reports⁽⁶⁾, and adopts them as GAC for these substances. Due to the use of decimal places rather than significant figures applied to the Contaminated Land Exposure Assessment (CLEA) tool outputs, the GAC presented may be marginally differently to the C4SL values, however any differences between the values are minimal and would not equate to an unacceptable risk.

For all other substances the C4SL exposure modifications, with the exception of the “top two” produce type approach taken in the C4SL, have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) for residential land use, reducing exposure frequency for dermal contact outdoors for residential land use, and updated produce type consumption rates (90th percentile) based on recent data from the National Diet and Nutrition Survey.

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 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.

Conceptual model

In accordance with SR3⁽⁵⁾, the residential with home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3⁽⁵⁾, the pathways considered for production of the SAC in the residential with home-grown produce scenario are

- direct soil and dust ingestion
- consumption of home-grown produce
- consumption of soil attached to home-grown produce
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium⁽¹⁾, the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh} , are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

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 LLTC^(3,6) has been published for a substance, RSK has used these input parameters to derive the RSK GAC. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium, methyl tertiary-butyl ether (MTBE), 1,1,2-trichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, 2-chloronaphthalene, chloroethane, chloromethane, cis 1,2-dichloroethene, dichloromethane, hexachloroethane and trans 1,2-dichloroethene were obtained from the CL:AIRE Soil Generic Assessment Criteria report⁽¹¹⁾.

For TPH, aromatic hydrocarbons C₅–C₈ were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential with home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. The house is assumed to have a 100m² private garden consisting of lawn and flowerbeds, incorporating a 20m² plot for growing fruit and vegetables consumed by the residents. SR3⁽⁵⁾ notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3⁽³⁾, with a dust loading factor detailed in Section 9.3 of SR3⁽⁵⁾. 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 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 residential with home-grown produce land-use scenario

In summary, the RSK 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 Tables 2 and 3 below.

The final selected GAC are presented by pathway in Table 4 and the combined GAC in Table 5.

Figure 1: Conceptual model for residential scenario with home-grown produce

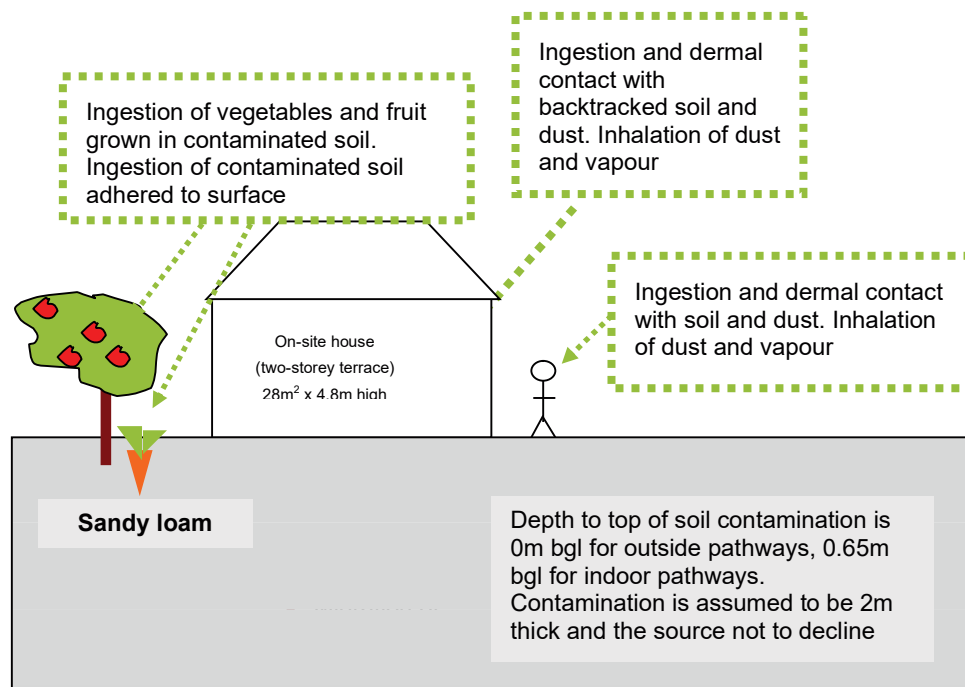


Table 1: Exposure assessment parameters for residential scenario with home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, SR3 ⁽⁵⁾
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3) ⁽⁵⁾
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3) ⁽⁵⁾
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3 ⁽⁵⁾
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil 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: Residential with home-grown produce – modified home-grown produce data

Name	Consumption rate 90 th percentile (g FW kg ⁻¹ BW day ⁻¹) by age class						Dry weight conversion factor (g DW g ⁻¹ FW)	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor (g g ⁻¹ DW)	Preparation correction factor
	1	2	3	4	5	6					
Green vegetables	7.12	5.87	5.87	5.87	4.53	4.53	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.7	2.83	2.83	2.83	2.14	2.14	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16	6.6	6.6	6.6	4.95	4.95	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.39	3.39	3.39	2.24	2.24	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.46	0.46	0.46	0.19	0.19	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	10.3	10.3	10.3	5.16	5.16	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 3.4, SP1010 ⁽³⁾						Table 6.3, SR3 ⁽⁵⁾	Table 4.19, SR3 ⁽⁵⁾		Table 6.3, SR3 ⁽⁵⁾	

Table 3: Residential with home-grown produce – modified use and receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr ⁻¹	180	365	365	365	365	365
EF (consumption of home-grown produce)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, indoor)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr ⁻¹	170	170	170	170	170	170
EF (inhalation of dust and vapour, indoor)	day yr ⁻¹	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr ⁻¹	365	365	365	365	365	365
Justification		Table 3.5, SP1010 ⁽³⁾ ; Table 3.1, SR3 ⁽⁵⁾					
Soil to skin adherence factor (outdoor)	mg cm ⁻² day ⁻¹	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010 ⁽³⁾					
Inhalation rate	m ³ day ⁻¹	5.4	8.0	8.9/f	10.1	10.1	10.1
Justification		Mean value USEPA, 2011 ⁽¹²⁾ ; Table 3.2, SP1010 ⁽³⁾					
Notes: For cadmium , the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI _{oral} and TDI _{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3 ⁽¹⁾ , Science Report SC050021/Cadmium SGV ⁽¹⁾ and the project report SP1010 ⁽³⁾ for more information.							

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 4

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce 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)	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR
Barium	(b)	1.34E+03	NR	NR	NR	1.34E+03	NR	NR	NR	1.34E+03	NR	NR	NR
Beryllium		1.13E+02	1.72E+00	NR	NR	1.13E+02	1.72E+00	NR	NR	1.13E+02	1.72E+00	NR	NR
Boron		3.00E+02	5.20E+06	NR	NR	3.00E+02	5.20E+06	NR	NR	3.00E+02	5.20E+06	NR	NR
Cadmium	(a)	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR
Chromium (III) - trivalent	(c)	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR
Chromium (VI) - hexavalent	(a,d)	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR
Copper		2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR
Lead	(a)	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR
Elemental Mercury (Hg ⁰)	(d)	NR	2.35E-01	NR	4.31E+00	NR	5.60E-01	NR	1.07E+01	NR	1.22E+00	NR	2.58E+01
Inorganic Mercury (Hg ²⁺)		3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR
Methyl Mercury (Hg ⁴⁺)		1.26E+01	1.87E+01	7.52E+00	7.33E+01	1.26E+01	3.62E+01	9.34E+00	1.42E+02	1.26E+01	7.68E+01	1.08E+01	3.04E+02
Nickel	(d)	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR
Selenium	(b)	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR
Vanadium		4.13E+02	1.46E+03	NR	NR	4.13E+02	1.46E+03	NR	NR	4.13E+02	1.46E+03	NR	NR
Zinc	(b)	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR
Cyanide (free)		1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR
Volatile Organic Compounds													
Benzene	(a)	2.62E-01	9.01E-01	2.03E-01	1.22E+03	5.39E-01	1.68E+00	4.08E-01	2.26E+03	1.16E+00	3.48E+00	8.72E-01	4.71E+03
Toluene		1.53E+02	9.08E+02	1.31E+02	8.69E+02	3.49E+02	2.00E+03	2.97E+02	1.92E+03	7.95E+02	4.55E+03	6.77E+02	4.36E+03
Ethylbenzene		1.10E+02	8.34E+01	4.74E+01	5.18E+02	2.61E+02	1.96E+02	1.12E+02	1.22E+03	6.00E+02	4.58E+02	2.60E+02	2.84E+03
Xylene - m		2.10E+02	8.25E+01	5.92E+01	6.25E+02	5.01E+02	1.95E+02	1.40E+02	1.47E+03	1.15E+03	4.56E+02	3.27E+02	3.46E+03
Xylene - o		1.92E+02	8.87E+01	6.07E+01	4.78E+02	4.56E+02	2.08E+02	1.43E+02	1.12E+03	1.05E+03	4.86E+02	3.32E+02	2.62E+03
Xylene - p		1.98E+02	7.93E+01	5.66E+01	5.76E+02	4.70E+02	1.86E+02	1.33E+02	1.35E+03	1.08E+03	4.36E+02	3.10E+02	3.17E+03
Total xylene		1.92E+02	7.93E+01	5.66E+01	6.25E+02	4.56E+02	1.86E+02	1.33E+02	1.47E+03	1.05E+03	4.36E+02	3.10E+02	3.46E+03
Methyl tertiary-Butyl ether (MTBE)		1.54E+02	1.04E+02	6.22E+01	2.04E+04	2.97E+02	1.69E+02	1.08E+02	3.31E+04	6.03E+02	3.21E+02	2.10E+02	6.27E+04
1,1,1,2-Tetrachloroethane		5.39E+00	1.54E+00	1.20E+00	2.60E+03	1.27E+01	3.56E+00	2.78E+00	6.02E+03	2.92E+01	8.29E+00	6.46E+00	1.40E+04
1,1,2,2-Tetrachloroethane		2.81E+00	3.92E+00	1.64E+00	2.67E+03	6.10E+00	8.04E+00	3.47E+00	5.46E+03	1.36E+01	1.76E+01	7.67E+00	1.20E+04
1,1,1-Trichloroethane		3.33E+02	9.01E+00	8.77E+00	1.43E+03	7.26E+02	1.84E+01	1.80E+01	2.92E+03	1.62E+03	4.04E+01	3.94E+01	6.39E+03
1,1,2 Trichloroethane		1.95E+00	1.25E+00	7.62E-01	4.03E+03	4.21E+00	2.55E+00	1.59E+00	8.21E+03	9.35E+00	5.59E+00	3.50E+00	1.80E+04
1,1-Dichloroethene		1.93E+01	3.29E-01	3.23E-01	2.23E+03	3.85E+01	5.82E-01	5.74E-01	3.94E+03	8.15E+01	1.17E+00	1.16E+00	7.94E+03
1,2-Dichloroethane		3.17E-02	9.20E-03	7.13E-03	3.41E+03	5.73E-02	1.33E-02	1.08E-02	4.91E+03	1.09E-01	2.28E-02	1.88E-02	8.43E+03
1,2,4-Trimethylbenzene		NR	1.76E+00	NR	4.74E+02	NR	4.26E+00	NR	1.16E+03	NR	9.72E+00	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		4.28E+00	3.40E-02	3.37E-02	1.19E+03	8.44E+00	6.00E-02	5.96E-02	2.11E+03	1.77E+01	1.21E-01	1.20E-01	4.24E+03
Carbon Tetrachloride (tetrachloromethane)		3.10E+00	2.58E-02	2.57E-02	1.52E+03	7.11E+00	5.65E-02	5.62E-02	3.32E+03	1.62E+01	1.28E-01	1.27E-01	7.54E+03
Chloroethane	NR	1.17E+01	NR	NR	2.61E+03	NR	1.59E+01	NR	3.54E+03	NR	2.57E+01	NR	5.71E+03
Chloromethane	NR	1.17E-02	NR	NR	1.91E+03	NR	1.38E-02	NR	2.24E+03	NR	1.85E-02	NR	2.99E+03
Cis 1,2 Dichloroethene		1.56E-01	NR	NR	3.94E+03	2.66E-01	NR	NR	6.61E+03	5.18E-01	NR	NR	1.29E+04
Dichloromethane		7.04E-01	3.05E+00	6.24E-01	7.27E+03	1.27E+00	4.06E+00	1.08E+00	9.68E+03	2.33E+00	6.42E+00	1.92E+00	1.53E+04
Tetrachloroethene (PCE)		1.33E+01	3.19E-01	3.11E-01	4.24E+02	3.11E+01	7.15E-01	6.99E-01	9.51E+02	7.12E+01	1.64E+00	1.60E+00	2.18E+03
Trans 1,2 Dichloroethene		6.45E+00	2.76E-01	NR	3.42E+03	1.29E+01	4.99E-01	NR	6.17E+03	2.74E+01	1.02E+00	NR	1.26E+04
Trichloroethene (TCE)		9.30E-03	3.61E-02	NR	1.54E+03	1.95E-02	7.57E-02	NR	3.22E+03	4.34E-02	1.68E-01	NR	7.14E+03
Vinyl Chloride (chloroethene)		1.13E-02	1.47E-02	6.38E-03	1.36E+03	2.09E-02	1.90E-02	9.97E-03	1.76E+03	3.88E-02	2.91E-02	1.66E-02	2.69E+03
Semi-Volatile Organic Compounds													
2-Chloronaphthalene		2.76E+02	5.39E+00	5.29E+00	1.14E+02	6.59E+02	1.33E+01	1.30E+01	2.80E+02	1.45E+03	3.17E+01	3.10E+01	6.69E+02

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 4

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce 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	
Acenaphthene		2.27E+02	4.86E+04	2.26E+02	5.70E+01	5.41E+02	1.18E+05	5.38E+02	1.41E+02	1.18E+03	2.68E+05	1.17E+03	3.36E+02
Acenaphthylene		1.85E+02	4.59E+04	1.84E+02	8.61E+01	4.42E+02	1.11E+05	4.40E+02	2.12E+02	9.78E+02	2.53E+05	9.74E+02	5.06E+02
Anthracene		2.43E+03	1.53E+05	2.39E+03	1.17E+00	5.53E+03	3.77E+05	5.45E+03	2.91E+00	1.10E+04	8.76E+05	1.09E+04	6.96E+00
Benzo(a)anthracene		1.01E+01	2.47E+01	7.18E+00	1.71E+00	1.42E+01	4.37E+01	1.07E+01	4.28E+00	1.69E+01	6.26E+01	1.33E+01	1.03E+01
Benzo(a)pyrene	(a)	4.96E+00	3.51E+01	NR	9.11E-01	4.96E+00	3.77E+01	NR	2.28E+00	4.96E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		2.96E+00	1.93E+01	2.56E+00	1.22E+00	3.89E+00	2.13E+01	3.29E+00	3.04E+00	4.43E+00	2.22E+01	3.69E+00	7.29E+00
Benzo(g,h,i)perylene		3.77E+02	1.87E+03	3.14E+02	1.54E-02	4.09E+02	1.94E+03	3.38E+02	3.85E-02	4.23E+02	1.97E+03	3.48E+02	9.23E-02
Benzo(k)fluoranthene		8.92E+01	5.41E+02	7.66E+01	6.87E-01	1.10E+02	5.76E+02	9.22E+01	1.72E+00	1.21E+02	5.91E+02	1.00E+02	4.12E+00
Chrysene		1.66E+01	1.19E+02	1.46E+01	4.40E-01	2.54E+01	1.49E+02	2.17E+01	1.10E+00	3.19E+01	1.66E+02	2.67E+01	2.64E+00
Dibenzo(a,h)anthracene		2.90E-01	1.45E+00	2.41E-01	3.93E-03	3.43E-01	1.64E+00	2.84E-01	9.82E-03	3.69E-01	1.74E+00	3.04E-01	2.36E-02
Fluoranthene		2.87E+02	3.83E+04	2.85E+02	1.89E+01	5.63E+02	8.87E+04	5.60E+02	4.73E+01	9.00E+02	1.83E+05	8.96E+02	1.13E+02
Fluorene		1.77E+02	6.20E+03	1.72E+02	3.09E+01	4.19E+02	1.53E+04	4.07E+02	7.65E+01	8.98E+02	3.62E+04	8.77E+02	1.83E+02
Hexachloroethane		2.68E-01	NR	NR	8.17E+00	6.57E-01	NR	NR	2.01E+01	1.55E+00	NR	NR	4.81E+01
Indeno(1,2,3-cd)pyrene		3.09E+01	2.12E+02	2.70E+01	6.13E-02	4.22E+01	2.38E+02	3.59E+01	1.53E-01	4.92E+01	2.50E+02	4.11E+01	3.68E-01
Naphthalene		2.78E+01	2.33E+01	1.27E+01	7.64E+01	6.66E+01	5.58E+01	3.04E+01	1.83E+02	1.53E+02	1.31E+02	7.06E+01	4.32E+02
Phenanthrene		9.85E+01	7.17E+03	9.72E+01	3.60E+01	2.24E+02	1.76E+04	2.22E+02	8.96E+01	4.48E+02	4.07E+04	4.43E+02	2.14E+02
Pyrene		6.25E+02	8.79E+04	6.20E+02	2.20E+00	1.25E+03	2.04E+05	1.24E+03	5.49E+00	2.05E+03	4.23E+05	2.04E+03	1.32E+01
Phenol		1.60E+02	4.58E+02	1.20E+02	2.42E+04	2.96E+02	6.95E+02	2.09E+02	3.81E+04	5.86E+02	1.19E+03	3.93E+02	7.03E+04

Total Petroleum Hydrocarbons

Aliphatic hydrocarbons EC ₅ -EC ₆		4.99E+03	4.24E+01	4.23E+01	3.04E+02	1.13E+04	7.79E+01	7.78E+01	5.58E+02	2.50E+04	1.61E+02	1.60E+02	1.15E+03
Aliphatic hydrocarbons >EC ₅ -EC ₆		1.49E+04	1.04E+02	1.03E+02	1.44E+02	3.43E+04	2.31E+02	2.31E+02	3.22E+02	7.11E+04	5.29E+02	5.28E+02	7.36E+02
Aliphatic hydrocarbons >EC ₆ -EC ₁₀		1.61E+03	2.68E+01	2.67E+01	7.77E+01	2.91E+03	6.55E+01	6.51E+01	1.90E+02	4.26E+03	1.56E+02	1.54E+02	4.51E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂		4.57E+03	1.33E+02	1.32E+02	4.75E+01	5.51E+03	3.31E+02	3.26E+02	1.18E+02	5.98E+03	7.93E+02	7.65E+02	2.83E+02
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆		6.27E+03	1.11E+03	1.06E+03	2.37E+01	6.34E+03	2.78E+03	2.41E+03	5.91E+01	6.36E+03	6.67E+03	4.34E+03	1.42E+02
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	(b)	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC8-EC ₁₀		5.76E+01	4.74E+01	3.45E+01	6.13E+02	1.38E+02	1.16E+02	8.38E+01	1.50E+03	3.07E+02	2.77E+02	1.94E+02	3.58E+02
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂		8.29E+01	2.58E+02	7.52E+01	3.64E+02	1.96E+02	6.39E+02	1.79E+02	8.99E+02	4.25E+02	1.52E+03	3.91E+02	2.15E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆		1.47E+02	2.85E+03	1.45E+02	1.69E+02	3.36E+02	7.07E+03	3.32E+02	4.19E+02	6.81E+02	1.68E+04	6.74E+02	1.00E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	(b)	2.63E+02	NR	NR	5.37E+01	5.45E+02	NR	NR	1.34E+02	9.34E+02	NR	NR	3.21E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	(b)	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. SAC - soil assessment criteria.

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 naphthalene, 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 boron 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 - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 5
Human Health Generic Assessment Criteria for Residential with home-grown produce

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	37	37	37
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	300	300	300
Cadmium	22	22	22
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	2,500	2,500	2,500
Lead	200	200	200
Elemental Mercury (Hg ⁰)	0.2	0.6	1.2
Inorganic Mercury (Hg ²⁺)	39	39	39
Methyl Mercury (Hg ⁴⁺)	10	10	10
Nickel	130	130	130
Selenium	258	258	258
Vanadium	410	410	410
Zinc	3,900	3,900	3,900
Cyanide (free)	1.4	1.4	1.4
Volatile Organic Compounds			
Benzene	0.20	0.41	0.87
Toluene	130	300	680
Ethylbenzene	50	110	260
Xylene - m	59	140	327
Xylene - o	61	143	332
Xylene - p	57	133	310
Total xylene	57	133	310
Methyl tertiary-Butyl ether (MTBE)	60	110	210
1,1,1,2 Tetrachloroethane	1.20	2.78	6.46
1,1,2,2-Tetrachloroethane	1.6	3.5	7.7
1,1,1-Trichloroethane	9	18	39
1,1,2 Trichloroethane	0.8	1.6	3.5
1,1-Dichloroethane	0.32	0.57	1.16
1,2-Dichloroethane	0.007	0.011	0.019
1,2,4-Trimethylbenzene	1.8	4.3	9.7
1,3,5-Trimethylbenzene	NR	NR	NR
1,2-Dichloropropane	0.034	0.060	0.120
Carbon Tetrachloride (tetrachloromethane)	0.026	0.056	0.127
Chloroethane	11.7	15.9	25.7
Chloromethane	0.012	0.014	0.019
Cis 1,2 Dichloroethene	0.16	0.27	0.52
Dichloromethane	0.62	1.08	1.92
Tetrachloroethene (PCE)	0.31	0.70	1.60
Trans 1,2 Dichloroethene	0.28	0.50	1.02
Trichloroethene (TCE)	0.009	0.020	0.043
Vinyl Chloride (chloroethene)	0.006	0.010	0.017
Semi-Volatile Organic Compounds			
2-Chloronaphthalene	5	13	31
Acenaphthene	230	540	1,170
Acenaphthylene	180	440	970
Anthracene	2,400	5,500	10,900
Benzo(a)anthracene	7	11	13
Benzo(a)pyrene	5	5	5
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(g,h,i)perylene	310	340	350
Benzo(k)fluoranthene	77	92	100
Chrysene	15	22	27
Dibenzo(a,h)anthracene	0.24	0.28	0.30
Fluoranthene	290	560	900
Fluorene	170	410	880
Hexachloroethane	0.27	0.66	1.55
Indeno(1,2,3-cd)pyrene	13	30	71
Naphthalene	13	30	71
Phenanthrene	100	220	440
Pyrene	620	1,240	2,040
Phenol	120	210	390
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC ₅ -EC ₆	42	78	160
Aliphatic hydrocarbons >EC ₆ -EC ₈	100	230	530
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	27	65	154
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	130 (48)	330 (118)	760 (283)
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	1,100 (24)	2,400 (59)	4,300 (142)
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	65,000 (8)	92,000 (21)	110,000
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	65,000 (8)	92,000 (21)	110,000
Aromatic hydrocarbons >EC ₈ -EC ₁₀	30	80	190
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	80	180	390
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	140	330	670
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	260	540	930
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	1,100	1,500	1,700
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	1,100	1,500	1,700
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: ¹ 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. SAC - soil assessment criteria. ¹ LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry. 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 naphthalene, 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.			

APPENDIX D
EXTRACT FROM UNITED UTILITIES PSRAS BACKFILL MATERIAL
CHEMICAL TESTING CRITERIA.

Supplementary guidance for the selection of water pipes in land potentially affected by contamination

Introduction

In January 2011, UK Water Industry Research (UKWIR) published "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21; the 'UKWIR Guidance'). Its aim is to ensure that the correct materials are selected for water pipes and components to be used below ground in brownfield sites to protect the quality of drinking water whilst taking into account the service life of the water distribution system. It supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-03 "Laying Pipes in Contaminated Land" which has been withdrawn.

The UKWIR Guidance is for use by developers, self-lay organisations, water companies and consultants when planning, designing and constructing water mains and/or services in brownfield sites. It defines brownfield sites as "land or premises that have previously been used or developed. They may also be vacant or derelict. However, they are not necessarily contaminated." The UKWIR Guidance states that it does not apply to greenfield sites; however, we consider this supplementary guidance and the relevant sections of the UKWIR guidance as being equally suitable for application to those greenfield sites considered to be potentially affected by contamination. Where greenfield sites are not affected by contamination a preliminary risk assessment (see below) will suffice.

The UKWIR Guidance also states that there should be no departure from its provisions "except where formally approved by the Water Company, such departure being technically justifiable or representing advances in knowledge or product development".

We have adopted the UKWIR Guidance in principle and produced this company specific supplementary guidance (the 'UW Guidance') which includes the Risk Assessment for Water Pipes (the 'RA').

This guidance does not cover operative safety, health exposure modelling or accidental pipe damage.

which the pipes are to be laid may be affected by contamination. The application of the source, pathway, receptor concept will be an integral part of any pipeline risk assessment. For each potential source (the contamination) and each potential receptor (the water pipe), consideration shall be given to whether a potential pathway between source and receptor exists, or may exist in the future, linking the two. There are normally only three pathways by which contamination may come into contact with water pipes. These are direct contact with the soil or backfill, an excessive vapour phase or a contaminated groundwater regime. If none of these conditions exist on site (adopting the source, pathway, receptor concept) then it is likely that extended and/or targeted soil testing will not be required and a simple risk assessment will suffice. For those sites where land may be affected by contamination appropriate testing shall be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials. The testing requirements are as described in the following section.

The signatories of the Water Supply Application Form and the RA must ensure that all assessments of land condition have been carried out in accordance with applicable current standards and guidelines by or under the direction of a suitably qualified competent person.

We require the competent person to be a) a chartered member of an appropriate professional body (such as the Institution of Civil Engineers, the Geological Society of London or the Royal Institution of Chartered Surveyors) with relevant experience of investigating contaminated sites or b) a Specialist in Land Condition (SiLC) with appropriate geo-environmental experience.

Risk Assessment for Water Pipes in Land Potentially Affected by Contamination

Any application for new water supplies to a development (construction of new properties, or renovation or conversion of existing buildings) in land potentially affected by contamination shall include a completed RA.

As a minimum a desk study (preliminary risk assessment) shall be provided with the RA in accordance with the framework in Environment Agency publication "Model Procedures for the Management of Land Contamination" (ref: CLR11) that sets out whether the land through

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Testing Requirements

The soil, rock and if appropriate groundwater tests that are required on all sites where the potential for organic contamination has been identified in the desk study and where water pipes are proposed to be laid must be accredited by United Kingdom Accreditation Service (UKAS) as a minimum and where commercially available the Environment Agency's Monitoring Certification Service (MCERTS). These accredited tests should be undertaken for:

Banded hydrocarbons EC5-EC10, EC10-EC16, EC16-EC40 (Total aliphatic and aromatic hydrocarbons for each banding may be summed). Aliphatic/aromatic fractionation and subsequent banding may be required should a more detailed site specific risk assessment be undertaken. The bandings have been amended to take into account readily available laboratory tests. The equivalent carbon number (EC) is used to assess petroleum hydrocarbon mixtures rather than the actual number of carbon atoms in the molecule in line with guidance issued by the Environment Agency (2005).

Volatile organic compounds (VOCs) (method by head space or purge & trap GCMS) with tentative identification of compounds greater than 20µg/kg. The method used should be capable of detecting a wide range of compounds listed in US EPA Method 8260C or similar. The method should include analysis of naphthalene.

BTEX (Benzene, toluene, ethyl benzene and xylenes) plus MTBE (Methyl-tertiary butyl ether) (by head space GCMS)

Semi-Volatile Organic Compounds (SVOCs) (method by GCMS) with tentative identification of compounds greater than 20µg/kg The method used should be capable of detecting the compounds listed in US EPA Method 8270D or similar. The total concentration of SVOCs excludes polycyclic aromatic hydrocarbons, ethers, nitrobenzene, ketones, aldehydes, phenols, cresols and chlorinated phenols. Phenols, cresols and chlorinated phenols which are detected by the SVOC analysis are given their own assessment criteria.

We do not consider Table G1 and Table 3.1 of the UKWIR Guidance to be a definitive guide for assessing total concentrations. Table 1 in the RA below replaces Table 3.1 of the UKWIR Guidance.

Where previous site uses include the use, storage, treatment, disposal or manufacture of any of the following, appropriate testing for these substances will be required:

- Ethers, nitrobenzene, ketones, aldehydes and amines. Note that the presence of amines on any site at the proposed pipe depth +/- 1.0m precludes the use of polyethylene. The methods of analysis and method of calculation of total concentrations of these compounds will need to be agreed with UUW.

To comply with the testing requirements, the suites of tests that are required on all brownfield sites where wrapped steel, wrapped ductile iron or copper pipes are to be laid as minimum must include:

- pH, Conductivity and redox potential

Sufficiency of Testing

Water pipes are normally laid at between 0.75 and 1.35m from finished ground level to crown of pipe. Samples taken and tested must represent both a) the soil in which the water pipes are to be laid and b) the soil down to at least 500mm below the underside of the proposed pipe. Where the proposed depth of the pipes is unknown at the time of application, soil samples representative of the ground condition between surface level and 1.5m below finished ground level shall be taken as a minimum. Where appropriate (see UKWIR Guidance) groundwater sampling and groundwater monitoring will also be necessary. Photo-ionisation detection (PID) monitoring along the proposed route of the pipeline may be employed, though this does not provide a definitive guide to the suitability of water pipe materials.

Where required a sufficient number of test results should be obtained from the material in which the pipes are to be laid. CLAIRE/CIEH 2008 "Guidance on comparing soil contamination data with a critical concentration" may be used, where appropriate, to justify the number of soil samples tested; however, this statistical model should not be used on heterogeneous materials or used to average test results from different types of materials.

Further guidance on representative sampling is contained within BS10175:2011 Code of Practice for the Investigation of Potentially Contaminated Sites, the Department of the Environment's Contaminated Land Research Report "Sampling strategies for contaminated land" prepared by The Centre for Research into the Built Environment, Nottingham Trent University (Ref: CLR 4; 1994) and the Environment Agency's "Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination" (ref: R&D Technical Report P5-066/TR; 2000).

Where remediation has been carried out on the site, the test results obtained from validation samples will be used in the assessment. Where a horizontal capping system has been or will be employed using materials spread across a site, sufficient samples will need to be taken to characterise the capping material used and the results presented to UUW. However, the sufficiency of sampling on the horizontal capping system, in which the pipeline will be placed, may be assessed on the basis of the source, quantity and type of materials used.

Detection Limits

Only positive concentrations, ie those above the limit of detection should be used in summation of VOC and SVOC (or other test groups of compounds ie phenols, cresols and chlorinated phenols). Laboratory methods shall provide a minimum limit of detection of 10µg/kg for each individual VOC or SVOC (or other test groups of compounds) quantitatively detected in accordance with the methods described above. For tentatively identified compounds (TICs), only those compounds with a concentration of 20µg/kg or greater shall be used in the summation of VOC and SVOC (or other test groups of compounds).

Protective Measures

Where polyethylene, ductile iron, steel or copper pipes are to be laid on a brownfield site or other land potentially affected by contamination (whether or not it has been remediated) and where the concentrations exceed the generic guideline values set out in Table 1 of the RA, the developer shall provide either:

- a) a robust risk assessment to show how any contaminants will not significantly impact on proposed water supplies or buried assets over the lifetime of the assets; or
- b) more suitable pipe materials; or
- c) an engineering solution to protect the pipe work backed up by an adequate assessment of the risk.

Liquid free phase product (e.g. oil or free solvent layers) shall not remain in the ground or groundwater in the vicinity of water pipes, whether barrier pipe or any other pipe materials are used.

When designing pipe routes on land potentially affected by contamination, new preferential contamination pathways along the route of new water pipes shall not be created. Particular measures may be required to prevent the possible migration of contamination through pipe bedding and into controlled waters.

References

BS10175: 2011

"Investigation of Potentially Contaminated Sites Code of Practice"

CLAIRE/CIEH

"Guidance on comparing soil contamination data with a critical concentration" 2008

Department of the Environment Contaminated Land Research Report

"Sampling strategies for contaminated land"
prepared by The Centre for Research into the Built Environment, Nottingham Trent University (Ref: CLR 4) 1994

Environment Agency

"Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination"
(ref: R&D Technical Report P5-066/TR) 2000

Environment Agency

"Model Procedures for the Management of Land Contamination" (ref: CLR11), 2004

Environment Agency P5-080/TR3

"The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils", 2005

UK Water Industry Research (UKWIR)

"Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21) January 2011

Water Regulations Advisory Scheme (WRAS)

Information and Guidance Note 9-04-03

"Laying Pipes in Contaminated Land" 2002

Frequently asked questions

Why has UUW published supplementary guidance to the 'UKWIR Guidance for the Selection of Water Pipes to be used in Brownfield Sites'?

UUW agrees with the UKWIR Guidance in principle; we have published supplementary guidance to clarify some of the areas in which it will operate.

Does the UKWIR Guidance only apply to 'brownfield sites'?

Yes, the UKWIR Guidance does apply to brownfield sites; in addition United Utilities Water will apply this guidance and the UUW supplementary guidance to any greenfield sites which are potentially affected by contamination.

Who is responsible for completing/ signing the Risk Assessment for Water Pipes (RA)?

This may be the Developer, the Developers representative, or the competent person directing the land assessment. The signatory of the Risk Assessment for Water Pipes (RA) must ensure that all land assessments have been carried out in accordance with current standards and guidelines by or under the direction of a suitably qualified competent person. For water supply applications on land potentially affected by contamination, UUW requires the competent person to be either a chartered member of an appropriate professional body (such as the Institution of Civil Engineers, the Geological Society of London or the Royal Institution of Chartered Surveyors) with relevant experience of investigating contaminated sites or a Specialist in Land Condition (SiLC). This level of competency is intended to promote good practice and high professional standards and is no greater than that required for planning purposes by Local Authorities.

Do we need to agree the number and location of soil samples with the Water Company as indicated by the UKWIR guidance following the Preliminary Risk Assessment (PRA)?

Where a preliminary risk assessment (PRA) highlights the need for a site investigation UUW considers it is a responsibility of the qualified competent person directing the land assessment to determine the location and frequency of sampling. UUW's role would be to confirm that the appropriate

choice of pipe material has been made on the basis of the information provided.

What do we do if the pipe route is not known when the Site Investigation report is commissioned?

Where the route of the pipe is not known at the site investigation stage, then any resultant pipe selection needs to take account of any contamination found on the site. Consideration should be given to identifying the route and depth of the pipeline at the site investigation stage to avoid unnecessary testing.

Is it acceptable not to undertake a site investigation and specify the use of barrier pipe which seems to be suitable for all conditions?

Not all brownfield land is contaminated, and because of that a default to barrier pipe is not an acceptable approach to UUW, due to the possibility of higher installation and future maintenance costs. The approach as to whether a site investigation is needed should be risk based. For those sites where land may be affected by contamination appropriate testing shall be undertaken on the ground materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials.

Examples where defaulting to barrier pipe would not be acceptable:

- Where a capping layer (non-contaminated) is introduced within which the pipes will be installed.
- Sites with a potential low risk for contamination.
- Where liquid free phase product (e.g. oil or free solvent layers) is in the ground or groundwater in the vicinity of water pipes.
- Where the route of the pipe could be diverted to another suitable location free from contamination.

Are UUW employees who will assess the Design Proposals for contaminated sites suitably qualified?

It is the role of the Developer's suitably qualified competent person to deal with or direct the assessment of land. UUW's role is to assess the Risk Assessment for Water

Pipes and supporting Site Assessment Report (SAR) which is provided with any new water supply application (ie. it has been provided in the correct format, proposals for pipe selection are included, the methodology is in line with the UKWIR Guidance and UUW Supplementary Guidance, it has been directed by a suitably qualified competent person etc.). If UUW do need to provide assistance or information in deciding pipe materials then the assessment would be carried out under the direction of a suitably qualified competent person.

What happens to existing PE that is in the ground under the "old" guidelines?

The latest UKWIR guidance and UUW's supplementary guidance are intended to be used to decide what pipe materials will be used for new water mains and services. It will have no effect for developers with regard to any parts of UUW's existing network.

Will the Developer be required to submit a fully completed Risk Assessment for Water Pipes (RA) and supporting Site Assessment Report (SAR), including pipe material recommendation, for both the option of a mains requisition application and the option of a self-lay application?

Yes, UUW expect the 'Developer', as defined in UUW Supplementary Guidance, to submit a Risk Assessment for Water Pipes (RA) and supporting Site Assessment Report (SAR), including pipe material recommendation, in respect of any water pipes being installed on the development irrespective of who is to install them.

Does Table 1 in UUW's Risk Assessment for Water Pipes (RA) replace any of the tables to be completed in the Site Assessment Report (SAR) as required in the UKWIR Guidance?

UUW does not consider Table G1 and Table 3.1 of the UKWIR Guidance to be a definitive guide for assessing total concentrations. Table 1 in UUW's RA replaces Table 3.1 of the UKWIR Guidance.

Have any other Water Companies adopted the UKWIR Guidance yet?

You will need to contact the water company concerned if you are intending to install water pipes outside UUW's licensed area.

About us

United Utilities is the North West's water company. We keep the taps flowing and toilets flushing for seven million customers every day. From Crewe to Carlisle, we work hard behind the scenes to help your life flow smoothly.

Risk assessment for water pipes (RA)

The risk assessment for water pipes will help you choose appropriate materials for your development. We are happy to deal with a risk assessment for water pipes in advance of any formal application for a new water supply.

If you need any help completing the form please call us on **0345 072 6067**.

Section 1: Development details

Development name *(if it has one)*

Development address

OS Grid reference *(mid point)*

Developer's name

UUW reference number
(for UU use only)

Please provide details below of the current and historical use of the site and adjacent sites.

If your supporting information has details of the current and historical site use, please reference below the relevant sections of your report.

Section 2: Preliminary risk assessment

Has your desk study and site walkover identified any land potentially affected by contamination?

☐ Yes ☐ No

If the site is potentially affected by contamination but you have not completed any intrusive site investigation please provide details below of the rationale behind the intended pipe selection.

If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.

Section 3: Intrusive site investigation																									
Have you completed any intrusive site investigation?	☐ Yes ☐ No																								
Have you completed any none intrusive site investigation?	☐ Yes ☐ No																								
Date(s) when the site investigation(s) undertaken	<table><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>																								
At what level has groundwater been encountered?	<table><tr><td> </td><td>metres below ground level or</td></tr><tr><td colspan="2">☐ Not encountered</td></tr></table>		metres below ground level or	☐ Not encountered																					
	metres below ground level or																								
☐ Not encountered																									
Table 1 (Pipeline Selection Risk Assessment Summary (PSRAS)) below classifies testing required where the preliminary risk assessment has identified land potentially affected by contamination. Please provide details below of any test groups which have not been tested and the rationale for not testing. <i>If your supporting information has details of the rationale behind not testing any particular test groups, please reference below the relevant sections of your report.</i>																									
If the intrusive site investigation has identified concentrations above the PE threshold (see PSRAS) and your intended pipe selection is PE. Please provide details below of the rationale behind the intended pipe selection. <i>If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.</i>																									
Section 4: Site remediation																									
Please provide details below of any site remediation (which may include a change in site levels) already completed. <i>If your supporting information has details of the site remediation already completed, please reference below the relevant sections of your report.</i>																									
Has the PSRAS (Table 1) been completed using appropriate data after remediation?	☐ Yes ☐ No ☐ N/A																								
Please provide details below of any proposed site remediation and an analysis of whether this will affect your intended pipe selection. <i>If your supporting information has details of any proposed site remediation and whether this will affect your intended pipe selection, please reference below the relevant sections of your report.</i>																									

Section 5: Final use of site

Please provide details below of any chemicals (including fuel) to be stored on site and any other future contamination risks which may affect your intended pipe selection.

If your supporting information has details of potential contamination risks which may affect your intended pipe selection, please reference below the relevant sections of your report.

x

What water pipe materials are intended to be used on site?

☐ PE ☐ PE Barrier Pipe Type A ☒ PE Barrier Pipe Type B
Other (please specify): x

Section 6: Additional information

Please use the section below to provide any additional details to support your intended pipe selection.

x

Section 7: Risk assessor

Name and relevant qualifications of person directing the risk assessment for water pipes

x

Name and address of risk assessor's company

x

Date risk assessment performed

x x x x x x x d

Section 8: Declaration

I confirm I have completed this form and provided supporting information in accordance with 'UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' and UUW's Supplementary Guidance. I also confirm that if any further site investigation is needed and carried out, I will be required to submit an additional Risk Assessment for Water Pipes with the relevant supporting information. I understand that failure to supply any of the required information may delay my application being processed.

Name

x

Company

x

Telephone

x

Date

d d m m y y y y

Please email the completed form and supporting information to **DeveloperServicesWater@uuplc.co.uk** or post to us at United Utilities Water, Developer Services, Second floor Grasmere House, Lingley Mere, Warrington WA5 3LP.



About us

United Utilities is the North West's water company. We keep the taps flowing and toilets flushing for seven million customers every day. From Crewe to Carlisle, we work hard behind the scenes to help your life flow smoothly.

United Utilities Water Limited, Haweswater House, Lingley Mere Business Park, Lingley Green Avenue, Warrington WA5 3LP.
Registered in England and Wales. Registered Number 2366678.

Table 1 - Pipe selection risk assessment summary (PSRAS)

1. Testing must be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials. Please use the appropriate testing data to complete Table 1 below.

2. If more than one pipe selection is being made, for example, for pipes in different areas of a large site, a completed PSRAS is required for each selection.

What materials have been tested to populate Table 1 below?

☐ Existing ground materials ☐ Remediated materials ☐ Imported capping materials

All concentrations in mg/kg								
Test Group	Testing Required?	PE threshold	Metal Pipes/ Barrier Pipe	Laboratory Detection Limit	Testing UKAS accredited Y/N	Maximum concentration at proposed pipeline depth See Note [2]	Maximum site concentration See Note [3]	Locations and depths where concentrations exceed proposed pipeline threshold
Total VOCs	Where Preliminary Risk Assessment (PRA) has identified land potentially affected by contamination	0.5	Pass					
Total BTEX & MTBE		0.1	Pass					
Total SVOCs (excluding PAHs and those substances marked with an *)		2	Pass					
EC5-EC10 aliphatic and aromatic hydrocarbons		2	Pass					
EC10-EC16 aliphatic and aromatic hydrocarbons		10	Pass					
EC16-EC40 aliphatic and aromatic hydrocarbons		500	Pass					
Phenols* (from SVOC analysis)		2	Pass					
Cresols and chlorinated phenols* (from SVOC analysis)		2	Pass					
Ethers*	Only where identified	0.5	Pass					
Nitrobenzene*		0.5	Pass					
Ketones*		0.5	Pass					
Aldehydes*		0.5	Pass					
Amines		Fail	Pass					
Corrosive	Conductivity, Redox and pH	Pass	See Note [1]					

Note [1] Threshold: For wrapped steel, corrosive if pH<7 and conductivity > 400µS/cm. For wrapped ductile iron corrosive if pH<5, Eh not neutral and conductivity > 400µS/cm. For copper, corrosive if pH<5 or >8 and Eh positive.

Note [2] Water pipes are normally laid at 0.75-1.35m below finished ground level.

Note [3] Also state if liquid free product is present in soil or groundwater.



John Southworth Builders Ltd

Fernhill Caravan Park, Every Street, Bury

Materials Management Plan

Project no. 11752

NOVEMBER 2022

RSK GENERAL NOTES

Project No.: 11752

Title: Materials Management Plan: Fernhill Caravan Park, Every Street, Bury

Client: John Southworth Builders Ltd

Date: November 2022

Office: RSK Environment Limited, Fourways House, 57 Hilton Street, Manchester, M1 2EJ, tel: +44(0)161 236 2757, contact: Alex Smiles

Status: Final

Author	<u>Sam Diver</u>	Technical reviewer	<u>Tim Holding</u>
			
Signature		Signature	
Date:	<u>November 2022</u>	Date:	<u>November 2022</u>
Project manager	<u>Alex Smiles</u>	Qualified Person	<u>Poppy Whittle</u>
			
Signature		Signature:	
Date:	<u>November 2022</u>	Date:	<u>November 2022</u>

RSK Environment Limited (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

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.

Materials Management Plan (MMP) Form - October 2014

This form should be completed once the lines of evidence have been marshalled in relation to suitability for use, certainty of use and quantity required.

The answers to the questions posed within this form, together with the supporting information will constitute the MMP and must be provided to the Qualified Person.

A Qualified Person may comment on draft versions of this MMP, but will not complete the Declaration until all the relevant documents, demonstrating lines of evidence have been provided for each site.

The person / organisation who will pay the Declaration fee should confirm that they have read and understand the Terms and Conditions relating to the payment of the Declaration fee to CL:AIRE. These can be found on the CL:AIRE website.

The person / organisation agreeing to pay the Declaration Fee - Name, organisation and contact details inc. email address -	Mark Quinn John Southworth Building Ltd 10 Charles St, Dukinfield, Cheshire, SK16 4SD, United Kingdom Mark@johnsouthworth.co.uk Tel: 0161 339 3340
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✓ I confirm I have read and understood the Terms & Conditions.

Each question must be answered. If the question is not applicable please state this and provide a brief explanation.

1. Specify the scenario to which this MMP relates, as described in the Definition of Waste: Development Industry Code of Practice (DoW CoP) (1, 2, 3 or 4):

- ✓ 1. Reuse on the Site of Origin
- ☐ ~~2. Direct Transfer of clean naturally occurring soil / mineral materials~~
- ☐ ~~3. Cluster Project~~
- ☐ ~~4. Combination of any of the above~~

In the case of a combination of reuse scenarios, please describe it below (e.g. (i) Reuse on Site of Origin and Direct Transfer of clean naturally occurring unpolluted soils, (ii) Reuse on the Site of Origin with Direct Transfer of clean naturally occurring soil to x number of development sites etc: Re-use on site with direct transfer of clean naturally occurring unpolluted soils.

(NB: A Declaration is required for reuse on the Site of Origin and for any 2 site arrangement i.e. there is no facility for a combination Declaration)

2. Organisation and name of person preparing this MMP	Sam Diver RSK Environment Fourways House 57 Hilton Street Manchester M1 2EJ Tel: +44(0)161 236 2757
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Document Control

Date issued	November 2022
Revision date	
Summary of revision 1	
Summary of revision 2	

Insert additional lines to the table above for any subsequent revisions.

Note - revisions to the MMP do not trigger an additional Declaration by a Qualified Person, unless an additional site is added to the project.

Revisions to the MMP must be recorded and summarised in the document control box above.

Site Details

3. Site / Project name(s)	Fernhill Caravan Park, Every Street, Bury
Reuse / receiving site name :	As above
Donor site name (if Direct Transfer)	N/A

Landowners

4a. Name of Landowner(s) (full address and contact details) – where excavated materials are to be reused	Bury Council, Knowsley Place, Knowsley St, Bury BL9 0SW; Peter Masters-Hall 0161 686 8000
4b. Name of Landowner(s) (full address and contact details) – where excavated materials are arising from	Bury Council, Knowsley Place, Knowsley St, Bury BL9 0SW; Peter Masters-Hall 0161 686 8000

Summary and objectives

5a. Provide a brief description of the planned project and how excavated materials are to be reused.	Proposed development plans show that the entire site is to be demolished and the 17 individual plots are to be reduced to 12, including six single-storey double-facilities blocks, around the margins of the site, with each block to be shared between two plots. There will still be an office building to the east of the site entrance in the north-eastern corner of the site. Each plot will contain sufficient space for either one or two touring caravans, it will also have private soft landscaped areas. Cut and fill calculations performed by LK Remediate indicate a cut volume of 3,883.52m³ from made ground beneath current plots and material contained in the perimeter bunds, and fill volume of 185.95m³ to raise site levels beneath proposed plots to levels shown on the development plan. Of the 3,697.57m³ cut/fill balance, approximately 650m³ of recycled aggregates is proposed to be won from crush for the construction of piling mats and 1,050m³ of validated clean soils proposed to be won for reuse as subsoil in the clean cover layer gardens. This will leave a surplus of 1,997.57m³ material which is to be removed from the site by a registered waste carrier to a suitably licenced facility. The overall volume of material to be re-used at the site is therefore approximately 1,885.95m³.
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General Plans and Schematics

6. Attach a location plan for the site(s) and a plan of the site(s) which identifies where different materials are to be excavated from, stockpile locations (if applicable), where materials are to be treated (if applicable) and where materials are to be reused.	Plan Document Reference(s): The following plans are included in Appendix A: • Site Location Plan drawing ref: Figure 1: 11542-R01(00) • Proposed Site Layout – Paddock Johnson ref: 19144-101H dated October 2020 • Proposed Levels Plan – Paddock Johnson ref: 19144-101G dated October 2020 • Private Highway General Arrangement – Shape Consulting Engineers ref: 2288-0004-P01 dated January 2022 • Topographical Survey – West Coast Geomatics ref: WCG 20-1352-T-1:1 dated March 2020 • Cut and fill volumes and proposed levels – LK group
7. Attach a schematic of proposed materials movement. Where there is only one source area and one placement area briefly describe it. For all other projects a schematic is required.	Description & Schematic Document Reference: The following plan is included in Appendix B: • Schematic 1 – Confirmation of material suitability and Fernhill Caravan Site MMP Schematic 2

Parties Involved and Consultation – if more than one party please provide additional details for them and identify the location that they will be working e.g. where a site is zoned

8a. Main earthworks contractor(s) (full address and contact details) – Where excavated materials are to be reused	The LK Group Eton Business Park, Eton Hill Rd, Radcliffe, Manchester M26 2ZS Tel: 0161 763 7200
8b. Main earthworks contractor(s) (full address and contact details) - Where excavated materials are arising from	As above
9. Treatment contractor(s) (full address and contact details) – for treatment on site of origin, or at a Hub site within a fixed STF / Cluster Project	The LK Group Eton Business Park, Eton Hill Rd, Radcliffe, Manchester M26 2ZS Tel: 0161 763 7200
10. Where wastes and materials are to be transported between sites, provide details of the transport contractor(s) (full address, contact details and waste carriers registration details (if applicable))	To be confirmed. Possibly: MICHAEL KISLUK LTD, 21, HOLLINS ROAD, WIGAN, WN2 4JZ, Registration CBDU75186, Company number 04526312, Expiry date: 08/01/2025.

11. Provide Local Authority contact details (full address and named contacts) where excavated materials are to be reused	Judith Scott (Environmental Protection Officer) Bury Council Knowsley Place, Knowsley St, Bury BL9 0SW Email: j.scott@bury.gov.uk
12a. For the site where materials are to be reused and for Hub Site locations provide Environment Agency contact details (full address and named contacts):	Stephen Bostock The Waste Enquiries Helpdesk Team Environment Agency Richard Fairclough House, Knutsford Road, Warrington, WA4 1HT Email: gmmcwasteenquiries@environment-agency.gov.uk Tel: 03708 506 506
<i>For all Cluster Projects:</i> 12b. Attach any relevant documentation from the EA relating to the excavation and reuse of the materials to demonstrate no objection to the proposals (see 3.37 of DoW CoP) If the EA has not been consulted please explain why (see paragraph 3.39 of the DoW CoP).	N/A

Lines of Evidence

There is no one single factor that can be used to decide that a substance or object is waste, or when it is, at what point it ceases to be waste; as complete a picture as possible has to be created.

The following sections require completion to ensure the correct decision is made.

If a requested item is not relevant it is important to clearly state why this is so (e.g. no planning permission required because permitted development status exists).

Suitable for use criteria

13. Please describe or provide copies of the required specification(s) for the materials to be reused on each site.	Document Reference(s): As described within the Remediation Strategy Document RSK reference 11752-R01 (00) previous site investigations have been undertaken at the site with soil samples collected from made ground across the Site, which was described in four groups: recent made ground, deeper made ground, natural strata and the bund along the boundary of the Site. Test results showed slight contamination in the recent made ground associated with: lead and zinc; asbestos; polycyclic aromatic hydrocarbon compounds (PAHs) (principally benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(ah)anthracene); total petroleum hydrocarbon (TPH) compounds. In the Deeper Made Ground within BH2 (conjectured to comprise bi-product from a former waste destructor), elevated concentrations of arsenic, copper, lead, nickel and zinc were observed. 2 no. samples of natural strata were reported to be uncontaminated.
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	Investigations of the bund within the boundary of the Site reported elevated concentrations of zina and lead, PAHs, TPH bands (C12-C16, C16 to C21 and C21 to C35). It was determined that these were most likely derived from the combustion of organic based materials in the form of ash and clinkers. It was concluded that made ground present both underlying the site and contained within the bund is not suitable to be present at the surface and accessible to residents for the proposed end use as a caravan park as well as maintenance workers who may be required to excavate where services are located. Current estimates show there could be approximately 3,883.52m³ of material excavated and re-engineered assuming a conservative estimate of 1.5m soil turnover. Soils that are excavated are anticipated to be temporarily stockpiled and tested, where appropriate, to confirm suitability for the following categories of use: • Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials. • Material suitable for inclusion within 600 mm of surface in soft landscaping areas. • Material suitable for placing beneath car parks and roadways. Soils found to be unsuitable for any of the above purposes will be consigned for off-site disposal. The Remediation Strategy is provided in Appendix C.
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<i>Where contamination is suspected or known to be present</i> 14a. Please provide copies of or relevant extracts from the risk assessment(s) that has been used to determine the specification for use on the site. This must relate to the place where materials are to be used. This must be in terms of (i) human health (ii) controlled waters and (iii) any other relevant receptors. If a risk assessment is not relevant for a particular receptor given the site setting please explain why below:	Document Reference(s): The following referenced reports are included in Appendix C: • RSK Geo-environmental and Geotechnical Site investigation, ref: 11542-R02 (00) dated August 2021 Risks from contaminant linkages associated with controlled waters were not considered to be present following RSK's Geo-environmental assessment: • The analytical results for groundwater samples obtained from boreholes BH1 and BH3 are below the relevant GAC protective of groundwater receptors indicating contaminant linkages to the wider aquifer associated with contaminants in the dissolved phase are incomplete. Groundwater is not considered to be impacted by contamination. Therefore, specific criteria for assessing risks to controlled waters are not proposed.
14b. Please attach any relevant documentation from the LA relating to the excavation and reuse of the materials to demonstrate no objection (see 3.37 of the CoP)	A response from Judith Scott, the Environmental Protection Officer at Bury Council is included in Appendix D. The response emails states they have no objection to use of the CLAIRE DoW CoP to support the proposed development at Fernhill Caravan Park.
14c. Please attach any relevant documentation from the EA relating to the excavation and reuse of the materials to	Email response from Stephen Bostock, a member of the GMMC Waste Enquiries Team include in Appendix E. Response states providing that the DoWCoP is followed in full the Environment Agency have no objections to materials use, in accordance with our Regulatory Position Statement.

demonstrate no objection (see 3.37 and Table 2 of the CoP)	
14d. Please attach any relevant documentation from any other regulators (if relevant) relating to the excavation and reuse of the materials to demonstrate no objection (see 3.37 of the CoP)	Document Reference(s): N/A

<i>Where contamination is not suspected</i>	Document Reference(s)
15a. Please attach copies or relevant extracts from the Desk Top Study that demonstrates that there is no suspicion of contamination.	N/A
15b. Please attach copies of or relevant extracts from the site investigation/testing reports that adequately characterise the clean materials to be used (if appropriate).	Document Reference(s): N/A
15c. Please attach copies of any other relevant information (if available) confirming that land contamination is not an issue.	Document Reference(s) N/A

NB: It is your responsibility to assess the nature of the material to be used and that it fits within the limitations of the scenario under which it is to be used

Certainty of use

Various lines of evidence are required to demonstrate that the materials are certain to be used. This includes:

- The production of this MMP
- An appropriate planning permission (or conditions that link with the reuse of the said materials)
- An agreed Remediation Strategy(ies)
- An agreed Design Statement(s)
- Details of the contractual arrangements

Please identify in the following sections what lines of evidence relate to the site(s) **where the materials are to be used**.

16a. Planning Permission(s) relating to the site where materials are to be reused Please provide a copy of the relevant planning permission	Document Reference: See attached in Appendix F: • Planning application number 67596
16b. Explain how the reuse of the excavated materials fits within the planning permission(s) for each site.	In line with cut/fill calculations outlined by LK Remediate, it is anticipated that 1885.95m³ of material will be re-used at the site to reduce site levels to those stated in approved level drawings. It is assumed the units will be either situated on a semi-stiff integral raft or ground beams supported on piles. The processing and crushing of obstructions and rubble will be done under the crusher's mobile plant licence provided by the local authority from where it is registered. The sub-contractor for this has not yet been appointed. Copies of the mobile plant licence and deployment notice will be included in the final verification report.

	Given the type and form of asbestos identified within the investigations, has been identified as chrysotile in both fibres and clumps, with one sample of chrysotile board with the bund containing loose fibres/clumps between 0.006% and 0.062% by weight, is unlikely to require licensing but is recommended to be notifiable to the HSE. It will be for a competent contractor to obtain all the required licenses and permits to ensure that the proposed works are undertaken within the current legal and regulatory frameworks. It will be for the contractor to prove that through the process of sorting the made ground, all unacceptable materials have been removed and those materials remaining on site are suitable for reuse and hence no longer should be considered waste. The processing of the soils will create a geotectonically suitable development platform, with sterile corridors (within a Terram wrap) to mitigate the risk of service contractors coming into contact with soils which may contain asbestos fibres. Given the proposed soil turnover to be used a construction development platform, soil materials will be re-used on site and additional chemical testing should be undertaken to inform suitability for re-use. Soils that are excavated are anticipated to be temporarily stockpiled and tested, where appropriate, to confirm suitability for the following categories of use: • Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials. • Material suitable for inclusion within 600 mm of surface in soft landscaping areas.
--	---

	• Material suitable for placing beneath car parks and roadways. Soils found unsuitable for any of the above purposes will be consigned for offsite disposal. It is possible that soils will be disposed off-site despite suitability for re-use if stockpiling is impracticable or a surplus volume of material is present. In addition to general excavations, aggregate may also be generated from processing of concrete slabs and old foundations to a suitable granular fill material though at this stage likely volumes derived from these sources are considered to be small and it may be impractical to mobilise suitable equipment for small volumes of material.
16c. If planning permission is not required for any one site please explain why below e.g. permitted development, clean-up of a chemical spill, surrender of an Environmental Permit, re-contouring within the existing permission.	N/A

<i>Where contamination is suspected or is known to be present</i> 17. Please provide a copy of any Remediation Strategy(ies) that have been agreed with relevant regulators.	Document Reference(s): See attached in Appendix C: • RSK Remediation Strategy – 11752 R01 (00)
<i>Where contamination is not suspected</i> 18. Please provide a copy of any Design Statement(s) that have been agreed (e.g. with the planning authority or in the case of permitted developments the client).	Document Reference(s): • N/A

Quantity of Use

19. Please provide a breakdown of the excavated materials for each site and how much will be placed at each site or sub area of each site. Where this is not specific to a single readily identifiable source refer to an annotated plan, schematic or attach a tabulated summary.	Document Reference(s): The following plans are included in Appendix A and Appendix B respectively: • Cut and fill and MMP schematics (1 and 2). The findings of the site investigation carried out by RSK in August 2021 indicate that the site is underlain by made ground beneath hardstanding of thicknesses ranging from 0.4m bgl (below ground level) and 1.90m. This made ground is described as relatively recently deposited gravel comparable to MOT road stone beneath a bitumen surface. In BH4, the thickness of bitumen was found to be 0.55m underlain by 0.50m gravel/MOT. Deeper made ground encountered in BH2 was found to comprise principally of ash and clinker with steel fragments. Natural strata were encountered at depths between 0.50-1.90m bgl below existing ground levels over the majority of the site, however in BH2 the natural stratum was encountered at 5.40m. The strata were noted to comprise a soft to firm clayey very sandy silt or very silty sand. The material within the raised mounds that surrounds most of the site was reported by Tergeo Consulting to be made ground comprising sandy, gravelly clay with fragments of brick, concrete, ceramic, plastics, fabrics, glass, macadam and mixed lithologies. Asbestos was detected in 2 no. samples (chrysotile) at 0.062% and 0.006% of total mass. A subsequent RSK soil assessment (October 2018) described the mound as consisting of two distinct layers: • Thin topsoil layer comprising light to dark brown slightly silty gravelly sand with sandstone, rare brick and concrete and abundant rootlets to 0.1m below the top of mound (BTM)
--	--

	Made ground comprising dark brown gravelly sand with low to medium cobble content and manmade products making up between <5% to 30% of the volume between 0.1m to 0.4m. The made ground underlying the topsoil layer of the mound comprised of: brick, concrete, plastic sheeting, glass, asphalt, ceramic, clinker, plastic wrappers, string, wood (manufactured) and cloth. Items such as nails, tin cans, rubber tyres, a bin lid and concrete flagstones were identifiable. The mounds had variable levels of man-made material within them with the northern section comprising approximately 30%, the northwest of 1-15% and south and east <5%. The proposed cut and fill from existing levels to proposed levels gives a 3,697.57m³ surplus of material. The LK Group have stated that they will aim to generate circa 1,050m³ of clean soil and 650m³ of crushed aggregates for placement above reduced levels as 450mm thickness of subsoil in grassed areas and 150mm thickness capping layer and piling mats – reducing the surplus to 1,997.57m³ of material to be sent for off-site disposal.
20a. How has consolidation/compaction being considered in the above mass balance calculations?	It is assumed any small consolidation volumes will be offset by bulking volumes in aggregates produced for the construction platforms.
20b. How has loss due to treatment being considered in the above mass balance calculations (if applicable)?	Not applicable.

20c. How has the addition of treatment materials being considered in the above mass balance calculations (if applicable)? Note - An exact figure is not required but one that is reasonable in the circumstances and can be justified if challenged.	Not applicable.
--	-----------------

Contingency arrangements

Explain what is to happen in the following situations and **identify the appropriate clauses** in the contract(s) (Such clauses must be provided to the Qualified Person, preferably as a summary document): or

21a. What is to happen to, and who is to pay for out of specification materials?	LK Remediate will remove materials that aren't physically or chemically suitable for reuse on-site.
21b. What is to happen to, and who is to pay for any excess materials?	LK Remediate will remove excess materials from the site.
21c. What happens if the project programme slips in relation to excavated materials or materials under -going treatment?	To mitigate programme prolongation LK Remediate will remove materials that aren't physically or chemically suitable for reuse on-site.

21d. Other identified risk scenarios for the project (relating to excavated materials)?	There is the potential for contamination not previously identified to be present. In the event significant contamination is encountered this may preclude reuse of material previously identified for reuse. Should this occur or where this is suspected, the material will be disposed off-site under waste Duty of Care arrangements.
---	--

The Tracking System

Where contamination is suspected or known to be present, state the procedures put in place to:

22a. For all sites please describe the tracking system to be employed to monitor materials movements.	Daily Records will be kept of all material movements at the site with periodic visits by a John Southworth Builders Ltd appointed geo-environmental engineer to inspect and test stockpiles of material proposed for re-use with written confirmation that material may be re-used provided. Annotated plans of excavations, stockpile locations and reuse areas will be maintained on-site for subsequent inclusion within the MMP Verification Report. Off-site disposal of unsuitable / excess materials will be undertaken in accordance with DoC requirements.
<i>Where contamination is suspected or known to be present, state the procedures put in place to:</i> 22b. Prevent contaminants not suitable for the treatment process being accepted	N/A – treatment not proposed
<i>Where contamination is suspected or known to be present, state the procedures put in place to:</i>	The availability of suitable storage areas on site to quarantine soils that are awaiting confirmation testing may be insufficient or unavailable, depending on the nature of the work being undertaken. If storage is unavailable, it may be necessary to place the cover system soils directly into place as they are received and schedule chemical testing from samples

22c. Prevent cross contamination of materials not in need of treatment, wastes awaiting treatment and treated materials	taken in-situ. In the event that the chemical test data shows an exceedance of the assessment criteria, there is a risk this soil would need to be excavated and removed from site or used in another location where it will be suitable. A general watching brief should be maintained throughout earthworks looking for visual and/or olfactory evidence of contamination. This will allow any unexpected areas of contamination to be identified and assessed. In the event that unexpected horizons of contaminated soils are identified during excavation works, the contractor will inform the site manager and/or contact the environmental consultant immediately. Work will be postponed in the area of discovery and the work area cordoned off. The soils will be inspected, sampled and/or analysed to assess the potential risks. The environmental consultant will document any findings. Stockpiled materials will be clearly marked and referenced on site to minimise the risk of materials that either not validated, unsuitable or destined for off-site disposal being reused in error.
<i>Where contamination is suspected or known to be present, state the procedures put in place to:</i> 22d. Demonstrate that materials that do not require treatment and successfully treated materials reach their specific destination	The tracking sheet shall be supported by surveying records, annotated plans and photographs collected as part of the daily record keeping maintained by the contractor. John Southworth Builders Ltd appointed geo-environmental engineer will undertake periodic visits throughout the earthworks programme to review the contractors' daily records and collect its own records in support.
<i>Where contamination is suspected or known to be present, state the procedures put in place to:</i>	All materials to be disposed off-site will be sampled, tested, assessed and classified in accordance with WM3. Where appropriate, further Waste Acceptance Criteria (WAC) analysis will be undertaken to identify the suitability of material for disposal at a specific class of landfill where WAC limits apply.

22e. Ensure that waste for off-site disposal or treatment is properly characterised and goes to the correct facility	
23. Please attach a copy of the tracking forms / control sheets that are to be used to monitor materials movements. To include transfer of loads on site into stockpiles prior to treatment (if applicable), stockpiled after treatment (if applicable), stockpiled awaiting use (as appropriate) and final placement.	Document reference(s); The following tracking sheet is included in Appendix G – Tracking Table
<i>For Hub Sites within Cluster Projects & where materials need treatment before reuse</i> 24. Please attach a copy of the Environmental Permit covering the treatment process. Alternatively if the treatment is covered by a Mobile Plant Permit and associated Deployment Form, attach a copy of the EA agreement to the Deployment Form.	Permit reference / EA letter reference: N/A

Records

25. Where, and in what form, are records to be kept? Note – records e.g. transfer notes, delivery tickets, Desk Top Study, Site Investigation, Risk Assessment(s), Verification Report(s) need to be kept for at least 2 years after the completion of the works and production of the Verification Report	LK Remediate keeps digital site records. Paper copies of transfer notes and tickets will be retained in the site folder.
--	---

Verification Plan

26. Provide or explain the Verification Plan which sets out how you will record the placement of materials and prove that excavated materials have been reused in the correct location and in the correct quantities within the development works (see 3.4 of the DoW CoP).	Document Reference Verification plan specific for the MMP is provided as Appendix H.
---	---

APPENDIX A – DEVELOPMENT DRAWINGS



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Client

Bury Council

Project Title

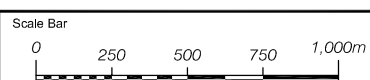
Fernhill Caravan Park, Every Street, Bury

Drawing Title

SITE LOCATION MAP

Rev	Drawn	Date	Checked	Date	Approved	Date
00	NP	09.12.20	LB	09.12.20	-	-
Dimensions		Scale		Original Size		
m		1:25,000		A4		

Project Number	Grid Ref
11542	SD 804 117



Drawing Number
FIGURE 1



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REV: DATE: DESCRIPTION: MK
A 25.01.21 Static caravan and touring units, adjusted MK
B 15.02.21 Pitches 1 & 2 amended, static added MK
C 30.03.21 Pitches renumbered, plots 11 & 12 amended MK
D 14.05.21 Static indicated plots 11 & 12 amended MK
E 22.06.21 Dropped kerbs indicated adj. site access MK
F 15.10.21 Fence boundary lines updated MK
G 30.11.21 Red line amended MK
H 17.08.22 Static & touring positions switched pitch 1 MK

CLIENT: Bury Council

PROJECT: Fernhill Gypsy and Traveller Site Re-development

DRAWING NUMBER: 19144-101H

DRAWING TITLE: Proposed Site Layout

STATUS: **PLANNING**

BY: MK

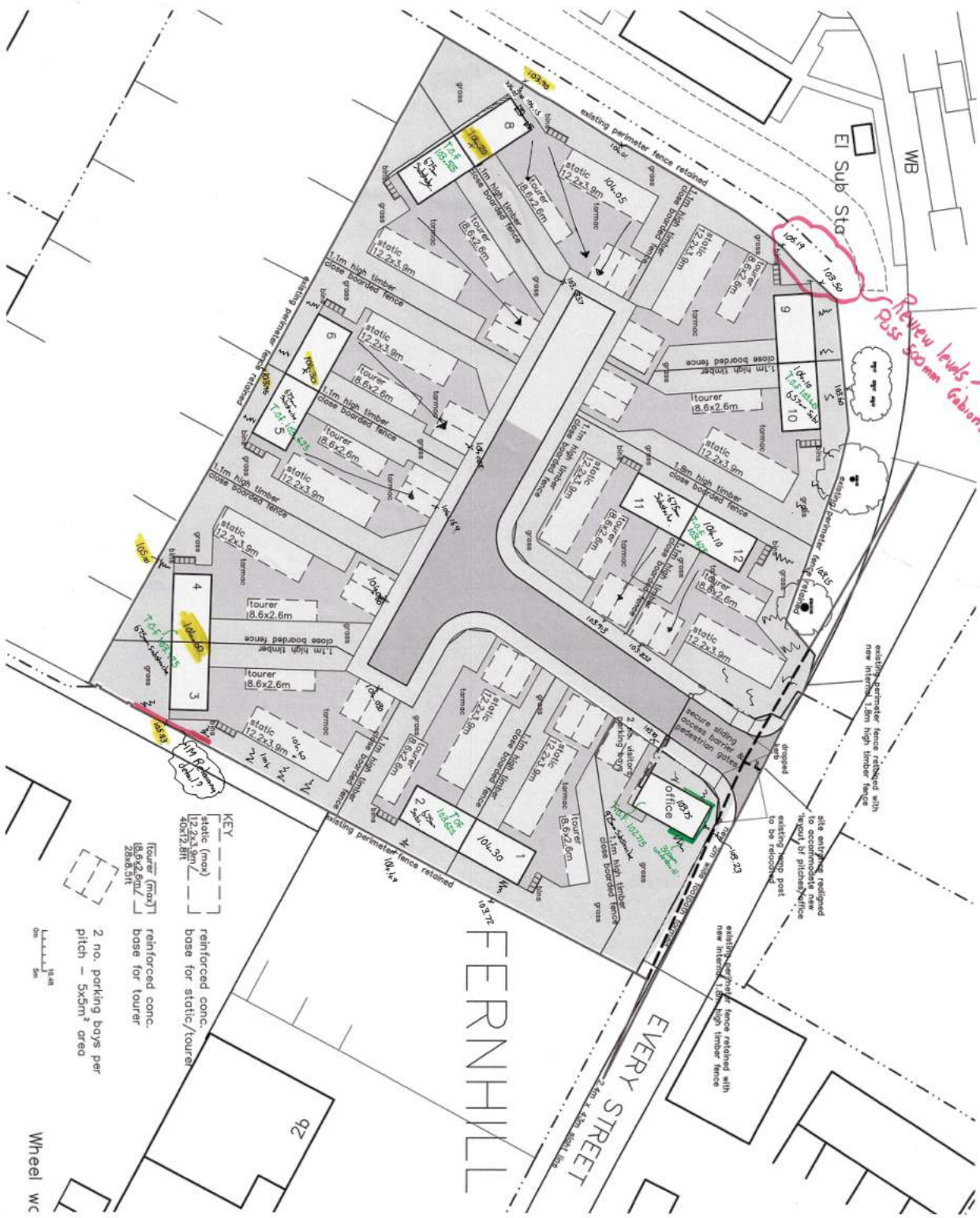
CHECKED: SH

SCALE: 1:500@A3

DATE: 22.10.20.

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PADDOCK
JOHNSON



CLIENT: Bury Council
 PROJECT: Fernhill Gypsy and Traveller Site Re-development
 DRAWING TITLE: Proposed Site Layout

DRAWING NUMBER: 19144-101G
 SCALE: 1:500 @ A3
 DATE: 22.10.20

STATUS: PLANNING
 BY: MK
 CHECKED: SH

PADDOCK JOHNSON

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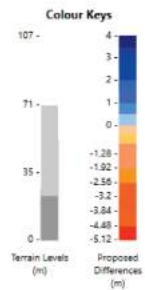
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REV	DATE	DESCRIPTION
A	25.01.21	Static caravan and tower dims. adjusted
B	15.02.21	Pitches 1 & 2 amended, static added
C	30.03.21	Pitches renumbered, plots 11 & 12 amended
D	14.05.21	Static indicated plots 11 & 12 added
E	22.05.21	Dropped kerbs indicated and site access
F	15.07.21	Fence boundary notes updated
G	30.11.21	Field line amended

Cut
Volume 3,883.52m³
2D Area 5,161.87m²
3D Area 5,311.54m²
Depths 0.75m Av., 3.23m Max.
Levels 102.42m to 107.00m

Fill
Volume 185.95m³
2D Area 1,398.38m²
3D Area 1,419.51m²
Heights 0.13m Av., 0.53m Max.
Levels 103.07m to 105.04m

Cut & Fill
Net Volume 3,697.57m³ cut
2D Area 6,560.25m²
3D Area 6,731.05m²
Differences -3.23m to 0.53m, -0.56m Av.
Levels 102.42m to 107.00m



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NOTES

1. ALL LEVELS TO mAD
2. DO NOT SCALE FROM THIS DRAWING
- 3.

KEY

xxx

REV	DESCRIPTION	DATE	BY
-----	-------------	------	----

CLIENT

JOHN SOUTHWORTH LTD

LK REMEDIATE

LK Remediate
Eton Hill Road
Radcliffe
M26 2ZS
T: 0161 736 7200
www.thelkgroup.com

JOB TITLE

EVERY STREET, BURY

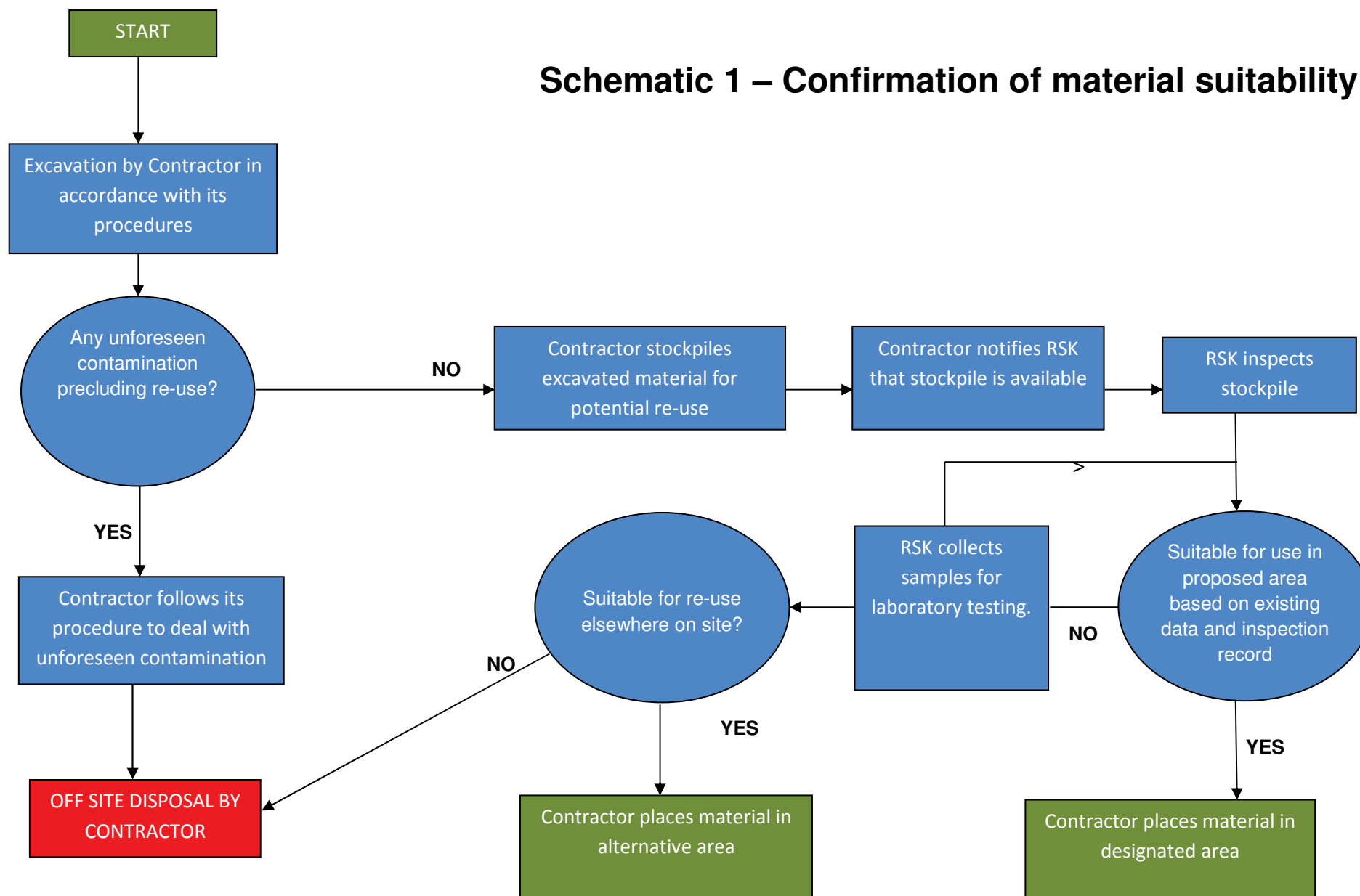
DRAWING TITLE

CUT/FILL CALCULATIONS

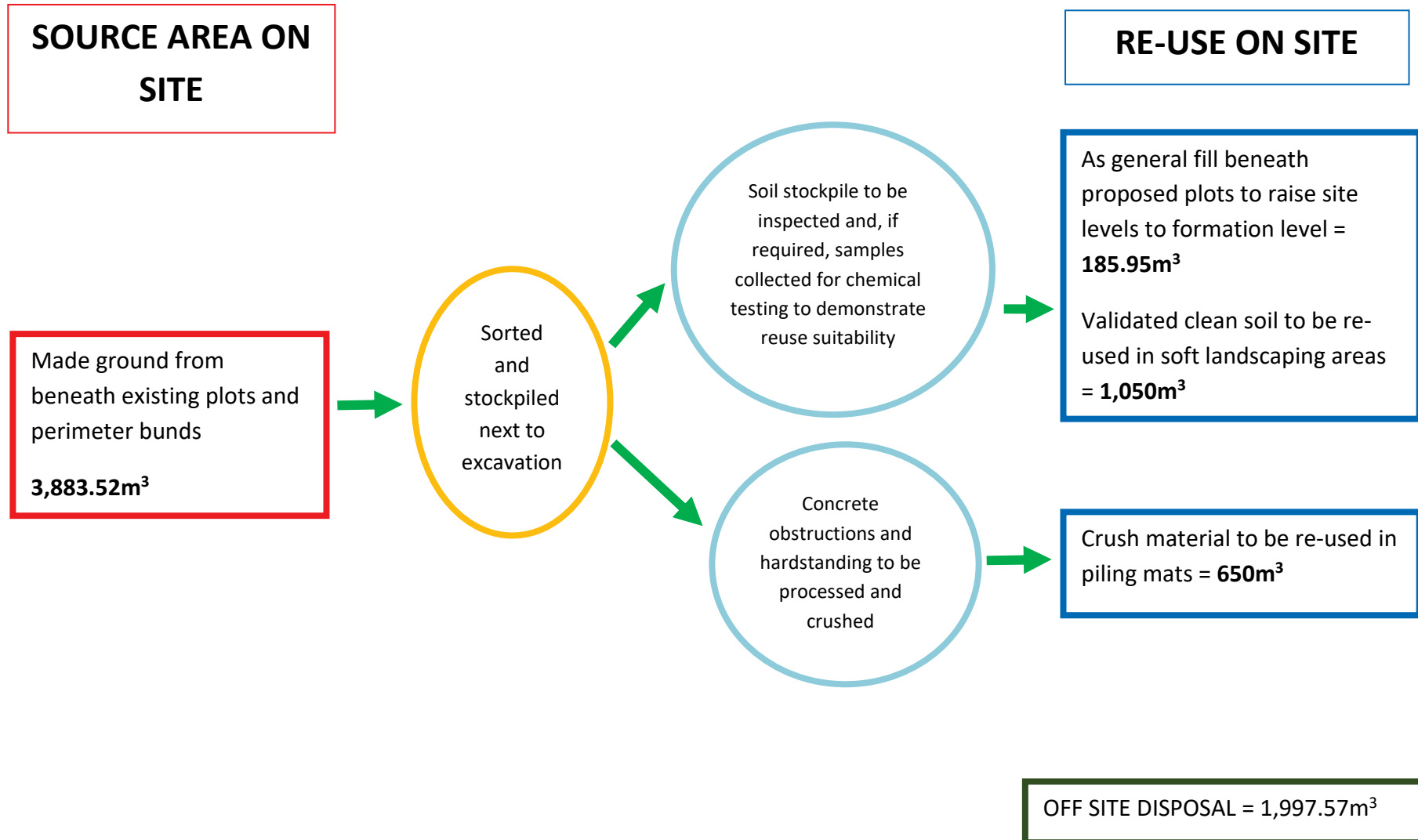
DRAWN	DATE	APPROVED	DATE
RC	17/10/2022	PD	17/10/2022
SCALE	SHEET	DRAWING NUMBER	REVISION
NTS	A4	LKR221029_MMP_01	0

APPENDIX B – LK SCHEMATIC PLANS

Schematic 1 – Confirmation of material suitability



Fernhill Caravan Site MMP – Schematic 2



APPENDIX C – PREVIOUS REPORTS



John Southworth Builders Ltd

Fernhill Caravan Park, Every Street, Bury

Remediation Strategy

11752 R01 (00)

RSK GENERAL NOTES

Project No.: 11752

Title: Remediation Strategy: Fernhill Caravan Park, Every Street, Bury

Client: John Southworth Builders Ltd

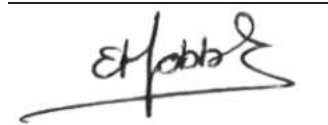
Date: October 2022

Office: RSK Environment Limited, Fourways House, 57 Hilton Street, Manchester, M1 2EJ. Tel 0161 2362757

Status: Rev 00

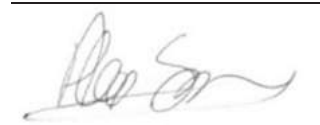
Author Emma Hobbs

Signature



Technical reviewer Alex Smiles

Signature



Project manager Alex Smiles

Signature



Quality reviewer Poppy Whittle

Signature



Revision control sheet				
Revision ref.	Date	Reason for revision	Amended by:	Approved by:
Rev 00	Oct 22	First issue	n/a	see above

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Appendix D	Extract from United Utilities PSRAS backfill material chemical testing criteria.

1 INTRODUCTION

RSK Environment Limited (RSK) was commissioned by John Southworth Builders Ltd on behalf of Bury Council to prepare a remediation strategy (RS) document for the proposed development of the Fernhill Caravan Park located at Every Steet, Bury. The requirement to produce a Remediation Strategy is in line with pre-commencement planning conditions (planning conditions 3 and 4) in planning application 67596 dated 01/11/2021 with Bury Council.

1.1 Background

The Site boundary and current site layout are shown on [Figure 2](#). The Site covers an area of approximately 0.69 hectares. It is currently occupied by Fernhill Caravan Park, a residential site for travellers with 17 plots and six facility blocks.

The site is roughly rectangular in shape and access is gained via Every Street, along the central northern boundary.

Each individual plot was separated by wooden fencing secured with concrete posts, approximately 1.20 m high, and occupied plots contain a mobile caravan, which have a lounge and bedrooms that are used by the occupants. The facility blocks include a food preparation area with plumbing for washing, cleaning, and toilets.

RSK completed an intrusive investigation at the site in March 2021 which included 5no. window sample boreholes to a maximum depth of 6.45mbgl. Ground conditions encountered comprised recent made ground of clay and silty sand with much brick and gravel, and varied in thickness from 0.50m to up to 2.00m. Pre 1930's made ground comprised almost exclusively of ash and clinker and was encountered within borehole BH2 underlying the recent made ground. Underlying the made ground was medium dense silty sand and silt (alluvium). Groundwater was noted to be confined to sand lenses within the silt and was deep during the ground gas monitoring programme.

The made ground was noted to contain elevated concentrations of metals and polycyclic aromatic hydrocarbons. Asbestos was also encountered within the recent made ground.

Given the presence of hydrocarbons within made ground, it was recommended that barrier pipes, in the form of Protectorline or similar, be utilised on site to reduce the risk of contamination permeating potable water supply pipes and impacting drinking water. If inert service corridors are installed during the significant 'turnover' of the site, the requirement for barrier pipes may be removed to PE piping.

The report recommends that a 0.6m thick inert cover system would be required in areas of proposed gardens, the details of which should be set out within a remediation strategy. The requirement for a remediation strategy is outlined in planning condition 3 which states that 'Where remediation/protection measures is/are required, a detailed Remediation Strategy shall be submitted to, and approved in writing by, the Local Planning Authority'.

1.2 Objective

The objective of this RS document is to clearly set out the present site condition and state the objectives of the remediation work to be carried out in order to address pre-commencement planning conditions (planning conditions 3 and 4) in planning application 67596 dated 01/11/2021 with Bury Council.

1.3 Scope of report

The scope of this report is to present a RS, the function of which is to demonstrate to the regulatory and planning authorities that the full details of required remedial actions have been considered and documented. The following details are included for approval by the regulatory and planning authorities before works commence:

- remediation objectives with details of proposed remediation and verification works
- mitigation measures
- licenses and consents
- contingency measures.

Given that the development form will be adequate to achieve a remediation solution for the site by providing an engineered break in the pathway of potentially complete contaminant linkages, completion of a remediation options appraisal was not considered necessary.

In addition to the RS, there remains a requirement in a condition of the extant planning permission for a verification report to be completed once the remediation works have been finished, and for formal approval of this document to be confirmed in writing by the local planning authority before the site is occupied.

1.4 Limitations

The RS is presented to a level of detail considered sufficient for the purposes of planning and regulatory authorities. 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 should be noted any change to the development layout, proposed end uses, or other significant amendment will impact on the findings and recommendations of this strategy and may require its full or partial reinterpretation.

This report is subject to the RSK service constraints given in [Appendix A](#).

1.5 Proposed development

The proposed development will include construction of a number of green/blue-roofed The proposed layout of the site, at the time of preparing this report, is shown in [Appendix B](#).

Proposed development plans show that the entire site is to be demolished and the 17 individual plots are to be reduced to 12, including six single-storey double-facilities blocks, around the margins of the site, with each block to be shared between two plots. There will still be an office building to the east of the site entrance in the north eastern corner of the site. Each plot will contain sufficient space for either one or two touring caravans, which will be used for sleeping and it will also have private soft landscaped areas.

Details from LK Remediate indicate an initial removal of hardstanding and obstructions up to 2m below existing ground level (mbegl). At this stage, allowance for a 1.5m turnover of shallow material is to be excavated and re-engineered, if chemically and geotechnically suitable, for construction platforms. Approximately 9,750m³ of soil will be excavated to be taken from the perimeter bunds and made ground beneath the site surface.

Cut and fill calculations performed by LK Remediate indicate a surplus of material in the region of 3,700m³ requiring removal from the site without any value engineering. Approximately 650m³ of recycled aggregates is proposed to be won from crush for the construction of piling mats and 1,000m³ of validated clean soils proposed to be won for reuse as subsoil in the clean cover layer gardens. This could reduce the surplus to circa 2,100m³. Surplus material is to be removed from the site by a registered waste carrier to a suitably licenced facility.

2 SUMMARY OF CONCEPTUAL MODEL AND RISK ASSESSMENT

2.1 Introduction

This section of the report lists the previous reports provided to RSK for review and produced by RSK as part of the various stages of investigation. A conceptual site model (CSM) was developed and refined during the earlier phases of investigation 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 Environment Agency publication the Land Contamination Risk Management (LCRM) guidance. Where exploratory hole locations from the preceding phases of the RSK work are referenced, their locations on site are presented on [Figure 2](#).

2.2 Previous investigations

2.2.1 RSK reports

The following reports detailing investigation and assessment undertaken at the site by RSK have been produced:

- Soil Assessment – Generic Quantitative Risk Assessment: Traveller Site (Fernhill Caravan Park), Bury 11151-R01(01), dated October 2018.
- Soil Assessment – Detailed Quantitative Risk Assessment: Traveller Site (Fernhill Caravan Park), Bury 11151-R02(00), dated October 2018.
- Preliminary Risk Assessment (PRA): Fernhill Caravan Park, Every Street, Bury. 11542-R01(00) dated December 2020.
- Geo-environmental and geotechnical site investigation: Fernhill Caravan Park, Every Street, Bury 11542-R02(00) dated August 2021.

2.2.2 Reports produced by Third Parties

The following report detailing an assessment of the soil mounds around the perimeter of the site was made available to RSK for review. A detailed review of this report was presented in the Geo-environmental and geotechnical report completed by RSK in August 2021.

- Tergeo Ltd, Travellers Site, Every Street, Bury, BL9 5BE, Ref: 0293_01, March 2017.

2.3 Findings of the RSK investigation (August 2021)

RSK carried out intrusive investigation works with subsequent monitoring and sampling of ground gases and groundwaters between March and June 2021 as reported in the RSK report 11542-R02 (00), dated August 2021. A summary of the findings of the investigations is provided in the below sections.

2.3.1 Geology and groundwater

2.3.1.1 *Surface construction*

Current ground surface across the site comprises a gravel stratum comparable to MOT road stone beneath a bitumen surface. In BH4, the thickness of bitumen was noted to be 0.55 m and was underlain by a significant thickness of gravel (0.50 m).

2.3.1.2 *Made ground*

The made ground which is considered relatively recently deposited was generally encountered beneath hardstanding and either comprised a very sandy clay or a silty sand. Both were noted to contain fragmented concrete, brick, bitumen and tar, glass, wood, and clinker. Where the bitumen was encountered, there was a slight hydrocarbon odour. The maximum depth of recent made ground from existing ground level ranged from 0.50 m to 1.90 m.

Deeper seated made ground encountered within borehole BH2 was distinctly different from the recent deposits and comprised principally ash and clinker with steel fragments and was conjectured to be waste bi-product deposited within the former gravel pit from the refuse destructor (incinerator) that was present beyond the north western boundary.

2.3.1.3 *Variable cohesive and granular unit*

The natural strata were encountered at a depth of between 0.50 and 1.90 below existing ground levels over the majority of the site; however, where the gravel pit was encountered within borehole BH2, the depth to natural stratum was 5.40 m. The strata were noted to comprise a soft and soft to firm / loose laminated clayey, very sandy silt or very silty sand. The units were highly variable in thickness and it is anticipated that there is likely to be more discrete variability with these strata than had been recorded within the visual assessment of the cores.

2.3.1.4 *Bedrock*

Bedrock was not encountered during the site investigation.

2.3.1.5 *Hydrogeology*

Site is underlain by superficial deposits comprising Till (an undifferentiated aquifer). Beneath the Till is bedrock of the Pennine Lower Coal Measures (a secondary A aquifer). The Till is a Secondary (undifferentiated) aquifer, and therefore low sensitivity.

The majority of groundwater strikes recorded during the investigation were situated within the silt. Borehole BH3 encountered groundwater perched within the made ground overlying natural clay. Resting groundwater levels were measured between 1.9m below existing ground level (begl), and 5.39m begl. For the duration of the monitoring programme, the groundwater within all the wells remained static. The greatest variation in groundwater level was noted in borehole BH3 in Round 5, with the first 4 visits having 0.27 m variability.

Shallow groundwater in the site area is anticipated to flow in a south westerly direction, i.e., towards and in the direction of flow of the River Irwell.

2.3.1.6 Observed contamination

The only odours recorded were associated within the recent made ground where bituminous materials were encountered. The odours are anticipated to be remnant diesel and polycyclic aromatic hydrocarbons associated with its use as a hardstanding but will be relatively immobile.

2.3.2 Contaminant linkages

Potentially complete contaminant linkages were identified following the intrusive investigation works and were assessed by risk assessment where appropriate. The contaminant linkages identified before a quantitative risk assessment was completed comprised:

- Linkage (1) – Plausible contaminant linkage to future residents via oral, dermal and inhalation exposure with impacted soil and soil vapour inhalation.
- Linkage (2) – Plausible contaminant linkage to future site residents by inhalation of airborne asbestos fibres from impacted soil.
- Linkage (3) – Plausible contaminant linkage to plant growth by vegetation uptake of contaminants
- Linkage (4) – Plausible contaminant linkage to water supply pipes via permeation of plastic by organic soil contaminants (with implications for human health).
- Linkage (5) – Plausible contaminant linkage to groundwater in the underlying aquifer via leaching of soil contaminants and dissolved phase migration from potentially impacted Made ground soil.
- Linkage (6) – Plausible contaminant linkage to future site residents from migration of onsite ground gasses and vapours into indoor areas via preferential pathways (such as backfill around services or compromised drainage) with subsequent risk of inhalation, asphyxiation or explosion.

2.4 Quantitative risk assessment (August 2021)

This section summarises the stages of quantitative risk assessment carried out during the project and is subdivided into human health and controlled waters receptors.

2.4.1 Human Health (Linkage 1)

All soil results in each dataset were directly compared against the GAC for residential with home-grown produce / residential without home-grown produce with a soil organic matter of 1%.

Recent, shallower made ground was noted to have slight contamination associated with lead and zinc (phytotoxic threshold), asbestos (loose fibres and cement of chrysotile), polycyclic aromatic hydrocarbon (PAH) compounds (principally benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(ah)anthracene), with the shallow sample of BH6 encountering additional PAH compounds (indeno(123-cd)pyrene, naphthalene and phenanthrene). Total petroleum hydrocarbon (TPH) compounds were encountered elevated above threshold concentrations also with the same samples with elevated concentrations of PAH compounds.

Deeper made ground within borehole BH2 was conjectured to comprise the bi-product of the waste destructor (ash and clinker). This stratum was noted to contain significant concentrations of arsenic (194 mg/kg), copper (1,440 mg/kg), lead (2,110 mg/kg), nickel (137 mg/kg) and zinc (1,100 mg/kg), although all concentrations of compounds within the TPH CWG and US EPA 16 suites were all negligible.

Two samples of natural strata were uncontaminated.

There was also a bund within the boundary of the site. This was sampled by both Tergeo and RSK during 2017 and 2018. Several samples in both investigations reported soil contaminants above the threshold for selected metals (zinc and lead), PAHs and total petroleum hydrocarbons bands, particularly between the chain lengths C12 to C16, C16 to C21 and C21 to C35. It was determined that rather being fuel derived, these were associated with the combustion of organic based materials, most likely in the form of ash and clinkers.

The report concluded that made ground present on site, both underlying the site and contained within the bund around the site boundary is not suitable to be present at the surface and accessible to residents for the proposed end use as a caravan park, as well as maintenance workers who may be required to excavate where services are located.

2.4.2 Asbestos (Linkage 2)

Asbestos was encountered within both the made ground underlying the site, as well as the bund surrounding the site. The analysis of the soils has identified the asbestos to be chrysotile and present as both fibres and clumps, with one sample of chrysotile board.

The bund was noted to contain loose fibres/clumps between 0.006% and 0.062% by weight.

A potential linkage therefore exists between asbestos that has been identified on site for the future site users, and for construction workers and users of adjacent sites during development works.

2.4.3 Phytotoxic risk (Linkage 3)

Phytotoxic metals were noted to be above threshold concentrations within the made ground, although below human health threshold concentrations. As the made ground requires remediation and mitigation due to other compounds and elements, the phytotoxic assessment becomes irrelevant and is addressed within the mitigation requirements.

2.4.4 Potable water supply pipes (linkage 4)

For initial assessment purposes, the results from the investigation were compared against the GAC 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 indicate that a relevant linkage is likely to exist associated with organic contaminants due to polycyclic aromatic hydrocarbon compounds within the TPH CWG analysis. We anticipate that Protectorline or similar barrier pipework will be required for the potable water supply for this site. The site is to undergo a significant 'turnover' and hence the materials will be completely disturbed. As the site is to have an inert service corridor, the requirement for this form of potable protection maybe removed to standard

PE piping; however, the threshold values as stated on the risk assessment must be achieved with imported aggregate.

2.4.5 Controlled waters (Linkage 5)

Groundwater analysis of samples obtained from the boreholes did not indicate that mobile contamination is present.

2.4.6 Ground gas (Linkage 6)

Six ground gas monitoring visits were undertaken between May and June 2021. Based on the results of the six monitoring rounds the maximum concentration of methane and carbon dioxide encountered across the site was 0.1% by volume and 7.4% by volume respectively. Methane was only encountered at this trace level within boreholes BH3 and BH5 on one occasion, with all other readings being zero. Carbon dioxide was only encountered above the initial assessment threshold of 5% on one occasion (BH2 third visit) with the next highest concentration of 4.1% by volume within BH2 (fifth visit).

Based on the current understanding of the conceptual site model and the assessment undertaken, the site has been classified as CS1. In accordance with BS8485, ground gas protective measures are not considered necessary within proposed buildings.

The NHBC Guidance for ground gas is not relevant to this form of development as this risk assessment is only to be used where ground floor slabs comprise a screed, block and beam/pre-cast concrete ground floor slab system. These structures will not be constructed in this manner.

2.5 Contaminant linkages requiring remedial action

Following the quantitative risk assessment, the following contaminant linkage was identified as still being potentially complete and requiring remediation or mitigation measures to be incorporated into the redevelopment planned for the site:

- Linkage (1) – Plausible contaminant linkage to future residents via oral, dermal and inhalation exposure with impacted soil and soil vapour inhalation.
- Linkage (2) – Plausible contaminant linkage to future site residents by inhalation of airborne asbestos fibres from impacted soil.
- Linkage (4) – Plausible contaminant linkage to water supply pipes via permeation of plastic by organic soil contaminants (with implications for human health).

3 REMEDIAL AND DEVELOPMENT OBJECTIVES

3.1 Remedial objectives

The objective of the remedial works is to address the relevant contaminant linkages identified in [Section 2.5](#), to render the site suitable for the proposed end use. The following remedial objectives are taken into account 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 taken into account in formulating this strategy:

- Subject to space restrictions, minimise off-site disposal of soil by re-using chemically and geotechnically suitable soil where possible and selecting materials as suitable for a particular purpose, e.g., some soils may be suitable beneath hard standing but unsuitable in open space (maintained landscape areas)
- 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.

4.2 Primary source removal

Primary sources of contamination (e.g. below ground storage tanks, area of landfilling waste, immediate risks to controlled waters) have not been identified at the site. Should primary sources of contamination be encountered during the redevelopment earthworks advice should be sought from RSK and the risks / implications considered in the context of this strategy.

Where required, the contamination shall be assessed by an environmental specialist and samples of the impacted materials submitted for chemical analysis. Dependent on the results of chemical testing and assessment it may be necessary to remove contaminated soils from the site. Removal of any unanticipated sources contamination will be documented and form part of the verification report.

In the event that removal of any unanticipated primary 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 Secondary source removal

Secondary sources identified at the site typical relate to the presence of elevated PAH compounds, heavy metals and asbestos in made ground beneath the site and within the perimeter bunds. For the purposes of this definition, made ground does not include engineering fill materials which have been recycled on site from demolition materials or any imported soils, aggregates which have been otherwise validated as suitable for the use to which it is intended.

4.3.1 Secondary sources - Contaminant Linkages 1 & 2

Based on the findings of the previous site investigations, the identified risks to human health receptors from direct contact / fibre inhalation from soils impacted by heavy metals, PAH compounds and asbestos can be managed by incorporation of engineered measures into the built development that isolate the end-user from potential exposure to these contaminants.

Engineered methods may include, but are not limited to, floor slabs, hard surfacing of areas (roads etc) and soil cover system in areas of soft landscaping or gardens where made ground materials are present (thus removing the pathway).

It should be noted that groundworks contractors working within the highways and paved areas are considered at risk of exposure to these contaminants and the adoption of adequate PPE and good site hygiene practices are recommended.

Where gardens and areas of soft landscaping are proposed and located over made ground materials, a clean soil cover system will be necessary. Cover systems should be at least 0.6m thick in gardens and 0.3m in other soft landscaped area (e.g. public open space areas) and comprise a minimum 0.15m thickness of suitable topsoil underlain by subsoil. A layer of marker Terram or 0.1m thick layer of inert hard to dig aggregate shall be placed between the cover system and underlying made ground soils.

Where made ground is currently present within 0.6m of the final ground levels in gardens or 0.3m in other soft landscaping areas, the made ground shall be removed to the requisite depth to allow installation of the cover system. Should in situ natural soils be present within 0.6m of ground level in gardens or 0.3m of ground level in other soft landscaping areas, these soils may be retained providing they are considered to be a suitable growing medium for vegetation and chemical testing is undertaken to demonstrate the soils are chemically suitable.

Any imported soils used in these areas should be subject to chemical validation testing of material imported and compared against the range of determinants and requirements for a simple soil cover system presented in [Section 5](#) (and in accordance with validation requirements outlined in [Section 5](#)). In addition, any material used as capping in these areas will need to possess sufficient infiltration characteristics to allow site drainage networks to function.

Photographic records showing the soil capping depth has been achieved will be required once completed along with information on the source for any imported clean soils. Photographs should include a survey staff for measurement as evidence the 600 mm capping requirements have been achieved. This information will be required for completion of the Phase 3b Site Validation Report for the project.

4.3.2 General Watching brief

Extrapolation between site data is undertaken to assume ground conditions between points of data collection. Therefore, it is possible the contamination that has not been identified could be encountered during development works.

A general watching brief should be maintained by construction site staff throughout earthworks looking for visual and/or olfactory evidence of contamination. This will allow any unexpected areas of contamination to be identified and assessed. In the event that unanticipated contamination (e.g. ACM, hydrocarbon impact) is encountered during earthworks, construction activities should be temporarily suspended in this area and the advice of an environmental specialist sought.

A methodology and/or appropriate measures for dealing with contamination can then be put into place before work continues (e.g. revised remediation strategy, production of a specific asbestos in soil management plan and during construction activities). It may also be necessary to inform the local authority where any unanticipated contamination is encountered to obtain their agreement with any proposals for dealing with the contamination, which in accordance with planning conditions, may require a revised remediation strategy to be prepared.

4.4 Management of asbestos in soil during redevelopment (Linkage 2)

Asbestos was encountered within both the made ground underlying the site, as well as the bund surrounding the site. The analysis of the soils has identified the asbestos to be chrysotile and present as both fibres and clumps, with one sample of chrysotile board. The bund was noted to contain loose fibres/clumps between 0.006% and 0.062% by weight.

The exploratory holes where asbestos in soil has been detected suggests that the asbestos is likely to be consistently present throughout the made ground soils that underlie and form the perimeter bunds of the site. As such it will be necessary to employ asbestos mitigation measures during the redevelopment work to safeguard the health and safety of site staff and users of adjacent sites (further details of which are provided in this section).

4.4.1 Safety of construction workers during ground works

Asbestos fibres are released more readily from granular soil. Exploratory hole records for previous investigations at the site indicate that a significant portion of made ground is granular, either silty sand within shallow made ground or ashy gravel in deeper historic made ground. Fibres are also released more readily during dry and windy conditions with fibre release reduced when soil moisture contents are maintained greater than 10%. Asbestos fibre concentrations in the soil range between <0.001% and 0.062%. To prevent, where practicable, exposure and spreading of asbestos fibres in line with the Control of Asbestos Regulations (2012) mitigation measures are recommended (see Section 4.4.4).

4.4.2 Users of adjacent sites during the earthworks

The area around the site primarily consists of industrial and commercial developments with a waste transfer facility to the west and other industrial units to the west and south. Of higher sensitivity is a primary school and residential area within 50m of the north of the site. Given the potential close proximity of the general public to the proposed works, this linkage will require mitigation measures to prevent, where practicable, exposure to adjacent occupants in line with the Control of Asbestos Regulations (2012) (see [Section 4.4.4](#)).

4.4.3 Mitigation measures for dealing with asbestos

It is likely that the asbestos that has been identified relates to asbestos containing materials which has become entrained within made ground from various historic sources prior to placement, likely from the site's historic development and subsequent demolition of a railway and two buildings of unknown use. From onsite testing, made ground present beneath the site and contained within the perimeter bunds have been found to contain chrysotile loose fibres and board.

In addition to the above, the moisture content of the soil samples is not known but it is likely that the potential may be variable across the site as the made ground can vary

considerably and their moisture content (linked to the ease of fibre liberation) can also be very variable. It will be necessary to control the release of nuisance dust from the site during the works and such control will also limit the release of asbestos. RSK considers the works are unlikely to require licensing but it is recommended to be notifiable to the HSE.

To manage spreading and exposure risks RSK recommends:

- Excavations within the made ground and perimeter bunds comprising made ground be dampened down.
- Stockpiles of the made ground and perimeter bunds comprising made ground to be covered.
- All site staff to receive training on the identification of ACM and an understanding of actions to be implemented if ACM is identified.
- Implement stop work procedures if potential unforeseen ACM is identified.

To demonstrate these mitigation works are adequate and because of the potentially close proximity of sensitive land uses to the north (primary school and residential area), RSK recommends boundary monitoring be undertaken during periods when excavating, handling and transporting the made ground. Further details of the boundary monitoring are provided in the following subsections.

4.4.4 Mitigation measures to manage spreading and exposure

The asbestos contamination within made ground presents a potential risk to site personnel and the general public during the development of the site. Disturbance of the made ground on site by vehicles and excavation activity has the potential to cause airborne fibre release. Fibre release is generally considered to be greatest from granular material with a low moisture content. This shall be minimised by the implementation of the following control measures:

- The exposed made ground soil should be dampened down to reduce the potential for asbestos fibre release. The moisture content at the surface of the area being excavated and in any uncovered stockpiles of excavated made ground material should be maintained at >10%.
- To prevent spreading of potential asbestos contamination to 'clean' soils, where excavated made ground should, if possible, be stored on impacted areas that are later to be excavated and removed or on hard standing. If this is not possible, stockpiles should be placed on plastic sheeting.
- If stockpiles are to be left in place for more than 12 hours, leading to possible drying out (or sooner if the weather conditions dictate), they shall be covered to prevent the possible release of fibres.
- When impacted soils are required to remain on site outside of working hours then appropriate fencing and signage should be present to secure the area.
- Vehicle movements need to be managed to avoid spreading of asbestos fibres. To minimise the potential for affecting natural soils within the site, vehicular movement routes should be signed and where possible loading areas will be restricted either to

hard standing, or to haul roads constructed of 'clean' imported fill or natural clean soils from site.

- Should the exterior or wheels of any tipper lorry be affected by potentially contaminated material, a vehicle jet-wash will be used to clean the vehicle, with the wash water directed into the contaminated area.

4.4.5 Health and safety of site personnel

It is the responsibility of the principal contractor and any appointed sub-contractors to enforce an appropriate health and safety regime for all site personnel. Full details regarding the proposed working practices in connection with the remediation works shall be agreed in advance of the commencement of the works with the Principal Designer.

A project health and safety plan will be produced before site works commence. This will detail the anticipated hazards associated with the site work, for example asbestos, machinery and open excavation. It will also detail the control measures that will be put in place to reduce these risks to an acceptable level. This plan will also document emergency procedures and include the address and location of the nearest hospital with an A&E department. A copy of this will be made available to principal contractor before commencement and also kept on site and made available on request.

Measures will be necessary to protect the health and safety of site workers during the site works. The contractors will be under a statutory obligation to take reasonable care to protect the health and safety of their employees. The following measures are suggested to provide a minimum level of protection:

- All site staff should undergo asbestos awareness training as part of the site induction.
- All ground workers on-site should be issued with protective clothing, respiratory protective equipment to FFP3 standard, footwear and gloves. These should not be removed from site, and advice should be given on when and how they are to be used.
- Care should be taken to minimise the amount of dust and mud generated on-site.
- Good practices relating to personal hygiene should be adhered to on-site, i.e., food and drink should only be consumed within designated areas on the site and smoking should be prohibited in all working areas.

Reference should also be made to the Health and Safety Executive (HSE) document "Protection of Workers and the General Public during the Development of Contaminated Land".

4.4.6 Mitigation measures to manage unforeseen ACM

Owing to the potential for unforeseen concentrations of ACM throughout excavation of made ground, RSK recommends a watching brief be maintained by a suitably experienced engineer. The engineer should carefully inspect the soil for the presence of previously unidentified ACM, such as clumps of fibrous asbestos, material that may contain asbestos such as board, rope, textile, vinyl or ceramics. Should the engineer suspect ACM from their visual observations, works should cease, and the situation re-evaluated. The duration and frequency of the watching brief can be reviewed during the works to allow certainty that an engineer is present during the higher risk operations.

Re-evaluation may require wetting of soil, additional monitoring, risk assessment and personal protective equipment to be adopted. Should it be necessary to obtain samples for bulk analysis or quantification of asbestos, samples will be taken in a controlled manner and utilising appropriate dust suppression techniques. Samples will be double bagged at the sampling location and uniquely labelled. The approximate location will be recorded on the site plan for future reference.

4.4.7 Monitoring and analysis

Upon commencement of excavation works at the site, air sampling and counting of asbestos fibres should be undertaken.

The air monitoring should be undertaken during the first week of the excavation works and reviewed after this time. If the fibre levels are above the limit of quantification (0.01 f/ml), additional air monitoring should be undertaken until the clearance levels are satisfied (0.01 fibres/ml).

The specific location of air monitoring will depend upon wind direction and the extent of the excavation works. Therefore, it will be determined upon arrival at the site on the day of monitoring. The monitoring location will be recorded by the engineer undertaking the 'watching brief'.

Where power is available on site, the results of air sampling will be determined on site following completion of the tests. Should power not be available, then fibre levels would need to be determined back at RSK's laboratories with results reported later the same day or first thing on the following day.

4.5 Water supply and drainage (linkage 4)

An initial screen of chemical testing results from previous Phase 2 site investigation works indicates potentially chemically aggressive ground conditions may be present on site such that the integrity of new potable water supply pipework may be at risk of damage. It is noted from discussions with contractors there is an aspiration to adopt a clean trench fill system for water pipe runs.

This will entail the excavation of water supply pipe runs to required depth and width, installation of infrastructure, and backfill with clean granular engineered fill. It is considered that, assuming all water supply runs are constructed using this method and adequate validation records, photographs and other evidential records are collected, the exposure linkage will be broken.

Once completed validation testing of soils used as backfill within trench excavations will be required to allow the completion of a United Utilities risk assessment. Further details as to the validation requirements to confirm this element of groundworks have met the remedial requirements.

4.6 Re-use of materials

Current estimates show there could be approximately 9,750m³ of material excavated and re-engineered assuming a conservative estimate of 1.5m soil turnover. It is assumed the units will be either situated on a semi-stiff integral raft or ground beams supported on piles.

The process of turning over this site will require a temporary mobile plant licence to undertake the works. Given the type and form of asbestos identified within the investigations, has been identified as chrysotile in both fibres and clumps, with one sample of chrysotile board with the bund containing loose fibres/clumps between 0.006% and 0.062% by weight, is unlikely to require licensing but is recommended to be notifiable to the HSE.

It will be for a competent contractor to obtain all the required licenses and permits to ensure that the proposed works are undertaken within the current legal and regulatory frameworks.

It will be for the contractor to prove that through the process of sorting the made ground, all unacceptable materials have been removed and those materials remaining on site are suitable for reuse and hence no longer should be considered waste.

The processing of the soils will create a geotectonically suitable development platform, with sterile corridors (within a Terram wrap) to mitigate the risk of service contractors coming into contact with soils which may contain asbestos fibres.

The proposed foundation option (piles or semi-stiff raft foundation) will require confirming prior to the turnover being undertaken as there are different requirements for proposed ground levels during these operations with the different build types. Typically for piling projects a piling blanket will be required, although the turnover may create a surface suitable for lower loaded piling rigs. A specific pile blanket calculation will be required depending upon the plant to be used and the ground conditions.

Given the proposed soil turnover to be used a construction development platform, soil materials will be re-used on site and additional chemical testing should be undertaken to inform suitability for re-use.

Soils that are excavated are anticipated to be temporarily stockpiled and tested, where appropriate, to confirm suitability for the following categories of use:

- Material suitable for use as general fill material beneath proposed buildings, e.g., as backfill, as re-grade materials.
- Material suitable for inclusion within 600 mm of surface in soft landscaping areas.
- Material suitable for placing beneath car parks and roadways.

Soils found unsuitable for any of the above purposes will be consigned for offsite disposal. It is possible that soils will be disposed off-site despite suitability for re-use if stockpiling is impracticable or a surplus volume of material is present. In addition to general excavations, aggregate may also be generated from processing of concrete slabs and old foundations to a suitable granular fill material though at this stage likely volumes derived from these sources are considered to be small and it may be impractical to mobilise suitable equipment for small volumes of material.

Re-use of materials on site shall be subject to the provisions of an MMP.

4.7 Off-site disposal

Current cut/fill estimates indicate a surplus of material in the region of 3,700m³ requiring removal from the site without any value engineering. It is proposed to win 650m³ of

recycled aggregates for the construction of piling mats and 1,000m³ of validated clean soil for reuse as subsoil in the clean cover layer gardens; potentially reducing the surplus to 2100m³.

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 bund investigation in 2018 and the August 2021 investigation. Two samples (HP8 and HP10) from the analysis undertaken by RSK of the bund were noted to have a concentration of hydrocarbon compounds which exceeded 1,000 mg/kg and are considered to exceed the hazardous threshold for carcinogenic risk HP7, and mutagenic risk HP11. Three samples (BH2 at 0.40 m, BH2 at 1.55 m and BH6 at 0.60 m) from the analysis undertaken by RSK from boreholes drilled across the site are considered to be hazardous waste for the same risk factors. It is anticipated that zinc also fails the threshold within BH2 at 1.55 m.

WAC Analysis should be undertaken on any surplus soils on site for disposal.

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.

5 REQUIREMENTS FOR REMEDIATION VERIFICATION

5.1 Introduction

This section identifies the proposed form of verification and reporting that will be undertaken to demonstrate that the mitigation measures that are considered necessary have been implemented on site.

The source of any imported material for the provision of soft landscaped areas will be presented to the local authority for their comment and approval before it is brought to site.

5.2 Frequency and Records

Record Keeping

A record of all soil imports to site for will be maintained. This will include:

- certificates of quality - material imported under the WRAP protocol will be accompanied by certificates of conformity that are less than two months old and relating to the material being imported
- invoices and lorry tickets – importation tickets should be completed in full and legible so the origin of the soil can be traced to the specific donor site
- chemical test data – all data obtained from the donor site or from site initiated chemical testing
- storage – the location of temporary storage or quarantine areas will be identified, and plans/photographs retained to show where the position and movement of stockpile at the site
- verification reports – reports that are generated following visits for the purpose of verification will be retained on site.
- “As built” drawing information and records should be collated detailing information of completed earthworks and remedial operations.

Site records will be maintained so that sufficient data are available for the purpose of compiling a robust verification report. 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 as previously discussed. Records of any environmental monitoring (for asbestos, dust etc.), if undertaken, during the remediation programme shall also be retained so they can be included in the final verification report.

Excavations and capping systems

Along proposed water supply pipe work run it will be necessary to excavate trenches to the required depth and alignment to suit design requirements. The “as built” alignment of these trenches should be recorded along with their dimensions (e.g. width, depth); photographic records should also be obtained at regular intervals during water supply construction as evidence of their excavation and backfill with clean imported soils.

Where a clean soil cover system is proposed for garden and landscaping areas where these are situated on made ground, system shall be a minimum of 600mm thick and comprise a 150mm minimum thickness of topsoil, overlying a suitable thickness of subsoil.

A marker layer of Terram shall be placed between the cover system and underlying made ground soils. The marker layer of Terram will not be required should natural in situ soils form part of the cover system.

Following placement of the cover system the resulting thickness should be checked by excavation and measurement, including confirmatory photographic records at a frequency of 1 per 2 plots/gardens and 4 in total for landscaped areas. It is proposed that the Principal Contractor will provide the environmental consultant with photographic evidence confirming that the physical thickness of installed cover systems are in accordance with the provisions of this document. The environmental consultant shall undertake 'spot checks' of the physical thickness of installed cover systems at a frequency not less than 1 in 10 plots in order to verify the records provided by the Contractor.

Chemical Validation Testing

Chemical test data and visual confirmation of suitability will be recorded prior to confirming the imported soils as being suitable. As detailed in earlier sections of this report, verification records of the remedial works will be collated in a verification report on completion of all site works. There is a risk that soils may need to be removed from site if the chemical test data shows they are not suitable. Therefore, any imported materials should be clearly demarcated as awaiting clearance until suitable data are available and acceptance confirmed by the environmental specialist.

The frequency of chemical testing of imported soils utilised in soil capping systems (either in landscaping zones or as part of clean fill potable water supply pipe runs) should be completed at a frequency of 1/250m³ used. Details of the range of determinants and the associated "suitable for use" values are provided in Table 1.

Table 1: Sampling and Testing Requirements

	Number of samples	Testing schedule
Greenfield soils	Minimum 3, or 1 per 250m ³ (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), asbestos
Brownfield / screened soils	Minimum 6 or 1 per 100m ³ (whichever is the greater)	As, Cd, Cr, CrVI, Cu, Hg, Ni, Pb, Se, Zn, PAH (16 USEPA speciation), TPH (CWG banded), asbestos and any additional analysis depending on the history of the donor site

5.3 Remedial criteria

5.4 Growing Media (<0.6m in gardens and <0.3m in landscaped areas)

Any soils that are present within 0.6m of ground level in gardens and 0.3m of ground level in other landscaped areas will be assessed are the HH GAC in Table 4 of Appendix C will be adopted for assessment of potential risks.

5.4.1 General fill (>0.6m from surface of soft cover or directly under areas of hard cover buildings)

For the purpose of this report the definition of general fill relates to any material placed >0.6m below ground level in garden areas and >0.3m below ground level in other soft landscaped areas and includes engineered fill used as base materials for road and pavement construction.

5.4.1.1 Site-won materials

By design, placement of site won soil >600mm below the final restoration level in soft cover areas or below hard surfacing (buildings, hardstanding etc.) is sufficient to protect end-users from direct contact with soil contaminants. Thus, a remedial criterion for contaminants, including asbestos in soil, are not applicable to soils destined for re-use as general fill.

5.4.1.2 Imported materials

For imported materials, much of the required testing may be undertaken at source and provided by the supplier; however, verification analysis will be required upon arrival to site in accordance with the requirements for Table 1. The GAC in Table 4 of Appendix D will be adopted for assessment of potential risks to future site users from materials placed as general fill. However, any materials containing detectable concentrations of asbestos must not be imported onto the site.

It is not anticipated that chemical testing will be required to validate the chemical suitability of imported aggregate derived from natural sources (e.g. quarry stone) provided an appropriate level of information confirming the provenance of such material is provided in support of it being imported.

However, where such materials are being used within clean fill water supply pipe work runs it will be necessary to obtain samples for chemical validation against United Utilities Pipe Work Risk Assessment criteria (and thus allow completion of the pipework RA form to support their adoption by United Utilities). A copy of the validation testing criteria has been included within Appendix D and is reproduced below.

Extract from United Utilities PSRAS backfill material chemical testing criteria.

Test Group	Testing Required?	PE threshold	Metal Pipes/ Barrier Pipe	Laboratory Detection Limit	Testing UKAS accredited Y/N	Maximum concentration at proposed pipeline depth See Note [2]	Maximum site concentration See Note [3]	Locations and depths where concentrations exceed proposed pipeline threshold
Total VOCs	Where Preliminary Risk Assessment (PRA) has identified land potentially affected by contamination	0.5	Pass					
Total BTEX & MTBE		0.1	Pass					
Total SVOCs (excluding PAHs and those substances marked with an *)		2	Pass					
EC5-EC10 aliphatic and aromatic hydrocarbons		2	Pass					
EC10-EC16 aliphatic and aromatic hydrocarbons		10	Pass					
EC16-EC40 aliphatic and aromatic hydrocarbons		500	Pass					
Phenols* (from SVOC analysis)		2	Pass					
Cresols and chlorinated phenols* (from SVOC analysis)		2	Pass					
Ethers*	Only where identified	0.5	Pass					
Nitrobenzene*		0.5	Pass					
Ketones*		0.5	Pass					
Aldehydes*		0.5	Pass					
Amines		Fail	Pass					
Corrosive	Conductivity, Redox and pH	Pass	See Note [1]					

Note [1] Threshold: For wrapped steel, corrosive if pH<7 and conductivity > 400µS/cm. For wrapped ductile iron corrosive if pH<5, Eh not neutral and conductivity > 400µS/cm. For copper, corrosive if pH<5 or >8 and Eh positive.

Note [2] Water pipes are normally laid at 0.75-1.35m below finished ground level.

As previously discussed, the frequency of chemical testing of imported soils utilised in soil capping systems (either in landscaping zones or as part of clean fill potable water supply pipe runs) should be completed at a frequency of 1/250m³ used.

5.4.1.3 Road and Pavement Aggregate

All imported aggregate for use within road corridors, beneath pavements and driveways must be free of asbestos. All sources of reclaimed/recycled aggregate (including 'scalpings') must have the matrix/dusts/fine content analysed for asbestos prior to acceptance on site. If stockpiled temporarily awaiting testing/return of results, this must be covered and damped down.

This is the most prevalent way sites become impacted by asbestos. Site Managers have a responsibility to inform RSK with each load of this material for analysis. Should loads not be disclosed, there is a high chance that asbestos may be distributed across the site, and fibres maybe wicked from stockpiles or placed aggregates impacting soils which are being controlled and managed through the material management process.

6 CONSTRAINTS AND ADDITIONAL ASSESSMENT

6.1 Potential constraints

The availability of suitable storage areas on site to quarantine soils that are awaiting confirmation testing may be insufficient or unavailable, depending on the nature of the work being undertaken. If storage is unavailable, it may be necessary to place the cover system soils directly into place as they are received and schedule chemical testing from samples taken in-situ. In the event that the chemical test data shows an exceedance of the assessment criteria, there is a risk this soil would need to be excavated and removed from site or used in another location where it will be suitable.

6.2 Unanticipated contamination

Extrapolation between site data is undertaken to assume ground conditions between points of data collection. Therefore, it is possible the contamination that has not been identified could be encountered during development works. A general watching brief should be maintained throughout earthworks looking for visual and/or olfactory evidence of contamination. This will allow any unexpected areas of contamination to be identified and assessed.

In the event that unexpected horizons of contaminated soils are identified during excavation works, the contractor will inform the site manager and/or contact the environmental consultant immediately. Work will be postponed in the area of discovery and the work area cordoned off. The soils will be inspected, sampled and/or analysed to assess the potential risks. The environmental consultant will document any findings.

6.3 Asbestos containing material

The potential risk to site end-users from asbestos contamination is considered appropriately mitigated through the placement of the proposed hard and soft barrier systems. The potential risk to on-site workers and to the surrounding residents and site users during site development will be controlled by the mitigation measures detailed in [Section 4](#).

6.4 Waste disposal

Disposal of general waste will be managed under a site waste management plan the development of which is outside the scope of this report.

The off-site disposal of soils (including made ground) may be required to break contaminant linkages and/or to facilitate the site development. Disposal soils to off-site waste receiving/treatment facilities will also be covered under the site waste management plan. This will require a sufficient frequency and scope of chemical and physical testing to be undertaken to allow suitable waste characterisation to be completed.

REFERENCES

British Standards Institution (2013), BS8576:2013. Guidance on investigations for ground gas – permanent gases and volatile organic compounds (VOCs)

CIRIA C665. Assessing risks posed by hazardous ground gases to buildings. 2007.

BS3882: 2015. Specification for topsoil and requirements for use. British Standards Institution, 2007.

Environment Agency (2018), 'Technical Guidance WM3. Guidance on the classification of and assessment of waste, 1st Edition, v.1.1, May 2018.

Environment Agency (2020), Land contamination risk management, <https://www.gov.uk/government/publications/land-contamination-risk-management-lcrm>, 8 October 2020

FIGURES

FIGURE 1 SITE LAYOUT PLAN



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Client

Bury Council

Project Title

Fernhill Caravan Park, Every Street, Bury

Drawing Title

SITE LOCATION MAP

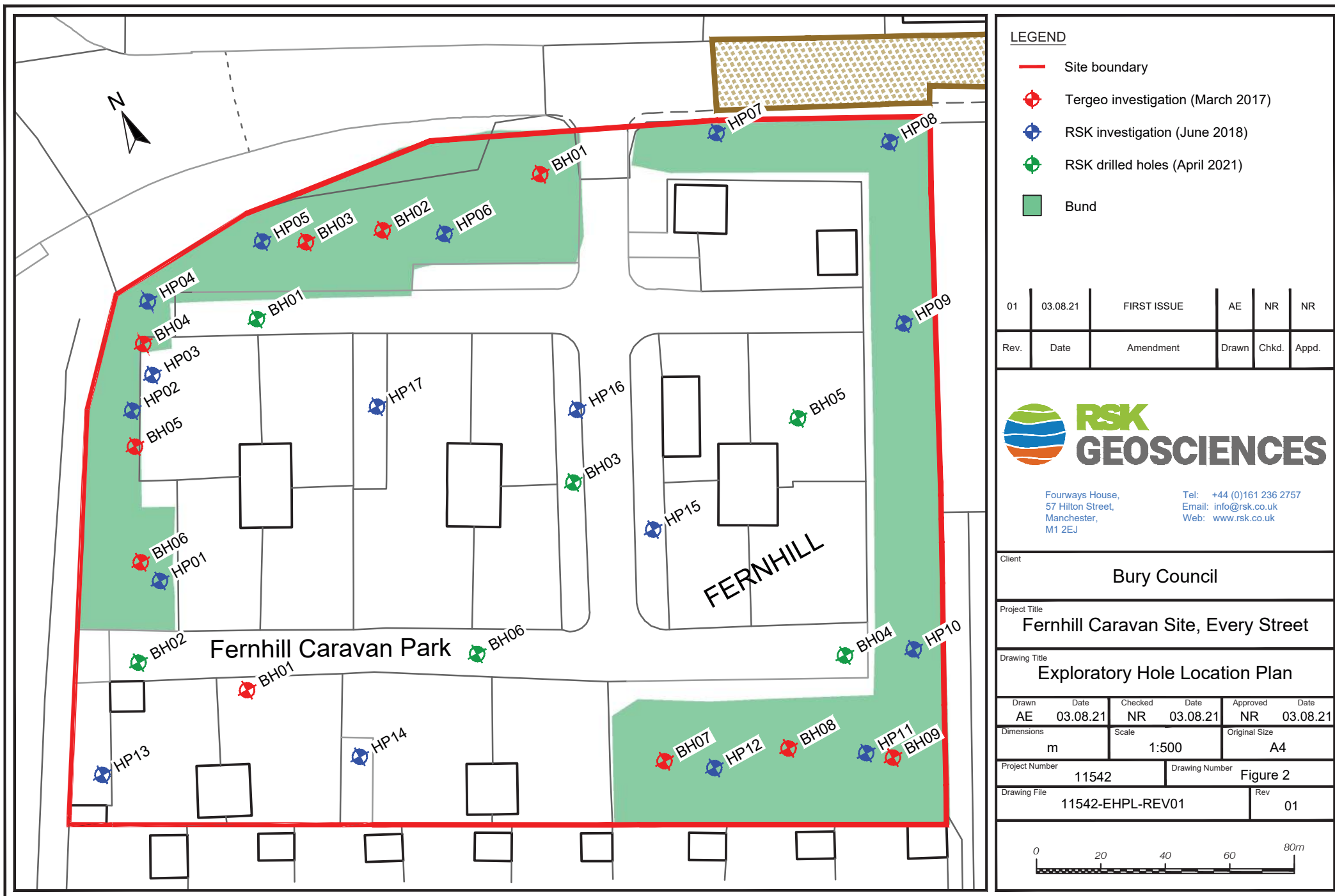
Rev	Drawn	Date	Checked	Date	Approved	Date
00	NP	09.12.20	LB	09.12.20	-	-
Dimensions		Scale		Original Size		
m		1:25,000		A4		

Project Number	Grid Ref
11542	SD 804 117

Scale Bar
0 250 500 750 1,000m

Drawing Number
FIGURE 1

FIGURE 2 EXPLORATORY LOCATION PLAN



APPENDICES

APPENDIX A

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 John Southworth Builders Ltd in accordance with the terms of a contract [RSK Environment Standard Terms and Conditions] 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 site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS/ PFOS) 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

DEVELOPMENT DRAWINGS





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REV: DATE: DESCRIPTION: MK
A 25.01.21: Static caravan and touring dims. adjusted MK
B 15.02.21: Plots 1 & 2 amended, static added MK
C 30.03.21: Plots renumbered, plots 11 & 12 amended MK
D 14.05.21: Static indicated plots 11 & 12 amended MK
E 22.06.21: Dropped kerbs indicated adj. site access MK
F 15.10.21: Fence boundary notes updated MK
G 30.11.21: Red line amended MK
H 17.08.22: Static & touring positions switched pitch 1 MK

CLIENT: Bury Council

PROJECT: Fernhill Gypsy and Traveller Site Re-development

DRAWING NUMBER: 19144-101H

DRAWING TITLE: Proposed Site Layout

DRAWING NUMBER: 19144-101H

DRAWING TITLE: Proposed Site Layout

DRAWING NUMBER: 19144-101H

DRAWING TITLE: Proposed Site Layout

DATE: 22.10.20.

SCALE: 1:500@A3

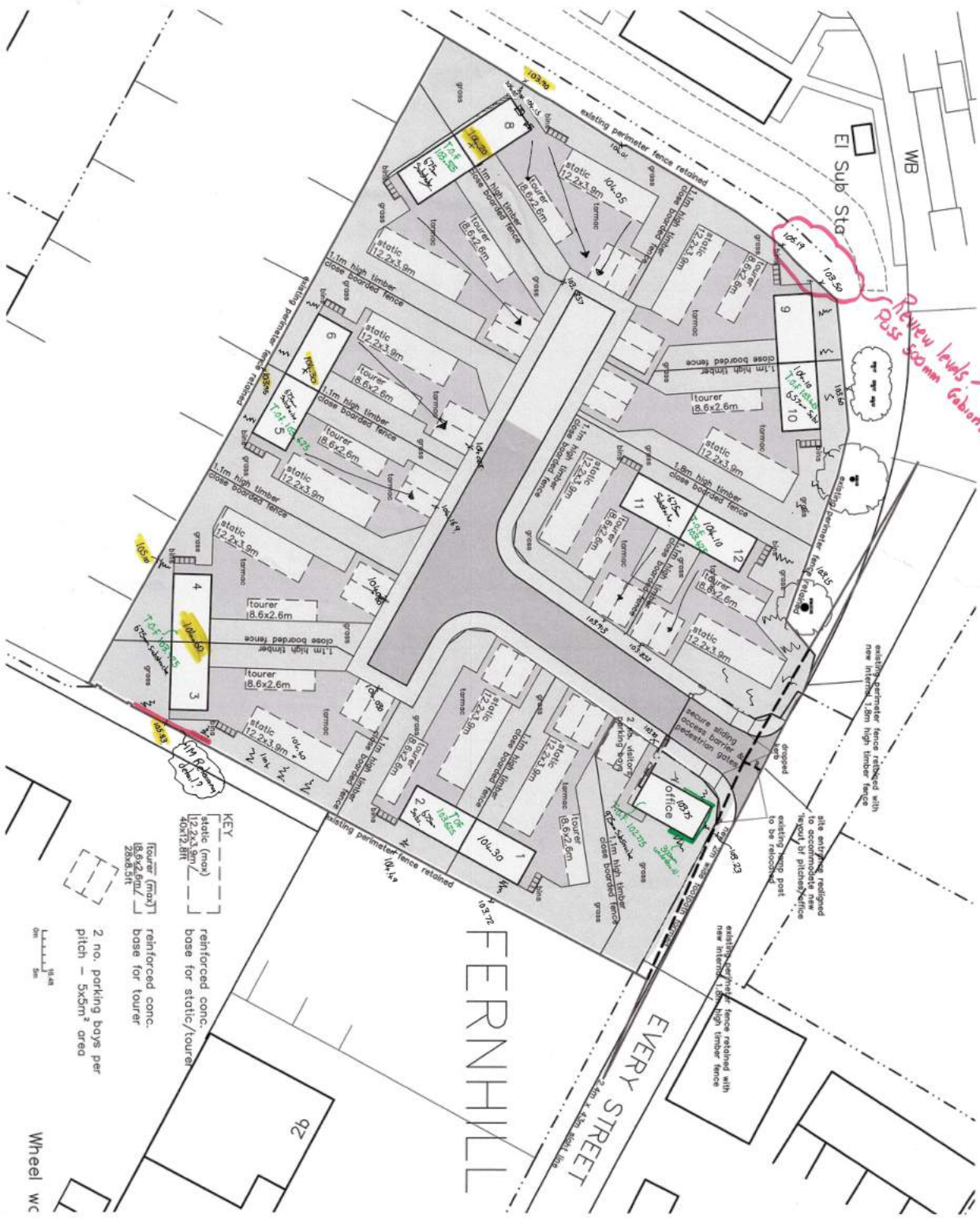
BY: MK

CHECKED: SH

STATUS: **PLANNING**

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JOHNSON**



Review levels?
PSS 500mm gabions?

CLIENT: Bury Council
PROJECT: Fernhill Gypsy and Traveller Site Re-development

DRAWING TITLE: Proposed Site Layout

DRAWING NUMBER: 19144-101G
SCALE: 1:500 @ A3
DATE: 22.10.20

STATUS: PLANNING
BY: MK
CHECKED: SH

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REV	DATE	DESCRIPTION
A	25.01.21	Static caravan and tower dims. adjusted
B	15.02.21	Pitches 1 & 2 amended, static added
C	30.03.21	Pitches renumbered, plots 11 & 12 amended
D	14.05.21	Static indicated plots 11 & 12 added
E	22.05.21	Dropped kerbs indicated and site access
F	15.07.21	Fence boundary notes updated
G	30.11.21	Field line amended

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APPENDIX C
GENERIC ASSESSMENT CRITERIA – RESIDENTIAL WITH HOME
GROWN PRODUCE

Generic assessment criteria for human health: residential scenario with home-grown produce

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 initially 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⁾). Further C4SL were published in 2021 for vinyl chloride, tetrachloroethene (PCE) and trichloroethene (TCE). Where a C4SL has been published, the RSK GAC duplicates the C4SL using all input parameters within the SP1010 final project report⁽³⁾ and associated chemical specific reports⁽⁶⁾, and adopts them as GAC for these substances. Due to the use of decimal places rather than significant figures applied to the Contaminated Land Exposure Assessment (CLEA) tool outputs, the GAC presented may be marginally differently to the C4SL values, however any differences between the values are minimal and would not equate to an unacceptable risk.

For all other substances the C4SL exposure modifications, with the exception of the “top two” produce type approach taken in the C4SL, have been applied to the current RSK GAC. These include alterations to daily inhalation rates for residential and commercial scenarios, reducing soil adherence factors in children (age classes 1 to 12 only) for residential land use, reducing exposure frequency for dermal contact outdoors for residential land use, and updated produce type consumption rates (90th percentile) based on recent data from the National Diet and Nutrition Survey.

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 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.

Conceptual model

In accordance with SR3⁽⁵⁾, the residential with home-grown produce scenario considers risks to a female child between the ages of 0 and 6 years old as the highest risk scenario. In accordance with Box 3.1 of SR3⁽⁵⁾, the pathways considered for production of the SAC in the residential with home-grown produce scenario are

- direct soil and dust ingestion
- consumption of home-grown produce
- consumption of soil attached to home-grown produce
- dermal contact with soil and indoor dust
- inhalation of indoor and outdoor dust and vapours.

Figure 1 is a conceptual model illustrating these linkages.

In line with guidance in the EA SGV report for cadmium⁽¹⁾, the RSK GAC for cadmium has been derived based on estimates representative of lifetime exposure. Although young children are generally more likely to have higher exposures to soil contaminants, the renal toxicity of cadmium, and the derivation of the TDI_{oral} and TDI_{inh} , are based on considerations of the kidney burden accumulated over 50 years or so. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period.

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 LLTC^(3,6) has been published for a substance, RSK has used these input parameters to derive the RSK GAC. Toxicological and specific chemical parameters for 1,2,4-trimethylbenzene, barium, methyl tertiary-butyl ether (MTBE), 1,1,2-trichloroethane, 1,1-dichloroethene, 1,2-dichloropropane, 2-chloronaphthalene, chloroethane, chloromethane, cis 1,2-dichloroethene, dichloromethane, hexachloroethane and trans 1,2-dichloroethene were obtained from the CL:AIRE Soil Generic Assessment Criteria report⁽¹¹⁾.

For TPH, aromatic hydrocarbons C₅–C₈ were not modelled, as this range comprises benzene (>EC5-EC7) and toluene (>EC7-EC8), which are modelled separately.

Physical parameters

For the residential with home-grown produce scenario, the CLEA default building is a small, two-storey terrace house with a concrete ground-bearing slab. The house is assumed to have a 100m² private garden consisting of lawn and flowerbeds, incorporating a 20m² plot for growing fruit and vegetables consumed by the residents. SR3⁽⁵⁾ notes this residential building type to be the most conservative in terms of potential for vapour intrusion. The building parameters used in the production of the RSK GACs are the default CLEA v1.06 inputs presented in Table 3.3 of SR3⁽³⁾, with a dust loading factor detailed in Section 9.3 of SR3⁽⁵⁾. 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 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 residential with home-grown produce land-use scenario

In summary, the RSK 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 Tables 2 and 3 below.

The final selected GAC are presented by pathway in Table 4 and the combined GAC in Table 5.

Figure 1: Conceptual model for residential scenario with home-grown produce

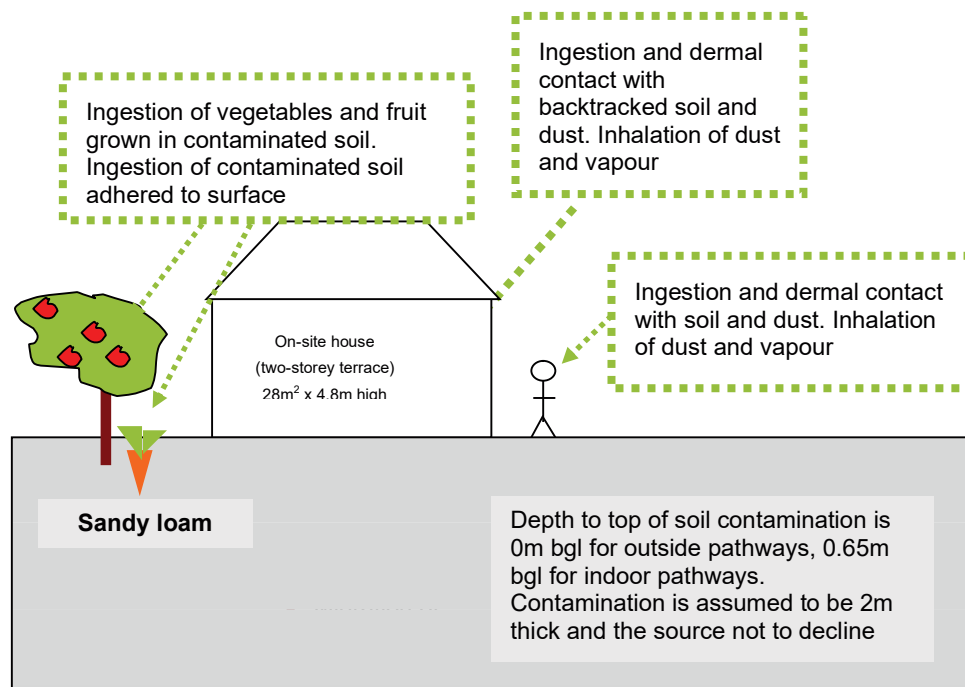


Table 1: Exposure assessment parameters for residential scenario with home-grown produce – inputs for CLEA model

Parameter	Value	Justification
Land use	Residential with homegrown produce	Chosen land use
Receptor	Female child age 1 to 6	Key generic assumption given in Box 3.1, SR3 ⁽⁵⁾
Building	Small terraced house	Key generic assumption given in Box 3.1, SR3. Small, two-storey terraced house chosen, as it is the most conservative residential building type in terms of protection from vapor intrusion (Section 3.4.6, SR3) ⁽⁵⁾
Soil type	Sandy Loam	Most common UK soil type (Section 4.3.1, from Table 3.1, SR3) ⁽⁵⁾
Start AC (age class)	1	Range of age classes corresponding to key generic assumption that the critical receptor is a young female child aged 0–6. From Box 3.1, SR3 ⁽⁵⁾
End AC (age class)	6	
SOM (%)	6	Representative of sandy loamy soil 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: Residential with home-grown produce – modified home-grown produce data

Name	Consumption rate 90 th percentile (g FW kg ⁻¹ BW day ⁻¹) by age class						Dry weight conversion factor (g DW g ⁻¹ FW)	Home-grown fraction (average)	Home-grown fraction (high end)	Soil loading factor (g g ⁻¹ DW)	Preparation correction factor
	1	2	3	4	5	6					
Green vegetables	7.12	5.87	5.87	5.87	4.53	4.53	0.096	0.05	0.33	1.00E-03	2.00E-01
Root vegetables	10.7	2.83	2.83	2.83	2.14	2.14	0.103	0.06	0.4	1.00E-03	1.00E+00
Tuber vegetables	16	6.6	6.6	6.6	4.95	4.95	0.21	0.02	0.13	1.00E-03	1.00E+00
Herbaceous fruit	1.83	3.39	3.39	3.39	2.24	2.24	0.058	0.06	0.4	1.00E-03	6.00E-01
Shrub fruit	2.23	0.46	0.46	0.46	0.19	0.19	0.166	0.09	0.6	1.00E-03	6.00E-01
Tree fruit	3.82	10.3	10.3	10.3	5.16	5.16	0.157	0.04	0.27	1.00E-03	6.00E-01
Justification	Table 3.4, SP1010 ⁽³⁾						Table 6.3, SR3 ⁽⁵⁾	Table 4.19, SR3 ⁽⁵⁾		Table 6.3, SR3 ⁽⁵⁾	

Table 3: Residential with home-grown produce – modified use and receptor data

Parameter	Unit	Age class					
		1	2	3	4	5	6
EF (soil and dust ingestion)	day yr ⁻¹	180	365	365	365	365	365
EF (consumption of home-grown produce)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, indoor)	day yr ⁻¹	180	365	365	365	365	365
EF (skin contact, outdoor)	day yr ⁻¹	170	170	170	170	170	170
EF (inhalation of dust and vapour, indoor)	day yr ⁻¹	365	365	365	365	365	365
EF (inhalation of dust and vapour, outdoor)	day yr ⁻¹	365	365	365	365	365	365
Justification		Table 3.5, SP1010 ⁽³⁾ ; Table 3.1, SR3 ⁽⁵⁾					
Soil to skin adherence factor (outdoor)	mg cm ⁻² day ⁻¹	0.1	0.1	0.1	0.1	0.1	0.1
Justification		Table 3.5, SP1010 ⁽³⁾					
Inhalation rate	m ³ day ⁻¹	5.4	8.0	8.9/f	10.1	10.1	10.1
Justification		Mean value USEPA, 2011 ⁽¹²⁾ ; Table 3.2, SP1010 ⁽³⁾					
Notes: For cadmium , the exposure assessment for a residential land use is based on estimates representative of lifetime exposure AC1-18. This is because the TDI _{oral} and TDI _{inh} are based on considerations of the kidney burden accumulated over 50 years. It is therefore reasonable to consider exposure not just in childhood but averaged over a longer period. See the Environment Agency Science Report SC05002/ TOX 3 ⁽¹⁾ , Science Report SC050021/Cadmium SGV ⁽¹⁾ and the project report SP1010 ⁽³⁾ for more information.							

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GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 4

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce 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)	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR	3.71E+01	5.26E+02	NR	NR	
Barium	(b)	1.34E+03	NR	NR	NR	1.34E+03	NR	NR	NR	1.34E+03	NR	NR	NR	
Beryllium		1.13E+02	1.72E+00	NR	NR	1.13E+02	1.72E+00	NR	NR	1.13E+02	1.72E+00	NR	NR	
Boron		3.00E+02	5.20E+06	NR	NR	3.00E+02	5.20E+06	NR	NR	3.00E+02	5.20E+06	NR	NR	
Cadmium	(a)	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR	2.30E+01	4.88E+02	2.21E+01	NR	
Chromium (III) - trivalent	(c)	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR	1.84E+04	9.07E+02	NR	NR	
Chromium (VI) - hexavalent	(a,d)	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR	5.85E+01	2.06E+01	NR	NR	
Copper		2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR	2.72E+03	1.41E+04	2.47E+03	NR	
Lead	(a)	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR	2.01E+02	NR	NR	NR	
Elemental Mercury (Hg ⁰)	(d)	NR	2.35E-01	NR	4.31E+00	NR	5.60E-01	NR	1.07E+01	NR	1.22E+00	NR	2.58E+01	
Inorganic Mercury (Hg ²⁺)		3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR	3.95E+01	3.63E+03	3.91E+01	NR	
Methyl Mercury (Hg ⁴⁺)		1.26E+01	1.87E+01	7.52E+00	7.33E+01	1.26E+01	3.62E+01	9.34E+00	1.42E+02	1.26E+01	7.68E+01	1.08E+01	3.04E+02	
Nickel	(d)	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR	1.27E+02	1.81E+02	NR	NR	
Selenium	(b)	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR	2.58E+02	NR	NR	NR	
Vanadium		4.13E+02	1.46E+03	NR	NR	4.13E+02	1.46E+03	NR	NR	4.13E+02	1.46E+03	NR	NR	
Zinc	(b)	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR	3.86E+03	3.63E+07	NR	NR	
Cyanide (free)		1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR	1.37E+00	1.37E+04	1.37E+00	NR	
Volatile Organic Compounds														
Benzene	(a)	2.62E-01	9.01E-01	2.03E-01	1.22E+03	5.39E-01	1.68E+00	4.08E-01	2.26E+03	1.16E+00	3.48E+00	8.72E-01	4.71E+03	
Toluene		1.53E+02	9.08E+02	1.31E+02	8.69E+02	3.49E+02	2.00E+03	2.97E+02	1.92E+03	7.95E+02	4.55E+03	6.77E+02	4.36E+03	
Ethylbenzene		1.10E+02	8.34E+01	4.74E+01	5.18E+02	2.61E+02	1.96E+02	1.12E+02	1.22E+03	6.00E+02	4.58E+02	2.60E+02	2.84E+03	
Xylene - m		2.10E+02	8.25E+01	5.92E+01	6.25E+02	5.01E+02	1.95E+02	1.40E+02	1.47E+03	1.15E+03	4.56E+02	3.27E+02	3.46E+03	
Xylene - o		1.92E+02	8.87E+01	6.07E+01	4.78E+02	4.56E+02	2.08E+02	1.43E+02	1.12E+03	1.05E+03	4.86E+02	3.32E+02	2.62E+03	
Xylene - p		1.98E+02	7.93E+01	5.66E+01	5.76E+02	4.70E+02	1.86E+02	1.33E+02	1.35E+03	1.08E+03	4.36E+02	3.10E+02	3.17E+03	
Total xylene		1.92E+02	7.93E+01	5.66E+01	6.25E+02	4.56E+02	1.86E+02	1.33E+02	1.47E+03	1.05E+03	4.36E+02	3.10E+02	3.46E+03	
Methyl tertiary-Butyl ether (MTBE)		1.54E+02	1.04E+02	6.22E+01	2.04E+04	2.97E+02	1.69E+02	1.08E+02	3.31E+04	6.03E+02	3.21E+02	2.10E+02	6.27E+04	
1,1,1,2-Tetrachloroethane		5.39E+00	1.54E+00	1.20E+00	2.60E+03	1.27E+01	3.56E+00	2.78E+00	6.02E+03	2.92E+01	8.29E+00	6.46E+00	1.40E+04	
1,1,2,2-Tetrachloroethane		2.81E+00	3.92E+00	1.64E+00	2.67E+03	6.10E+00	8.04E+00	3.47E+00	5.46E+03	1.36E+01	1.76E+01	7.67E+00	1.20E+04	
1,1,1-Trichloroethane		3.33E+02	9.01E+00	8.77E+00	1.43E+03	7.26E+02	1.84E+01	1.80E+01	2.92E+03	1.62E+03	4.04E+01	3.94E+01	6.39E+03	
1,1,2 Trichloroethane		1.95E+00	1.25E+00	7.62E-01	4.03E+03	4.21E+00	2.55E+00	1.59E+00	8.21E+03	9.35E+00	5.59E+00	3.50E+00	1.80E+04	
1,1-Dichloroethene		1.93E+01	3.29E-01	3.23E-01	2.23E+03	3.85E+01	5.82E-01	5.74E-01	3.94E+03	8.15E+01	1.17E+00	1.16E+00	7.94E+03	
1,2-Dichloroethane		3.17E-02	9.20E-03	7.13E-03	3.41E+03	5.73E-02	1.33E-02	1.08E-02	4.91E+03	1.09E-01	2.28E-02	1.88E-02	8.43E+03	
1,2,4-Trimethylbenzene		NR	1.76E+00	NR	4.74E+02	NR	4.26E+00	NR	1.16E+03	NR	9.72E+00	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		4.28E+00	3.40E-02	3.37E-02	1.19E+03	8.44E+00	6.00E-02	5.96E-02	2.11E+03	1.77E+01	1.21E-01	1.20E-01	4.24E+03	
Carbon Tetrachloride (tetrachloromethane)		3.10E+00	2.58E-02	2.57E-02	1.52E+03	7.11E+00	5.65E-02	5.62E-02	3.32E+03	1.62E+01	1.28E-01	1.27E-01	7.54E+03	
Chloroethane		NR	1.17E+01	NR	2.61E+03	NR	1.59E+01	NR	3.54E+03	NR	2.57E+01	NR	5.71E+03	
Chloromethane		NR	1.17E-02	NR	1.91E+03	NR	1.38E-02	NR	2.24E+03	NR	1.85E-02	NR	2.99E+03	
Cis 1,2 Dichloroethene		1.56E-01	NR	NR	3.94E+03	2.66E-01	NR	NR	6.61E+03	5.18E-01	NR	NR	1.29E+04	
Dichloromethane		7.04E-01	3.05E+00	6.24E-01	7.27E+03	1.27E+00	4.06E+00	1.08E+00	9.68E+03	2.33E+00	6.42E+00	1.92E+00	1.53E+04	
Tetrachloroethene (PCE)		1.33E+01	3.19E-01	3.11E-01	4.24E+02	3.11E+01	7.15E-01	6.99E-01	9.51E+02	7.12E+01	1.64E+00	1.60E+00	2.18E+03	
Trans 1,2 Dichloroethene		6.45E+00	2.76E-01	NR	3.42E+03	1.29E+01	4.99E-01	NR	6.17E+03	2.74E+01	1.02E+00	NR	1.26E+04	
Trichloroethene (TCE)		9.30E-03	3.61E-02	NR	1.54E+03	1.95E-02	7.57E-02	NR	3.22E+03	4.34E-02	1.68E-01	NR	7.14E+03	
Vinyl Chloride (chloroethene)		1.13E-02	1.47E-02	6.38E-03	1.36E+03	2.09E-02	1.90E-02	9.97E-03	1.76E+03	3.88E-02	2.91E-02	1.66E-02	2.69E+03	
Semi-Volatile Organic Compounds														
2-Chloronaphthalene		2.76E+02	5.39E+00	5.29E+00	1.14E+02	6.59E+02	1.33E+01	1.30E+01	2.80E+02	1.45E+03	3.17E+01	3.10E+01	6.69E+02	

GENERIC ASSESSMENT CRITERIA FOR HUMAN HEALTH - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 4

Human Health Generic Assessment Criteria by Pathway for Residential With Home-Grown Produce 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	
Acenaphthene		2.27E+02	4.86E+04	2.26E+02	5.70E+01	5.41E+02	1.18E+05	5.38E+02	1.41E+02	1.18E+03	2.68E+05	1.17E+03	3.36E+02
Acenaphthylene		1.85E+02	4.59E+04	1.84E+02	8.61E+01	4.42E+02	1.11E+05	4.40E+02	2.12E+02	9.78E+02	2.53E+05	9.74E+02	5.06E+02
Anthracene		2.43E+03	1.53E+05	2.39E+03	1.17E+00	5.53E+03	3.77E+05	5.45E+03	2.91E+00	1.10E+04	8.76E+05	1.09E+04	6.96E+00
Benzo(a)anthracene		1.01E+01	2.47E+01	7.18E+00	1.71E+00	1.42E+01	4.37E+01	1.07E+01	4.28E+00	1.69E+01	6.26E+01	1.33E+01	1.03E+01
Benzo(a)pyrene	(a)	4.96E+00	3.51E+01	NR	9.11E-01	4.96E+00	3.77E+01	NR	2.28E+00	4.96E+00	3.89E+01	NR	5.46E+00
Benzo(b)fluoranthene		2.96E+00	1.93E+01	2.56E+00	1.22E+00	3.89E+00	2.13E+01	3.29E+00	3.04E+00	4.43E+00	2.22E+01	3.69E+00	7.29E+00
Benzo(g,h,i)perylene		3.77E+02	1.87E+03	3.14E+02	1.54E-02	4.09E+02	1.94E+03	3.38E+02	3.85E-02	4.23E+02	1.97E+03	3.48E+02	9.23E-02
Benzo(k)fluoranthene		8.92E+01	5.41E+02	7.66E+01	6.87E-01	1.10E+02	5.76E+02	9.22E+01	1.72E+00	1.21E+02	5.91E+02	1.00E+02	4.12E+00
Chrysene		1.66E+01	1.19E+02	1.46E+01	4.40E-01	2.54E+01	1.49E+02	2.17E+01	1.10E+00	3.19E+01	1.66E+02	2.67E+01	2.64E+00
Dibenzo(a,h)anthracene		2.90E-01	1.45E+00	2.41E-01	3.93E-03	3.43E-01	1.64E+00	2.84E-01	9.82E-03	3.69E-01	1.74E+00	3.04E-01	2.36E-02
Fluoranthene		2.87E+02	3.83E+04	2.85E+02	1.89E+01	5.63E+02	8.87E+04	5.60E+02	4.73E+01	9.00E+02	1.83E+05	8.96E+02	1.13E+02
Fluorene		1.77E+02	6.20E+03	1.72E+02	3.09E+01	4.19E+02	1.53E+04	4.07E+02	7.65E+01	8.98E+02	3.62E+04	8.77E+02	1.83E+02
Hexachloroethane		2.68E-01	NR	NR	8.17E+00	6.57E-01	NR	NR	2.01E+01	1.55E+00	NR	NR	4.81E+01
Indeno(1,2,3-cd)pyrene		3.09E+01	2.12E+02	2.70E+01	6.13E-02	4.22E+01	2.38E+02	3.59E+01	1.53E-01	4.92E+01	2.50E+02	4.11E+01	3.68E-01
Naphthalene		2.78E+01	2.33E+01	1.27E+01	7.64E+01	6.66E+01	5.58E+01	3.04E+01	1.83E+02	1.53E+02	1.31E+02	7.06E+01	4.32E+02
Phenanthrene		9.85E+01	7.17E+03	9.72E+01	3.60E+01	2.24E+02	1.76E+04	2.22E+02	8.96E+01	4.48E+02	4.07E+04	4.43E+02	2.14E+02
Pyrene		6.25E+02	8.79E+04	6.20E+02	2.20E+00	1.25E+03	2.04E+05	1.24E+03	5.49E+00	2.05E+03	4.23E+05	2.04E+03	1.32E+01
Phenol		1.60E+02	4.58E+02	1.20E+02	2.42E+04	2.96E+02	6.95E+02	2.09E+02	3.81E+04	5.86E+02	1.19E+03	3.93E+02	7.03E+04

Total Petroleum Hydrocarbons

Aliphatic hydrocarbons EC ₅ -EC ₆		4.99E+03	4.24E+01	4.23E+01	3.04E+02	1.13E+04	7.79E+01	7.78E+01	5.58E+02	2.50E+04	1.61E+02	1.60E+02	1.15E+03
Aliphatic hydrocarbons >EC ₅ -EC ₆		1.49E+04	1.04E+02	1.03E+02	1.44E+02	3.43E+04	2.31E+02	2.31E+02	3.22E+02	7.11E+04	5.29E+02	5.28E+02	7.36E+02
Aliphatic hydrocarbons >EC ₆ -EC ₁₀		1.61E+03	2.68E+01	2.67E+01	7.77E+01	2.91E+03	6.55E+01	6.51E+01	1.90E+02	4.26E+03	1.56E+02	1.54E+02	4.51E+02
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂		4.57E+03	1.33E+02	1.32E+02	4.75E+01	5.51E+03	3.31E+02	3.26E+02	1.18E+02	5.98E+03	7.93E+02	7.65E+02	2.83E+02
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆		6.27E+03	1.11E+03	1.06E+03	2.37E+01	6.34E+03	2.78E+03	2.41E+03	5.91E+01	6.36E+03	6.67E+03	4.34E+03	1.42E+02
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	(b)	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	6.46E+04	NR	NR	8.48E+00	9.17E+04	NR	NR	2.12E+01	1.10E+05	NR	NR	5.09E+01
Aromatic hydrocarbons >EC8-EC ₁₀		5.76E+01	4.74E+01	3.45E+01	6.13E+02	1.38E+02	1.16E+02	8.38E+01	1.50E+03	3.07E+02	2.77E+02	1.94E+02	3.58E+02
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂		8.29E+01	2.58E+02	7.52E+01	3.64E+02	1.96E+02	6.39E+02	1.79E+02	8.99E+02	4.25E+02	1.52E+03	3.91E+02	2.15E+03
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆		1.47E+02	2.85E+03	1.45E+02	1.69E+02	3.36E+02	7.07E+03	3.32E+02	4.19E+02	6.81E+02	1.68E+04	6.74E+02	1.00E+03
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	(b)	2.63E+02	NR	NR	5.37E+01	5.45E+02	NR	NR	1.34E+02	9.34E+02	NR	NR	3.21E+02
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	(b)	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	(b)	1.09E+03	NR	NR	4.83E+00	1.47E+03	NR	NR	1.21E+01	1.70E+03	NR	NR	2.90E+01

Notes:

EC - equivalent carbon. SAC - soil assessment criteria.

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 naphthalene, 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 boron 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 - RESIDENTIAL WITH HOME-GROWN PRODUCE



Table 5
Human Health Generic Assessment Criteria for Residential with home-grown produce

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	37	37	37
Barium	1,300	1,300	1,300
Beryllium	1.7	1.7	1.7
Boron	300	300	300
Cadmium	22	22	22
Chromium (III) - trivalent	910	910	910
Chromium (VI) - hexavalent	21	21	21
Copper	2,500	2,500	2,500
Lead	200	200	200
Elemental Mercury (Hg ⁰)	0.2	0.6	1.2
Inorganic Mercury (Hg ²⁺)	39	39	39
Methyl Mercury (Hg ⁴⁺)	10	10	10
Nickel	130	130	130
Selenium	258	258	258
Vanadium	410	410	410
Zinc	3,900	3,900	3,900
Cyanide (free)	1.4	1.4	1.4
Volatile Organic Compounds			
Benzene	0.20	0.41	0.87
Toluene	130	300	680
Ethylbenzene	50	110	260
Xylene - m	59	140	327
Xylene - o	61	143	332
Xylene - p	57	133	310
Total xylene	57	133	310
Methyl tertiary-Butyl ether (MTBE)	60	110	210
1,1,1,2 Tetrachloroethane	1.20	2.78	6.46
1,1,2,2-Tetrachloroethane	1.6	3.5	7.7
1,1,1-Trichloroethane	9	18	39
1,1,2 Trichloroethane	0.8	1.6	3.5
1,1-Dichloroethane	0.32	0.57	1.16
1,2-Dichloroethane	0.007	0.011	0.019
1,2,4-Trimethylbenzene	1.8	4.3	9.7
1,3,5-Trimethylbenzene	NR	NR	NR
1,2-Dichloropropane	0.034	0.060	0.120
Carbon Tetrachloride (tetrachloromethane)	0.026	0.056	0.127
Chloroethane	11.7	15.9	25.7
Chloromethane	0.012	0.014	0.019
Cis 1,2 Dichloroethene	0.16	0.27	0.52
Dichloromethane	0.62	1.08	1.92
Tetrachloroethene (PCE)	0.31	0.70	1.60
Trans 1,2 Dichloroethene	0.28	0.50	1.02
Trichloroethene (TCE)	0.009	0.020	0.043
Vinyl Chloride (chloroethene)	0.006	0.010	0.017
Semi-Volatile Organic Compounds			
2-Chloronaphthalene	5	13	31
Acenaphthene	230	540	1,170
Acenaphthylene	180	440	970
Anthracene	2,400	5,500	10,900
Benzo(a)anthracene	7	11	13
Benzo(a)pyrene	5	5	5
Benzo(b)fluoranthene	2.6	3.3	3.7
Benzo(g,h,i)perylene	310	340	350
Benzo(k)fluoranthene	77	92	100
Chrysene	15	22	27
Dibenzo(a,h)anthracene	0.24	0.28	0.30
Fluoranthene	290	560	900
Fluorene	170	410	880
Hexachloroethane	0.27	0.66	1.55
Indeno(1,2,3-cd)pyrene	13	30	71
Naphthalene	13	30	71
Phenanthrene	100	220	440
Pyrene	620	1,240	2,040
Phenol	120	210	390
Total Petroleum Hydrocarbons			
Aliphatic hydrocarbons EC ₅ -EC ₆	42	78	160
Aliphatic hydrocarbons >EC ₆ -EC ₈	100	230	530
Aliphatic hydrocarbons >EC ₈ -EC ₁₀	27	65	154
Aliphatic hydrocarbons >EC ₁₀ -EC ₁₂	130 (48)	330 (118)	760 (283)
Aliphatic hydrocarbons >EC ₁₂ -EC ₁₆	1,100 (24)	2,400 (59)	4,300 (142)
Aliphatic hydrocarbons >EC ₁₆ -EC ₃₅	65,000 (8)	92,000 (21)	110,000
Aliphatic hydrocarbons >EC ₃₅ -EC ₄₄	65,000 (8)	92,000 (21)	110,000
Aromatic hydrocarbons >EC ₈ -EC ₁₀	30	80	190
Aromatic hydrocarbons >EC ₁₀ -EC ₁₂	80	180	390
Aromatic hydrocarbons >EC ₁₂ -EC ₁₆	140	330	670
Aromatic hydrocarbons >EC ₁₆ -EC ₂₁	260	540	930
Aromatic hydrocarbons >EC ₂₁ -EC ₃₅	1,100	1,500	1,700
Aromatic hydrocarbons >EC ₃₅ -EC ₄₄	1,100	1,500	1,700
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: ¹ 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. SAC - soil assessment criteria. ¹ LOD for weight of asbestos per unit weight of soil calculated on a dry weight basis using PLM, handpicking and gravimetry. 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 naphthalene, 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.			

APPENDIX D
EXTRACT FROM UNITED UTILITIES PSRAS BACKFILL MATERIAL
CHEMICAL TESTING CRITERIA.

Supplementary guidance for the selection of water pipes in land potentially affected by contamination

Introduction

In January 2011, UK Water Industry Research (UKWIR) published "Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21; the 'UKWIR Guidance'). Its aim is to ensure that the correct materials are selected for water pipes and components to be used below ground in brownfield sites to protect the quality of drinking water whilst taking into account the service life of the water distribution system. It supersedes the Water Regulations Advisory Scheme (WRAS) Information and Guidance Note 9-04-03 "Laying Pipes in Contaminated Land" which has been withdrawn.

The UKWIR Guidance is for use by developers, self-lay organisations, water companies and consultants when planning, designing and constructing water mains and/or services in brownfield sites. It defines brownfield sites as "land or premises that have previously been used or developed. They may also be vacant or derelict. However, they are not necessarily contaminated." The UKWIR Guidance states that it does not apply to greenfield sites; however, we consider this supplementary guidance and the relevant sections of the UKWIR guidance as being equally suitable for application to those greenfield sites considered to be potentially affected by contamination. Where greenfield sites are not affected by contamination a preliminary risk assessment (see below) will suffice.

The UKWIR Guidance also states that there should be no departure from its provisions "except where formally approved by the Water Company, such departure being technically justifiable or representing advances in knowledge or product development".

We have adopted the UKWIR Guidance in principle and produced this company specific supplementary guidance (the 'UW Guidance') which includes the Risk Assessment for Water Pipes (the 'RA').

This guidance does not cover operative safety, health exposure modelling or accidental pipe damage.

which the pipes are to be laid may be affected by contamination. The application of the source, pathway, receptor concept will be an integral part of any pipeline risk assessment. For each potential source (the contamination) and each potential receptor (the water pipe), consideration shall be given to whether a potential pathway between source and receptor exists, or may exist in the future, linking the two. There are normally only three pathways by which contamination may come into contact with water pipes. These are direct contact with the soil or backfill, an excessive vapour phase or a contaminated groundwater regime. If none of these conditions exist on site (adopting the source, pathway, receptor concept) then it is likely that extended and/or targeted soil testing will not be required and a simple risk assessment will suffice. For those sites where land may be affected by contamination appropriate testing shall be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials. The testing requirements are as described in the following section.

The signatories of the Water Supply Application Form and the RA must ensure that all assessments of land condition have been carried out in accordance with applicable current standards and guidelines by or under the direction of a suitably qualified competent person.

We require the competent person to be a) a chartered member of an appropriate professional body (such as the Institution of Civil Engineers, the Geological Society of London or the Royal Institution of Chartered Surveyors) with relevant experience of investigating contaminated sites or b) a Specialist in Land Condition (SiLC) with appropriate geo-environmental experience.

Risk Assessment for Water Pipes in Land Potentially Affected by Contamination

Any application for new water supplies to a development (construction of new properties, or renovation or conversion of existing buildings) in land potentially affected by contamination shall include a completed RA.

As a minimum a desk study (preliminary risk assessment) shall be provided with the RA in accordance with the framework in Environment Agency publication "Model Procedures for the Management of Land Contamination" (ref: CLR11) that sets out whether the land through

How to contact us about the information in this leaflet



DeveloperServicesWater@uuplc.co.uk



0345 072 6067

Opening hours:
8am-5pm Mon to Thurs
8am-4.30pm Fri

Testing Requirements

The soil, rock and if appropriate groundwater tests that are required on all sites where the potential for organic contamination has been identified in the desk study and where water pipes are proposed to be laid must be accredited by United Kingdom Accreditation Service (UKAS) as a minimum and where commercially available the Environment Agency's Monitoring Certification Service (MCERTS). These accredited tests should be undertaken for:

Banded hydrocarbons EC5-EC10, EC10-EC16, EC16-EC40 (Total aliphatic and aromatic hydrocarbons for each banding may be summed). Aliphatic/aromatic fractionation and subsequent banding may be required should a more detailed site specific risk assessment be undertaken. The bandings have been amended to take into account readily available laboratory tests. The equivalent carbon number (EC) is used to assess petroleum hydrocarbon mixtures rather than the actual number of carbon atoms in the molecule in line with guidance issued by the Environment Agency (2005).

Volatile organic compounds (VOCs) (method by head space or purge & trap GCMS) with tentative identification of compounds greater than 20µg/kg. The method used should be capable of detecting a wide range of compounds listed in US EPA Method 8260C or similar. The method should include analysis of naphthalene.

BTEX (Benzene, toluene, ethyl benzene and xylenes) plus MTBE (Methyl-tertiary butyl ether) (by head space GCMS)

Semi-Volatile Organic Compounds (SVOCs) (method by GCMS) with tentative identification of compounds greater than 20µg/kg The method used should be capable of detecting the compounds listed in US EPA Method 8270D or similar. The total concentration of SVOCs excludes polycyclic aromatic hydrocarbons, ethers, nitrobenzene, ketones, aldehydes, phenols, cresols and chlorinated phenols. Phenols, cresols and chlorinated phenols which are detected by the SVOC analysis are given their own assessment criteria.

We do not consider Table G1 and Table 3.1 of the UKWIR Guidance to be a definitive guide for assessing total concentrations. Table 1 in the RA below replaces Table 3.1 of the UKWIR Guidance.

Where previous site uses include the use, storage, treatment, disposal or manufacture of any of the following, appropriate testing for these substances will be required:

- Ethers, nitrobenzene, ketones, aldehydes and amines. Note that the presence of amines on any site at the proposed pipe depth +/- 1.0m precludes the use of polyethylene. The methods of analysis and method of calculation of total concentrations of these compounds will need to be agreed with UUW.

To comply with the testing requirements, the suites of tests that are required on all brownfield sites where wrapped steel, wrapped ductile iron or copper pipes are to be laid as minimum must include:

- pH, Conductivity and redox potential

Sufficiency of Testing

Water pipes are normally laid at between 0.75 and 1.35m from finished ground level to crown of pipe. Samples taken and tested must represent both a) the soil in which the water pipes are to be laid and b) the soil down to at least 500mm below the underside of the proposed pipe. Where the proposed depth of the pipes is unknown at the time of application, soil samples representative of the ground condition between surface level and 1.5m below finished ground level shall be taken as a minimum. Where appropriate (see UKWIR Guidance) groundwater sampling and groundwater monitoring will also be necessary. Photo-ionisation detection (PID) monitoring along the proposed route of the pipeline may be employed, though this does not provide a definitive guide to the suitability of water pipe materials.

Where required a sufficient number of test results should be obtained from the material in which the pipes are to be laid. CLAIRE/CIEH 2008 "Guidance on comparing soil contamination data with a critical concentration" may be used, where appropriate, to justify the number of soil samples tested; however, this statistical model should not be used on heterogeneous materials or used to average test results from different types of materials.

Further guidance on representative sampling is contained within BS10175:2011 Code of Practice for the Investigation of Potentially Contaminated Sites, the Department of the Environment's Contaminated Land Research Report "Sampling strategies for contaminated land" prepared by The Centre for Research into the Built Environment, Nottingham Trent University (Ref: CLR 4; 1994) and the Environment Agency's "Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination" (ref: R&D Technical Report P5-066/TR; 2000).

Where remediation has been carried out on the site, the test results obtained from validation samples will be used in the assessment. Where a horizontal capping system has been or will be employed using materials spread across a site, sufficient samples will need to be taken to characterise the capping material used and the results presented to UUW. However, the sufficiency of sampling on the horizontal capping system, in which the pipeline will be placed, may be assessed on the basis of the source, quantity and type of materials used.

Detection Limits

Only positive concentrations, ie those above the limit of detection should be used in summation of VOC and SVOC (or other test groups of compounds ie phenols, cresols and chlorinated phenols). Laboratory methods shall provide a minimum limit of detection of 10µg/kg for each individual VOC or SVOC (or other test groups of compounds) quantitatively detected in accordance with the methods described above. For tentatively identified compounds (TICs), only those compounds with a concentration of 20µg/kg or greater shall be used in the summation of VOC and SVOC (or other test groups of compounds).

Protective Measures

Where polyethylene, ductile iron, steel or copper pipes are to be laid on a brownfield site or other land potentially affected by contamination (whether or not it has been remediated) and where the concentrations exceed the generic guideline values set out in Table 1 of the RA, the developer shall provide either:

- a) a robust risk assessment to show how any contaminants will not significantly impact on proposed water supplies or buried assets over the lifetime of the assets; or
- b) more suitable pipe materials; or
- c) an engineering solution to protect the pipe work backed up by an adequate assessment of the risk.

Liquid free phase product (e.g. oil or free solvent layers) shall not remain in the ground or groundwater in the vicinity of water pipes, whether barrier pipe or any other pipe materials are used.

When designing pipe routes on land potentially affected by contamination, new preferential contamination pathways along the route of new water pipes shall not be created. Particular measures may be required to prevent the possible migration of contamination through pipe bedding and into controlled waters.

References

BS10175: 2011

"Investigation of Potentially Contaminated Sites Code of Practice"

CLAIRE/CIEH

"Guidance on comparing soil contamination data with a critical concentration" 2008

Department of the Environment Contaminated Land Research Report

"Sampling strategies for contaminated land"
prepared by The Centre for Research into the Built Environment, Nottingham Trent University (Ref: CLR 4) 1994

Environment Agency

"Secondary Model Procedure for the Development of Appropriate Soil Sampling Strategies for Land Contamination"
(ref: R&D Technical Report P5-066/TR) 2000

Environment Agency

"Model Procedures for the Management of Land Contamination" (ref: CLR11), 2004

Environment Agency P5-080/TR3

"The UK Approach for Evaluating Human Health Risks from Petroleum Hydrocarbons in Soils", 2005

UK Water Industry Research (UKWIR)

"Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites" (Ref 10/WM/03/21) January 2011

Water Regulations Advisory Scheme (WRAS)

Information and Guidance Note 9-04-03

"Laying Pipes in Contaminated Land" 2002

Frequently asked questions

Why has UUW published supplementary guidance to the 'UKWIR Guidance for the Selection of Water Pipes to be used in Brownfield Sites'?

UUW agrees with the UKWIR Guidance in principle; we have published supplementary guidance to clarify some of the areas in which it will operate.

Does the UKWIR Guidance only apply to 'brownfield sites'?

Yes, the UKWIR Guidance does apply to brownfield sites; in addition United Utilities Water will apply this guidance and the UUW supplementary guidance to any greenfield sites which are potentially affected by contamination.

Who is responsible for completing/ signing the Risk Assessment for Water Pipes (RA)?

This may be the Developer, the Developers representative, or the competent person directing the land assessment. The signatory of the Risk Assessment for Water Pipes (RA) must ensure that all land assessments have been carried out in accordance with current standards and guidelines by or under the direction of a suitably qualified competent person. For water supply applications on land potentially affected by contamination, UUW requires the competent person to be either a chartered member of an appropriate professional body (such as the Institution of Civil Engineers, the Geological Society of London or the Royal Institution of Chartered Surveyors) with relevant experience of investigating contaminated sites or a Specialist in Land Condition (SiLC). This level of competency is intended to promote good practice and high professional standards and is no greater than that required for planning purposes by Local Authorities.

Do we need to agree the number and location of soil samples with the Water Company as indicated by the UKWIR guidance following the Preliminary Risk Assessment (PRA)?

Where a preliminary risk assessment (PRA) highlights the need for a site investigation UUW considers it is a responsibility of the qualified competent person directing the land assessment to determine the location and frequency of sampling. UUW's role would be to confirm that the appropriate

choice of pipe material has been made on the basis of the information provided.

What do we do if the pipe route is not known when the Site Investigation report is commissioned?

Where the route of the pipe is not known at the site investigation stage, then any resultant pipe selection needs to take account of any contamination found on the site. Consideration should be given to identifying the route and depth of the pipeline at the site investigation stage to avoid unnecessary testing.

Is it acceptable not to undertake a site investigation and specify the use of barrier pipe which seems to be suitable for all conditions?

Not all brownfield land is contaminated, and because of that a default to barrier pipe is not an acceptable approach to UUW, due to the possibility of higher installation and future maintenance costs. The approach as to whether a site investigation is needed should be risk based. For those sites where land may be affected by contamination appropriate testing shall be undertaken on the ground materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials.

Examples where defaulting to barrier pipe would not be acceptable:

- Where a capping layer (non-contaminated) is introduced within which the pipes will be installed.
- Sites with a potential low risk for contamination.
- Where liquid free phase product (e.g. oil or free solvent layers) is in the ground or groundwater in the vicinity of water pipes.
- Where the route of the pipe could be diverted to another suitable location free from contamination.

Are UUW employees who will assess the Design Proposals for contaminated sites suitably qualified?

It is the role of the Developer's suitably qualified competent person to deal with or direct the assessment of land. UUW's role is to assess the Risk Assessment for Water

Pipes and supporting Site Assessment Report (SAR) which is provided with any new water supply application (ie. it has been provided in the correct format, proposals for pipe selection are included, the methodology is in line with the UKWIR Guidance and UUW Supplementary Guidance, it has been directed by a suitably qualified competent person etc.). If UUW do need to provide assistance or information in deciding pipe materials then the assessment would be carried out under the direction of a suitably qualified competent person.

What happens to existing PE that is in the ground under the "old" guidelines?

The latest UKWIR guidance and UUW's supplementary guidance are intended to be used to decide what pipe materials will be used for new water mains and services. It will have no effect for developers with regard to any parts of UUW's existing network.

Will the Developer be required to submit a fully completed Risk Assessment for Water Pipes (RA) and supporting Site Assessment Report (SAR), including pipe material recommendation, for both the option of a mains requisition application and the option of a self-lay application?

Yes, UUW expect the 'Developer', as defined in UUW Supplementary Guidance, to submit a Risk Assessment for Water Pipes (RA) and supporting Site Assessment Report (SAR), including pipe material recommendation, in respect of any water pipes being installed on the development irrespective of who is to install them.

Does Table 1 in UUW's Risk Assessment for Water Pipes (RA) replace any of the tables to be completed in the Site Assessment Report (SAR) as required in the UKWIR Guidance?

UUW does not consider Table G1 and Table 3.1 of the UKWIR Guidance to be a definitive guide for assessing total concentrations. Table 1 in UUW's RA replaces Table 3.1 of the UKWIR Guidance.

Have any other Water Companies adopted the UKWIR Guidance yet?

You will need to contact the water company concerned if you are intending to install water pipes outside UUW's licensed area.

About us

United Utilities is the North West's water company. We keep the taps flowing and toilets flushing for seven million customers every day. From Crewe to Carlisle, we work hard behind the scenes to help your life flow smoothly.

Risk assessment for water pipes (RA)

The risk assessment for water pipes will help you choose appropriate materials for your development. We are happy to deal with a risk assessment for water pipes in advance of any formal application for a new water supply.

If you need any help completing the form please call us on **0345 072 6067**.

Section 1: Development details	
Development name <i>(if it has one)</i>	
Development address	
OS Grid reference <i>(mid point)</i>	
Developer's name	
UUW reference number <i>(for UU use only)</i>	
Please provide details below of the current and historical use of the site and adjacent sites. <i>If your supporting information has details of the current and historical site use, please reference below the relevant sections of your report.</i>	
Section 2: Preliminary risk assessment	
Has your desk study and site walkover identified any land potentially affected by contamination?	☐ Yes ☐ No
If the site is potentially affected by contamination but you have not completed any intrusive site investigation please provide details below of the rationale behind the intended pipe selection. <i>If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.</i>	

Section 3: Intrusive site investigation																									
Have you completed any intrusive site investigation?	☐ Yes ☐ No																								
Have you completed any none intrusive site investigation?	☐ Yes ☐ No																								
Date(s) when the site investigation(s) undertaken	<table><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr><tr><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td><td> </td></tr></table>																								
At what level has groundwater been encountered?	<table><tr><td></td><td>metres below ground level or</td></tr><tr><td colspan="2">☐ Not encountered</td></tr></table>		metres below ground level or	☐ Not encountered																					
	metres below ground level or																								
☐ Not encountered																									
Table 1 (Pipeline Selection Risk Assessment Summary (PSRAS)) below classifies testing required where the preliminary risk assessment has identified land potentially affected by contamination. Please provide details below of any test groups which have not been tested and the rationale for not testing. <i>If your supporting information has details of the rationale behind not testing any particular test groups, please reference below the relevant sections of your report.</i>																									
If the intrusive site investigation has identified concentrations above the PE threshold (see PSRAS) and your intended pipe selection is PE. Please provide details below of the rationale behind the intended pipe selection. <i>If your supporting information has details of the rationale behind the intended pipe selection, please reference below the relevant sections of your report.</i>																									
Section 4: Site remediation																									
Please provide details below of any site remediation (which may include a change in site levels) already completed. <i>If your supporting information has details of the site remediation already completed, please reference below the relevant sections of your report.</i>																									
Has the PSRAS (Table 1) been completed using appropriate data after remediation?	☐ Yes ☐ No ☐ N/A																								
Please provide details below of any proposed site remediation and an analysis of whether this will affect your intended pipe selection. <i>If your supporting information has details of any proposed site remediation and whether this will affect your intended pipe selection, please reference below the relevant sections of your report.</i>																									

Section 5: Final use of site

Please provide details below of any chemicals (including fuel) to be stored on site and any other future contamination risks which may affect your intended pipe selection.

If your supporting information has details of potential contamination risks which may affect your intended pipe selection, please reference below the relevant sections of your report.

What water pipe materials are intended to be used on site?

☐ PE ☐ PE Barrier Pipe Type A ☐ PE Barrier Pipe Type B
Other (please specify):

Section 6: Additional information

Please use the section below to provide any additional details to support your intended pipe selection.

Section 7: Risk assessor

Name and relevant qualifications of person directing the risk assessment for water pipes

Name and address of risk assessor's company

Date risk assessment performed

D	D	M	M	Y	Y	Y	Y
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Section 8: Declaration

I confirm I have completed this form and provided supporting information in accordance with 'UKWIR Guidance for the Selection of Water Supply Pipes to be used in Brownfield Sites' and UUW's Supplementary Guidance. I also confirm that if any further site investigation is needed and carried out, I will be required to submit an additional Risk Assessment for Water Pipes with the relevant supporting information. I understand that failure to supply any of the required information may delay my application being processed.

Name

Company

Telephone

Date

D	D	M	M	Y	Y	Y	Y
---	---	---	---	---	---	---	---

Please email the completed form and supporting information to **DeveloperServicesWater@uuplc.co.uk** or post to us at United Utilities Water, Developer Services, Second floor Grasmere House, Lingley Mere, Warrington WA5 3LP.



About us

United Utilities is the North West's water company. We keep the taps flowing and toilets flushing for seven million customers every day. From Crewe to Carlisle, we work hard behind the scenes to help your life flow smoothly.

United Utilities Water Limited, Haweswater House, Lingley Mere Business Park, Lingley Green Avenue, Warrington WA5 3LP.
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Table 1 - Pipe selection risk assessment summary (PSRAS)

1. Testing must be undertaken on the materials within which the pipes are to be laid, whether that be existing ground materials, remediated materials or imported capping materials. Please use the appropriate testing data to complete Table 1 below.

2. If more than one pipe selection is being made, for example, for pipes in different areas of a large site, a completed PSRAS is required for each selection.

What materials have been tested to populate Table 1 below?

☐ Existing ground materials ☐ Remediated materials ☐ Imported capping materials

All concentrations in mg/kg								
Test Group	Testing Required?	PE threshold	Metal Pipes/ Barrier Pipe	Laboratory Detection Limit	Testing UKAS accredited Y/N	Maximum concentration at proposed pipeline depth See Note [2]	Maximum site concentration See Note [3]	Locations and depths where concentrations exceed proposed pipeline threshold
Total VOCs	Where Preliminary Risk Assessment (PRA) has identified land potentially affected by contamination	0.5	Pass					
Total BTEX & MTBE		0.1	Pass					
Total SVOCs (excluding PAHs and those substances marked with an *)		2	Pass					
EC5-EC10 aliphatic and aromatic hydrocarbons		2	Pass					
EC10-EC16 aliphatic and aromatic hydrocarbons		10	Pass					
EC16-EC40 aliphatic and aromatic hydrocarbons		500	Pass					
Phenols* (from SVOC analysis)		2	Pass					
Cresols and chlorinated phenols* (from SVOC analysis)		2	Pass					
Ethers*	Only where identified	0.5	Pass					
Nitrobenzene*		0.5	Pass					
Ketones*		0.5	Pass					
Aldehydes*		0.5	Pass					
Amines		Fail	Pass					
Corrosive	Conductivity, Redox and pH	Pass	See Note [1]					

Note [1] Threshold: For wrapped steel, corrosive if pH<7 and conductivity > 400µS/cm. For wrapped ductile iron corrosive if pH<5, Eh not neutral and conductivity > 400µS/cm. For copper, corrosive if pH<5 or >8 and Eh positive.

Note [2] Water pipes are normally laid at 0.75-1.35m below finished ground level.

Note [3] Also state if liquid free product is present in soil or groundwater.



Bury Council

Fernhill Caravan Park, Every Street, Bury

Geo-environmental and geotechnical site investigation

11542-R02 (00)

RSK GENERAL NOTES

Project No.: 11542 R02 (00)

Title: Geo-environmental and geotechnical site investigation: Fernhill Caravan Park,
Every Street, Bury

Client: Bury Council

Date: August 2021

Office: RSK Environment Limited, Fourways House, 57 Hilton Street, Manchester, M1
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Status: Rev (00)

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Revision control sheet				
Revision ref.	Date	Reason for revision	Amended by:	Approved by:
00	13/08/21	First issue for client review	n/a	see above

RSK Environment Limited (RSK) has prepared this report for the sole use of the client, showing reasonable skill and care, for the intended purposes as stated in the agreement under which this work was completed. The report may not be relied upon by any other party without the express agreement of the client and RSK. No other warranty, expressed or implied, is made as to the professional advice included in this report.

Where any data supplied by the client or from other sources have been used, it has been assumed that the information is correct. No responsibility can be accepted by RSK for inaccuracies in the data supplied by any other party. The conclusions and recommendations in this report are based on the assumption that all relevant information has been supplied by those bodies from whom it was requested.

This work has been undertaken in accordance with the quality management system of RSK Environment Ltd. No part of this report may be copied or duplicated without the express permission of RSK and the party for whom it was prepared.

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.

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EXECUTIVE SUMMARY

Commissioning and purpose of assessment	RSK Environment Limited (RSK) was commissioned by Bury Council to carry out a geo-environmental and geotechnical report of the land at the Fernhill Caravan Park, Every Street, Bury, BL9 5BL, grid reference SD 805117. The overall aim of the project was to assess land contamination sources and geotechnical constraints to the proposed development
DESK-BASED ASSESSMENT	
Site description and proposed development	The site currently comprises a caravan park for travellers and occupies an area of 1.7 acres (0.69 hectares) and is being considered for development for a similar use.
History of site and surrounding area	The site was formerly used for a gravel pit and Corporation Yard. Potential sources of contamination identified on-site comprise imported contaminated soils, general waste (uncontrolled), incinerator ash and clinker, hydrocarbon products. Several potentially contaminative current activities have been identified in the surrounding area, including timber yards, foundries, railway land and a refuse destructor (incinerator).
Previous site investigation (SI) reports	This is the only deep ground investigation of the site; however, an investigation into the contents of the bunds (as well as limited area of shallow verges) which were present within the site boundary had been completed by Tergeo (2017) and RSK (2018). The volume of the bund was approximately 2,000 m ³ .
Geology and environmental setting	The Site is underlain by Devensian age Diamicton Till over Pennine Lower Coal Measures Formation (PLCMF) of Carboniferous age according to published geological data. There is also likely to be made ground associated with former use. Not affected by radon. Not affected by coal mining. • Groundwater within Till classified as a secondary aquifer* • Groundwater within bedrock classified as a secondary aquifer* • No groundwater abstractions within the vicinity of the site. • The River Irwell was situated 203 m west of the site boundary. • A primary school (St John with St Mark C of E) is situated immediately beyond the northern boundary.
Site reconnaissance findings	The site comprised 17 plots of permanent caravans with 6 facility blocks. A significant soil bund surrounded the majority of the perimeter of the site, which varied in height from 0.50 m to 4 m. The highest point was in the southern corner of the site, with the general heights varying between 1.50 m and 2.50 m.
Geotechnical constraints assessment	Access was limited on site due to be currently occupied by travellers and limited areas of drilling works.

Initial conceptual site model (CSM) and preliminary risk assessment (PRA)	Potentially complete contaminant linkages on site include: • Made ground associated with former buildings and gravel pit on-site – future site users - oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres • Made ground associated with former buildings and gravel pit on-site – future buildings and services - direct contact with contaminated soils or groundwater and chemical attack • Made ground associated with former buildings and gravel pit on-site - groundwater in the underlying secondary aquifers within the superficial deposits and the bedrock – leaching and percolation through permeable strata to aquifer/ lateral and vertical migration of dissolved phase • Made ground associated with on-site previous buildings and infilled former gravel pit – future site users and future buildings and services - vertical migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation • Previous shallow underground mine workings more than 50 years since last worked below site - future site users and future buildings and services - vertical migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation • Made ground associated with the previous off-site gravel pit - future site users and future buildings and services - vertical migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation. Uncertainties and data gaps have been identified in the CSM at desk study stage: • gaps in available historical OS maps • access not available to the existing facility blocks or office • proposed service positions not known • previous investigation information is only available for the soil in the perimeter soil mounds. There are no previous investigations available for the rest of the site, therefore no information on actual concentrations of contaminants in soil and groundwater or ground gas at this stage • groundwater depth and flow direction are conceptual at this stage • proposed site levels and foundation solutions are unknown
INTRUSIVE INVESTIGATION & ASSESSMENT	
SI scope	6 window sample boreholes drilled to 6 m, with 5 ground gas monitoring wells. The purpose of the investigation was to determine the depth of made ground, as well as its composition, and assess whether the site was impacted by ground gases.

SI factual findings	The made ground was noted to comprise a recent and a pre-1930's made ground. The recent made ground comprised a varied deposit of clay and silty sand with much brick and gravel and varied in thickness from 0.50 m to up to 2 m. The pre-1930's made ground comprised almost exclusively of ash and clinker and was encountered within borehole BH2 underlying the recent made ground. Underlying the made ground was medium dense silty sand and silt (alluvium). Groundwater was noted to be confined to sand lenses within the silt and was deep during the ground gas monitoring programme.
Refined conceptual site model and geo-environmental assessment	The made ground was noted to contain elevated concentrations of metals and polycyclic aromatic hydrocarbons which will require mitigation for occupants within garden areas. Asbestos had also been encountered within the recent made ground, and this will require mitigation to protect residents within gardens as well as maintenance workers repairing services within the highways and private connections. Turn over proposed to recover as much of the bund materials and process the recent made ground to create a geotechnically suitable platform. A 0.60 m thick inert cover required for garden areas. Service corridor to be provided beneath highways and for private connections to protect maintenance workers. Protectorline potable water supply mains anticipated to be required. Pre-1903's made ground will require proof rolling. No ground gas mitigation required. As many soils are to be retained on site, with all unsuitable materials removed from site following screening for the turnover.
Geotechnical assessment	The proposed single storey modular units are anticipated to either be piled or rafted on the turned over materials. The piles to be adopted should not bring soils to surface.
Recommendations including issues for further assessment	No further investigation considered to be required. The works to reprocess the recent made ground overlying the site, as well as the made ground in the bund will require permitting and potential licensing beyond the mobile plant license. The works are anticipated to be undertaken under the CL:AIRE Code of Practice for the Definition of Waste. Assessment and a watching brief will be required during the processing of the made ground to confirm the consistency and to address any hot spots of contamination encountered.
<i>The information given in this summary is necessarily incomplete and is provided for initial briefing purposes only. The summary must not be used as a substitute for the full text of the report.</i>	



Site Name	Fernhill Traveller Caravan Park	NGR	SD 805117
Site Address	Every Street, Bury, BL9 5BL	Site Area	0.69ha (1.7 acres)

1 INTRODUCTION

1.1 Commissioning

RSK Environment Limited (RSK) was commissioned by Bury Council to carry out a geoenvironmental and geotechnical site investigation of the land at Fernhill Caravan Park, Every Street, Bury. The project was carried out to an agreed brief as set out in RSK's proposal (Ref. 11542 TL02(00), dated 09 February 2021).

RSK's service constraints are shown in [Appendix A](#).

The Site in question is being considered for the improvement and replacement of the existing residential traveller's site and its facilities.

1.2 Objectives

The objective of the work is:

- to identify any land contamination and/or geotechnical constraints to the proposed development and to support discharge of relevant planning conditions and relevant building control requirements
- to identify the need for any additional investigation or remediation works to demonstrate that the site is suitable for its proposed use

1.3 Scope of works

The scope of this assessment has been developed in accordance with relevant British Standards and authoritative technical guidance as referenced through the report. The assessment of the contamination status of the site is in line with the technical approach presented in Land Contamination Risk Management (LCRM) (Environment Agency, 2020) – which supersedes CLR11 Model Procedures for Land Contamination – and in general accordance with BS 10175: 2011 + A2 2017 (BSI, 2017). It is also compliant with relevant planning policy and guidance.

The scope of the intrusive investigation has been designed in line with the recommendations of BS5930:2015+A1:2020 Code of practice for ground investigations (BSI, 2020), which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. It has also been developed in general accordance with BS 10175: 2011 + A2 2017. Ground gas assessment has been undertaken in general accordance with BS8576: 2013 and BS 8485:2015+A1:2019.

A brief summary of relevant legislation and policy relating to land contamination is given in Appendix C.

The scope of works for the assessment has included the following:

- design and implementation of an intrusive investigation, in situ testing, soil sampling, laboratory geo-environmental and geotechnical testing, groundwater and ground gas monitoring of installed boreholes
- interpretation of data to develop a refined conceptual site model (CSM)

- generic quantitative risk assessment (GQRA) of relevant contaminant linkages
- interpretation of ground conditions and geotechnical data to provide preliminary recommendations with respect to foundations and infrastructure design
- preparation of this interpretative report

1.4 Existing reports

RSK are only aware of the following reports pertaining to the site:

- 1. Tergeo (March 2017). Travellers Site, Every Street, Bury, BL9 5BE. Ref: 0293_01
- 2. RSK (October 2018). 11151-R01(01). Traveller Site (Fernhill Caravan Park), Bury. Soil Assessment – GQRA.
- 3. RSK (October 2018). 11151-R02(00). Traveller Site (Fernhill Caravan Park), Bury. Soil Assessment – DQRA.
- 4. RSK (Dec 2020). 11542-01(00). Fernhill Caravan Park, Every Street, Bury. Preliminary Risk Assessment (PRA).

Pertinent information from these reports has been summarised in [Section 2.6](#), with the potentially complete contaminant linkages identified in the RSK 2020 PRA forming the basis of our initial conceptual understanding of site and thus, the basis of this report.

1.5 Limitations

This report is subject to the RSK service constraints given in [Appendix A](#) and limitations that may be described through this document.

2 SITE DETAILS

2.1 Site location

Site location details are presented in Table 1 and a site location plan is provided on [Figure 1](#).

Table 1: Site location details

Site name	Fernhill Caravan Park, Every Street, Bury
Full site address and postcode	Every Street, Bury, BL9 5BL

2.2 Site description

The Site boundary and current site layout are shown on [Figure 2](#). The Site covers an area of approximately 0.69 hectares. It is currently occupied by Fernhill Caravan Park, a residential site for travellers with 17 plots and six facility blocks.

The site is roughly rectangular in shape and access is gained via Every Street, along the central northern boundary. There was no site security at the time of the site visit, and the gates are open to the public.

Each individual plot was separated by wooden fencing secured with concrete posts, approximately 1.20 m high, and occupied plots contain a mobile caravan, which have a lounge and bedrooms that are used by the occupants. The facility blocks include a food preparation area with plumbing for washing, cleaning, and toilets.

2.3 Surrounding land uses

The site is located in Bury, within a predominantly industrial and commercial setting. Immediate surrounding land uses are detailed in Table 2.

Table 2 Surrounding land uses

North	Residential properties and a primary school
East	Industrial and commercial units with residential beyond
South	Industrial and commercial units
West	Waste transfer station with railway beyond

2.4 Development plans

The proposed layout of the site, at the time of preparing this report, is shown in [Appendix B](#).

Proposed development plans show that the entire site is to be demolished and the 17 individual plots are to be reduced to 12, including six single-storey double-facilities blocks,

around the margins of the site, with each block to be shared between two plots. There will still be an office building to the east of the site entrance in the north eastern corner of the site. Each plot will contain sufficient space for either one or two touring caravans, which will be used for sleeping and it will also have private soft landscaped areas.

No details of the proposed ground levels have been provided therefore for the purpose of this report it has been assumed that the current levels will remain unchanged.

No planning applications pertaining to this development were found on the Bury Council planning portal.

The desktop study was designed generally to meet the objectives of a preliminary (phase 1) investigation, as defined by BS 10175:2011 + A2 2017 (BSI, 2017) and this assessment relates to LCRM Stage 1, Tier 1 preliminary risk assessment. The "vicinity" of the site for the purposes of this report is defined as locations situated within an approximate 250 m radius of the site, although certain sources and/ or sensitive targets further than 250 m may also have been considered.

The study aims principally to identify and assess the potential risks and liabilities associated with contamination of the ground, on and in the vicinity of the site. While this includes consideration of current operations and housekeeping on the site, the report does not constitute a comprehensive environmental audit of the site, as covered under ISO 14001.

2.5 Site history

2.5.1 Historical development record

The development history of the site and surrounding area based upon assessment of historical plans and records is detailed in Table 3. The historical maps reviewed are shown within the environmental database report in [Appendix D](#).

Table 3 Summary of historical development

Date from	Date to	Historical Land Use (on-site)	Area of site
1850	-	Site noted to be situated within a field. No features on site.	Entire site
1893	1930	Western and central southern area of the site was noted to be part of a gravel pit, with most of the site noted as a Corporation Yard. The remainder of the site was open. In 1910 the westernmost part of the site appears to be infilled. The entire gravel pit is infilled by 1930.	Central and western parts
1910	1992	The alignment of Every Street is shown to the immediate north and a track from this street enters the Site and is aligned west to east. From the 1939 mapping, the road within the Site is no longer marked. A railway/tram line passed through the west of the site, and possibly connected the former gravel pit with an	North and south east

		industrial facility south of the Site. A path in the south east corner connects with an unnamed street	
1910	1999	Two small buildings were shown near the northern end of the railway/tram line and close to the edge of the gravel pit. From 1959, only one of the buildings remained. The railway/tram line was only shown on the 1910 map. From the 1959 mapping a track follows the alignment of the former [narrow gauge] railway line. From 1978 the site is marked in the area of a Council Depot	Centre
Date from	Date to	Historical Land Use (off-site)	Distance (m) and orientation
1893	1978	Gravel Pit (shown to be flooded)	20 m west
1893	Present day	'Refuse Destructor' (incinerator) with associated chimney. An expansion is shown on the 1910 map. In present day is licensed as a waste transfer station.	90 m north west
1893	Present day	Raised land to west, possibly associated with Refuse Destructor, which is to the immediate north of the land. Raised land covers the area of the former gravel pit, to the west of the site. This area is part covered in trees and rough grass and is labelled as Corporation Yard from 1959 to at least 1982. Area is referred to as a Refuse Destructor from the 1992 mapping.	15 m west
1893	Present day	Railway situated at a lower level in a cutting.	110 m west
1910	1930	Tanks (type not specified but possibly associated with railway and used for water for steam train boilers).	100 m west
1910	1978	A former disused Iron Foundry is now labelled Fernhill Chemical Works	130 m west
1930	1959	Saw Mill with Timber Yard	50 m north east
1930	Present day	Residential properties	60 m north
1939	1978	Allotment gardens	80 m north west
1959	1978	Allotment gardens	20 m north
1978	Present day	St John's C of E Primary School	20 m north
1850	1893	Open farmland	Surrounding the site
1893	Present day	Woollen Mills	100 m east, 150 m south east
1893	Present day	Hat/textile Works	200 m south east

1893	1978	Residential properties	Directly south east
1893	Present day	Unlabelled complex of buildings that appears to possibly be a works with a chimney. The chimney structure is no longer shown from the 1959 map	30 m south
Relevant information sources: Historical OS maps ☒ Town plans ☐ Information from the Local Planning Authority ☐ Aerial photography ☒ Previous reports ☐			
<i>Note: Reference to published historical maps provides invaluable information regarding the land use history of the site, but historical evidence may be incomplete for the period pre-dating the first edition and between successive maps.</i>			

The site was situated within an area noted to be a Corporation Yard, with a refuse destructor and chimney (incinerator) beyond the north western site boundary. It is anticipated that the bi-products of the incinerated waste were used to backfill the gravel pit which was present within the western and southern central area of the site, as well as beyond the western boundary. The gravel pit was not shown on the 1850 historical map, and extraction was completed prior to the 1890 map edition. The gravel pits were filled (omitted from the historical maps) by 1930. It is anticipated that the bi-products comprised predominantly ash and clinker with the potential for bottom furnace slag to be present.

The site was noted to be open land with two small structures present centrally on site between 1930 and 1939, and by 1959, several tracks were noted to cross the site. The Corporation Yard was shown within the area of the gravel pit beyond the western boundary. Between 1960 and 1982, the site, as well as the surrounding area appears to have been covered by hardstanding and incorporated within a Council depot.

Between 1984 and 1996, a traveller site had been established off Todd Street, immediately beyond the south eastern boundary. The Todd Street site was abandoned by 2000, and the site for redevelopment was occupied. According to a review of the images from Google Earth, an earth bund was present around the northern and north western boundary, as well as the north eastern, eastern, and south eastern boundaries from the establishment of the site. The bund appears unchanged from the 2000 to 2019 image. According to the topographic survey, the majority of the bund varies between 1 m and 2.50 m in height, with the greatest height being 4 m in the southern corner of the site.

The site of the former Todd Street traveller site was replaced with hardstanding between 2003 and 2005. Between 2012 and 2017, this area was utilised for material storage, waste tyres, crushing and material sorting plant, with soils being deposited on the depot land beyond the north eastern site boundary in the 2017 image. The site appears to have been used for the storage of cement mixers, articulated lorries, and vans.

A traveller site was also situated beyond the southern boundary between 2013 and 2017. The site beyond the north eastern boundary with soils being deposited was covered with hardstanding by 2019 and used to store Intermediate Bulk Containers (IBC's).

The land to the west of the site, was occupied by the Every Street waste transfer station (currently operated by Suez). Land to the south of the waste transfer station (south west of the site) was noted to have a large stockpile of material, which had been removed

between 2013 and 2017, and was subsequently shown to be used as a storage area for articulated trailers.

There has been significant landfilling on and around the site, predominantly associated with the incineration of waste in the refuse destructor. The source of the bund around the site is unknown, although this may be associated with the levelling of the site, but it is also clear that soils have been imported to adjacent sites and hence these may have contributed to the current landform.

Other historical land uses surrounding the site are unlikely to present a significant risk to the site's proposed development. Several of the industrial land uses utilised chimneys, which can sometimes disperse potential contaminants to areas downwind, however, RSK consider the risk to be negligible.

2.6 Summary of previous investigations

A summary of pertinent information from previous investigations is included below in Table 4.

Relevant information relating to the identified ground and groundwater conditions has not been included within the table below but has been incorporated into [Section 2.7](#).

Table 4 Summary of previous site investigation reports

Report Details	1. Tergeo (March 2017). Travellers Site, Every Street, Bury, BL9 5BE - (ref: 0293_01)
Site coverage	The report pertains to the soil mounds around the perimeter of the Traveller Site.
Summary scope of works	Nine holes were dug with a hand-held auger to a maximum depth of 2.50 m below ground level (bgl) on the top of the earth mounds. Soil samples were tested for volatile organic compounds (VOCs) and sent for laboratory chemical analysis.
Does the client have reliance upon the report?	Yes

Key factual findings	No evidence of VOCs was detected during fieldwork. A generic quantitative risk assessment (GQRA) was completed, and exceedances were found in three of the samples for TPHCWG and PAH compounds. Asbestos containing material (ACM) was detected in two of the 11 samples tested with concentrations of 0.006% and 0.062%. These concentrations are below the hazardous threshold for waste acceptance. However, the report concludes that although the detections of quantifiable asbestos in the soil samples is at low levels, these less than the lowest order of detection concentrations need to be considered where the material is to be excavated and redeposited as asbestos is still present within the sample. The conclusion was that the measured concentrations of PAH and TPH compounds do not exceed the thresholds significantly, indicating that there is likely to be a moderate risk presented to the residents if the soil is left in-situ and unmanaged (it is possible that harm could arise to a receptor from a contaminant).
Report Details	2. RSK (October 2018). Geo-environmental Assessment: Traveller Site (Fernhill Caravan Park), Bury (ref:11151-R01 (00))
Site coverage	This report was associated with the soil mounds around the perimeter of the Traveller Site, including within the back gardens of three of the plots.
Summary scope of works	17 holes were excavated with hand tools along the soil mound and in the narrow soft landscaped strips either side of the main road to a maximum depth of 0.40 m (HP01 to HP17) Three of the holes were excavated in the soil mound within the back gardens of three of the plots (plots 10, 15 and 17). 19 soil samples were collected from the 17 holes and analysed for a suite of contaminants including metals, pH, total organic carbon (TOC), polycyclic aromatic hydrocarbon (PAH) compounds, asbestos, TPH CWG and moisture content.
Does the client have reliance upon the report?	Yes
Key factual findings	A GQRA was undertaken. Chemical analysis results were compared to RSK's generic assessment criteria (GAC), which found there to be exceedances in three PAH compounds in the perimeter mounds (benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(a,h)anthracene) plus four PAH compounds in individual plots (benzo(a)anthracene, benzo(a)pyrene,

	benzo(b)fluoranthene and dibenzo(a,h)anthracene), except Plot 10. Asbestos was encountered in two of thirteen shallow (<0.30 m) soil samples, with concentrations of below the laboratory method detection limit (LMDL) of <0.001.
Assessment and conclusions	It was concluded that risks to site residents due to asbestos were low. The potentially risks associated with PAH compounds which were considered to require further investigation or assessment were: a) direct contact (soil and dust ingestion and/or inhalation and dermal contact) with potentially contaminated shallow soils in the perimeter soil mounds by site residents b) direct contact (soil and dust ingestion and/or inhalation and dermal contact) with potentially contaminated shallow soils in the plots/landscaped areas adjacent to internal roadways by site residents
Report Details	3. RSK (October 2018). Soil Assessment – DQRA: Traveller Site (Fernhill Caravan Park), Bury (ref: 11151-R02 (00))
Site coverage	This report was associated with the soil mounds around the perimeter of the Traveller Site, including within the back gardens of three of the plots.
Summary scope of works	17 holes were excavated with hand tools along the soil mound and in the narrow soft landscaped strips either side of the main road to a maximum depth of 0.40 m (HP01 to HP17) Three of the holes were excavated in the soil mound within the back gardens of three of the plots (plots 10, 15 and 17). 19 soil samples were collected from the 17 holes and analysed for a suite of contaminants including metals, pH, total organic carbon (TOC), polycyclic aromatic hydrocarbon (PAH) compounds, asbestos, TPH CWG and moisture content.
Does the client have reliance upon the report?	Yes
Assessment and conclusions	The DQRA concluded that the soils surrounding the site do not pose a significant possibility of significant harm to human health and intervention under part 2A was not warranted. This was based on the current use of the site, likely activities at the site and observations made by RSK regarding use of the perimeter mounds.

Report Details	4. RSK (December 2020) Fernhill Caravan Park, Every Street, Bury. Preliminary Risk Assessment (ref). 11542-01(00).
Site coverage	This report relates to the entire site and was a desk study alone with no further ground investigation.
Summary scope of works	Review of the history of development on the site and surroundings, including a study of historical ordnance Survey mapping and other sources of historical information via an environmental database report. Assessment of local geology, hydrogeology and surface water setting, including the identification of potential geological hazards including mining etc. Assessment of the potential risks from past, present and future coal mining activities obtained from a Coal Authority Mining Report. Risk from unexploded ordnance (UXO). Completion of a site reconnaissance survey to assess the visual condition of the site. Development of an initial conceptual site model (CSM) identifying potential contaminant linkages for potential contaminants, completion of a preliminary risk assessment (PRA) and identification of key uncertainties and assumptions in the CSM. Preliminary consideration of geotechnical constraints and hazards Identification of the need for further action, e.g., intrusive investigations, where applicable.
Does the client have reliance upon the report?	Yes
Assessment and conclusions	Potentially complete contaminant linkages on site include: • Made ground associated with the infilling of the gravel pit on-site – future site users - oral, dermal and inhalation exposure with impacted soil, soil vapour and dust/fibres • Made ground associated with the infilling of the gravel pit on-site – future buildings and services - direct contact with contaminated soils or groundwater and chemical attack • Made ground associated with the infilling of the gravel pit on-site - groundwater in the underlying secondary aquifers within the superficial deposits and the secondary aquifer status bedrock– leaching and percolation through permeable strata. • Made ground associated with the infilled of the former gravel pit – future site users and future buildings and

	services - vertical migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation • Previous shallow underground mine workings more than 50 years since last worked below site - future site users and future buildings and services - vertical migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation • Made ground associated with the previous off-site gravel pit - future site users and future buildings and services - vertical migration and ingress of ground gases into buildings, build-up in confined spaces and explosion/ asphyxiation The following recommendations are made for an intrusive exploratory investigation at the site to address the risks identified above and/or to address remaining uncertainties: • A Coal Mining Risk Assessment is recommended to better understand potential risks from historical coal mining at and in the vicinity of the site • An intrusive ground investigation to assess the soil and groundwater conditions on site with subsequent production of ground investigation report • Chemical and geotechnical laboratory analysis of soils • A gas and groundwater monitoring programme An MMP and waste classification laboratory testing if soils are to be moved off-site.
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2.7 Site setting

A summary of the site setting based on findings from previous site investigations and desk study information is presented in Table 5.

Table 5 Site setting

Geology	Published geological records report the Site is underlain by superficial deposits comprising Till (an undifferentiated aquifer). Beneath the Till is bedrock of the Pennine Lower Coal Measures (a secondary A aquifer). The 2018 RSK site investigation was limited to the raised bund within the majority of the boundary of the site and soft landscaped areas within three of the plots. This comprised topsoil, to approximately 0.10 m, over made ground to a minimum depth of 0.40 m. The made ground generally
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	comprised dark brown gravelly sand with cobbles and 5-30% man-made constituents including plastic, brick, metal, ceramics, wood, asphalt and clinker. A historic BGS borehole (SD 81SW 210, approx.140 m east of site) indicates that the made ground is underlain by Till, to 6.80 m, and comprised brown clayey silty sandy gravels and gravelly silty clays. Bedrock was encountered at 6.80 m to a maximum proven depth of 7.30 m. According to the British Geological Survey Manchester sheet 85 (Scale 1:50,000), solid geology map, the bedrock comprises grey siltstone and mudstone with coal seams, dipping 6° to the south.
Hydrology	There are no ponds, streams, or drainage ditches on or adjacent to the site. The nearest identified surface watercourse to the site is the River Irwell, located approximately 222 m to the west of the Site according to the Groundsure report. The Environmental Database report identifies the Irwell as River Quality C category. The environmental database report indicates that there are 18 current licensed surface water abstractions within a 2 km radius of the site. The closest of these, which is located 529 m to the south west is utilised for hydroelectric power generation and is unlikely to impact the proposed site. Surface drainage from the site appears to be discharged into the underground drainage network. The indicative floodplain map for the area, shows that the site does not lie in an area at risk from flooding from rivers or the sea.
Hydrogeology	As the previous ground investigation was only associated with the investigation of the soil boundary bund, no assessment can be made regarding the groundwater. Given the varied nature of the superficial deposits, groundwater is likely to be present perched locally over low permeable strata. The historical BGS borehole log, reference SD81SW210, approx.140 m east of site, indicates no groundwater was found in the full depth of the 7 m borehole. Shallow groundwater in the site area is anticipated to flow in a south westerly direction, i.e., towards and in the direction of flow of the River Irwell. It is also likely that shallow water may be present in any made ground deposits present on-site. The nearby former mineshaft 100 m south east of the site, could potentially have an impact on current hydrogeology,

	including the potential for rebounding groundwater levels following the end of mining and associated dewatering (see mining and quarrying below). The environmental database report indicates that there nine active licensed groundwater abstractions within a 2 km radius of the site, none of which was public water supply boreholes. The nearest of which is 140 m east of the site, for P&S Textiles Ltd, ref: 2569001015, at Fernhill Mill, used for manufacturing.
Mining and quarrying	The site is located over Lower Pennine Coal Measures bedrock and may therefore have been affected by coal mining activities. An initial site appraisal based on the Coal Authority Interactive GIS system identified that the entire site is in a Development High Risk Area. According to the Coal Authority Consultants Report, reference 71007891158001, dated 16 June 2021 a filled mine shaft was located in 1975, 100 m south east of the site, ref: 380411-001. The only reference to coal seams was the Arley Coal seam (1.30 m thick) at a depth of 49 m (dipping at 3° to the south east) was last mined beneath the site in 1900 (pillar and stall). According to the report, the site is not affected by probable unrecorded shallow workings or spine roads at shallow depths. No further works are required associated with coal mining.

3 SITE INVESTIGATION STRATEGY & METHODOLOGY

3.1 Introduction

RSK carried out intrusive investigation works with subsequent monitoring and sampling of ground gases and groundwaters between March and June 2021. The intrusive works comprised window sample boreholes over 2 phases of works, having encountered difficult ground conditions during Phase 1.

3.2 Objectives

The specific objectives of the current investigation were as follows:

- to establish the ground conditions underlying the site which were not investigated previously, including the extent and thickness of made ground.
- to investigate specific potential sources of contamination identified in the initial CSM
- to determine groundwater depth and flow direction
- to confirm the ground gas regime underlying the site
- to assess geotechnical properties of soils, to inform future geotechnical designs
- to identify any hazardous properties in soils

3.3 Selection of investigation methods

The techniques adopted for the investigation were chosen with consideration of the objectives and site constraints, which are described below.

Window sampling was chosen to target shallow made ground, natural soils and groundwaters across the Site, at or adjacent to potential contaminative sources identified during the previous site investigation and the RSK 2020 PRA. A small-tracked window sampling rig was the only form of plant able to enter all areas due to restricted access. The rig facilitates rapid drilling of shallow boreholes, with in-situ testing, collection of disturbed samples and allows for the installation of gas monitoring wells. Temporary casing was used to keep the borehole open in loose soils and enable monitoring wells to be installed at their target depth.

Prior to conducting intrusive works, utility service plans were obtained, and buried service clearance undertaken in line with RSK's health and safety procedures.

During the preliminary stages of the desktop assessment for the site, the Consultant's Report provided by the Coal Authority, reference 51002333075002, dated 1 December 2020 stated that the Arley coal seam was situated at a very close shallow depth. When queried, the depth of 3 m to 29 m beneath the site as stated in the report, was increased to 49 m within their report reference 71007891158001, dated 16 July 2021 was issued. The Arley coal seam is a regionally important commercially sought seam which was recorded within the general area to be typically 1.30 m in thickness. The Coal Authority do not consider that the site is impacted by shallow mine workings (generally <30 m) and

hence further exploratory boreholes to determine the potential for worked seams is not considered to be required based on the report provided.

3.4 Investigation strategy

The ground investigation was carried out using intrusive ground investigation techniques in general accordance with the recommendations of BS5930:2015+A1:2020, which maintains compliance with BS EN 1997-1 and 1997-2 and their related standards. Whilst every attempt was made to record full details of the strata encountered in the boreholes, techniques of hole formation and sampling will inevitably lead to disturbance, limited mixing, or loss of material in some soils and rocks.

The investigation strategy involved non targeted and targeted boreholes. The investigation comprised an exploratory investigation, providing a good spread of locations across site to establish the ground conditions, including the extent and thickness of made ground which had been identified as a potential source of contamination in the initial CSM.

The constraints to the investigation were as follows:

- Restricted access to exploratory positions located in and around occupied plots
- Parked cars over most exploratory positions during both Phases 1 and 2.
- Breaking out concrete/asphalt via concrete coring.
- Difficult ground conditions encountered during Phase 1, resulting in slow progress.

Small-tracked drilling rigs were used to gain access to restricted areas. Boreholes positioned on concrete/asphalt were facilitated by a concrete core rig.

To avoid striking buried services and structures, a specialist utility surveyor was commissioned to ensure exploratory were scanned using EML and GPR, as well as a CAT scanner.

Details of the investigation locations, installations and rationale are presented in Table 6. The initial drilling work was undertaken on 9th March 2021, comprising 2 dynamic sampled boreholes (BH01 and BH03). The second phase for drilling was undertaken on 16th April 2021 and comprised 4 dynamic sampled boreholes (BH02, BH04-BH06). All boreholes were drilled to a maximum depth of 6.45 m bgl, with 5 boreholes installed with a combined gas and groundwater monitoring well. An exploratory hole location plan is shown on [Figure 2](#). BH07 was concrete cored but not drilled due to insufficient time and sufficient spatial coverage across site.

Table 6 Exploratory hole and monitoring well location rationale

Investigation type	Number	Designation	Monitoring well installation	Rationale examples below
Boreholes by dynamic/windowless sampling methods	5	BH01 to BH03, BH05, BH06	Gas/ groundwater	To determine the contamination status of the ground beneath the site and to install additional dual-

Investigation type	Number	Designation	Monitoring well installation	Rationale examples below
				purpose groundwater and gas monitoring wells

3.4.1 Implementation of investigation works

The exploratory holes were logged by an engineer in general accordance with the recommendations of BS5930:2015+A1:2020 (which incorporates the requirements of BS EN ISO 14688-1, 14688-2 and 14689-1).

The monitoring well construction and associated response zones are detailed on the exploratory hole records in [Appendix G](#). The response zones were installed to target identified gas generation sources or migration pathways detailed in the initial preliminary CSM. The installations within boreholes BH1 and BH3 started at or just below the made ground, to determine control sampling of the drift and whether ground gases were migrating (should they be present) from deeper areas of made ground beyond the site boundary within the underlying coal measures bedrock. Borehole BH2 had been drilled within the former gravel pit and encountered deep made ground, with the installation being constructed within the deeper ash and clinker (waste associated with the refuse destructor). Boreholes BH5 and BH6 were both installed entirely within the made ground; however, it should be noted that the base of BH5 included a section of core which had been noted as 'no recovery'. Obviously, core cannot disappear during drilling, although, it is considered that this stratum comprises a saturated fine sand which is lost during the recovery. The thickness of lost core in this instance is 0.60 m.

The soil sampling and analysis strategy was designed to characterise each encountered soil strata, permit an assessment of the potential contaminant linkages identified and investigate the geotechnical characteristics. In addition, samples were taken to allow for geo-environmental and geotechnical testing to be undertaken.

Soils collected for laboratory analysis were placed in a variety of containers appropriate to the anticipated testing suite required. They were dispatched to the laboratory in cool boxes under chain of custody documentation. Samples were stored in accordance with the RSK quality procedures to maintain sample integrity and preservation and to minimise the chance of cross contamination.

3.5 Monitoring programme

3.5.1 Ground gas monitoring

In line with the initial CSM, response zones, shown in Table 15, were installed to target the identified sources or pathways. Dual gas taps were installed in line with BS8576 at depths of at least 0.50 m above the ground water level recorded at the time of drilling.

Dual gas taps were utilised on site. Methane is lighter than air, but in the mixtures in which it is generally found in the ground, there is little difference in mass to air. Carbon dioxide is denser than air and will tend to collect in low points and depressions. Gases that differ in density can be stratified in a well. To allow for full gas circulation the standpipe was fitted

with a bung with two valves (in line with BS 8576). A pipe extended from one of the valves to the base of the borehole (or to just above the water table)

Six monitoring rounds have been undertaken to provide data to support refining of the CSM. The number of monitoring rounds undertaken is in general accordance with the decision matrix presented as Figure 6 of BS8576 for a very low (infilled gravel pit) to moderate (mine workings and shallow made ground) source generation potential and high sensitivity development.

A calibrated infrared gas meter (Geotechnical Instruments GA5000) was used to measure gas flow, concentrations of carbon dioxide (CO₂), methane (CH₄) and oxygen (O₂) in percentage by volume, while hydrogen sulphide (H₂S) and carbon monoxide (CO) were recorded in parts per million.

Initial and steady state concentrations were recorded.

The atmospheric pressure before and during monitoring, together with the weather conditions, were recorded. The monitoring included periods of falling atmospheric pressures and after/during rainfall.

All ground gas monitoring results together with the temporal conditions are contained within [Appendix H](#). Equipment calibration certificates are available on request.

3.5.2 Groundwater monitoring and sampling

Groundwater levels were monitored during each ground gas monitoring visit, and groundwater was sampled on one occasion.

Groundwater was noted to be very deep within all wells on site, and hence there was no requirement to circulate the groundwater present.

Depths to groundwater were recorded using an electronic dip meter on each of the return monitoring visits.

Groundwater samples were retrieved using a United States Environment Protection Agency (USEPA) approved low-flow purging and sampling methodology. Details of the low-flow sampling procedure are set out in [Appendix F](#). Water samples were dispatched to the laboratory in cool boxes under chain of custody documentation.

3.6 Laboratory testing

Laboratory testing was undertaken at a UKAS accredited laboratory with ISO17025 and MCERTS accredited test methods were specified where applicable for contamination testing and as shown in the laboratory test certificates appended.

3.6.1 Chemical analysis of soil samples

The soil sampling strategy was designed to characterise made ground and/or natural strata typically within the upper 1 m of the ground profile whilst also characterising deeper strata and the potential for contaminant migration from relevant sources of identified within the preliminary CSM.

The programme of chemical tests undertaken on soil samples obtained from the intrusive investigation is presented in Table 7 with the laboratory testing results contained in

[Appendix I](#). The suite of analysis below does not include the suites completed by both TerGeo and RSK for samples obtained from the bund surrounding the site, and this will be addressed later within the report.

Table 7 Summary of chemical testing of soil samples

Stratum	Tests undertaken	Number of tests
Made ground (MOT gravel)	Asbestos screening, metals, BRE sulphates, PAH USEPA 16, TPH CWG	1
Made ground (Clay)	Asbestos screening, metals, BRE sulphates, PAH USEPA 16, TPH CWG	3
Made ground (Silt)	Metals, BRE sulphates, PAH USEPA 16, TPH CWG	1
Made ground (Sand)	Asbestos screening, metals, BRE sulphates, PAH USEPA 16, TPH CWG, Total organic content	1
Made ground (Gravel)	Asbestos screening, metals, BRE sulphates, PAH USEPA 16, TPH CWG	1
Made ground (ash and clinker) – <1930's waste	Metals, BRE sulphates, PAH USEPA 16, TPH CWG	1
Natural – Silt	Metals, BRE sulphates, PAH USEPA 16, TPH CWG	2
Natural peaty/Clay	Metals, BRE sulphates, PAH USEPA 16, TPH CWG	3

3.6.2 Geotechnical analysis of soils

Due to the thickness of the made ground, the very low loading of the proposed structures for the site, and the anticipation treatment of the made ground to accommodate the bund material, no geotechnical analysis, beyond the chemical analysis to address sub surface concrete classification in accordance with BRE Special Digest SD1 was undertaken.

3.6.3 Infiltration testing

Due to the site being underlain by significant depths of made ground, infiltration testing was not undertaken, nor falling or rising head tests within the window sample boreholes drilled.

3.6.4 Chemical analysis of groundwater and surface water samples

Chemical testing undertaken on water samples obtained during the monitoring programme is presented in Table 8 with the laboratory testing results contained in [Appendix I](#). Groundwater samples were collected in containers appropriate to the anticipated testing suite required. The containers were filled to capacity and placed in a cool box to minimise volatilisation.

Table 8 Summary of chemical testing of water samples

Sample type	Tests undertaken	Number of tests
Groundwater	Metals, US EPA 16 PAH, TPH CWG	2

4 SITE INVESTIGATION FACTUAL FINDINGS

The results of the intrusive investigation and subsequent geo-environmental and geotechnical laboratory analysis undertaken are detailed below.

4.1 Ground conditions encountered

The descriptions of the strata encountered, notes regarding visual or olfactory evidence of contamination, list of samples taken, field observations of soil and groundwater, in-situ testing, and details of monitoring well installations are included on the exploratory hole records presented in [Appendix G](#).

The exploratory holes revealed that the site was underlain by a variable thickness of made ground between 0.50 m and 5.40 m.

For the purpose of discussion, the ground conditions encountered during the fieldworks are summarised in Table 9 with the strata discussed in subsequent subsections.

Table 9 General succession of strata encountered

Stratum	Exploratory holes encountered	Depth to top of stratum m bgl	Proven thickness (m)
Made ground (recent)	All	Beneath hardstanding	0.50 m to 1.90 m
Made ground (<1930's waste)	BH2	1.45 m	3.95 m
Interbedded very sandy SILT and silty SAND	All	0.50 m to 5.90 m	Base of boreholes 6.45 m to 7.45 m

4.1.1 Made ground

The made ground which is considered relatively recently deposited was generally encountered beneath a gravel stratum comparable to MOT road stone beneath a bitumen surface. In BH4, the thickness of bitumen was noted to be 0.55 m and was underlain by a significant thickness of gravel (0.50 m). The remaining boreholes either comprised a very sandy clay or a silty sand. Both were noted to contain fragmented concrete, brick, bitumen and tar, glass, wood, and clinker. Where the bitumen was encountered, there was a slight hydrocarbon odour. The maximum depth of recent made ground from existing ground level ranged from 0.50 m to 1.90 m.

Deeper seated made ground encountered within borehole BH2 was distinctly different from the recent deposits and comprised principally ash and clinker with steel fragments and was conjectured to be waste bi-product deposited within the former gravel pit from the refuse destructor (incinerator) that was present beyond the north western boundary.

The majority of made ground was noted to have low 'N' values from the Standard Penetration Tests (SPT's) completed, although several tests appear to have been impacted by gravel and cobbles.

The made ground within boreholes BH1 and BH4 were too shallow to undertake SPT's due to the service pit being taken to 1.20 m.

Borehole BH2 had one 'N' value within the recent made ground and was noted to be 25/50 for 20 mm which is indicative of encountering an obstruction which impacted the progress of the test. The deeper-seated ash and clinker made ground increased from 2 at 2 m, to 4 at 3 m, with single increment improvements until the base of the made ground (5 m) where an 'N' value of 6 was encountered.

Borehole BH3 encountered gravel and cobbles as the stratum for the SPT and encountered a very low 'N' value of 1, although 32 blows were recorded, which is indicative that the test was impacted by obstructions, as would be expected for this stratum.

Boreholes BH5 and BH6 both encountered clay made ground and recorded low density 'N' values of 4 and 9 respectively.

4.1.2 Variable cohesive and granular unit

The natural strata were encountered at a depth of between 0.50 and 1.90 below existing ground levels over the majority of the site; however, where the gravel pit was encountered within borehole BH2, the depth to natural stratum was 5.40 m. The strata were noted to comprise a soft and soft to firm / loose laminated clayey, very sandy silt or very silty sand. The units were highly variable in thickness and it is anticipated that there is likely to be more discrete variability with these strata than had been recorded within the visual assessment of the cores.

The 'N' values were all noted to increase with depth, and it should be noted that the horizons with no core recovery also recorded progressive values. The range of 'N' values are as noted below in Table 10:

Table 10 SPT 'N' Values and their representative stratum

Exploratory Position ref	SPT 'N' Values	Density	Depth
Borehole BH1	9 - 21	Medium dense	Full depth
Borehole BH2	20	Medium dense	5.40 m - 6.45 m
Borehole BH3	15 - 20	Medium dense	2 m – 6.45 m
Borehole BH4	6 - 8	Loose	1 m – 2 m
Borehole BH4	12 - 24	Medium dense	2 m – 6.45 m
Borehole BH5	4 - 14	Loose/Loose to medium dense	2 m - 4 m
Borehole BH6	7 - 22	Loose to medium dense	2 m - 3 m

Exploratory Position ref	SPT 'N' Values	Density	Depth
Borehole BH6		Medium dense	4 m - 6 m

4.1.3 Visual/olfactory evidence of soil contamination

The only odours recorded were associated within the recent made ground where bituminous materials were encountered. The odours are anticipated to be remnant diesel and polycyclic aromatic hydrocarbons associated with its use as a hardstanding but will be relatively immobile.

4.2 Groundwater and surface water

4.2.1 Groundwater encountered during intrusive works

Groundwater was encountered in 4 of the 6 boreholes, with boreholes BH2 and BH6 noted as being dry during drilling.

The majority of groundwater strikes recorded were situated within the silt. Borehole BH3 encountered groundwater perched within the made ground overlying natural clay.

Boreholes BH4 and BH5 encountered sections of missing core, which coincided with groundwater strikes. Although it is hard to prove, it is likely these are saturated sand lenses that collapse as the core is returned to the surface. The Standard Penetration Test 'N' values all indicate that this stratum was a medium dense sand.

4.2.2 Groundwater encountered during monitoring

Rest groundwater levels recorded during the monitoring programme are summarised in Table 11 based on the data provided in [Appendix H](#).

Table 11 Summary of groundwater monitoring results

Monitoring well	Response Zone Depths (m aOD begl)	Response zone stratum	Groundwater elevation (m begl) – min.	Groundwater elevation (m begl) – max.
BH1	1.00 m – 5.00 m	Sandy SILT and silty SAND	4.49	4.59
BH2	2.40 m – 5.40 m	Ash & clinker made ground	5.37	5.39
BH3	1.55 m – 6.00 m	Sandy SILT and a 0.9 5 m sand lenses	4.74	5.23
BH4	No Well Installed			
BH5	0.50 m – 2.50 m	Made ground, clay and saturated sand	1.9	2.25
BH6	0.50 m – 2.00 m	Clay made ground	2.5	2.51

For the duration of the ground gas monitoring programme, the groundwater within all the wells have been static. The greatest variation in groundwater level was noted in borehole BH3 in Round 5, with the first 4 visits having 0.27 m variability.

It should be noted that groundwater levels might fluctuate for a number of reasons including seasonal variations.

4.2.3 Visual/olfactory evidence of groundwater contamination

There was no evidence of groundwater contamination during the course of the ground investigation.

4.3 Chemical laboratory results

The soil and groundwater testing results are presented in Appendix I.

Asbestos was encountered within one of three samples where analysis was undertaken. It should be noted that as a routine precaution for the health and safety of laboratory staff, all samples undergo a basic assessment for the presence of asbestos. RSK were not notified about the presence of asbestos in any of the other samples.

4.4 Geotechnical laboratory results

No geotechnical analysis was undertaken due the proposed development and the anticipated methods of founding these structures.

4.5 Ground gas monitoring

The results of the ground gas monitoring and testing carried out are given in [Appendix H](#) and discussed in Section 5.

5 GEO-ENVIRONMENTAL ASSESSMENT

5.1 Refinement of initial CSM

The initial conceptual model for the potential risk of former land use is shown below in Table 12.

Table 12 Summary of sources for contamination

Potential sources	Contaminants of concern	Current or historical?
On-site		
Made ground (i.e. fill material) associated with the former buildings and earth mounds surrounding the Site	Unknown fill material but potentially including brick, ash and clinker and containing toxic and phytotoxic metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), asbestos	Historical
Former gravel pit (c.1890s to 1930s)	Unknown fill material but potentially including brick, ash and clinker and containing toxic and phytotoxic metals, inorganics, polycyclic aromatic hydrocarbons (PAHs), asbestos	Historical
Off-site		
Surrounding industrial land uses including: Woollen Mills, Gravel Pit, Refuse Destructor, unspecified Tanks, Saw Mill	Various contaminants including petroleum hydrocarbons, PAHs, toxic and phytotoxic metals, inorganics, metals	Current and historical

The potential risk associated with ground gas were determined as below in Table 13.

Table 13 Summary of sources for ground gas

Potential sources	Indicative ground gas generation potential (CIEH, 2008)	Additional information
On-site		
Made ground associated with the infilled former gravel pit (1890s to 1930s)	Moderate	Infill material is unknown and could potentially generate ground gases
Mine workings more than 50 years since last worked	Moderate	Shallow mine workings have been reported below the site
Off-site		
Made ground associated with historic infilled gravel pit (1890s to 1970s), 20 m to west	Low/ moderate	Infill material is unknown and could potentially generate ground gases which could migrate to the site

The ground investigation largely confirmed the assumptions made within the initial conceptual site model (CSM). There were two forms of made ground, that conjectured prior to the 1930's formed from the combustion of waste within the former gravel pit, overlain by a site wide general cohesive and granular made ground of a more recent age.

Groundwater was deep on site and encountered as confined seepages within the alluvium silt at depth or within the granular made ground and was relatively static. Groundwater was not considered during the CSM.

It was conjectured prior to the ground gas investigation that due to the age of the made ground the likelihood that ground gas would be generated would be low. It should be noted that as the made ground would be formed by the bi-product of the waste destructor (incinerator) what little putrescible materials were disposed of at this time would have been burnt off. Carbon dioxide was considered the most likely form of ground gas present.

The ground gas monitoring completed on site determined that although carbon dioxide was present, the concentration encountered was both below the tier 1 threshold concentration of 5% for all bar one readings, with no ground gas flow recorded. Hence, ground gas is not considered to pose a risk to the development of this site.

All potential linkages associated with ground gas (associated with both made ground and coal mining) can therefore be dismissed as not relevant.

(incinerator) what little putrescible materials were disposed of at this time would have been burnt off. Carbon dioxide was considered the most likely form of ground gas present.

The ground gas monitoring completed on site determined that although carbon dioxide was present, the concentration encountered was both below the tier 1 threshold concentration of 5% for all bar one readings, with no ground gas flow recorded. Hence, ground gas is not considered to pose a risk to the development of this site.

All potential linkages associated with ground gas (associated with both made ground and coal mining) can therefore be dismissed as not relevant.

5.2 Linkages for assessment

As described in LCRM (Environment Agency, 2021), there are two stages of quantitative risk assessment (QRA), Tier 2 generic (GQRA) and Tier 3 detailed (DQRA). The GQRA comprises the comparison of soil, groundwater, soil gas and ground gas results with generic assessment criteria (GAC) that are appropriate to the linkage being assessed. This comparison can be undertaken directly against the laboratory results or following statistical analysis depending upon the sampling procedure that was adopted. This assessment relates to LCRM Stage 1, Tier 2 generic quantitative risk assessment

Following the refinement of the CSM, the potentially complete contaminant linkages that require further assessment and the methodology of assessment are presented in Table 14.

Table 14 Linkages for GQRA

Potentially relevant contaminant linkage	Assessment method
Soil data	
1. Oral, dermal and inhalation exposure with impacted soil, soil vapour and dust by future residents	Human health GAC in Appendix J for a proposed residential end use with home-grown produce since the proposed end use includes residential gardens. Consideration given to the applicability of the use of Statistical Assessment.
2. Inhalation exposure of future residents to asbestos fibres	Qualitative assessment based on the asbestos minerals present, their form, concentration, location, and the nature of the proposed development.
3. Uptake of contaminants by vegetation potentially impacting plant growth (phytotoxicity)	Comparison of soil data to GAC for phytotoxicity.
4. Contaminants permeating potable water supply pipes	Comparison of soil data to GAC in Appendix K for plastic water supply pipes using UKWIR (2010) guidance and the United Utilities Risk Assessment.
5. Leaching of soil contaminants and dissolved phase migration	Since no leachate data is available the potential for leaching has been considered qualitatively using soil and groundwater results.
Ground Gas	
1. Concentrations of methane and carbon dioxide in ground gas entering and accumulating in enclosed spaces or small rooms in new buildings, which could affect future site users. For methane this could create a potentially explosive atmosphere, while death by asphyxiation could result from carbon dioxide.	Borehole hazardous gas flow rates (Qhg) have been calculated using maximum (peak) methane and carbon dioxide concentrations and steady state flow rates in accordance with BS8485. This is subject to interpretation and use of professional judgement to designate the site or zones of the site characteristic situation by comparison to a Gas Screening Value (GSV) as appropriate and in line with the CSM. For applicable low-rise residential developments (with a pre-cast concrete floor system) reference to NHBC guidance has also been considered.

5.3 Methodology and assessment of soil results

The analysis of laboratory results relating to soil samples submitted for testing, including leachate analysis, is included in the following sections.

5.3.1 Oral, dermal and inhalation exposure with impacted soil by future occupants/site users

In order to assess the soil results against the appropriate GAC, the soil results have been split into appropriate data sets relevant to the oral, dermal and inhalation linkage.

The datasets being considered in the assessment are:

- data set 1a Made ground underlying the site.
- data set 1b Made ground within the bund surrounding the site.

As an initial assessment of each dataset, all soil results in each dataset have been directly compared against the GAC for residential with home-grown produce / residential without home-grown produce.

5.3.1.1 Data set 1a – Made Ground underlying the site

All made ground results have been compared with the residential with and without plant uptake GAC. A soil organic matter (SOM) of 1% has been selected since laboratory results within the made ground range from 1.07% and 11.5%. The soil screening output spreadsheet is presented as [Appendix L](#).

Of the 8 samples analysed, Borehole BH5 (1.95 m) and BH6 (2.30 m) were natural, and all other samples were made ground. Samples from boreholes BH2 (0.40 m), BH4 (0.80 m and 1.25 m), BH5 (0.90 m) and BH6 (0.60 m) were all sampled from what is regarded as more recent made ground. Borehole BH2 (1.55 m) was obtained from made ground which was pre-1930's and associated with infilling of the gravel pit from the waste destructor.

Using the most conservative assessment for human health risk assessment (residential with plant uptake 1% soil organic matter), both samples of natural strata were uncontaminated.

The **most recent made ground** was noted to have slight contamination associated with lead and zinc (phytotoxic threshold), asbestos (loose fibres and cement of chrysotile), polycyclic aromatic hydrocarbon (PAH) compounds (principally benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene, chrysene, dibenzo(ah)anthracene), with the shallow sample of BH6 encountering additional PAH compounds (indeno(123-cd)pyrene, naphthalene and phenanthrene).

Total petroleum hydrocarbon (TPH) compounds were encountered elevated above threshold concentrations also with the same samples with elevated concentrations of PAH compounds. All elevated compounds were aromatic phase and between C12-C16 and C21 to C35, which is anticipated to comprise predominantly of the PAH compounds already encountered rather than fuel.

A source signature double ratio plot had been completed to assess the potential source of the PAH compounds encountered, and all are associated with coal-based processes.

Deeper made ground (<1930's) within borehole BH2 was conjectured to comprise the bi-product of the waste destructor (ash and clinker). This stratum was noted to contain significant concentrations of arsenic (194 mg/kg), copper (1,440 mg/kg), lead (2,110 mg/kg), nickel (137 mg/kg) and zinc (1,100 mg/kg), although all concentrations of compounds within the TPH CWG and US EPA 16 suites were all negligible.

5.3.1.2 Data set 1b – Made Ground within the bund surrounding the site

There was also a bund within the boundary of the site. This was sampled by both Tergeo and RSK during 2017 and 2018.

The Tergeo investigation comprised 9 hand augered boreholes with 11 samples obtained from up to 2.50 m depth below the crest of the bund. All samples were analysed for the presence of asbestos, 5 samples were analysed for metals and BRE Special Digest SD1 compounds, 5 samples were analysed for TPH CWG speciated aliphatic and aromatic

compound, VOC and SVOC compounds, and 5 samples for phenols and cresols. It should be noted that although for most of the analysis 5 samples were selected, it is not necessary the same samples that have been analysed for all analytes. Asbestos was only encountered within 2 samples as fibres and clumps of chrysotile (0.062% BH2 at 2.00 m and 0.006% BH6 at 1.00 m).

Metals exceeded the threshold for human health with and without vegetable uptake for lead within 3 of the 5 samples, and the phytotoxic threshold for zinc in 1 sample. These were suitable for use at depth as general fill, but below 0.45 m from the base of topsoil (0.60 m from proposed surface), and hence will be suitable for use.

The hydrocarbon compound assessment determined that only BH1 at 1.00 m encountered elevated concentrations of aromatic compounds between the chain lengths C12 to C16, C16 to C21 and C21 to C35. As the PAH compounds are situated within this range of the elevated concentrations of TPH compounds, it was determined that rather being fuel derived, these were associated with the combustion of organic based materials, most likely in the form of ash and clinkers. Having completed a source signature ratio plot for the sample, this is also indicative of the source being combustion rather than fuel.

PAH compounds were noted to be elevated in all of the samples; however, the highest concentrations were in BH1 at 1.00 m. Compounds which exceed the human health threshold for use with plant uptake were phenanthrene (BH1 at 1.00 m), benzo(a)anthracene (BH1 at 1.00 m, BH2 at 2.00 m and BH9 at 2.50 m), benzo(a)pyrene and chrysene (BH1 at 1.00 m, BH2 at 2.00 m and BH9 at 2.50 m), and benzo(b)fluoranthene (in all 5 samples). The majority of the compounds and elements noted above also exceed the threshold for residential usage without plant uptake. Assuming the compounds are not liable to leach, all are within threshold to be utilised within general materials suitable to be engineered fill, with the exception of asbestos, which will require special mitigation measures to be adopted, and restrictions for placement to prevent contact with personnel who may repair services.

RSK (11151) excavated 17 shallow (<0.40 m) hand dug holes to recover samples from both the bund as well as the service strips either side of the road. Three of the exploratory holes were excavated within the bund which was present within the rear gardens of three plots. Nineteen samples were analysed and encountered exceedances in 3 PAH compounds in the perimeter mounds, including benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(a,h)anthracene) plus 4 PAH compounds in individual plots, which include (benzo(a)anthracene, benzo(a)pyrene, benzo(b)fluoranthene and dibenzo(a,h)anthracene), except Plot 10. Two samples were noted to have a presence of asbestos; however, the concentration was less than detection using accredited methods (<0.001%). The form of asbestos was chrysotile board (HP2) and loose fibres (HP6).

There was correlation between the analysis undertaken between the Tergeo and RSK within the bund with regard to specific PAH compounds and metals which exceed threshold concentrations for residential end use. The only form of asbestos encountered was chrysotile.

5.3.1.3 Summary

The made ground present on site, both underlying the site and contained within the bund around the site boundary is not suitable to be present at the surface and accessible to

residents for the proposed end use as a caravan park. Mitigation measures, which will include segregation and sorting of materials will be required to allow those materials suitable to be retained on site to be recovered.

The made ground is not considered to pose a risk to the wider environment; however, it does pose a potential risk of harm to the end users of the development (residents) as well as maintenance workers who may be required to excavate where services are located.

It is recommended that all soft landscaping on site adopts an inert cover. The thickness of the inert cover should be 0.60 m, with a material separator/hard to dig at the boundary with the underlying made ground. The inert cover will comprise 0.15 m of topsoil, with underlying subsoil. Acceptable concentrations of elements and compounds within the topsoil and subsoil are presented in Appendix J.

All road corridors should be free of contamination which may impact maintenance workers who will repair services. The services are to be provided in clean channels, with a material separator (i.e., Terram woven sheet) between the made ground and the clean corridor. There should be a minimum of 0.50 m of clean material below the invert level of the deepest drainage (typically the foul). These works will be part of the turnover operation. All shallower service corridors for private supply will need to also be created, otherwise potentially contaminated soils will require disposal if to be completed during the build phase of the development. It should also be noted that should areas without mitigation measures be excavated post development, contractors may bring contaminated soils to the surface.

5.3.2 Inhalation exposure of future occupants/site users to asbestos fibres

Asbestos was encountered within both the made ground underlying the site, as well as the bund surrounding the site. The analysis of the soils has identified the asbestos to be chrysotile and present as both fibres and clumps, with one sample of chrysotile board.

The bund was noted to contain loose fibres/clumps between 0.006% and 0.062% by weight.

Mitigation measures will be required for both the handling of this material during the development phase of the site, as well as post development.

5.3.3 Uptake of contaminants by vegetation potentially inhibiting plant growth (phytotoxicity)

Phytotoxic metals were noted to be above threshold concentrations within the made ground, although below human health threshold concentrations. As the made ground requires remediation and mitigation due to other compounds and elements, the phytotoxic assessment becomes irrelevant and is addressed within the mitigation requirements.

5.3.4 Impact of organic contaminants on potable water supply pipes

For initial assessment purposes, the results of the investigation have been compared with the GAC presented in [Appendix J](#) 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 United Utilities Risk Assessment for water pipes has been partially filled out and is contained in [Appendix K](#).

The results indicate that a relevant linkage is likely to exist associated with organic contaminants due to polycyclic aromatic hydrocarbon compounds within the TPH CWG analysis. We anticipate that Protectorline or similar barrier pipework will be required for the potable water supply for this site. The site is to undergo a significant ‘turnover’ and hence the materials will be completely disturbed. As the site is to have an inert service corridor, the requirement for this form of potable protection maybe removed to standard PE piping; however, the threshold values as stated on the risk assessment must be achieved with imported aggregate.

5.3.5 Leaching of contaminants and dissolved phase migration to wider secondary aquifer*

Groundwater analysis of samples obtained from the boreholes did not indicate that mobile contamination is present.

5.4 Methodology and assessment of water results

5.4.1 Dissolved phase migration of contaminants to wider secondary aquifer*

The analytical results for groundwater samples obtained from boreholes BH1 and BH3 are below the relevant GAC protective of groundwater receptors indicating contaminant linkages to the wider aquifer associated with contaminants in the dissolved phase are incomplete. Groundwater is not considered to be impacted by contamination.

5.5 Ground gas risk assessment – bulk gases

5.5.1 Appropriate guidance

The risks to development from ground gases have been assessed in accordance with BS8485:2015+A1:2019 (BS8485), which provides guidance on ground gas (methane and carbon dioxide) characterisation and hazard assessment, as well as providing a framework for the prescription of protection measures within new buildings.

The process involves characterising the gas hazard from combining the qualitative assessment of risk (using the CSM) with ground investigation data so that a ‘characteristic situation’ (CS) can be derived for the site or zones within the site. Characteristic situations range from CS1 to CS6, the higher the CS, the higher the hazard potential. Gas protection measures within new buildings can be prescribed using a point scoring system, taking into consideration the CS and the proposed building type.

BS8485 indicates that the gas hazard can be characterised using the following methods:

- an empirical semi-quantitative approach using gas monitoring data to determine the ‘characteristic situation’ of the site (or zones of the site) and subsequent protective measures (Wilson and Card approach).
- an empirical semi-quantitative approach using TOC data to determine the ‘characteristic situation’ of the site (or zones of the site) and subsequent protective measures (CL:AIRE RB17 approach) or
- detailed quantitative assessment methodologies

For the purpose of this assessment, the empirical semi-quantitative using gas monitoring approach above has been used to characterise the gas hazard and provide advice on the protective measures likely to be required within new buildings at the site.

5.5.2 Summary of the refined CSM for ground gas

In the assessment of risks and selection of appropriate mitigation measures, BS8485 highlights the importance of the conceptual model. In summary, potential sources of ground gas within influencing distance of the site identified in [Section 5.1](#) comprise:

- Made ground (Recent) typically <2.00 m deep site wide – on site
- Made ground (<1930) – limited to the area of former gravel pit – on site.
- Made ground beyond the boundary – extensions to that noted above close proximity.
- Corporation Yard – on site
- Chemical works and multiple industrial works – former – situated within 200 m

The made ground derived from the waste destructor (incinerator) is considered to have a low potential for organic content due to the combustion process; however, carbon dioxide was a potential risk. The recent made ground appeared low in organic content and was also considered to have a low to moderate risk for carbon dioxide. There were no sources which would be considered as having ground gases under pressure/flowing within close proximity to the proposed site; however, certain industrial processes up hydraulic gradient may have mobile sources of contamination within the groundwater which may impact the site with regard to vapours, although this is considered unlikely.

Pathways and receptors for ground gas were identified in [Section 5.1](#). It is understood that building foundations are to include piles or raft with an integral floor slab.

This assessment has been undertaken to determine the risks to building structures and proposed end users. The assessment has not taken into consideration the health and safety of construction workers. Risks may still be present to construction workers especially where works include the entry into excavations within the ground. Construction workers should undertake appropriate risk assessments and risks should be managed through health and safety procedures and safe systems of work.

The risk assessment has been undertaken based on the current understanding of the CSM.

5.5.3 Empirical semi-quantitative approach using borehole monitoring data (Wilson and Card approach, BS8485)

5.5.3.1 Background

The empirical semi quantitative approach using gas monitoring data requires the designation of a gas screening value (GSV) for the entire site or zones within the site, which informs the hazard potential and associated prescribed ground gas protection measures within new buildings (where necessary). BS8485 defines the GSV as the *'flow rate (l/hr) of a specific hazardous gas **representative of a site or zone**, derived from assessment of borehole concentration and flow rate measurements and taking account of all other influencing factors, in accordance with a conceptual site model'*.

BS8485 Section 6.3.1 outlines the process for developing a GSV for the site or a zone as follows:

- borehole hazardous gas flow rate (Q_{hg}) is calculated for each borehole standpipe for each monitoring event. The borehole hazardous gas flow rate is defined in BS8485 as the '*flow rate of a specific hazardous gas, either methane or carbon dioxide, from a borehole standpipe*'. The Q_{hg} is calculated from individual borehole measurements of total gas flow and the concentration of the specific hazardous gas. BS8485 states in Section 6.3.4 that the **maximum** gas concentration recorded during the monitoring event should be used, together with **steady-state** values of gas flows.
- the reliability of the measured gas flow rates and concentrations are assessed taking into account borehole construction;
- decisions are made about how to deal with any temporal or spatial shortages in the data; and
- judgements are made about what GSV to designate for use for design purposes taking all relevant information and the conceptual site model into account.

Once the Q_{hg} has been calculated for methane and carbon dioxide, individual borehole measurements are compared to the thresholds presented in Table 2 of BS8485 which inform the CS that directly relates to each individual measurement. Taking into account the site data (i.e., borehole gas concentration and flow rate to calculate the Q_{hg}) and all other influencing factors in accordance with the CSM, a decision can then be made regarding the GSV that is considered to be representative of the site or a zone within it.

Typical threshold concentrations of methane (1% v/v) and carbon dioxide (5% v/v), and flow rates (>70 l/h), are also considered when designating the GSV for the site or zone, which in turn dictates the hazard potential and CS. It is important to note that the site or zone characteristic GSV and maximum concentration or flow thresholds are guideline values and not absolute. The thresholds may be exceeded in certain circumstances, if the CSM indicates it is safe to do so.

5.5.3.2 Designation of a GSV for the site or zone

The results of the ground gas monitoring and testing undertaken, alongside site conditions at the time of monitoring, are given in [Appendix H](#).

No wells were flooded or otherwise impeded in their construction or ground conditions. Groundwater was noted to be deep in all wells.

A summary of the maximum recorded concentrations per borehole (or minimum for oxygen) is presented in Table 9 overleaf. This table also presents details of the response zone, maximum recorded initial and steady state flow rates, and minimum recorded depth to water across all monitoring rounds.

The maximum concentration of methane and carbon dioxide encountered across the site was 0.1% by volume and 7.4% by volume respectively. Methane was only encountered at this trace level within boreholes BH3 and BH5 on one occasion, with all other readings being zero. Carbon dioxide was only encountered above the initial assessment threshold of 5% on one occasion (BH2 third visit) with the next highest concentration of 4.1% by volume within BH2 (fifth visit).

To assess the potential risk of ground gas the concentration encountered is divided by 100, then multiplied by the flow rate to derive the gas screening value (GSV). The worst-case ground gas situation using the worst-case concentrations/flows from across the site and not borehole/visit specific are as follows:

Methane

$(0.1\% \text{ by volume}/100) \times 0.2 \text{ l/hr} = 0.0002 \text{ l/hr}$

Carbon dioxide

$(7.4\% \text{ by volume}/100) \times 0.2 \text{ l/hr} = 0.0148 \text{ l/hr}$

As neither the methane or the carbon dioxide posed a risk and were classified as requiring Characteristic Situation 1 (CS1) ground gas mitigation measures for properties to be constructed on site, there is no requirement for zonation or any other form of delineation on site.

Table 15 Summary of ground gas monitoring results

Exploratory position ID	Response zone top (mbgl)	Response zone base (mbgl)	No. of monitoring rounds	Peak CH ₄ max. (%/vol)	Steady-state CH ₄ max. (%/vol)	Peak CO ₂ max. (%/vol)	Steady-state CO ₂ max. (%/vol)	Oxygen min. (%/vol)	Peak gas flow max. (l/hr)	Steady-state gas flow max. (l/hr)	Depth to water min. (m)	Depth to water max. (m)	Atm. pressure min. (mb)	Atm. pressure max. (mb)
BH1	1	6	6	0	0	3	3	8.9	0.2	0.2	4.64	4.74	974	1012
BH2	2.4	5.4	6	0	0	7.4	7.3	7.5	0	0	5.5	DRY	974	1012
BH3	1.55	6	6	0.1	0	2.9	2.9	1.4	0	0	4.84	5.33	974	1012
BH5	0.5	2.5	4	0.1	0	2.1	2.1	18.2	0.1	0.1	2	2.34	974	1012
BH6	0.5	2	6	0	0	3.8	3.6	7.6	0.1	0.1	2.61	DRY	974	1012

Borehole Response Zone Geology Unit

- BH1 - Loose to medium dense, light brown, slightly gravelly, very sandy SILT, and thick lenses of fine to coarse sand.
- BH2 - MADE GROUND Loose, dark brown, slightly silty SAND and GRAVEL
- BH3 - Soft to firm, orangish, brown, slightly gravelly, very sandy SILT
- BH5 - MADE GROUND Sandy, gravelly CLAY, and very soft organic clay (possible made ground)
- BH6 - MADE GROUND Sandy, gravelly CLAY

5.5.3.3 Summary of borehole hazardous gas flow rates

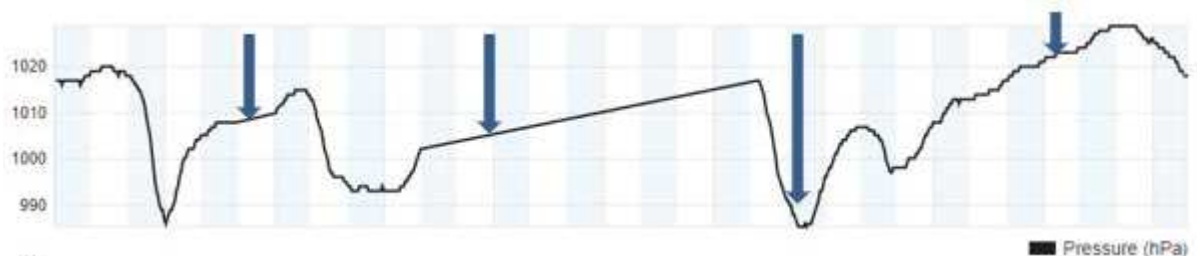
Borehole hazardous gas flow rates (Q_{hg}) have been calculated for each borehole standpipe, for each monitoring round and are presented, alongside two 'worst case' checks in [Appendix H](#) comprising a probable 'worst case' and potential 'worst case' from the available monitoring data. Within this data gas concentrations exceeding the thresholds presented in Table 2 of BS8485 are identified, alongside the CS that could be associated with each individual borehole monitoring event.

The majority of ground gas monitoring visits for all boreholes encountered zero ground gas flow recorded. The highest flow rate was 0.2 l/hr and was noted in borehole BH1 on one occasion. All other visits to this borehole encountered zero or -0.1 l/hr. For the worse case assessment, 0.2 l/hr should be adopted as the ground gas flow rate to assess the potential ground gas risk for this site.

During the period of monitoring (7 May to 18 June 2021), the atmospheric pressure was noted to vary between 974 mbars and 1012 mbars, with the initial two readings being less than 1,000 mbars. Borehole BH5 was the only installation not to be monitored six times, with four visits completed, one of which was completed during a period of atmospheric pressure below 1,000 mbars.

The closest weather station to the site was noted as IBURY40 (amateur station) situated on Fairlands Road, Bury (Latitude / Longitude: 53.612° N, 2.291° W, Elevation: 423 m aOD). The atmospheric pressure charts shown below for this weather station have arrows indicating monitoring dates. There were no readings taken between 10 and 20 May 2021 by the weather station.

Atmospheric pressure for May 2021 (no readings for 10 to 20 May 2021)



Atmospheric pressure for June 2021



(<https://www.wunderground.com/dashboard/pws/IBURY40/graph/2021-05-30/2021-05-30/monthly>)

According to the pressure charts, the third monitoring visit on the 21 May 2021 was undertaken during a deep period of very low pressure, with the first, fourth and fifth readings taken close to the peak high pressure, with the atmospheric pressure still rising.

Although due to the station being offline for a period of time the deep low pressure maybe erroneous.

5.5.3.4 Consideration of negative flow rates

Several very minor negative flow rates were encountered during the monitoring which may be associated with the borehole installation or minor fluctuations of groundwater.

5.5.3.5 Data Limitations

It should be noted that there are inherent limitations in ground gas monitoring including spatial adequacy of monitoring locations, changes in groundwater levels, variation in temporal or atmospheric conditions and whether these have been adequately characterised by the scope of monitoring undertaken.

The investigation undertaken to date has incorporated an appropriate number of ground gas monitoring visits, the data is considered reliable, and spatially representative of the site. It is also noted that 6 round(s) were completed during low and falling atmospheric pressure (<1000 mb) indicating that possible worst-case conditions have been present during monitoring.

5.5.3.6 Trace gases

Carbon monoxide and hydrogen sulphide are also monitored as part of this phase of the investigation.

No hydrogen sulphide had been encountered in any of the boreholes during monitoring.

Carbon monoxide had been encountered within all boreholes with concentrations ranging from 2.1ppm to 7.4ppm. Carbon dioxide is a colourless, odourless, tasteless gas which is generally associated with combustion. Typically, domestic carbon monoxide monitors have alarms set once concentrations reach between 50ppm and 300ppm (certificated BS EN 50291). It should be noted that those alarms sounding at lower concentrations than 300ppm where the gas is detected over a longer period of time. The 50ppm alarm is activated between 60 minutes and 90 minutes. The concentrations on site are not considered to pose a risk to the development.

5.5.4 BS8485 recommended ground gas protection measures

Case 1: CS1 classification

Based on the current understanding of the conceptual site model and the assessment undertaken, the site has been classified as CS1. In accordance with BS8485, ground gas protective measures are not considered necessary within proposed buildings.

5.5.5 Application of NHBC Guidance

The NHBC Guidance for ground gas is not relevant to this form of development as this risk assessment is only to be used where ground floor slabs comprise a screed, block and beam/pre-cast concrete ground floor slab system. These structures will not be constructed in this manner.

5.6 Uncertainties and implications in refined CSM and GQRA

In accordance with good practice, data gaps and uncertainties in the refined CSM have been identified at this stage. These are summarised in Table 16 along with the likely implications.

Table 16 Data gaps and uncertainties

Data gap/ uncertainty	Details	Implications
The full extent of the gravel pit has not been established	The former gravel pit was associated with deep made ground (<1930's)	Using the historical mapping it should be possible to determine the extent of the gravel pit as far as required. The depth of the gravel pit has not been confirmed. Should further confirmation be required additional boreholes will be required to delineate this feature.
The area of the bund as well as the sites of the current occupied units were inaccessible for investigation.	Restrictions to the area of the investigation.	Unforeseen ground conditions could be present within these areas; however, the investigation completed to date indicated consistent ground in accordance with that observed on the historical maps/
Low concentrations of asbestos were found in made ground samples tested	It should be noted that due to the location of the site and the origin of the more recent made ground being unknown, more asbestos may be encountered.	Vigilance should be maintained for any potential ACM or fibrous material during below ground works
Hydrocarbon contamination not identified in SI or monitoring works	This area was historically used as a Corporation Yard as well as a traveller site. There is the potential for localised hotspots of hydrocarbon contamination which have not been encountered to date.	The site will be remediation using a turnover solution, and hence any localised contamination may be identified and treated during the works.

6 PRELIMINARY WASTE ASSESSMENT

In accordance with the definition provided in the Waste Framework Directive (WFD), materials are only considered waste if 'they are discarded, intended to be discarded or required to be discarded, by the holder'. Naturally occurring soils are not considered waste if reused on the site of origin for the purposes of development. Soils such as made ground that are not of clean and natural origin (irrespective of whether they are contaminated or not) and other materials such as recycled aggregate, do not become waste until the criteria above are met. Further background information is provided in [Appendix F](#).

The site has a significant volume of waste present and comprises the following:

- Pre-1930's Incinerator waste – The former gravel pit appears to have been filled using the ash and clinker wastes from the refuse destructor that was present north west of the site.
- Post 1930's to circa 2000 – Generally thin layer of made ground approximately 2 m in depth. This made ground is anticipated to have derived from beyond the site boundary from unknown sources.
- Circa 2000 – Bund surrounding the site anticipated to be formed from a site scrape, with possible off-site sources contributing.

The site is not classified as a landfill site in accordance with the desktop searches.

To undertake a sustainable development, the client is proposing to retain as much material on site as possible. As such, the client is proposing to undertake a turnover process for the site within the most recent made ground (excluding the <1930 made ground) as well as the bund. This will remove any unsuitable material present, and breakup oversized granular units (such as concrete and brick wall sections). All unacceptable 'U' grade materials (Classes U1A, U1B and U2 in accordance with Volume 1, Specification for Highways Works, Series 600, Earthworks) will be removed from site. All remaining materials to be retained on site will be suitable for use to create a development platform and hence should not be considered waste.

Due to the potential for asbestos to be present within the made ground, all road corridors will be clean development strips, with inert cover required for soft landscaping which will require 100% importation.

Excavation arisings from the development may therefore be classified as waste if surplus to requirements or unsuitable for reuse. The following assessments assume the material tested is classified subsequently as waste.

6.1 Hazardous waste assessment

Technical Guidance WM3 (EA, 2018) sets out in its Appendix D requirements for waste sampling. It is a legal requirement to correctly assess and classify waste. The level of sampling should be proportionate to the volume of waste and its heterogeneity. The preliminary assessment provided below is based only upon the available sample results and may not be sufficient to adequately classify the waste.

6.1.1 Chemical contaminants

EnviroLab, an RSK company, has developed a waste soils characterisation assessment tool (HASWASTE), which follows the guidance within Technical Guidance WM3. The analytical results have been assessed using this tool to assess the hazardous properties to support potential off-site disposal of materials in the future. Note that it is ultimately for landfills to confirm what wastes they are able to accept within the constraints of their permit.

Two samples (HP8 and HP10) from the analysis undertaken by RSK of the bund were noted to have a concentration of hydrocarbon compounds which exceeded 1,000 mg/kg and are considered to exceed the threshold for **carcinogenic risk HP7**, and **mutagenic risk HP11**. These are anticipated to be associated with bitumen products within the bund. It should be noted that asbestos had not been quantified within this assessment, and asbestos containing materials had been recovered and identified. The hazardous waste threshold concentration is 0.1%. We anticipate that handpicking fragments will minimise the potential for asbestos concentrations to exceed this value.

Three samples (BH2 at 0.40 m, BH2 at 1.55 m and BH6 at 0.60 m) from the latest analysis undertaken by RSK from boreholes drilled across the site are considered to be hazardous waste for the same risk factors. It is anticipated that zinc also fails the threshold within BH2 at 1.55 m.

It should be noted that hydrocarbon compounds are considered to comprise polycyclic aromatic hydrocarbon compounds and are likely to diminish through the processing of the soils. The concentrations which have been recorded are all compliant for soils to be situated at depth (0.45 m>)

6.1.2 Asbestos within waste soils

Technical Guidance WM3 requires that within a mixed waste the separately identifiable wastes be assessed separately.

For instance, where waste soil contains identifiable pieces of asbestos (visible to the naked eye) the asbestos should, where feasible, be separated from the soil and classified separately. This should be disposed of within a hazardous, stable non-reactive hazardous waste landfill or a special cell in a non-hazardous waste landfill.

6.1.3 Processing Soils for Reuse

The process of turning over this site will require a temporary mobile plant licence to undertake the works. Depending upon the amount of asbestos encountered, this may also be potentially licensable or non-notifiable works.

It will be for a competent contractor to obtain all the required licenses and permits to ensure that the proposed works are undertaken within the current legal and regulatory frameworks.

It will be for the contractor to prove that through the process of sorting the made ground, all unacceptable materials have been removed and those materials remaining on site are suitable for reuse and hence no longer should be considered waste.

The processing of the soils will create a geotectonically suitable development platform, with sterile corridors (within a Terram wrap) to mitigate the risk of service contractors coming into contact with soils which may contain asbestos fibres.

The proposed foundation option (piles or semi-stiff raft foundation) will require confirming prior to the turnover being undertaken as there are different requirements for proposed ground levels during this operations with the different build types. Typically for piling projects a piling blanket will be required, although the turnover may create a surface suitable for lower loaded piling rigs. A specific pile blanket calculation will be required depending upon the plant to be used and the ground conditions.

Ground levels are anticipated to require raising around the areas piled, due to cropping of surplus lengths, capping and the construction of the associated ground beam.

Raft foundations are integral units which have a shallow toe and are typically founded 1.0 m below finished floor level (0.8 5 m below proposed ground level), and hence this will be remediation platform level for turn over works.

A full remediation proposal for the turnover operation will be required.

6.2 WAC assessment

Waste Acceptance Criteria (WAC) Assessment tests have not been completed on this site, as these should be undertaken on stockpiles of material for disposal.

It is intended to reuse the majority of the soils, although unacceptable materials will be stripped out of the soil mass for specific waste streams for disposal. It is anticipated that, assuming approximately 30% of the surrounding bund consists of unacceptable materials, there should be a rough balance of materials to maintain, although considering the location of the site, should there be a surplus, it is not anticipated that a rise in ground level will impact on the development or the surrounding industrial area.

A full cut and fill model will be required, as well as the assessment for foul drainage requirements of the site to determine the minimum finished ground levels for this site.

WAC Analysis should be undertaken on any surplus soils on site for disposal.

7 GEOTECHNICAL ASSESSMENT

7.1 Proposed development

It is understood that the proposed development is to involve the construction of six pairs of semi-detached, single storey modular units and associated infrastructure, as well as a single storey gatehouse/office.

At this stage no specific information relating to building loads has been provided and therefore a bearing capacity of 50kN/m² has been considered. It has been assumed the units will be either situated on a semi-stiff integral raft or ground beams supported on piles.

7.2 Key geotechnical hazards / development constraints

The key risk identified from the available ground investigation data are discussed below:

- Differential settlement from a variable depth and consistency of made ground

7.3 Foundations

7.3.1 Foundation options

As the site will be turned over, a competent development platform will be created which will be sufficient to support a 50kN/m² bearing capacity load.

It will be a commercial decision as to whether the modular units will be founded on a semi-stiff integral raft or piles. The development is to be a design and build contract whereby the modular unit developers will determine which foundation will be adopted. It should be noted that raft foundations will require modification to address noise transmission between the semi-detached units if adopted, although as these are a non-standard construction consultation with either Premier Guarantee or the NHBC will be required. It should be noted that usually noise transmission is addressed in the robust details for the proposed structures.

The raft foundations must be designed by a Structural Engineer, and we anticipate that one design will be sufficient for this site as all units will be identical. By using semi-stiff rafts in lieu of standard stiff rafts, groundworks contractors should be able to construct all aspects of this structure without the requirement of steel fixers.

Should piles be adopted, these may comprise micro-piles, standard pre-cast concrete piles, screw piles or reverse flight auger piles (to avoid bringing potentially contaminated soils to the surface). The pile design should be completed by the piling contractor and will be dependent on structural loadings.

The depth and number of piles cannot be determined at this stage without maximum line loads known. Deeper boreholes would be recommended to confirm the depth of silt underlying the site and the presence of more competent ground for the deeper-seated piles.

The development platform should be suitable to be considered as a piling blanket.

It should be noted that solutions such as screw piles are outside the scope of standard piling and their design will be specific to the contractor.

7.3.2 Foundation works risk assessment

It is anticipated that a foundation works risk assessment report will not be required for the development because:

- the type of foundation/ ground improvement method* proposed does not have the potential to create preferential pathways for migration of ground gas to surface or groundwater to depth
- there are no identified ground gas sources present at depth that could be affected by the type of foundation and ground improvement method proposed

7.3.3 Floor slabs

INTEGRAL

Should semi-stiff raft foundations be adopted, these are integral units whereby the ground floor slab is tied into the footing forming the toe. These will be cast in situ, and situated on proof rolled, compacted made ground.

CAST IN-SITU CONCRETE SLAB

Either a cast in situ or pre-cast concrete suspended ground floor slab will be supported on ground beams for the piles. The ground beams may be pre-cast or cast in situ concrete and will be designed by the piling contractor with approval by the Structural Engineer.

7.4 Roads and hardstanding

The contractor who will be undertaking the turnover for the proposed development will be creating sterile road corridors suitable for services.

It is assumed this will be an adoptable highway and a minimum CBR of 5% will be present 0.60 m below the proposed top of road level and built up with suitable capping in accordance with Local Authority requirements.

The sub-grade condition at the time of construction should be confirmed by testing at the final formation level by in situ CBR and plate loading tests.

7.5 Excavations for foundations and services

It is not possible to observe the short-term stability of side walls where boreholes are drilled. It is therefore recommended to assume that side walls of excavations will be unstable in the short term and hence excavation support systems are utilised during the groundwork stage of the development. No manned entry is permitted to excavations unless appropriate temporary works are adopted to support the sides (with associated gas monitors).

Confined spaces protocols for the Health and Safety of personnel should always be used where man entry into excavations is to be undertaken as low oxygen conditions may be present.

Dewatering maybe required for deep excavations, with localised removal of infiltrated and surface water inflow from shallow to medium depth excavations. Sump excavations maybe prudent to allow localised dewatering.

Excavation should be possible using conventional site plant. Breakers may be necessary to remove any concrete obstructions within the made ground.

7.6 Chemical attack on buried concrete

This assessment of the potential for chemical attack on buried concrete at the site is based on BRE Special Digest 1: Concrete in aggressive ground, which represents the most up-to-date guidance on this topic currently available in the UK.

The desk study and site reconnaissance indicate that, for the purposes of assessing the aggressive chemical environment of the site, the site should be considered as comprising brownfield ground unlikely to contain pyrite.

Based on chemical analysis completed on the samples obtained during the window sample drilling over the site, and omitting the soil analysis in the surrounding bunds, Table 17 gives the characteristic pH, water-soluble and total sulphate content values for soils from each of the geological units and groundwater encountered on-site. As the soils are not considered to contain pyritic materials, there is no reason to consider the total potential sulphate results.

Table 17 Characteristic pH, water soluble sulphate and total sulphate values

Stratum	Number of Samples	pH	Water Soluble Sulphate (mg/l)	Total Potential Sulphate (mg/l)
Recent made ground	4	6.92 – 8.1	<0.01 – 0.09	<200 – 770
<1930 made ground	1	7.31	0.07	1,300
Alluvial Clay	2	7.09 – 7.74	<0.01	<200 - 230

Based on the results above and following the steps outlined in the BRE guidance, the Design Sulphate Classes and Aggressive Chemical Environment for Concrete classifications are summarised in Table 18 on the basis of water-soluble sulphate.

The groundwater within the made ground has been assessed as being static, as a significant proportion was either a silty granular strata, or a clay. There are granular layers which may be classified as mobile; however, the static assessment is the most onerous.

Table 18 Concrete design class

Stratum	Groundwater	DS Class	AC Class	DC Class
Made Ground	Static	DS-1	AC-1s	DC-1
Alluvial Clays	Static	DS-1	AC-1s	DC-1

7.7 Infiltration drainage

It is unlikely, due to the thicknesses of made ground on this site, that soakaway pits for surface water drainage will be permitted and will require discharge to the surface water drainage system, although small scale SuD's schemes such as permeable paving may be permitted.

8 CONCLUSIONS AND RECOMMENDATIONS

8.1 Geo-environmental assessment

Based on the results of the site investigation and GQRA, the contaminant linkages that have been identified to be potentially complete (relevant contaminant linkages) and to require further action are:

- Elevated concentrations of metals, PAH and TPH compounds as well as asbestos (chrysotile).
- No ground gas mitigation required.

It is proposed to turn over the upper 2 m of the site and utilise the material contained within the bund (once screened and sorted for suitable material) to form a development platform. All road corridors and private supplies will be contained within clean corridors to a depth of 0.50 m below the invert of the deepest sewer (assumed foul). The corridor will have a woven geotextile to prevent material mixing.

For all landscaping, 0.60 m inert cover will be required, comprising 0.15 m of topsoil and 0.45 m subsoil.

Soils were noted to be potentially hazardous waste due to elevated concentrations of metals as well as hydrocarbon compounds (anticipated to be PAH compounds). Asbestos has not been identified as being a component of hazardous waste; however, asbestos maybe present within the bund at above 0.1% and not encountered to date.

Protectorline potable water supply barrier pipework anticipated to be required.

8.2 Geotechnical assessment

The site is to be turned over to create a development platform for the proposed properties. This will be designed to at least 50kN/m² bearing capacity to accommodate either the semi-stiff raft foundations with integral ground floor slabs or piles.

8.3 Recommendations

No further investigation considered to be required.

The works to reprocess the recent made ground overlying the site, as well as the made ground in the bund will require permitting and potential licensing beyond the mobile plant license. The works are anticipated to be undertaken under the CL:AIRE Code of Practice for the Definition of Waste.

Assessment and a watching brief will be required during the processing of the made ground to confirm the consistency and to address any localised areas of contamination encountered.

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FIGURES

FIGURE 1 SITE LOCATION PLAN



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Project Title

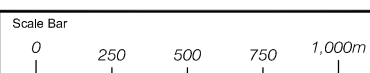
Fernhill Caravan Park, Every Street, Bury

Drawing Title

SITE LOCATION MAP

Rev	Drawn	Date	Checked	Date	Approved	Date
00	NP	09.12.20	LB	09.12.20	-	-
Dimensions		Scale		Original Size		
m		1:25,000		A4		

Project Number	Grid Ref
11542	SD 804 117



Drawing Number
FIGURE 1

FIGURE 2 EXPLORATORY HOLE PLAN

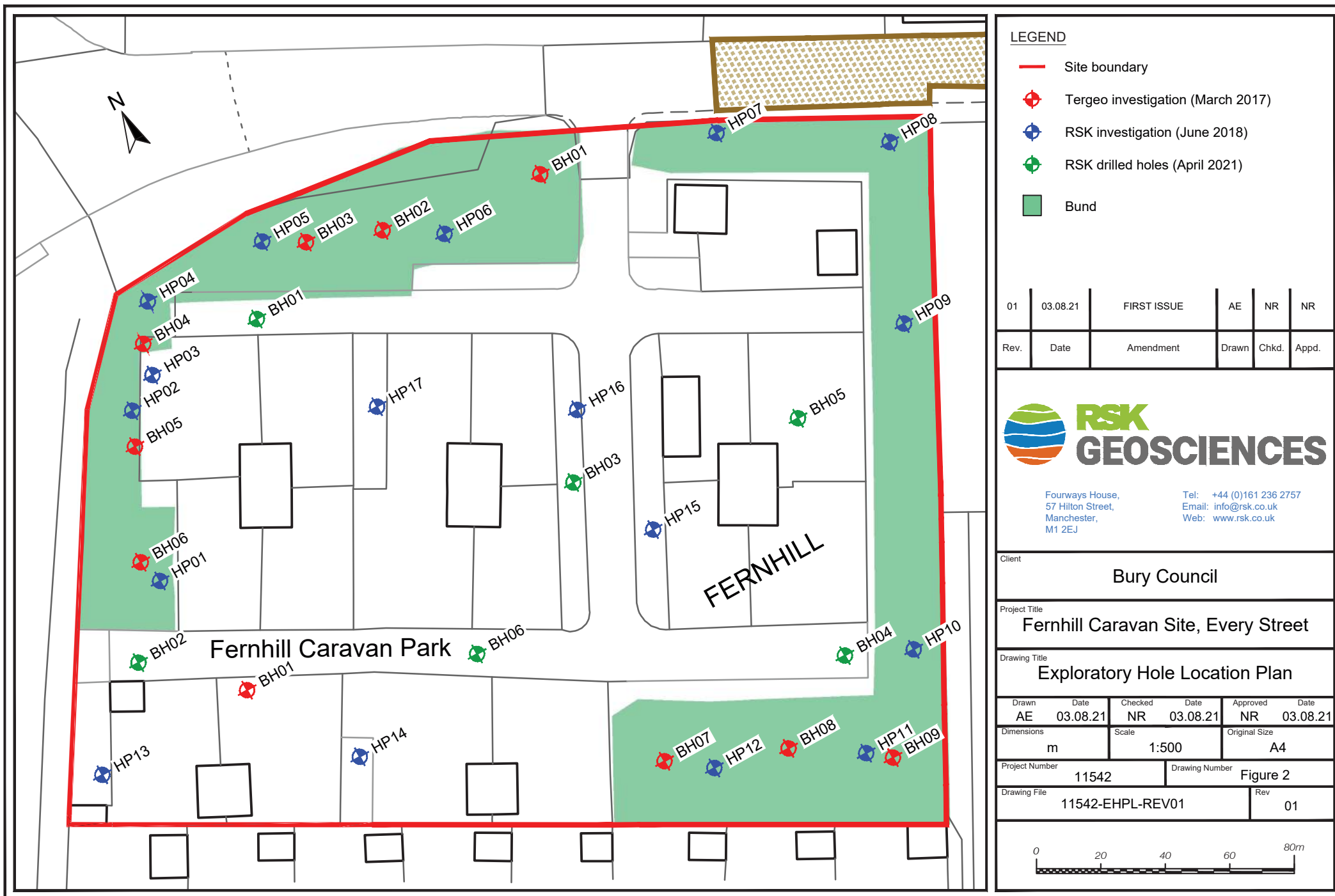


FIGURE 3 SITE PLAN (HISTORICAL LAND USE)

EVERY STREET

FERNHILL

- Site boundary
- ⊕ Tergeo investigation (March 2017)
- ⊕ RSK investigation (June 2018)
- ⊕ RSK drilled holes (April 2021)
- Former Buildings (1910-1939 (West) and 1991 (East))
- + Former Train/Tram Line (1910)
- Former maximum extent of gravel pit (1850-1930)
- Tracks

01	03.08.21	FIRST ISSUE	AE	NR	NR
Rev.	Date	Amendment	Drawn	Chkd.	Appd.



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Client
Bury Council

Project Title
Fernhill Caravan Site, Every Street

Drawing Title
Site Plan (Historical Landuse)

Drawn	Date	Checked	Date	Approved	Date
AE	03.08.21	NR	03.08.21	NR	03.08.21
Dimensions	Scale		Original Size		
m	1:500		A4		
Project Number	11542		Drawing Number	Figure 3	
Drawing File	11542-SPHL-REV01		Rev	01	



FIGURE 4 SITE PLAN (HISTORICAL LAND USE AND CURRENT LAYOUT)

APPENDICES

APPENDIX A

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 Bury Council (the "Client") in accordance with the terms of a contract between RSK and the Client, dated 30 November 2020. 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 site of asbestos, invasive plants, electromagnetic fields, lead paint, heavy metals, radon gas, persistent, bioaccumulative or toxic chemicals (including PFAS/ PFOS) 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.

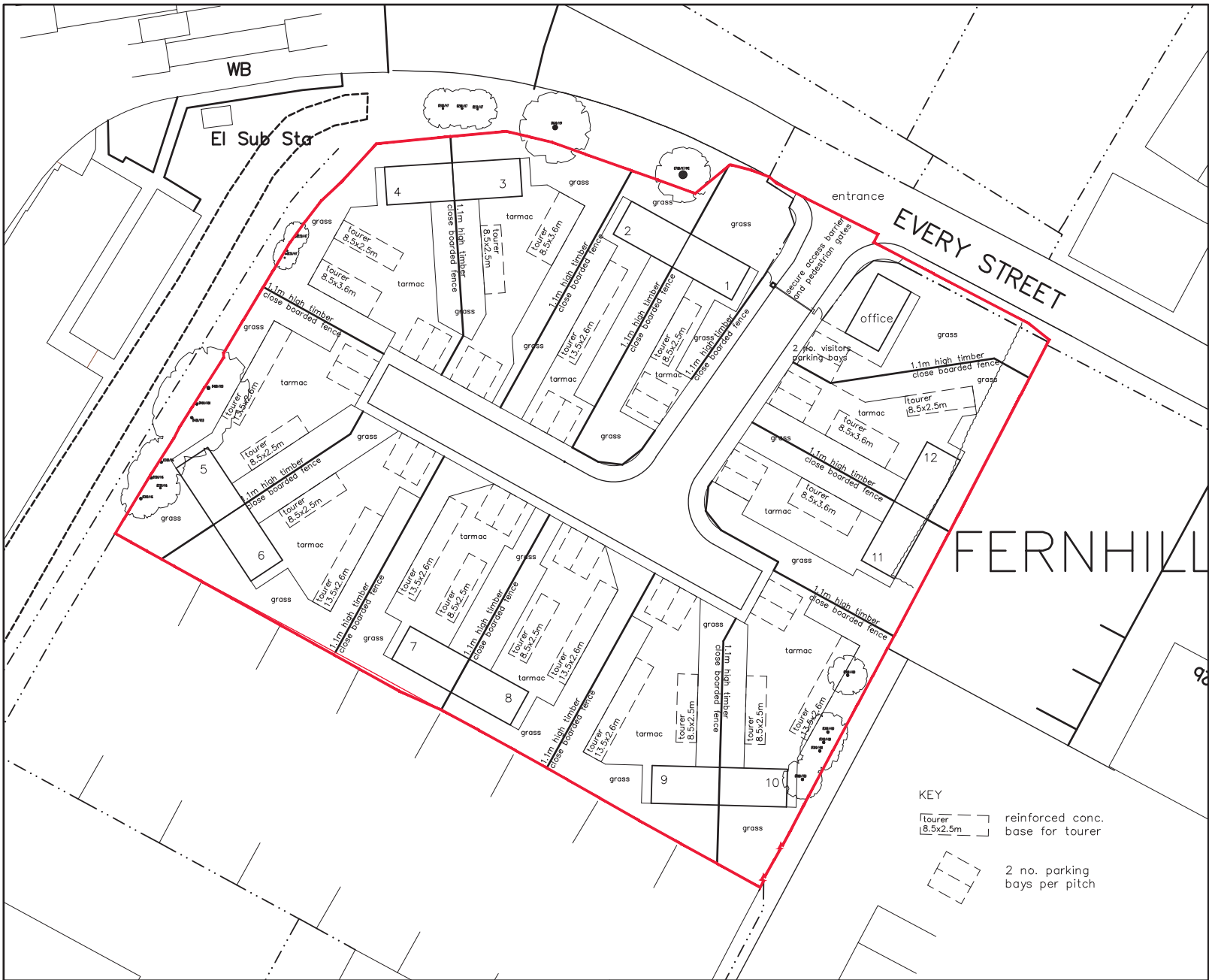
- b. The Services were limited by the accuracy of the information, including documentation, reviewed by RSK and the observations possible at the time of the visual inspection.
- c. The Services did not attempt to independently verify the accuracy or completeness of information, documentation or materials 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

REFERENCE DRAWINGS



Notes: This drawing is the copyright Paddock Johnson Partnership Limited and may not be used without their prior written consent.
Written dimensions to be taken in preference to scaled dimensions.
Due to the inaccuracies of scanning, scanned images should not be scaled.

+ REV: DATE: DESCRIPTION: BY:

KEY
tower 8.5x2.5m reinforced conc. base for tower
2 no. parking bays per pitch

CLIENT:	PROJECT:	DRAWING TITLE:	DRAWING NUMBER:	SCALE:	DATE:
Bury Council	Fernhill Gypsy and Traveller Site Re-development	Proposed Site Layout - Alternative Site Entrance	19144-101	1:500@A3	22.10.20.
			STATUS:	BY:	CHECKED:
			For Information	MK	SH

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APPENDIX C

SUMMARY OF LEGISLATION AND POLICY RELATING TO LAND CONTAMINATION

Part IIA of the Environmental Protection Act 1990

Part IIA of the Environmental Protection Act 1990 (Part IIA) and its associated Contaminated Land Regulations 2000 (SI 2000/227), which came into force in England on 1 April 2000, formed the basis for the current regulatory framework and the statutory regime for the identification and remediation of contaminated land. Part IIA of the EPA 1990 defines contaminated land as 'any land which appears to the Local Authority in whose area it is situated to be in such a condition by reason of substances in, on or under the land, that significant harm is being caused, or that there is significant possibility of significant harm being caused, or that pollution of controlled waters is being or is likely to be caused'. Controlled waters are considered to include all groundwater, inland waters and estuaries.

In August 2006, the Contaminated Land (England) Regulations 2006 (SI 2006/1380) were implemented, which extended the statutory regime to include Part IIA of the EPA as originally introduced on 1 April 2000, together with changes intended chiefly to address land that is contaminated by virtue of radioactivity. These have been replaced subsequently by the Contaminated Land (England) (Amendment) Regulations 2012, which now exclude land that is contaminated by virtue of radioactivity.

The intention of Part IIA is to deal with contaminated land issues that are considered to cause significant harm on land that is not undergoing development (see Environmental Protection Act 1990: Part 2A Contaminated Land Statutory Guidance, April 2012). This document replaces Annex III of Defra Circular 01/2006, published in September 2006 (the remainder of this document is now obsolete).

Planning Policy

Contaminated land is often dealt with through planning because of land redevelopment. This approach was documented in Planning Policy Statement: Planning and Pollution Control PPS23, which states that it remains the responsibility of the landowner and developer to identify land affected by contamination and carry out sufficient remediation to render the land suitable for use. PPS23 was withdrawn early in 2012 and has been replaced by much reduced guidance within the National Planning Policy Framework (NPPF), reference ISBN: 978-1-5286-1033-9, February 2019.

The new framework has only limited guidance on contaminated land, as follows:

Chapter 11. Making effective use of land

117 Planning policies and decisions should promote an effective use of land in meeting the need for homes and other uses, while safeguarding and improving the environment and ensuring safe and healthy living conditions. Strategic policies should set out a clear strategy for accommodating objectively assessed needs, in a way that makes as much use as possible of previously-developed or 'brownfield' land.

118. Planning policies and decisions should:

c) give substantial weight to the value of using suitable brownfield land within settlements for homes and other identified needs, and support appropriate opportunities to remediate despoiled, degraded, derelict, contaminated or unstable land.

Chapter 15. Conserving and enhancing the natural environment

170. Planning policies and decisions should contribute to and enhance the natural and local environment by:

e) preventing new and existing development from contributing to, being put at unacceptable risk from, or being adversely affected by, unacceptable levels of soil, air, water or noise pollution or land instability. Development should, wherever possible, help to improve local environmental conditions such as air and water quality, taking into account relevant information such as river basin management plans; and

f) remediating and mitigating despoiled, degraded, derelict, contaminated and unstable land, where appropriate.

Ground conditions and pollution

178. Planning policies and decisions should ensure that:

a) a site is suitable for its proposed use taking account of ground conditions and any risks arising from land instability and contamination. This includes risks arising from natural hazards or former activities such as mining, and any proposals for mitigation including land remediation (as well as potential impacts on the natural environment arising from that remediation);

b) 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; and

c) adequate site investigation information, prepared by a competent person, is available to inform these assessments.

179. Where a site is affected by contamination or land stability issues, responsibility for securing a safe development rests with the developer and/or landowner.

Water Resources Act (WRA)

The Water Resources Act 1991 (Amendment) (England and Wales) Regulations 2009 updated the Water Resources Act 1991, which introduced the offence of causing or knowingly permitting pollution of controlled waters. The Act provides the Environment Agency with powers to implement remediation necessary to protect controlled waters and recover all reasonable costs of doing so.

Water Framework Directive (WFD)

The Water Framework Directive 2000/60/EC is designed to:

- enhance the status and prevent further deterioration of aquatic ecosystems and associated wetlands that depend on the aquatic ecosystems
- promote the sustainable use of water
- reduce pollution of water, especially by 'priority' and 'priority hazardous' substances
- ensure progressive reduction of groundwater pollution.

The WFD requires a management plan for each river basin be developed every six years.

Groundwater Directive (GWD)

The 1980 Groundwater Directive 80/68/EEC and the 2006 Groundwater Daughter Directive 2006/118/EC of the WFD are the main European legislation in place to protect groundwater. The 1980 Directive is due to be repealed in December 2013. The European legislation has been transposed into national legislation by regulations and directions to the Environment Agency.

Priority Substances Directive (PSD)

The Priority Substances Directive 2008/105/EC is a 'Daughter' Directive of the WFD, which sets out a priority list of substances posing a threat to or via the aquatic environment. The PSD establishes environmental quality standards for priority substances, which have been set at concentrations that are safe for the aquatic environment and for human health. In addition, there is a further aim of reducing (or eliminating) pollution of surface water (rivers, lakes, estuaries and coastal waters) by pollutants on the list. The WFD requires that countries establish a list of dangerous substances that are being discharged and EQS for them. In England and Wales, this list is provided in the River Basin Districts Typology, Standards and Groundwater threshold values (Water Framework Directive) (England and Wales) Directions 2010. In order to achieve the objectives of the WFD, classification schemes are used to describe where the water environment is of good quality and where it may require improvement.

Environmental Permitting Regulations (EPR)

The Environmental Permitting (England and Wales) Regulations 2016 (as amended) provide a single regulatory framework that streamlines and integrates waste management licensing, pollution prevention and control, water discharge consenting, groundwater authorisations, and radioactive substances regulation. Schedule 22, paragraph 6 of EPR 2016 states: 'the regulator must, in exercising its relevant functions, take all necessary measures - (a) to prevent the input of any hazardous substance to groundwater; and (b) to limit the input of non-hazardous pollutants to groundwater so as to ensure that such inputs do not cause pollution of groundwater.'

Notes:

1. *The above information is provided for background but does not constitute site-specific advice*
2. *The above summary applies to England only. Variations exist within other countries of the United Kingdom*

APPENDIX D

ENVIRONMENTAL DATABASE REPORT
